

**Sustainable Humanity
Sustainable Nature
Our Responsibility**

Pontificiae Academiae Scientiarum Extra Series 41
Pontificiae Academiae Scientiarum Socialium Acta 19

The Proceedings
of the Joint Workshop on

Sustainable Humanity Sustainable Nature Our Responsibility

2-6 May 2014

Edited by

Partha S. Dasgupta
Veerabhadran Ramanathan
Marcelo Sánchez Sorondo



EX AEDIBVS ACADEMICIS
IN CIVITATE VATICANA • MMXV

The Pontifical Academy of Sciences
Casina Pio IV, 00120 Vatican City
Tel: +39 0669883195 • Fax: +39 0669885218
Email: pas@pas.va • Website: www.pas.va

The Pontifical Academy of Social Sciences
Casina Pio IV, 00120 Vatican City
Tel: +39 0669881441 • Fax: +39 0669885218
Email: pass@pass.va • Website: www.pass.va

The opinions expressed with absolute freedom during the presentation of the papers of this meeting, although published by the Academy, represent only the points of view of the participants and not those of the Academy.

ISBN 978-88-7761-108-6

© Copyright 2015

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form, or by any means, electronic, mechanical, recording, photocopying or otherwise without the expressed written permission of the publisher.

THE PONTIFICAL ACADEMY OF SCIENCES
LIBRERIA EDITRICE VATICANA
VATICAN CITY



Today no one in our world feels responsible; we have lost a sense of responsibility for our brothers and sisters. We have fallen into the hypocrisy of the priest and the levite whom Jesus described in the parable of the Good Samaritan: we see our brother half dead on the side of the road, and perhaps we say to ourselves: “poor soul...!”, and then go on our way. It’s not our responsibility, and with that we feel reassured, assuaged. The culture of comfort, which makes us think only of ourselves, makes us insensitive to the cries of other people, makes us live in soap bubbles which, however lovely, are insubstantial; they offer a fleeting and empty illusion which results in indifference to others; indeed, it even leads to the globalization of indifference. ... “Adam, where are you?” “Where is your brother?” These are the two questions which God asks at the dawn of human history, and which he also asks each man and woman in our own day. Today too, Lord, we hear you asking: “Adam, where are you?” “Where is the blood of your brother?”.

Homily of Holy Father Francis during his visit to Lampedusa, “Arena” sports camp, Salina Quarter, Monday, 8 July 2013.







Contents

Introduction	14
Introduzione	18
Sustainable Humanity, Sustainable Nature: Our Responsibility Oscar Andrés Cardinal Rodríguez Maradiaga, SDB	22
Word of Welcome Werner Arber	33
Word of Welcome Margaret S. Archer	35
Programme	37
List of Participants	42
 <i>Scientific Papers</i>	
▶ I. THE BROADER CONTEXT	
Human-Nature Co-Evolution Werner Arber	49
The Emergence of Humans: Brains (Bodies and Hands), Mind and Soul Yves Coppens	55
▶ THE NEW ERA OF HUMAN-NATURE INTERACTIONS	
II. FUNDAMENTAL DRIVERS OF FOOD, HEALTH, AND ENERGY NEEDS	
Impediments to Sustainable Development: Externalities in Human-Nature Exchanges Partha Dasgupta	63

Population et Nature: Antagonisme ou Concordance? People and Nature: Antagonism or Concordance?	
Gérard-François Dumont	79
Food Demand, Natural Resources, and Nature	
Joachim von Braun	115
Sustainable Development Goals for a New Era	
Jeffrey D. Sachs	134
▮ III. ANTHROPOCENE: GLOBAL CLIMATE CHANGE	
Climate-System Tipping Points and Extreme Weather Events	
Hans Joachim Schellnhuber and Maria A. Martin	151
An Oceanographic Perspective	
Walter Munk	171
▮ IV. COMPETING DEMANDS ON NATURE AS A SOURCE	
Can We “Save” the Ocean?	
Nancy Knowlton	181
Tropical Forests, for Richer and for Poorer	
Jeffrey R. Vincent	192
The Promise of Mega-Cities: Moving from Despair to Hope. Urban Informality and the Favelas of Rio de Janeiro	
Janice Perlman	206
▮ V. COMPETING DEMANDS ON THE CRYOSPHERE	
Glaciers as Source of Water: The Himalaya	
Anil V. Kulkarni	219
The Polar Regions	
Peter Wadhams	225

▶ VI. COMPETING DEMANDS ON THE BIOSPHERE

Green Fields: Feeding the Hungry, Raising the Poor and Protecting Nature in Africa	
Robert (Bob) Scholes	239

Stability of Coastal Zones	
Marcia McNutt	248

▶ VII. SOCIETY'S RESPONSE TO CURRENT UNSUSTAINABLE GROWTH

Why Have Climate Negotiations Proved So Disappointing?	
Scott Barrett	261

Towards an Inclusive “Green Economy”: Rethinking Ethics and Economy in the Age of the Anthropocene	
Achim Steiner	277

The Two Worlds Approach for Mitigating Air Pollution and Climate Change	
Veerabhadran Ramanathan	285

Mainstreaming the Values of Nature for People into Decision-Making	
Gretchen C. Daily	301

Energy for Sustainable and Equitable Development	
Daniel M. Kammen, Peter Alstone, Dimitry Gershenson	316

Global Knowledge Action Network	
Charles F. Kennel	347

Sustainable Transformation of Human Society in Asia	
Yuan Tseh Lee	370

▶ VIII. SOCIAL INFRASTRUCTURE

The Price of Inequality: How Today's Divided Society Endangers our Future	
Joseph E. Stiglitz	379

Humanity’s Responsibility Toward Creation – An Ethical and Anthropological Challenge	
Archbishop Roland Minnerath	400
Nature and the Law: The Global Commons and the Common Concern of Humankind	
Edith Brown Weiss	407
IX. SOCIAL INCLUSION	
Towards a Social Balance of the Current Globalization	
Juan J. Llach	425
Sustainable Education: Uruguay’s Plan Ceibal	
Antonio M. Battro and Cecilia de la Paz	448
Being Trafficked to Work: How Can Human Trafficking Be Made Unsustainable?	
Margaret S. Archer	460
Precariedad laboral, exclusión social y economía popular	
Juan Grabois	483
The Influence of Virtuous Human Life in Sustaining Nature	
Stefano Zamagni	539
Social Inclusion in Governance and Peace-Building in Asia	
Wilfrido V. Villacorta	567
Intergenerational Solidarity: Old and New Scenarios, Challenges and Prospects	
Pierpaolo Donati	579
X. CLOSING SESSION: MOTIVATING SOCIETIES	
What Role for Scientists?	
Naomi Oreskes, Dale Jamieson, Michael Oppenheimer	617
Existential Risks	
Martin Rees	650

Humanity’s Responsibility Toward Nature	
Enrico Berti	661
▮ XI. CELEBRATIONS FOR THE TWENTIETH ANNIVERSARY OF PASS	
The History of the Pontifical Academy of Social Sciences	
Herbert Schambeck	669
Summary	
Werner Arber	677
Sumario	
Werner Arber	681
Statement of the Joint PAS/PASS Workshop on “Sustainable Humanity, Sustainable Nature: Our Responsibility”	685
Declaración final del Workshop PAS y PASS sobre “Humanidad y naturaleza sostenibles: nuestra responsabilidad”	688
Statement finale del Workshop PAS e PASS su “Umanità Sostenibile, Natura Sostenibile: La Nostra Responsabilità”	692
Déclaration finale de la réunion sur “Humanité durable, Nature durable: Notre responsabilité”	696
بيان ورشة العمل المشتركة للأكاديمية البابوية للعلوم والأكاديمية البابوية للعلوم الإنسانية، حول الإنسانية المستدامة والطبيعة المستدامة: مسؤوليتنا	700
人類與自然的永續存在：我們的責任 宗座科學院／宗座社會科學院 聯合研討會聲明	702
Signatories to the Statement	704

Introduction

Are Humanity's dealings with Nature sustainable? What is the status of the Human Person in a world where science predominates? How should we perceive Nature and what is a good relationship between Humanity and Nature? Should one expect the global economic growth that has been experienced over the past six decades to continue for the foreseeable future? Should we be confident that knowledge and skills will increase in such ways as to lessen Humanity's reliance on Nature despite our increasing economic activity and growing numbers? Is the growing gap between the world's rich and world's poor in their reliance on natural resources a consequence of those growths?

Human-Nature Interchanges

Contemporary discussions on the questions are now several decades old. If they have remained alive and are frequently shrill, it is because two opposing empirical perspectives shape them. On the one hand, if we look at specific examples of what one may call natural capital (aquifers; ocean fisheries; tropical forests; estuaries; wetlands; the atmosphere as a sink for carbon, brown clouds, and other pollutants), there is convincing evidence that at the rates at which we currently exploit them, they are very likely to change character dramatically for the worse with little advance notice. The melting of glaciers and sea-ice are recent symptoms, but the Millennium Ecosystem Assessment reported in 2005 that 15 of the 24 ecosystem services that the Assessment had investigated world-wide were either degraded or being exploited at unsustainable rates (MEA, 2005a-d).

On the other hand, if we study trends in food consumption, life expectancy, and recorded incomes in regions that are currently rich and in those that are on the way to becoming rich, resource scarcities wouldn't appear to have bitten so far.

Those conflicting intuitions are also not unrelated to an intellectual tension between the concerns people share about carbon emissions and biodiversity loss that sweep across regions, nations and continents; and about declines in the availability of firewood, fresh water, coastal resources, and forest products in as small a locality as a village. That is why "environmental problems" and "future prospects" present themselves in different ways to different people. Some identify environmental problems with population growth, while others identify them with wrong sorts of economic growth, involving, for example,

excessive consumption in rich countries. There are those who see environmental problems as urban pollution in emerging economies, while others view them through the spectacle of poverty in the world's poorest countries. Some allude to "sustainable development" only when considering economic development in the global economy, while others see it in terms of the development prospects of villages in sub-Saharan Africa.

Each of the visions is correct. We now know, for example, that what begins as urban pollution becomes in time layers of atmospheric brown clouds (ABCs), containing black carbon particles and ozone, that annually destroy some 2 million lives and over 100 million tons of crops, disrupts the Monsoon circulation and contributes to the melting of arctic ice and the Himalayan snow. There is no single environmental problem, there is a large collection of interrelated problems. Some are presenting themselves today, while others are threats to the future. And they manifest themselves at different spatial scales and operate at different speed. Although growth in industrial and agricultural pollutants has accompanied economic development, neither preventive nor curative measures have kept pace with their production in industrialized countries. That neglect is now prominent in the rapidly growing regions in Brazil, Russia, India, China, and South Africa (BRICS). Moreover, the scale of the human enterprise, both by virtue of unprecedented increases in the size of the world's population and the level of economic activity, has so stretched the capabilities of ecosystems, that Humanity is today Earth's dominant species. During the 20th century world population grew by a factor of four (to more than 6 billion) and world output by 14, industrial output increased by a multiple of 40 and the use of energy by 16, methane-producing cattle population grew in pace with human population, fish catch increased by a multiple of 35, and carbon and sulfur dioxide emissions by more than 10. The application of nitrogen to the terrestrial environment from the use of fertilizers, fossil fuels, and leguminous crops is now at least as great as that from all natural sources combined. About 45 per cent of the 45-60 billion metric tons of carbon that are harnessed annually by terrestrial photosynthesis (net primary production of the biosphere) is currently being appropriated for human use. These are rough estimates, but the figures do put the scale of the human presence on the planet in perspective. Humanity is hitting against Nature's constraints both locally and globally. It is not without cause that our current era, starting some 200 years ago, has been named the Anthropocene.

On the other hand, economic growth has brought with it improvements in the quality of a number of environmental resources. The large-scale availability of potable water and the increased protection of human populations

against both water- and air-borne diseases in advanced industrial countries have come allied to the economic growth those countries have enjoyed over the past 200 years. Moreover, the physical environment inside the home has improved beyond measure (cooking in Asia and Africa, involving the burning of solid biomass and coal, continues to be a central cause of respiratory illnesses among women). Increases in scientific knowledge, investment in public infrastructure, and universal education in advanced industrial countries have meant that citizens there have far greater knowledge of environmental hazards than their counterparts in poor regions. They also have resources to avoid them. These examples reflect positive links between economic growth and environmental quality.

Despite the conflicting intuitions, many people are convinced that scientific and technological advances, the accumulation of reproducible capital (machinery, equipments, buildings, roads), growth in human capital (education, skills), and improvements in the economy's institutions can overcome diminutions in natural capital. Otherwise it is hard to explain why so much of the social sciences in the twentieth century has been detached from the environmental sciences. Nature is all too often seen as a backdrop from which resources and services can be drawn in isolation. Macroeconomic forecasts routinely exclude natural capital. Accounting for Nature, if it comes into the calculus at all, is usually an afterthought. The rhetoric has been so successful, that if someone exclaims, "Economic growth!", one does not need to ask, "Growth in what?" – we all know they mean growth in gross domestic product (GDP).

The rogue word in GDP is "gross". GDP, being the market value of all final goods and services, ignores the degradation of natural capital. If fish harvests rise, GDP increases even if the stock declines. If logging intensifies, GDP increases even if the forests are denuded. And so on. The moral is significant though banal: GDP is impervious to Nature's constraints. There should be no question that Humanity needs urgently to redirect our relationship with Nature so as to promote a sustainable pattern of economic and social development.

A proposal

Rio+20 Summit on biodiversity preservation was convened to provide a resolution to the problems Humanity faces in our interchanges with Nature. In practical terms though, it is widely acknowledged to have been a failure. Nevertheless, the occasion provided an opportunity for concerned people to air their views on the various types of biodiversity losses the world has been experiencing in recent decades. Concomitantly, the Summit offered

a platform for people to review the character of both global and local resource stresses.

Looking through the Summit's programme of events, however, it is hard to detect an overarching intellectual framework that was used to identify Nature's constraints. The lacuna was inevitable. The engagements that took place alongside the Summit were ones where citizens brought their particular concerns to the table; they weren't an occasion for a collective endeavour among natural and social scientists. That is why we are proposing a joint PAS-PASS workshop on *Sustainable Humanity, Sustainable Nature*.

Our idea is not to catalogue environmental problems. That has been done at many other gatherings. We propose instead to view Humanity's interchanges with Nature through a triplet of fundamental, but inter-related Human needs – Food, Health, and Energy – and ask our respective Academies to work together to invite experts to speak to the various pathways that both serve those needs and reveal constraints on Nature's ability to meet them. That requires a collaborative effort of natural and social scientists. We would hope some of the sessions would consist of presentations by a pair of experts from the natural and social sciences, respectively.

Introduzione

I rapporti che l'Umanità intrattiene con la Natura sono sostenibili? Qual è lo status della Persona Umana in un mondo in cui predomina la scienza? Come va intesa la Natura e come si valuta se il rapporto che l'Uomo ha con essa è buono? Possiamo attenderci che, anche in un prossimo futuro, continui la crescita economica globale che si è avuta negli ultimi sei decenni? Possiamo contare sul fatto che le conoscenze e le competenze aumentino in modo tale da ridurre la dipendenza dell'Uomo sulla Natura, nonostante la crescita esponenziale delle nostre attività economiche e della popolazione? Il divario sempre maggiore tra i ricchi e i poveri del mondo, in termini di dipendenza dalle risorse naturali, è la conseguenza di questo sviluppo?

Il dibattito contemporaneo su tali questioni dura ormai da decenni. Se va avanti, spesso in modo dissonante, è perché è plasmato da due punti di vista opposti ed empirici. Da una parte, se consideriamo gli esempi specifici di ciò che si può chiamare capitale naturale (falde acquifere; zone di pesca oceaniche; foreste tropicali; estuari; acquitrini; l'atmosfera come luogo di smaltimento del carbonio; le nuvole marroni e altri inquinanti), vi sono prove convincenti che, ai tassi di sfruttamento attuali, le caratteristiche di questo capitale molto probabilmente muteranno in peggio con poco preavviso. Lo scioglimento dei ghiacciai e del ghiaccio marino sono sintomi recenti, ma già nel 2005 il Millennium Ecosystem Assessment aveva rilevato che 15 dei 24 ecosistemi che aveva valutato nel mondo erano degradati o venivano sfruttati a tassi insostenibili (MEA, 2005a-d).

D'altra parte, se studiamo le tendenze del consumo di cibo, dell'aspettativa di vita, e del reddito registrato nelle regioni attualmente ricche e in quelle che stanno per diventarlo, la scarsità di risorse non sembra ancora aver colpito.

Queste intuizioni contrastanti non sono scollegate da una certa tensione intellettuale prodotta dalle preoccupazioni condivise dalla gente riguardo alle emissioni di carbonio e alla perdita di biodiversità che coinvolgono regioni, nazioni e continenti; e anche riguardo alla riduzione della disponibilità di legna da ardere, acqua potabile, risorse costiere e prodotti boschivi, persino in località molto piccole, a livello di singoli villaggi. Ecco perché "i problemi ambientali" e "le prospettive future" vengono intesi in maniera diversa a seconda delle persone. Alcuni identificano i problemi ambientali con la crescita della popolazione, altri con forme errate di crescita economica. Ci sono coloro che ritengono un problema ambientale l'inquina-

mento urbano nelle economie emergenti; altri si riferiscono alle condizioni di povertà in cui si vive nei paesi più poveri del mondo. Alcuni parlano di “sviluppo sostenibile” solo quando alludono allo sviluppo economico dell’economia globale, mentre altri lo considerano in termini di prospettive di sviluppo dei villaggi nell’Africa sub-sahariana.

Ognuno di questi punti di vista è corretto. Sappiamo che ciò che inizia come inquinamento urbano si andrà a stratificare formando le Atmospheric Brown Cloud (ABC), nuvole marroni contenenti particelle di carbonio nero e ozono, che ogni anno distruggono circa 2 milioni di vite umane e oltre 100 milioni di tonnellate di colture, perturbano la circolazione dei monsoni e contribuiscono allo scioglimento dei ghiacci e della neve dell’Himalaya. Non esistono problemi ambientali individuali, ma una vasta serie di problemi interconnessi. Alcuni si stanno presentando oggi, mentre altri sono potenziali rischi per il futuro. Si manifestano su diverse scale e procedono a velocità diverse. Sebbene lo sviluppo economico sia andato di pari passo con la crescita degli inquinanti industriali e agricoli, né le misure preventive né quelle curative hanno tenuto il passo con la loro produzione nei paesi industrializzati. Questa negligenza è diventata evidente nelle regioni in rapida crescita quali Brasile, Russia, India, Cina e Sud Africa (BRICS). L’entità dell’impresa umana ha inoltre messo a dura prova le capacità degli ecosistemi, cosicché l’Uomo è arrivato ad essere la specie dominante sulla Terra. Nel ventesimo secolo la popolazione mondiale è cresciuta di 4 volte (raggiungendo gli oltre 6 miliardi), la produzione mondiale di 14 volte, la produzione industriale è aumentata di 40 volte e l’utilizzo dell’energia di 16, la popolazione bovina che produce metano è cresciuta di pari passo con la popolazione umana, la quantità di pesce pescato è aumentata di 35 volte, le emissioni di carbonio e biossido di zolfo di 10 volte. L’apporto di azoto nell’ambiente terrestre derivato dall’impiego di fertilizzanti, combustibili fossili e piantagioni di leguminose è grande almeno quanto quello derivante dalla somma di tutte le fonti naturali. Il 45% circa delle 45-60 tonnellate di carbonio che sono trattenute annualmente dalla fotosintesi terrestre (produzione primaria netta della biosfera) vengono attualmente destinate ad uso umano. Sono stime approssimative, ma questi numeri fanno comprendere le proporzioni della presenza umana sulla terra. L’umanità si scontra contro i vincoli della Natura sia localmente, che a livello globale. Non è un caso che la nostra epoca attuale sia stata denominata *Antropocene*.

D’altra parte, la crescita economica ha portato al miglioramento di un certo numero di risorse ambientali in termini di qualità. La disponibilità capillare di acqua potabile e la maggiore protezione delle popolazioni umane dei paesi industriali avanzati nei confronti delle malattie trasmesse

via acqua e via aria hanno permesso la crescita economica di cui questi paesi hanno beneficiato nel corso degli ultimi 200 anni. Anche l'ambiente fisico all'interno delle abitazioni è oltremodo migliorato (in Asia e in Africa i metodi tradizionali di cuocere il cibo bruciando biomassa solida e carbone continuano a essere la causa principale delle malattie respiratorie tra le donne). Il miglioramento delle conoscenze scientifiche, gli investimenti in infrastrutture pubbliche e l'istruzione universale nei paesi industriali avanzati hanno fatto sì che i loro cittadini siano molto più consapevoli dei rischi ambientali rispetto alle loro controparti nelle regioni povere, avendo inoltre le risorse per evitarli. Questi esempi riflettono legami positivi tra crescita economica e qualità ambientale.

Nonostante le intuizioni contraddittorie, molti sono convinti che i progressi scientifici e tecnologici, l'accumulazione di capitale riproducibile (macchinari, attrezzatura, palazzi, strade), la crescita del capitale umano (istruzione, competenze), e il miglioramento delle istituzioni dell'economia possano supplire alle minusvalenze del capitale naturale. Altrimenti è difficile spiegare il motivo per cui le scienze sociali nel ventesimo secolo si siano in gran parte distaccate dalle scienze ambientali. La Natura è vista troppo spesso come un contesto dal quale ricavare servizi e risorse in isolamento. Le previsioni macroeconomiche solitamente escludono il capitale naturale. In quei rari casi in cui la Natura viene tenuta in conto e inserita nell'equazione, si tratta di solito di una considerazione dell'ultimo minuto. Questa retorica ha avuto tanto successo che quando si parla di "crescita economica", non c'è bisogno di chiedere, "crescita di che cosa?" Lo sappiamo tutti che si intende la crescita del prodotto interno lordo (PIL).

Tuttavia, la parola trabocchetto all'interno del PIL è l'aggettivo "lordo". Il PIL, essendo il valore di mercato di tutti i beni e servizi finali, ignora il degrado del capitale naturale. Se aumenta la pesca, aumenta il PIL, anche se le riserve di pesce diminuiscono. Se si intensifica l'abbattimento di legname, il PIL aumenta, anche se le foreste vengono disboscate. E così via. La morale è significativa anche se banale: il PIL è indifferente ai vincoli della Natura, mentre non si dovrebbe assolutamente mettere in dubbio l'urgente bisogno che l'Umanità ha di reimpostare il proprio rapporto con essa per promuovere un modello sostenibile di sviluppo economico e sociale.

Una proposta

Il vertice Rio+20 sulla conservazione della biodiversità è stato convocato per fornire una soluzione ai problemi che l'Umanità si trova ad affrontare nei suoi interscambi con la Natura: nella pratica, tuttavia, è stato ritenuto, in generale, un fallimento. Ciononostante è stata un'occasione per dare l'opportu-

nità alle persone interessate di esprimere le proprie opinioni sui vari tipi di perdite che il mondo subisce negli ultimi decenni a livello di biodiversità.

Il vertice ha inoltre offerto una piattaforma per esaminare le caratteristiche delle pressioni sulle risorse sia a livello globale che locale.

Analizzandone il programma è difficile rilevare il quadro complessivo utilizzato per individuare i vincoli della natura. La lacuna era inevitabile. Gli appuntamenti che hanno avuto luogo a margine del vertice hanno permesso ai cittadini di mettere a tavolino specifiche preoccupazioni; non sono stati un'occasione di sforzo collettivo tra scienziati naturali e sociali. È proprio per questo che abbiamo proposto questo gruppo di lavoro congiunto PAS-PASS su *Umanità sostenibile, natura sostenibile*.

Il nostro obiettivo non è quello di presentare un catalogo di problemi ambientali. Questo è già avvenuto in altri incontri. Ci proponiamo invece di rapportare gli interscambi dell'Umanità con la Natura a tre bisogni umani fondamentali tra loro collegati – alimentazione, salute e energia – e chiediamo alle nostre rispettive Accademie di collaborare, invitando esperti delle scienze naturali e delle scienze sociali a parlare dei vari percorsi che possano soddisfare queste esigenze, sottolineando gli ostacoli che la Natura si trova ad affrontare. Tutto ciò richiede lo sforzo collaborativo degli scienziati, sia delle scienze naturali che delle scienze sociali.

SUSTAINABLE HUMANITY, SUSTAINABLE NATURE: OUR RESPONSIBILITY

■ OSCAR ANDRÉS CARDINAL RODRÍGUEZ MARADIAGA, SDB

I would like to thank H.E. Msgr. Marcelo Sánchez Sorondo for his kind invitation to participate in the opening of this outstanding event.

I will speak about ethics in today's world, which is beginning to emerge from the biggest crisis it has ever experienced since 1930.

It is true that there have been times of similar distress between that year and the present – as is the case of the 1970s – but nothing has been as challenging as the current circumstances.

I have said that I will speak of ethics because every great economic or political crisis is coupled with a disruption of principles: societies feel that the ground has been shaken from under their feet, and that they have lost their knowledge of priorities and the very meaning of things. We are living in Zygmunt Bauman's "liquid society", a society governed by relativism as mentioned by Benedict XVI and other bright minds capable of going beyond fanaticism and fundamentalism.

Nowadays man finds himself to be a technical giant and an ethical child. The power of men over the means to their goals is incontestable, both in terms of technological capabilities and with respect to the potentialities of scientific knowledge.

However, this prowess is displayed in a difficult context where the goals may get fuzzy. The capacity of the "**how**" collides with the lack of clarity of the "**for what**", as not everything that is possible is necessarily convenient for man.

The "**we can**" of technology calls for ethical insight on the humanizing "**we must**". In other words, that which is humanizing in man, i.e., everything that allows man's realization as a human person within society and all that builds a society comprised of human persons, is the imperative benchmark for any science that intends to be infused with human nature.

Ethics is about wondering about the human meaningfulness of every activity, and it has an influence on both individuals and society at large. Humanization and "dehumanization" are the two ethical criteria on which lies any action that makes human dignity and solidarity into something real. As well, both criteria serve to denounce any action that goes against such dignity and solidarity.

With the Millennium Development Goals set to expire less than a year from now – and as the UN is considering the launch of a project of a similar nature – there is so much uncertainty about the global economy that, despite the efforts made since the year 2000, many think that the world will be unable to meet the MDG deadline, and new goals are being thought of as we speak.

A Natural Project: Ecology And Mankind

1. Man, Technology and Nature

Built on consumerism and the rapid augmentation of profits, progress in our post-industrial age has led to serious environmental imbalances in the most comprehensive sense of the term: an over-consumption of non-renewable raw materials, noise, visual and air pollution, and the extinction of animal and vegetable species. It has also brought about profound social and economic imbalances: a wealthy Northern Hemisphere where a poverty-stricken Fourth World has emerged, a Southern Hemisphere riddled with deprivation and misery, and forced emigration. In addition, our world is currently the sad witness of energy crises and speculation, of health disorders caused by the overabundance of food in some places and by famine elsewhere, and of old diseases in a new form as a result of antibiotic-resistant microbes.

No doubt man's life on Earth has been riddled with ordeals, which explains his aggressiveness and his drive for domination.

In the face of a difficult and hostile world, more and more sophisticated techniques have been created to domesticate it and make it inhabitable.

But technical advancements have progressed so much that it already seems as if we were living in an artificial world. Thus a sort of "supra-nature" has been created, which has partly helped man, but which has also detached him from Mother Nature. Both History and our current existence show that our "software" – i.e., our ideas and values – has evolved much more slowly than our "hardware", which has focused for centuries on maximum growth and productivity.

Science dehumanizes itself whenever it takes the path of utilitarian technology: thus technology becomes a strategy for life, as described by Oswald Spengler in his book about the decline of the West.¹ Technology is the de-

¹ Spengler, Oswald. *The Decline of the West*. Ed. Arthur Helps, and Helmut Werner. Trans. Charles F. Atkinson. New York: Oxford UP, 1991. ISBN 0-19-506751-7.

struction of every single myth, a sort of “anti-myth” which is in turn transformed into an ever more irrational and dehumanizing myth, as it subjects everything to unconditional objectification.

When modern technology turns its back on its inherent poetry and creativity and degrades Nature to something that is to be possessed, dominated and manipulated, it becomes “the grave danger”, as Martin Heidegger once warned.²

Coupled with rustic, coarse positivism, the dogma of unbridled growth has turned Nature into an object of use and exploitation. When Nature becomes a funfair for technology, and when it is turned into a repository of readily available resources, the vital bond between man and the environment is broken, and an imbalance of unforeseeable ramifications ensues.

Harmony – or the lack of it – between man and Nature will depend on whether man treats Nature from a purely utilitarian standpoint, or whether he interprets it as a space for life that is not to be reduced to a mere instrument or an object of his whim. Nature is neither separate from man, nor against man: rather, it exists **with man**. No sin is more heartless than our blindness to the value of all that surrounds us and our persistence in using it at the wrong time and abusing it at all times.

Only through universal unitedness between men, animals, plants and things will we be able to push aside the conceit of our race – which has come to think of itself as the despotic ruler of Creation – and turn it into the elder brother of all of its fellow creatures.

The environment cannot be solely a space for either peaceful or violent occupation. It must also be the object of great concern, as it is an extension of man himself, who lives on this planet as our hearts live inside our bodies.

Warning voices are currently being heard across all contexts about the grave deterioration of Sister Nature. Some people even talk about “terricide”, the murder of Earth. Nevertheless, it is also true that as with many other dominant issues of our time, people are easily tempted to exaggerate.

Still, it is also true that rivers, oceans, forests, fields, cities, food and the Earth’s atmosphere itself are becoming the victims of the unbridled ambition of not a few men. For this reason we must do everything within our reach to **humanize Nature**, and for Nature, in turn, to **humanize us**. This is a two-way street.

In the face of all this, two critical considerations come up from the standpoint of scientific awareness:

² Heidegger M. (1984), “La pregunta por la técnica”, *Ciencia y técnica*, Santiago de Chile, Editorial Universitaria.

1. Man is unable to have any relationship with his natural environment that is not based on plunder. Throughout History, our race has broken the laws of natural equilibrium: thus we have made the water on this planet undrinkable and its air unbreathable, we have polluted the soil to the point of barrenness, and we have implemented unequal and inequitable socio-economic resource management and distribution strategies. This sorry landscape is often known as “environmental crisis”.

Ethical considerations have been present ever since man became aware of his intervention in the world.

The rational use of ethics turns man into both the judge of and the party to his own deeds. More specifically, as soon as the human race grasped the effects of its aggressive behavior towards Nature, it became aware of the need to take corrective action.

2. In the face of the all-too-evident destruction of Nature, the current capitalist system cannot, on account of its very essence, attain sustainable development, as it engenders and feeds on inequity and social injustice, and is based on the unbridled and predatory use of natural resources, the anarchic production of goods and the encouragement of consumption with the goal of obtaining and concentrating profit.

Built on scientific and technological progress, present-day globalization – which has led to a deeper interconnectedness between production, trade and finance – is an engine that has pushed capitalism forward to unprecedented levels, producing serious social and cultural damage. Ushered in by neoliberalism, this novel socioeconomic plight enables and promotes the free play of market forces and fosters productivity, production and consumption, but fails to cater to the needs of society as a whole, which is conducive to increasing pressures on the environment. If this premise is objective, there is no other alternative than to encourage education in such a way as to promote a culture of “sustainability” of Nature. Such a culture should revisit the notion of man as part of the natural world in so many more ways than just biologically, as man is part and parcel of a cultural reality that allows him to comprehend his role in Nature.

2. The World, our Home

For Christians, the world is not inhospitable or prison-like, as pictured in quite a number of mystic and philosophical writings: rather, it is, as described by St. Bonaventure, “the house made for man”.³

³ Cf. G.H. Tavad, *Transiency and Permanence*, St. Bonaventure, N.Y., p. 40 1954.

The concept of “home” always entails a familiar, welcoming and endearing feeling.

If the universe fails to be our abode, it becomes a dreadful place. As stated by Martin Buber, “there is a cosmos for man only when the universe becomes his home”.⁴

For, as Gaston Bachelard beautifully puts it: “in the life of man, the house thrusts aside contingencies, its councils of continuity are unceasing. Without it, man would be a disperse being”.⁵

It is thanks to the house that man best learns to inhabit and deliver himself from the fear of feeling like a stranger. Man is no stranger to the world, nor is he thrown into it, as propounded by some philosophies of existence: rather, he is a being laid down in the warm enclosure of home. This home – something that is dearly ours – must be defended with care and passion.

With its pure and consistent Franciscan ingredients, Christian theology implies an anthropology and is conducive to an ecology, for everything – even matter itself – is good. God has created a marvelous world, and man is not supposed to manipulate it with rustic distrust. “Subdue the earth” does not give us free reign to exploit and destroy the environment: rather, it is a command for men and women to humanize nature by relating to it fruitfully.

I am very fond of the idea propounded by Werner Arber, the current president of the Pontifical Academy of Sciences, in his speech during the latest Synod on new evangelization: in his view, the duty of scientists today is to discover the possibilities of Nature and copy some of its evolutionary mechanisms so as to preserve it, perfect it or develop it to the extent possible. By thus acting, science would be offering men what God’s Providence has placed in Nature for their sustenance.⁶ Deep down this is the same idea as Paul VI’s in his encyclical *Populorum Progressio*, which stated that development – today “sustainable development” – is the new name for peace.

The path that we can propound is that of an education on environmental values that encourages a culture of vitality, healthiness, respect and responsibility, and that builds individuals endowed with a discerning and participative conscience. As long as it is not addressed in this manner, environmental education will do no more than supply knowledge on the natural world, over-

⁴ Buber M., *¿Qué es el hombre?*, F.C.E. Mexico 1949.

⁵ Judit Uzcátegui Araújo, *El imaginario de la casa en cinco artistas contemporáneas*, Eutelequia, Madrid, p. 15, 2011.

⁶ Werner Arber, Contemplation on the Relations Between Science and Faith, 12 October 2012, <http://www.casinapioiv.va/content/accademia/en/academicians/ordinary/arber/contemplation.html>

looking one of its principal roles: encouraging a change in perception that may be conducive to the emergence of new values.

Only when our attitudes and behaviors are pivoted on new, revitalized, motivating and harmonizing values will we be closer to many of the solutions that are so badly needed in the environmental arena.

3. Man's Attitudes Regarding the World

Throughout human History man has often changed his way of viewing and dealing with the world. By way of summary, the following points represent the most significant trends:

1. Man is in panic before the natural world: this is translated into fear, terror and adoration.
2. Man is in awe of the world, which leads to feelings of surprise, bewilderment, and admiration.
3. Man is respectful of the mysteries of the world, a place of harmony and beauty due to its being a reflection of the Creator.
4. Man rationalizes the world through mathematization, and as a reflection of the human race.
5. Man feels disillusioned with the world, which has been reduced to a mechanical model, is interpreted from a positivist standpoint and is seen solely from an efficacy perspective.
6. Man dominates and exploits the world as if it were a repository of unlimited resources, which he squanders and exhausts.
7. Man discovers – or rediscovers – the beauty of the world and his relationship with it. The world is our dear abode, and taking care of it or allowing it to deteriorate will both have inevitable repercussions on its dwellers. Caring for the world implies respecting Nature as well as developing it sustainably, that is, in keeping with its actual possibilities. Although this is in stark contrast with viewing the natural world as the object of man's whims, it does not mean that conserving our planet is equal to refraining from developing it.

The current situation contributes to accentuating the differences in the environmental impacts – which vary depending on the lifestyles and the socioeconomic conditions of the developed and the developing worlds – of human activities performed in a globalized planet that pretends to appear free of all boundaries.

Despite their environmentalist discourse, developed countries continue to increase production as well as consumption patterns.

In underdeveloped nations poverty is growing at an unbridled pace, and marginalization, unhealthiness and the lack of food safety are at their utmost, exacerbating pollution and the degradation of natural resources. This is added to the environmental impacts resulting from capital imports from wealthy countries, whose drive to obtain raw materials – by exploiting natural resources and hiring cheap labor – further increases the deterioration of the environment.

4. A Global Issue with a Latin American Sensibility:

In the Aparecida Document, the Bishops of Latin America have criticized international extractive industries and agribusiness, as well as the growing production of biofuels, especially when it is undertaken at the expense of the food necessary for human survival. I would like to quote a fragment from this Document: *“Financial institutions and transnational companies are becoming stronger to the point that local economies are subordinated, especially weakening the local States, which seem ever more powerless to carry out development projects at the service of their populations, especially when it involves long-term investments with no immediate dividends. International extractive industries and agribusiness often do not respect the economic, social, cultural, and environmental rights of the local populations, and do not assume their responsibilities.*

Preserving nature is very often subordinated to economic development, with damage to biodiversity, exhaustion of water reserves and other natural resources, air pollution, and climate change. The possibilities and potential problems of producing biofuels should be studied so that the value of human persons and their survival needs prevail. Latin America has the most abundant aquifers on the planet, along with vast extensions of forest lands which are humanity’s lungs. The world thus receives free of charge environmental services, benefits that are not recognized economically. The region is affected by the warming of the earth and climate change caused primarily by the unsustainable way of life of industrialized countries” (DA, 66).

In a visit to Punta Arenas, Chile, made on April 4, 1987, St. John Paul II urged us not to *“allow our world to become an ever more degraded and degrading land”*.

The final chapter of the Aparecida Document’s conclusions – called Our Peoples and Culture – also proposes a number of actions for attaining a balance between sustainable humanity, protected Nature and man’s rational responsibility for both realities.

For example, in Section 10.4 on new types of areopagus and decision-making centers, the Bishops state that they wish *“...to congratulate and encourage the many disciples and missionaries of Jesus Christ who with their coherent ethical presence, continue to sow the gospel values in the environments where culture is traditionally created and in the new types of areopagus: [...] ecology and protection of nature”* (DA, 491).

This can also be applied to this forum of the Pontifical Academy of Social Sciences: in the final section of the Document's conclusions, the Bishops speak about the paths of reconciliation and solidarity (Section 10.9) and assert that the culture of peace that should be aspired to (DA, 542) "*flows from sustainable and fair development that respects creation*".

5. Conclusion

The future of our habitat, the quality of our food and the wise use of the various sources of energy on Earth depends, of course, on scientists, politicians, philosophers, theologians, sociologists and psychologists: but it also depends on making the daily relationships of the world's inhabitants more humane. Henri Bergson used to say that the swollen body of humanity calls for a supplement of soul, and that the mechanical (i.e., the "swollen body") demands a mystique. Perhaps it might be better to assert that man needs to discover his own spirit, a spirit that rather than a supplement of his soul, is his own self. Only then will he be prepared to inhabit the natural world and furnish the technical world with a supplement of humanity and tenderness.

Man broadens the world's potential and ceaselessly transforms Nature into culture in unison with all the beings on this planet. For this purpose, he needs to perceive, discover and admire the wonders around him. One of the evils of mankind today is color-blindness, an inability to see reality thoroughly. Color-blindness implies seeing things partially, perceiving only some colors and shapes, and judging all of reality, all of life, from a limited and deformed viewpoint.

When we talk about values on a daily basis, we refer to the positive qualities that are attributable to a given individual, or to the importance that we ascribe to something.

Throughout History, the term "value", whose origins go back to Greek and Roman times, has been given different semantic implications. Its Greek meaning from the point of view of axiology is quite noteworthy, as is its Latin definition "be strong, be well".

Building, restoring and fostering the "values" that give shape to our behavior to produce harmonious and peaceful actions is an overall objective in present-day education.

Values education entails conveying concepts that embody, in and of themselves, motivations, intentions, purposes, affiliations, detractions, etc.

A value is much more than a concept stemming from the intellect, as it is capable of affecting man in his totality, i.e., as an intellectual and sensitive being. For this reason, values education is both education in its logic sense

as it must guide judgment-based choices, and education in the realm of feelings and emotions.⁷

Values education that goes beyond formal, bureaucratic pedagogical discourse must be capable of contesting, among other things, the centrality ascribed to “job opportunities”. Education must be targeted on building citizens that are both judicious and committed to the ideals of democracy, justice and respect for one another and the environment.

As Arnold J. Toynbee wrote some years ago, “to keep the biosphere inhabitable for another 2000 years, we and our descendants must forget the example of Pietro Bernardone, the successful wholesale cloth-merchant of the 13th Century, and his material prosperity, to follow the example of Francis, St. Francis, his son, the greatest of all men that have ever existed in the entire Western World... It is St. Francis's example that we Westerners should truly imitate...”⁸

This consistent testimonial of sustainable humanity and credible responsibility, and of a natural world that deserves being protected, can become a motto for all those who believe in a better future for mankind and the world, and who commit to working hard to build it.

Education entails boundless responsibility which exceeds the school and society arenas and affects the very existence of the state itself. The future and the survival of the state depend on the quality of the education that it imparts, and this is a matter of spiritual values.⁹ For education as a social practice is the means for translating the ideals of society.

In my view, our primary environmental strategy should be environmental education: this is a pressing and ongoing requirement, because through an education on the environment, individuals, societies and states will become aware of the transcendent meaningfulness of the world around us. Education will thus enable us to constructively absorb the skills, the experience, the values and the determination that will prompt us to work to solve both present and future problems in this realm and address them as challenges pertaining to our responsibility for the sustainability of both the environment and mankind.¹⁰

⁷ Barra Ruatta, *Educación en valores: La vida, la escuela, el sentimiento*, in *Educación y valores*. Boiero de De Angelo, M. Río Cuarto. Fundación UNRC, Argentina (2002).

⁸ Arnold J. Toynbee, *Entre el Maule y el Amazonas*, Emecé, España, pp. 51, 1967.

⁹ Laurence E., *The origins and growth of Modern education*. Middlesex: Penguin Books (1972).

¹⁰ The core theme of this Conference.

6. Food for Thought and Topics for Exchange

- I think that we lost our humility – it is not by chance that the word “humility” should come from the Latin *humus*, which means “earth” – when we deified ourselves as owners of the planet and turned our backs on our role as God’s stewards on Earth. By deeply experiencing creatural humility, we might be able to demythologize the anti-values that dehumanize us and denaturalize society. I have the impression that our societies are becoming – or have already become – dehumanized and denaturalized.
- An attitude of humility implies simplicity and gratitude. More often than not we are more aware of what we lack than of beauty, friendship, the joy of living and the many other gifts that God has to offer to us. Being wise enough to look upon life and the world around us with gratitude is an incentive for living in a state of joyfulness.
- In some ecology-oriented contexts the concern seems to be more about Nature than about man himself: this breaks the equilibrium between mankind and a sustainable natural world.

7. Conclusions

Science has helped us to discover a different approach to Nature, one that is fully rooted in our Christian tradition. If we paid more attention to it, we might be able to discern different pathways for solving many of the environmental issues of our time.

This issue is by no means the sole prerogative of Christians: rather, it is a matter that should concern all men from all cultures and religions, because we are all citizens of the same planet. In the face of an anthropogenic reality which has become man’s very trap, the road that remains is that of authentic education. For as long as it is viewed as an integral and integrating process, environmental education will raise awareness among individuals and social groups, and prompt them to embrace their share of responsibilities with respect to restoring the natural order.

Environmental education concerns all human beings, but it also implies considering the diverse components that make up the human race (age, region, culture, socioeconomic circumstances, etc.), as these components will determine what approaches are best for each set of conditions.

The solution to mankind’s sustainability issues is not to be improvised: we must prepare ourselves through education by developing discerning citizens that are committed with the ideals of democracy, justice, and respect for one another and the environment.

Bibliography

- Barquín, Julián. *Energía: técnica, economía y sociedad*. Madrid: Universidad Pontificia de Comillas, 2004. 294 p. ISBN 84-8468-8134-3.
- Buber M., ¿Qué es el hombre?, F.C.E. Mexico, 1949.
- Cassedy, Edwards S.; Grosmann, Peter Z. *Introduction to energy: resources, technology and society*. Cambridge: Cambridge University Press, 1990. XI, 338 p. ISBN 0-5213-5941-4.
- Documentos de Aparecida*, CELAM, Aparecida, 2007.
- Heidegger M., (1984) “La pregunta por la técnica”, *Ciencia y técnica*, Santiago de Chile, Editorial Universitaria.
- Ristinen, Robert A. *Energy and environment*. New York: John Wiley & Sons, 1999. XVI, 367 p. ISBN 0-4711-7248-0.
- Soulé, M.E. and J. Terborgh (eds) 1999. *Continental conservation. Scientific foundations of regional reserve networks*. Island Press, Washington.
- Spengler, Oswald. *The Decline of the West*. Ed. Arthur Helps, and Helmut Werner. Trans. Charles F. Atkinson. New York: Oxford UP, 1991.
- Stone, C.D. 1987. *Earth and other ethics*. Harper & Row, New York.
- Stonehouse, J.M. y J.D. Mumford. 1994. *Science, risk analysis and environmental policy decisions*. Environment and Trade, UNEP, Geneva.
- Soule, M.E. 1995. *The social siege of Nature*, p.137-170, In: “Reinventing Nature? Responses to postmodern deconstruction”. Island Press, Washington.
- Sunkel, O. 1980. Introducción. *La interacción entre los estilos de desarrollo y el medio ambiente en América Latina*. In “Estilos de desarrollo y medio ambiente en la América Latina”. Fondo Cultura Económica, Lecturas 36, Vol. 1, Mexico.
- Sunkel, O. 1990. *El desarrollo sustentable: del marco conceptual a una propuesta operacional para Chile*. IFDA Dossier 75/76: 51-61.
- Tavar, G.H., *Transiency and Permanence*, St. Bonaventure, N.Y., p.40 1954
- Toynbee, A.J., *Entre el Maule y el Amazonas*, Emecé, 1967
- Uzcátegui Araujo, J., *El imaginario de la casa en cinco artistas contemporáneas*, Eutelequia, Madrid, 2011
- Vogel, S. 1997. Habermas and the ethics of Nature. In: *The ecological community* (R.S. Gottlieb, ed.). Routledge, London.
- Von Moltke, K. 1992. Environmental protection and its effects on competitiveness. Seminar on International trade, environment and sustainable development, OAS, Santiago de Chile.

WORD OF WELCOME

■ WERNER ARBER, PAS PRESIDENT

Good morning! In the name of the Pontifical Academy of Sciences – natural sciences – I am very pleased to welcome all of you here. I consider it quite important that our two Academies treat the interdisciplinary topic of sustainability together, and I hope that we will find a good mutual understanding on the questions to be dealt with. I look forward to reach conclusions that can be communicated first of all to the Vatican, but then also to the outside world, to many attentive people in many countries. By the way, this joint workshop is the first regular meeting that our two Academies organize together.

In the past, our Pontifical Academy of Sciences has already discussed at several occasions questions and concerns relating to sustainability. In March 1999, at the transition to a new millennium, a Study-Week was devoted to *Science for Survival and Sustainable Development*¹ with highly relevant contributions.

In November 2008, our Academy devoted its Plenary Session to the topic *Scientific Insights into the Evolution of the Universe and of Life*.² It is mainly due to the advances of astrophysical knowledge that we know the age of our Universe and that in the course of extremely long time periods solar systems are born and eventually die after a long lifetime. Our solar system, including our planet Earth, exists since about 4,500 million years. Unicellular, anaerobic life on our planet can be assumed to have started about 3,500 million years ago. Some 2,500 million years ago cyanobacteria must have started to carry out photosynthesis, a reaction liberating free O₂ molecules that slowly accumulated in the atmosphere. At much later times, green plants showed up and intensified the production of O₂ by photosynthesis. When the oxygen level in the atmosphere had reached a level of 20% or more (some 540 million years ago), aerobic life became possible which gave rise to the evolution of animals and finally to primates including the human species. The relatively high O₂ level in the atmosphere gave also rise to the formation and maintenance of an ozone layer which protects us from damage by cosmic radiation.

¹ PAS *Scripta Varia* 98, pp. 427, 2000. Available online <http://www.casinapioiv.va/content/accademia/en/publications/scriptavaria/scienceforsurvival.html>

² PAS *Acta* 20, pp. 67 & 620, 2009. Available online <http://www.casinapioiv.va/content/accademia/en/publications/acta/evolution.html>

In a workshop entitled *Via humanitatis* organized by our Academy in cooperation with a group of French scientists in April 2013 (publication of the proceedings pending), it was concluded from archeological investigations that the species *homo sapiens* must have started its evolutionary origin some seven million years ago.

Referring again to astrophysical notions, we can assume that our sun can still spend us energy for another 4,000 million years. But, of course, one cannot predict if life on our planet can still continue to persist and to evolve so long. Various sources for serious disturbances are possible, such as a drastic collision with another large object circulating in the sky.

These considerations lead me to raise the question on the time horizon that we should envisage for a sustainable development on our planet under the impact of our cultural evolution. Should we envisage to maintain reasonable living conditions for humans for another few million years? Or is it more realistic to consider a much shorter time horizon of our cultural evolution in a rich and convenient natural environment?

I am aware that many contemporary humans define sustainability for just a few hundred years, i.e. to insure convenient living conditions for a few generations of their progeny. To my mind, this is not a responsible planning. I therefore propose to envisage a time period of at least 10,000 years. It is about 10,000 years ago that our cultural evolution began when humans started with agriculture, which represents their domestication of animals and of food plants. Up to that time, humans gathered and hunted to insure their daily diet, i.e., as the animals generally gather their daily nutrition. I am aware that a time horizon of 10,000 years for a responsible, sustainable development, is still difficult to plan, but I consider that it is feasible. I rather doubt that we could envisage the future development of appropriate living conditions for one or a few million years ahead. Let us keep in mind that our daily lives depend on a rich biodiversity, on appropriate habitats and on a number of essential inorganic, non-renewable resources, which our cultural evolution should protect and not use up and not destroy. With these expectations I now look forward to fruitful discussions in the next few days.

WORD OF WELCOME

■ MARGARET ARCHER, PASS PRESIDENT

Good morning everybody and welcome from the two Academies. We will start with the more senior, the Academy of Sciences, and then our newcomer, the parvenu, the Academy of Social Sciences, and it's always a pleasure when the two get together, especially on – well, we only get together on important topics. We've had a very good workshop on education together, now we are addressing sustainability and the whole programme, for which we must thank our three organisers, is about the issue of sustainability, so thank you very much to Ram – I'm told I'm allowed, I must call him Ram, because I will mispronounce his name otherwise, so forgive me for this – to Partha Dasgupta, on behalf of the Academy of Social Sciences and to Archbishop Roland Minnerath who, as usual, is the faithful source of continuity in our Academies and proceedings.

I think the only thing I want to say, apart from welcome, is very, very little about the novelty of the problem of sustainability. It is a late 20th century issue, it's a millennial issue, but it does raise two interesting questions to me, one about why it is so late, at least in human history, that we have a problem of sustainability. Up to 200 years ago we had David Ricardo, the economist, talking about the bounty of nature, that natural abundance was here to stay and, in true enlightenment fashion, man could become the master of all things natural. And amazingly, of course, this view which only Malthus, in one sense, challenged, with his contrast between the geometrical growth of population and the arithmetic growth of means of subsistence, only Malthus really challenged this seriously within the 19th century. So we all know the list of our unfriendly human dealings with the planet and its constituents on which we depend.

There is one thing that interests me, and this is the last point I want to make. In our discussions and in the papers I have had the chance to read so far, the whole emphasis falls, and rightly, in many ways, upon the unfriendly dealings of humankind with nature in all its aspects, but in this list, which I will not repeat – we all know it, although some people, as we well know, still deny it – one thing stood out to me. The human factor is treated as a constant: it's our institutions, it's the things we develop, it's our technology, our means of production. These things change but humankind is treated as some kind of constant in the equation which, and maybe this is the next problem on the human agenda, is not a constant any longer. We have ide-

ological movements for human enhancement techniques, and ideology which specifically aims to develop human capacities above and beyond their current average when humankind is treated as a natural kind. We have technological developments such as the ‘captors’, the implanted chips, the GPS systems, that human beings carry around with them, that enable new capacities for social control, social domination, surveillance, knowing exactly where all of us are all of the time, and if you put all of these together they’re going to give rise not, I think, to the cyborg that some of the more extreme theorists are trying to frighten us with but, certainly, we cannot assume that the needs, requirements, capacities, abilities of the human species are unchanging: they’re changing from day to day.

So what I hope is that there will be interchange and exchange between the two Academies on these crucially important issues, crucial for our very survival, and that, in a sense, we will not end up in this plenary meeting like the village dance where the same phenomenon seems to happen throughout the world, girls on one side, boys on the other side, and the dance is nearly over before they decide that they will get introduced.

Programme

FRIDAY 2 May 2014

- 9:00 *Word of Welcome*
PASS President Margaret S. Archer and PAS President Werner Arber
- 9:15 *Opening Address*
H.Em. Cardinal Oscar Andrés Rodríguez Maradiaga

I. THE BROADER CONTEXT

Chair: Margaret S. Archer

- 9:50 *Human-Nature Co-evolution*
Werner Arber
- 10:10 Discussion
- 10:30 *The Emergence of Humans: Brains (Bodies and Hands), Mind and Soul*
Yves Coppens
- 10:50 Discussion
- 11:10 Coffee Break
- 11:40 General Discussion

THE NEW ERA OF HUMAN-NATURE INTERACTIONS

II. FUNDAMENTAL DRIVERS OF FOOD, HEALTH, AND ENERGY NEEDS

Chair: Paul J. Crutzen

- 12:10 *Externalities, or the Unaccounted for Consequences of Our Actions that Undermine Nature*
Partha S. Dasgupta
- 12:30 Discussion
- 12:50 Lunch at the Casina Pio IV
- 15:00 *Population*
Gérard-François Dumont
- 15:20 Discussion
- 15:40 *Food Demand*
Joachim von Braun
- 16:00 Discussion
- 16:20 Coffee Break
- 16:50 *The World's Quest for Sustainable Development Goals*
Jeffrey D. Sachs
- 17:10 Discussion
- 17:30 General Discussion

III. ANTHROPOCENE: GLOBAL CLIMATE CHANGE

Chair: Walter H. Munk

- 18:00 *Food Production in the Anthropocene*
Paul J. Crutzen

- 18:20 Discussion
18:40 Dinner at the Casina Pio IV

SATURDAY 3 May 2014

- 8:30 *Tipping Points and Extreme Weather Events*
Hans Joachim Schellnhuber
8:50 Discussion
9:10 *Ocean Climate: Changes in the North Atlantic Circulation*
Walter H. Munk
9:30 Discussion
9:50 General Discussion
10:20 Coffee Break

IV. COMPETING DEMANDS ON NATURE AS A SOURCE

Chair: Partha S. Dasgupta

- 10:50 *The Oceans*
Nancy Knowlton
11:10 Discussion
11:30 *Tropical Forests*
Jeffrey R. Vincent
11:50 Discussion
12:10 Lunch at the Casina Pio IV
14:10 *The Mega-Cities Challenge*
Janice E. Perlman
14:30 Discussion
14:50 General Discussion

V. COMPETING DEMANDS ON THE CRYOSPHERE

Chair: Hans Joachim Schellnhuber

- 15:20 *Glaciers as Sources of Water*
Anil V. Kulkarni
15:40 Discussion
16:00 *The Polar Regions*
Peter Wadhams
16:20 Discussion
16:40 General Discussion
17:10 Coffee Break

VI. COMPETING DEMANDS ON THE BIOSPHERE

Chair: Naomi Oreskes

- 17:40 *Green Fields: Feeding the Hungry, Raising the Poor and Protecting Nature in Africa*
Robert E. Scholes
18:00 Discussion

- 18:20 *Stability of Coastal Zones*
Marcia K. McNutt
18:40 Discussion
19:00 General Discussion
19:30 Dinner at the Casina Pio IV

SUNDAY 4 May 2014

SPECIAL SESSION FOR THE 20TH ANNIVERSARY
OF THE PONTIFICAL ACADEMY OF SOCIAL SCIENCES

- 16:00 Holy Mass in the Casina's Chapel
16:45 Closed Session of the Pontifical Academy of Social Sciences
18:15 Coffee Break
18:45 *History of the PASS*
Herbert Schambeck
19:30 Dinner at the Casina Pio IV

VII. SOCIETY'S RESPONSE TO CURRENT UNSUSTAINABLE GROWTH

Chair: Timothy E. Wirth

- 9:00 *Why Have Climate Negotiations Proved So Disappointing?*
Scott Barrett
9:20 Discussion
9:40 *Transitions Towards an Inclusive "Green Economy": Achieving Food and Energy Security in a World of Growing Demand*
Achim Steiner
10:00 Discussion
10:20 *The Two Worlds Approach: The Top 4 Billion and the Bottom 3 Billion*
Veerabhadran Ramanathan
10:40 Discussion
11:00 Coffee Break
11:15 *Mainstreaming the Values of Nature into Decision-Making*
Gretchen Daily
11:35 Discussion
11:55 *Energy for Sustainable and Equitable Development*
Daniel M. Kammen
12:15 Discussion
12:35 *Global Knowledge Action Network for Adaption to Climate Change, 2*
Charles F. Kennel
12:55 Discussion
13:15 Lunch at the Casina Pio IV
15:00 *Valuing Nature: Getting the Trade-offs Right*
Karl-Goran Maler and Charles Perrings
15:20 Discussion
15:40 *Sustainable Transformation of Human Society in Asia*
Yuan Tseh Lee

- 16:00 Discussion
- 16:20 General Discussion
- 16:50 Coffee Break

VIII. SOCIAL INFRASTRUCTURE

Chair: Herbert Schambeck

- 17:10 *The Price of Inequality: How Today's Divided Society Endangers our Future*
Joseph E. Stiglitz
- 17:30 Discussion
- 17:50 *Human Natural Law as a Basis for the Safeguarding of Human Life and Nature in a Globalised World*
H.E. Msgr. Roland Minnerath
- 18:10 Discussion
- 18:30 *Nature and the Law: Ownership of the Global Commons*
Edith Brown Weiss
- 18:50 Discussion
- 19:10 General Discussion
- 19:40 Dinner at the Casina Pio IV

TUESDAY 6 May 2014

IX. SOCIAL INCLUSION

Chair: Werner Arber

- 9:00 *Globalization: A Social Balance*
Juan José Llach
- 9:20 Discussion
- 9:40 *Ensuring Learning for All Children and Youth*
Antonio M. Battro
- 10:00 Discussion
- 10:20 Coffee Break
- 10:50 *Being Trafficked to Work*
Margaret S. Archer
- 11:10 Discussion
- 11:30 *Labour Precarity, Social Exclusion and People's Economy*
Juan Grabois
- 11:50 Discussion
- 12:10 *The Influence of Virtuous Human Life in Sustaining Nature*
Stefano Zamagni
- 12:30 Discussion
- 12:50 Lunch at the Casina Pio IV
- 14:30 *Good Governance, Including Peace*
Wilfrido V. Villacorta
- 14:50 Discussion
- 15:10 *Intergenerational Solidarity*
Pierpaolo Donati
- 15:30 Discussion
- 15:50 General Discussion

X. CLOSING SESSION: MOTIVATING SOCIETIES

Chair: Veerabhadran Ramanathan

- 16:20 *Scientific Consensus and the Role and Character of Scientific Dissent*
Naomi Oreskes
- 16:40 Discussion
- 17:00 Coffee Break
- 17:30 *Existential Risks*
Martin J. Rees
- 17:50 Discussion
- 18:10 *Social Ethics: Humanity's Responsibility Toward Nature*
Enrico Berti
- 18:30 Discussion
- 18:50 Conference Summary
Andy Revkin
- 19:05 Conference Statement
Marcelo Sánchez Sorondo
- 19:20 Dinner at the Casina Pio IV

List of Participants

Speakers

Prof. Werner Arber

President of the Pontifical Academy of Sciences;
Biozentrum, Department of Microbiology,
University of Basel
Basel (Switzerland)

Prof. Margaret S. Archer

President of the Pontifical Academy
of Social Sciences
Centre for Social Ontology
University of Warwick
Coventry (UK)

Prof. Scott Barrett

Lenfest-Earth Institute Professor
of Natural Resource Economics
Columbia University
New York, NY (USA)

Prof. Antonio M. Battro

Academia Nacional de Educación
Buenos Aires (Argentina)

Prof. Enrico Berti

University of Padova
Dept. of Philosophy
Padova (Italy)

Prof. Joachim von Braun

Director, Center for Development Research (ZEF)
University of Bonn;
Professor, Economics and Technological Change
Bonn (Germany)

Prof. Edith Brown Weiss

Francis Cabell Brown Professor of
International Law
Georgetown University Law Center
Washington, DC (USA)

Prof. Yves Coppens

Collège de France
Paris (France)

Prof. Paul J. Crutzen

Max-Planck-Institute for Chemistry
Dept. of Atmospheric Chemistry
Mainz (Germany)

Prof. Gretchen Daily, Ph.D.

Professor of Biology, Senior Fellow,
Woods Institute for the Environment,
Stanford University, Stanford, CA (USA)

Prof. Partha S. Dasgupta

Frank Ramsey Professor Emeritus of Economics
University of Cambridge
Cambridge (UK)

Prof. Pierpaolo Donati

University of Bologna
Dept. of Sociology
Bologna (Italy)

Prof. Gérard-François Dumont

Université de Paris-Sorbonne
Paris (France)

Juan Grabois

Co-founder of the Excluded Workers Movement
and Confederation of Popular Economy Workers
Buenos Aires (Argentina)

Prof. Daniel M. Kammen

Energy and Resources Group, Dept. of Nuclear
Engineering; Founding Director of Renewable
and Appropriate Energy Laboratory (RAEL)
University of California, Berkeley (USA)

Dr. Charles F. Kennel

Chair of National Academies Space Studies Board
 Director and Distinguished Professor,
 Emeritus at Scripps Institution of
 Oceanography,
 University of California, San Diego (USA)

Dr. Nancy Knowlton

Sloan Research Fellowship in Ocean Sciences
 Committee and the National Board the Coral
 Reef Alliance Aldo Leopold Leadership Fellow
 Washington, DC (USA)

Dr. Anil V. Kulkarni

Distinguished Visiting Scientist, Divecha Center
 for Climate Change, Center for Atmospheric &
 Oceanic Sciences, Indian Institute of Sciences
 Bangalore (India)

Prof. Yuan-Tseh Lee

President of International Council for Science
 President Emeritus, Academia Sinica
 DRF, Institute of Atomic and Molecular Sciences
 Taipei (Taiwan)

Prof. Juan José Llach

Director, GESE (Centro de Estudios de
 Gobierno, Empresa, Sociedad y Economía)
 IAE-Universidad Austral
 Buenos Aires (Argentina)

Prof. Marcia K. McNutt

Editor-in-Chief of *Science*
 Washington, DC (USA)

Prof. Karl-Göran Mäler

Professor Emeritus, Researcher, former Director,
 The Beijer Institute of Ecological Economics,
 The Royal Swedish Academy of Sciences
 Stockholm (Sweden)

H.E. Msgr. Prof. Roland Minnerath

Archbishop of Dijon
 Dijon (France)

Prof. Walter H. Munk

Professor Emeritus, Institute of Geophysics
 and Planetary Physics
 Scripps Institution of Oceanography, UC
 San Diego, CA (USA)

Prof. Naomi Oreskes

Department of the History of Science
 Harvard University
 Cambridge, MA (USA)

Dr. Janice E. Perlman

Founder & President of the Mega-Cities Project
 Nyack, NY (USA)

Prof. Charles Perrings

Professor of Environmental Economics
 School of Life Sciences
 Arizona State University
 Tempe, AZ (USA)

Prof. Veerabhadran Ramanathan

Distinguished Professor of Climate
 and Atmospheric Science Scripps Institution
 of Oceanography, University of California
 San Diego, CA (USA)

Prof. Martin J. Rees

University of Cambridge
 Institute of Astronomy
 Cambridge (UK)

H.Em. Óscar Andrés

Card. Rodríguez Maradiaga
 Archbishop of Tegucigalpa
 President of Caritas Internationalis
 Tegucigalpa (Honduras)

Prof. Jeffrey D. Sachs

Director, The Earth Institute
 Columbia University
 New York, NY (USA)

H.E. Msgr. Marcelo Sánchez Sorondo

Chancellor of the Pontifical Academy of
 Sciences and of Social Sciences
 (Vatican City)

Prof. Herbert Schambeck

Professor Emeritus
University of Linz
Institute for Public Law and Political Sciences
Linz-Auhof (Austria)

Prof. Hans Joachim Schellnhuber

Founding Director of the Potsdam Institute
for Climate Impact Research (PIK)
Potsdam (Germany)

Prof. Robert E. Scholes

Brown University, Dept. of Modern Culture
and Media
Providence (USA)

Mr. Achim Steiner

UNEP Executive Director
and Under-Secretary-General
of the United Nations
Nairobi (Kenya)

Prof. Joseph E. Stiglitz

Columbia University
Graduate School of Business
New York, NY (USA)

Prof. Wilfrido V. Villacorta

Professor Emeritus
De La Salle University
Manila (Philippines)

Prof. Jeffrey R. Vincent

Korstian Professor in Forest Economics and
Management, Nicholas School of the
Environment and Earth Sciences, Duke University
Durham, NC (USA)

Prof. Peter Wadhams

Head of the Polar Ocean Physics Group
Dept. of Applied Mathematics and
Theoretical Physics
University of Cambridge
Cambridge (UK)

Prof. Stefano Zamagni

Vice director of the Bologna Center
Senior adjunct Prof. of International Economics
Professor of Economics, University of Bologna
Bologna (Italy)

*Outside Observers***Alpizar Francisco**

Ecological Economist from America Latina,
Costa Rica

Brasceso M. Veronica

Researcher

Casazza Marco

Researcher

Chitiga Margaret

Director of the Economic Performance and
Development research programme at the Human
Sciences Research Council

Czerny Michael

Office of the President, Pontifical Council for
Justice and Peace

Dasgupta Aisha

Research Student at the London School of
Hygiene and Tropical Medicine

Duke Luly

Founder and President, Fundación Amistad, NY,
USA

Duraiappah Anantha

International Human Dimensions Programme

Gardner Gary T.

Senior Fellow, Worldwatch Institute

Ghatak Amrita

India, GIDR

Kapellari H.E. Msgr. Egon

Representative of the Holy See to the Academy

Kelly Emily

Scripps Grad Student, Nominated by Grad Dept

Liebsch Martina

Caritas Internationalis

McKenzie Curtis

Intern at the Pontifical Council for Justice and Peace

Misleh Dan

Director, Catholic Coalition on Climate Change

Munoz Pablo

International Human Dimensions Programme

Pinheiro Franco João Luiz

Neurosurgeon, São Paulo, Brazil

Rabbani Atonu

Bangladesh, Dhaka University

Revkin Andy

NY Times Reporter

Richter Daniel

Legislative Director for the Citizens Climate Lobby (CCL). Former grad student at Scripps-UCSD

Ross Courtney

Founder and Chair, Ross Institute, NY, USA

Roy Michel

Caritas Internationalis

Shyamsundar Priya

Executive Director Sandee Kathmandu

Siegfried Matthew

Scripps-UCSD grad student, Nominated by Dept Interests: Greenland and Water Antarctic Glacier melt

Teavai-Murphy Hinano

Associate Director - Administration & Outreach, UC Berkeley Gump Research Center

Verga Daniele

Retired Ambassador

Vinciguerra Tebaldo

Pontifical Council for Justice and Peace

Warrian Peter

Chair of the Lupina Foundation

Weiss Charles

Distinguished Professor of Science, Technology and International Affairs at Georgetown University

Wirth Timothy E.

Vice Chairman and former President, United Nations Foundation, Washington, DC, USA

Wolnicki Mateusz

Senior Project Officer, Regional Sustainability Planning Section A, Strategic Approaches Branch, Environment Assessment & Compliance Division, Dept of the Environment, Canberra

Academicians

Buttiglione Rocco

Fumagalli Carulli Ombretta

Glendon Mary Ann

Hertzke Allen

Hösle Vittorio

Kuan Hsin-Chi

Le Douarin Nicole M.

Léna Pierre J.

Matlary Janne

Mittelstrass Jürgen

Mlčoch Lubomír

Possenti Vittorio

Raga José T.

Ramirez Mina M.

Suchocka Hanna

Tietmeyer Hans

Vicuña Rafael

Zacher Hans

Zulu Paulus

Scientific Papers

► I. THE BROADER CONTEXT

HUMAN-NATURE CO-EVOLUTION

■ WERNER ARBER

Introduction

In my *Word of Welcome* I referred to the very long time scales of both the terrestrial and the biological evolutions. Our human species has its roots in the long past evolutionary progress. We can expect that humanity can also participate in the future, slowly progressing evolution of the treasure of high diversities of forms of life and of their natural environments. A scientifically based knowledge of the laws and forces of nature driving the evolutionary progress can help us not to disturb the ongoing evolution and to undertake the appropriate responsibility.

In my presentation I will briefly outline the currently available scientific knowledge on biological evolution and on its systemic aspects. This will lead me to discuss a few conceptual conclusions.

From the roots of evolutionary biology to molecular Darwinism

It was in the middle of the 19th century that Charles Darwin published the theory of natural selection postulating that those organisms dealing best with their encountered natural environments have the best chance for long-term survival as a species. Darwin's theory was based on careful observations of phenotypic traits of some animals. Shortly thereafter, Gregor Mendel started the new discipline of classical genetics on the basis of phenotypic traits of plants. Almost 100 years later, work with bacteria revealed that a major reason for phenotypic traits is specific genetic information carried in filamentous DNA molecules.[1] When the double-helical structure of DNA molecules was determined,[2] it became clear how the linear sequences of nucleotides could carry genetic information and transmit it by replication to the progeny. In the meantime it has become possible to study nucleotide sequence alterations due to spontaneously occurring genetic variations.

The three pillars of Molecular Darwinism are: genetic variation as the driving force of biological evolution, natural selection influencing the direction taken by each step of biological evolution, and both reproductive and geographic isolation which modulates the evolutionary progress.[3] The data on spontaneous genetic variation to be reported below are mainly based on experimental investigations with microorganisms, but there is increasing evidence that the described principals are also valid in eukaryotic organisms.

Specific molecular mechanisms can be assigned to three natural strategies of spontaneous genetic variation

From intensive experimental investigations with *Escherichia coli* bacteria, some of its bacteriophages and a few other microorganisms, it became known that a number of different specific molecular mechanisms serve in nature for the relatively rare spontaneous production of genetic variants.[3] These mechanisms act normally at least to some degree contingently with regard to the site on the DNA and with regard to the time of mutagenesis.[4] It is in general only a minority of novel genetic variants that provide to the organism a selective advantage. Other spontaneous DNA sequence variations may either provide a selective disadvantage or they may not affect any phenotype and remain silent, neutral.

We may classify the various specific molecular mechanisms of spontaneous genetic variation into three natural strategies of genetic variation. Each of these strategies contributes with a different quality to the evolutionary progress:

- (a) One of the natural strategies of genetic variation produces local nucleotide sequence changes, such as a nucleotide substitution, the deletion or the insertion of one or a very few adjacent nucleotides, or a scrambling of a few adjacent nucleotides. By chance, a local nucleotide sequence change can improve already existing genetic information encoding either a specific gene product or a control signal for the expression of a particular gene product.
- (b) A second natural strategy of genetic variation consists in the intragenomic rearrangement of a DNA segment. This can bring about the translocation, a partial duplication, the deletion or the inversion of a DNA segment. By chance, these processes can sometimes result either in the fusion of two different functional domains of genetic information or in the provision of an open reading frame for a gene product with an alternative expression control signal. In the former case, a novel biological function may occasionally result from the fusion, whereas the efficiency of expression of the concerned gene product may be changed in the latter case.
- (c) The third natural strategy of genetic variation resides in the acquisition of foreign genetic information by horizontal gene transfer. This strategy can provide a valuable genetic capacity to an organism in just one single step. We can consider horizontal gene transfer as a sharing in the long-term evolutionary success of another kind of organism. Note that the universal genetic code, i.e. a common language of living beings, facilitates

the success of this strategy.[5] But we have to be aware that the functional harmony of the recipient organism must not be disturbed by the acquisition of additional gene functions.

At any time, novel genetic variants are submitted, together with their parental forms, to the pressure of natural selection. In the longer term, variants with selective advantage may thereby gain over the others. We must be aware, however, that optimal living conditions are neither unique nor absolutely constant for a given kind of living organism. Note that the living conditions depend both on the physico-chemical composition of the environment and on all other living beings present in a given ecosystem.

The natural reality takes actively care of biological evolution

In the living organisms studied so far a number of particular gene products is involved in the occasional production of genetic variants. Some of these enzymes are involved in genetic rearrangements, whereas others contribute to modulate the frequency of genetic variation. Keep in mind that Mother Nature is quite inventive, so that the specific mechanisms of genetically encoded variation generators and variation rate modulators may differ from case to case.

Nature also takes advantage of intrinsic non-genetic elements for spontaneous genetic variation. A good example is the impact of short-living isomeric forms of bioorganic molecules such as nucleotides. The isomeric imino form of the nucleotide adenine does not any longer pair with thymine, but it does so with cytosine.[6] As soon as the adenine reassumes its relatively stable standard form, the shortly before introduced cytosine results in a mispairing. In my opinion, it is wrong to interpret this as a replication error. I rather see in this process a welcome opportunity that can serve nature for the occasional production of a nucleotide substitution. As a matter of fact, the living organisms tested so far also possess so-called repair enzymes with the ability to prevent a stable fixation of the majority of nascent nucleotide mispairings. But their enzymatic prevention is not absolute, which allows to modulate the substitution rates to evolutionarily adequate low levels. In other words, the described process serves the evolutionary progress, it is not an error of the DNA replication fork.

Systemic aspects of life and of its biological evolution

It becomes more and more clear to what degree the living beings interdepend both on contributions provided by a multitude of other living beings and on their variable terrestrial habitats.[7] This insight represents

an important message to all human beings to prevent drastic interventions into the evolutionary progress of the treasure of the encountered biodiversity and of its habitats. We have to be aware that the evolutionary time scale is quite slow, so that we cannot easily perceive the evolutionary progress with our sensory organs. However, taking responsibility for the development at a longer term on our planet Earth, either by a religious mandate or by our own insights into the basic laws of nature, is well anchored in our cultural evolution.

Let me just recall here that the start of agriculture some 10,000 years ago represents an important contribution to improve the living conditions of the human population. Agriculture consists in the domestication of a number of food plants and animals ensuring our food provision. With increasing knowledge of specific values of various gene products we have only very recently started to “domesticate” individual genes, often also from organisms that cannot easily be maintained and propagated as such. But from case to case, a horizontal gene transfer into an appropriate carrier organism can enable us to profit from some products of domesticated genes.[8] This can serve, e.g., for medical and also for nutritional improvements.[9] Since the voluntary translocation of a single gene corresponds to the discussed law of nature of horizontal gene transfer as a driving force of biological evolution, there is no reason to assume risky consequences in all cases of such engineered transfers, in particular if such translocations are made on the basis of an identified and well studied gene product. A good example is golden rice providing a vitamin A precursor to the daily diet.[10]

As human beings we can identify more and more to what degree we interdepend on the rich existing biodiversity and its various habitats. Our microbiome [11] consists of a large diversity of microorganisms which co-habit in and on our bodies. We provide them appropriate habitats and they live with us in symbiosis, contributing mostly to our healthy living. Only relatively rarely we suffer from occasional pathogenic effects.

With these indications it may become clear that for at least two reasons, we have to take good care and not destroy the still rich biodiversity on our planet. As we have seen, spontaneous biological variation can bring about particular gene functions from one organism to another (including the human genome), in particular upon long-term cohabitation. On the other hand, future generations might possibly identify in the rich biodiversity still other useful gene functions which they might like to domesticate and use for their benefit. These long-term aspects should be kept in mind in our considerations on sustainable development. Specific genes are potential renewable resources and should not become lost.

Additional conceptual aspects of the evolutionary progress

In explaining his drawing of the tree of evolution, Charles Darwin postulated that living organisms must have a common origin. Still today, the sciences cannot explain how life on Earth started nor would we know if there was one or more than one independent start. However, we still use the tree of evolution as a concept. In view of the evolutionary relevance of horizontal gene transfer, I have started to introduce horizontal connectors between branches of the tree in order to symbolize the occasional acquisition of genetic information from another type of organism.[12] Therefore, living beings do not only have a common origin but also a common future. Any living being may, at some forthcoming time, take profit to acquire an additional genetic capacity that had been developed and improved elsewhere.

At least for well-studied bacteria, we can conclude on a duality of the genome. As I have outlined above, some of the genes serve biological evolution, producing variation generators and modulators of the rates of genetic variation. These evolution genes serve for the expansion of life and for providing a rich biodiversity. In contrast, the majority of the genes carried in the bacterial genome serves in the individual for the fulfilment of life from one generation to the next. I assume that this conceptual aspect does also apply to higher organisms.

May I just mention here that we should not assume that lost biodiversity becomes fast reconstituted by the continued evolutionary progress. Rather, we can expect that long-term evolution can bring about an enriched biodiversity again, but not with all the same genetic functions which had been lost before.

From today's point of view, it is important to realize that phenotypic traits do not uniquely depend on specific genetic information. We have to take note also, as already mentioned, of the relevance of symbiotic effects of the microbiome and of effects exerted by any other living organism existing in the same ecosystem. And we also have to consider epigenetic effects [13] of the environment and impacts of nutrition consumed.

In conclusion, life is of a high degree of complexity, which has to be considered in any deeper reflection on the long-term sustainable development of our planet Earth.

References

- [1] Avery, O.T., MacLeod, C.M. and McCarty, M. (1944), Studies on the chemical nature of the substance inducing transformation of pneumococcal types. Induction of transformation by a desoxyribonucleic acid fraction isolated from pneumococcal type III. *J. Exp. Med.* 79, 137-158.
- [2] Watson, J.D. and Crick, F.H.C. (1953), Molecular structure of nucleic acids.

- A structure for deoxyribose nucleic acid, *Nature*, 171, 737-738.
- [3] Arber, W. (2007), Genetic variation and molecular evolution. In: Meyers, R.A., (Ed.), *Genomics and Genetics*, Vol. 1. Weinheim: Wiley-VCH, pp. 385-406.
- [4] Arber, W. (2011), Molecular Darwinism: The contingency of spontaneous genetic variation. *Genome Biol. Evol.*, 3, 1090-1092.
- [5] Arber, W. (2006), The evolutionary strategy of DNA acquisition as a possible reason for a universal genetic code. *Hist. Phil. Life Sci.* 28, 525-532.
- [6] Watson, J.D. and Crick, F.H.C. (1953), The structure of DNA. *Cold Spring Harbor Symp. Quant. Biol.*, 18, 123-131.
- [7] Arber, W. (2009), Systemic aspects of biological evolution. *J. Biotech.*, 144, 242-244.
- [8] Rech, E.L. and Arber, W. (2013), Biodiversity as a source for synthetic domestication of useful genetic traits. *Ann. Appl. Biol.*, 162, 141-144.
- [9] Arber, W. (2009), The impact of science and technology on the civilization. *Biotech. Adv.*, 27, 940-944.
- [10] Potrykus, I. and Ammann, K. (Eds.) (2010), Transgenic plants for food security in the context of development, special issue of *New Biotech.*, 27, 445-717.
- [11] Blaser, M., Bork, P., Fraser, C., Knight, R. and Wang, J. (2013) The microbiome explored: recent insights and future challenges. *Nature Rev. Microbiol.*, 11, 213-217
- [12] Arber, W. (1991), Elements in microbial evolution, *J. Mol. Evol.*, 33, 4-12.
- [13] Allis, C.D. (Ed), Januwein, T., Reinberg, D. (2008) *Epigenetics*, Cold Spring Harbor Laboratory.

THE EMERGENCE OF HUMANS: BRAINS (BODIES AND HANDS), MIND AND SOUL

■ YVES COPPENS

Before describing the current situation of Nature and Humanity, I think that my duty today, as a geologist and a paleontologist, is to try to tell you when and how Nature was born and grew and when and how Humanity was born and grew.

According to astrophysicists, our universe is appearing in our scientific perception, in our knowledge, 13.7 billion years ago, let's say around 14 billion years ago. But Science does not know where from, or what for and Science, in an elegant way, is saying that the origin of our Universe is an open question!

But Science is able to tell the whole history of these last 14 billion years.

The very first result is that this history is growing towards more complexity but also more organization, a beautiful paradox which means that this history has a direction of growth, synonymous of meaning. In French, I would say that «comme l'histoire de l'Univers a un sens, elle a du 'sens'».

The astrophysicists are also saying that for them, this Universe, our Universe, is like a physical object, quite homogenous, where the physical laws have been the same all along these 14 «visible» billion years.

And they are describing a succession of structures, going from sort of large and flat pancakes to less large galaxies and, at last, to stars and planets. And inside these structures, matter, very simple and non-organised, is becoming less simple and more and more organized.

The astrophysicists again, but this time with the geologists, are telling the history of one of these stars, the Sun, born in a galaxy, the Milky Way, 4.6 billion years ago. And among the planets of this star, appeared one of them, not too far from the star, not too big, not too small, I mean big enough to keep water on it and gas around it. Our oceans and our atmosphere did exist as soon as 4 billion years ago; their composition was different

but their existence allowed water to reach a new level of complexity and organization: associations of molecules became cells, able to exchange matter and energy and able to duplicate themselves.

Part of the inert matter became a more complex matter, the living one (sometimes, more is different).

At this level of the history, I have an important point to make.

Many colleagues are currently claiming their sadness because our planet, so beautifully covered by Nature, is changing, becoming, because of Humanity, “anthropised”. Most of the landscapes, more and more, are showing humanity marks. And they declare their nostalgia of Nature before Man.

But these colleagues are forgetting that the Earth had a completely different aspect before Nature. In a comparative way, when after 500 to 600 million years of mineral landscapes, life appeared in water and, after 3.5 billion years, at last covered the surface of our planet, the aspect of the Earth, because of Nature, has been changing, becoming “biologised”. I guess that, if some colleagues had existed at that time, they would have had the nostalgia of Mineral before Nature.

This remark is to point out that mineralization, biologization, anthropisation are only comparative successive phenomena, probably followed by something else in a while.

So life has existed on the Earth since 4 billion years, maybe a bit less. And a large part of it will change, according to a necessity of adaptation to different environments, in the direction we have already mentioned: more complexity and more organization with an obsessional goal, to survive long enough for reproduction and transmission.

But in an interesting way, I would say that a new paradox is appearing as a guideline for life. More organized but more complex, life is also becoming more diversified but more constrained. I mean that its inventiveness to find adaptive strategies to survive is going with the development of successive mechanisms inside the organisms: RNA, proteins and then DNA, to control the succession. Life has the privilege of reproduction but with rules, called heredity.

Life is a precious patrimony of the earth, not yet known elsewhere in the Universe, useful for the biological equilibrium of humanity, useful for its needs, useful for its inspiration. So it would be good to take more care of its sustainability, useful, as far as we currently know, for the sustainability of Humanity itself. It would be good to respect it.

Life is evolving building the tree of filiations, from some beings composed of one cell to beings composed of several cells, from some beings with an inside skeleton in water to some vertebrates with lungs outside water, from some of them with hair and milk, laying eggs, to some mammals with placenta and, among these mammals, from Primates with binocular vision and climbing equipment to the so-called Prehumans, permanently upright for the first time, new bipedal locomotion but still climbing, new diet and new teeth, new behavior and new brain; standing posture means free hands, means also new vision, towards the horizon, towards the sky.

This is the beginning of what can be called Hominids. A very important event and we are able to say when this event happened: this geological time is ten million years ago.

Where: the geographical place is tropical Africa.

Why: because the climate is changing and the landscape is opening.

How: in changing posture, locomotion, diet, behavior, new way of looking, new way of thinking about it, new way of using hands, and improving their ability.

Around 3 million years ago, a second big step happened in the history of Hominids.

Prehumanity (Prehumans) had to adapt its anatomy, its diet, its behavior, its strategy, to survive to a new climate change, a drought. All the animals, hominid included, had to find new adaptations to this new situation.

And Hominids found three answers:

- A robust one, still with a small brain but with a strong, dissuasive body and bigger teeth to eat remaining fibrous plants;
- A gracile solution, still with a small brain but better anatomic equipment to walk and run faster;
- And a second gracile solution, with a small body but with a much bigger brain (more volume, more complexity, more irrigation) and teeth to eat almost anything, including meat, and this solution is called Man.

A particularly important event of course, and we are able to say:

When this event happened: the geological time is 3 million years.

Where: in tropical Africa.

Why: because the climate is changing and the landscape is opening more and more again.

How: the new brain for *Homo* (like bigger teeth for Elephants and like the new leg for Horses), means changing behavior, diet, a new way of looking, including inside ourselves, a new way of thinking, a new way of exchanging ideas, thanks to articulated language, permanent dialogue between thoughts, language, hands, tools, creations and symbols since the very first one – which means invention of a new environment, Culture.

And Man is Man as soon as he is Man, I mean Human and not Prehuman any more.

After the first paradox (more complexity, more organization), after the second one (more creativity, more control), appeared with Man a new paradox: more liberty, more responsibility which is soul.

I used to tell the history of Humans, of Humanity (the last three million years), in four steps, as far as the relationships of Humanity and the environment is concerned.

1. From 3 million years ago to ten thousand years ago, *l'environnement est subi*, the environment is not transformed because Humanity is not, demographically, important enough to do so. Humanity had to support the environment and its development was, of course, sustainable.
2. From 10 thousands years ago to the nineteenth century, *l'environnement est conquis*, it was the end of the last glaciation, the beginning of sedentarism for Humanity, which is developing agriculture and breeding.
3. From the nineteenth century to the first half of the twentieth century, *l'environnement est surprise*, like a surprise and like an excess. We were a few thousand people 3 million years ago in tropical Africa; we were about 10 million people, 10 thousand years ago, all over the world; we were about 200 million people at the time of the Christ, and for the first time, one billion at the beginning of the 18th century.

The consequence has been the necessity of mass production to feed humanity and it has been, at the same time, the time of the development of industry, technology, science. But Humanity was unconscious at the time of this turnover that development was becoming insidiously unsustainable.

4. Human demography increased from 1 billion people to 7 billion in less than two hundred years; a little more than half a century ago, several sciences, dealing with environment, inform us that the sustainability of Nature became a problem, as well as the sustainability of Humanity. I am calling this current epoch *l'environnement compris*. We understand that we now have to cope with this new situation. It is the reason why we are here, at this symposium dealing with our responsibility in this new change.

▶ THE NEW ERA OF HUMAN-NATURE INTERACTIONS

II. FUNDAMENTAL DRIVERS OF FOOD, HEALTH, AND ENERGY NEEDS

IMPEDIMENTS TO SUSTAINABLE DEVELOPMENT: EXTERNALITIES IN HUMAN-NATURE EXCHANGES*

■ PARTHA DASGUPTA**

Prologue

A problem in urgent need of attention in modern societies is to discover ways to de-link national income from recorded employment. If the loss were shared in a manner deemed fair by the general public, there would be nothing catastrophic for people in a country where the average income is 35,000 international dollars a year to suffer an income loss of even 25 per cent, let alone 5 per cent. Average income in the UK in 1990 was about 25 per cent less than in 2005. It is hard to maintain that UK citizens enjoyed significantly lower levels of personal well-being in 1990 than they did in 2005. Reports on “life satisfaction” suggest that a general rise in private consumption among a population already enjoying a high standard of living adds little to happiness (Oswald, 1997; Bok, 2009; Graham, 2009).

In contrast, employment is known to be a powerful factor in a person’s sense of well-being and self-worth.¹ It would be a catastrophe were a 25 per cent drop in average income in a rich country to be accompanied by a comparable drop in employment. Citizens would justifiably demand that if there is to be a significant drop in aggregate income, it should be shared by all. But that would require employment not to decline. Governments in modern economies have either been unable to or have chosen not to prevent inequities from appearing in employment and income, especially in hard times. The one route they have taken to achieve full employment is the design of policies that are thought to boost the demand for goods and services. That demand needs to keep rising if employment is not to decline is a view that

* Paper prepared for a Symposium, joint between the Pontifical Academy of Sciences (PAS) and the Pontifical Academy of Social Sciences (PASS), on *Sustainable Humanity, Sustainable Nature: Our Responsibility*, Vatican City, 2-6 May 2014.

** I am most grateful to the Councils of PAS and PASS, respectively, and our common Chancellor, Bishop Marcello Sanchez Sorondo, for the encouragement they have given Professor V. Ramanathan and me to help define and plan this Symposium.

¹ Layard (2011) contains a good summary of the findings.

appears to be shared by all decision makers, be they Keynesians or otherwise. Politicians and media commentators express anxiety when spending on High Street shows signs of decline. We are encouraged to think that to consume is to contribute to the social good. And we are not encouraged to ask whether the composition of output could be so altered as to weaken the link between employment and aggregate consumption. It is more than an irony that short run macroeconomic reasoning is wholly at odds with the now-universal desire for sustainable economic development.

The study of the demand for goods and services requires that we understand the processes operating at the interface of consumption, population, production, and use of the natural environment (we economists call the latter, “natural capital”). So it should come as a surprise that social commentators and public servants mostly avoid mentioning those processes even when paying homage to the idea of sustainable development. A prominent feature of the interface is the presence of *externalities*, which are the *unaccounted* for consequences for others – including future people – of decisions made by each one of us. Those consequences could be damaging to others, but as they are unaccounted for, people responsible for them aren’t obliged to compensate the victims. To be sure, any one person has only a very tiny effect on the global state of affairs, but when the effects that each of us has on others are added, the sum can be substantial. The socio-environmental system is not self-correcting, implying that the “invisible hand” does not work. Eliminating externalities requires collective action, variously at local, regional, national and international scales.

As a rule the presence of externalities implies wastage. In this paper I construct a unified account of a class of externalities whose presence signifies a possibly unsustainable use of key forms of natural capital (which by any measure is an enormous wastage). The source of those externalities includes both direct and indirect demands for nature’s services. That the demand involves politically sensitive matters may be the reason why, with but few exceptions – those related to directly to climate change, ocean acidification, and dead zones – externalities are mostly absent from public discourse.²

Economics textbooks often maintain that externalities are a symptom of market failure. That diagnosis was publicized in the *Stern Review of the*

² See any edition of the annual *World Development Report* of the World Bank or the annual *Human Development Report* of the United Nations Development Programme (UNDP). To the best of my knowledge neither publication has, for example, devoted a special issue devoted to the biodiversity loss that has been accompanying habitat destruction.

Economics of Climate Change, which contained the now oft-quoted claim that “climate change is the biggest market failure in history”. The remark misleads badly. Externalities are a symptom of *institutional failure*, not simply market failure. The destruction of the Aral Sea during the Soviet era was not caused by market failure, but state failure. When village slopes turn barren because the inhabitants collect firewood at an unsustainable rate, the cause is communitarian failure, not market failure. When people burn wood and dung to cook their meals and heat their homes, the agency inflicting externalities both indoors and outdoors isn’t “the market” but the household. And when we worry that the climate system could pass tipping points, we should blame the nations as a collective for continuing to be recalcitrant in negotiating a “climate policy”.³

The externalities I study here are mostly of a detrimental kind. Depending on the context, the group suffering from them could be a household, village, district, state, nation, or nations as a collective. Owing to differences in societal histories, institutions, customs, and ecologies, the externalities differ also in scale, magnitude, and speed. Nevertheless they have a common characteristic. In this paper I try to unearth that commonality.

Preliminaries

The use to which natural capital is put depends on humanity’s demand for goods and services. The demand in turn depends on population size and composition, incomes, the knowledge base, social practices, technologies in use, and so on. Many goods and services are produced (food, clothing, housing, transport, education), while others are supplied directly by nature (air for breathing, river water for drinking, micro-organisms for decomposing waste, birds and bees for seed dispersal and pollination). The aggregate demand for goods and services is tautologically the product of average demand per person (reflecting the degree of “affluence”) and population size. The “I=PAT” formula, made famous by Ehrlich and Holdren (1971), that the *Impact* on nature of human activity is a function of *Population*, *Affluence* and *Technology*, stands as a metaphor for a complicated set of relationships among reproduction, consumption, production, and our use of the natural environment.

The externalities discussed below amplify the “I” in the “I=PAT” equation, by affecting each of the elements on the right hand side of the formula. In decentralized societies the amplification is not self-correcting. Elimina-

³ See Dasgupta (2001), Barrett (2003), and Dasgupta and Ehrlich (2013).

tion, even dilution, of externalities requires some form of collective action. In contrast, what is required in a society that is not decentralized is a policy change by the agency responsible for the externalities.

In days when human population was thin and consumption was low relative to Earth's then capacity, the externalities I discuss here were far less pronounced at the global level than they are now. Currently over 45 per cent of the 45–60 billion metric tons of carbon that are harnessed annually by terrestrial photosynthesis is appropriated for human use (Vitousek *et al.*, 1986, 1997). Due in large measure to that (including the destruction of natural habitats), 15 of the 24 major ecosystem services examined in the Millennium Ecosystem Assessment were found to be either degraded or currently subject to unsustainable use (MEA, 2005a–d).

It would be absurd to claim that humanity's over-stretch over Earth has been intentional. Unravelling externalities enables us to discover the unintended reasons behind the over-stretch. Crude calculations suggest that if the 5.7 billion people in poor and middle-income countries today were to match the consumption patterns of the 1.3 billion people in the rich world, at least two more Earths would be needed to support everyone on a sustained basis (Rees, 2001). Because the consensus among demographers is that world population will be 9.5 billion or more by 2050, the demands made of Earth will prove to be even more unsustainable. If humanity is to have a fighting chance of achieving sustainable development, it behoves us at a minimum to identify the externalities that would have to be reduced, if not entirely eliminated.

Four classes of externalities are of interest in sustainability analysis. They are associated, respectively, with (1) consumption, (2) use of the natural environment, (3) reproduction, and (4) technology. We study them in turn.

1. Consumption

Consumption *habits* give rise to externalities that people inflict on their future selves. To the extent habit has a persistent influence (habits “die hard”), the past is ever present. This leads to path dependence in the pattern of consumption. That dependence in turn locks people into the desire for what could eventually be unsustainable consumption. Let us see how.

As social animals, we are both competitive and conformist. We want to attain status in our community in certain ways and yet want simultaneously to be like others in other ways. This leads to two types of consumption externalities.

1.1. *Competitive Consumption*

In his classic work on the Gilded Age, Veblen (1925) spoke of “conspicuous consumption” so as to draw attention to consumption as a status symbol (flashy cars, fineries, mansions). But if a commodity is to serve as a status symbol, its consumption must be observable by others; which explains the double-edged title of Veblen’s classic.

Veblen’s notion of status has been extended to cover the tendency of people to try to out-do the “Jones’s”. Social scientists have modelled such forms of consumption competition as “rat races”, where each household tries to beat all others in their consumption patterns in what is a self-defeating proposition (Duesenberry, 1949; Hirsch, 1977; Oswald, 1997). It’s rather like someone trying to walk up an escalator as it moves down at the same speed (the externality). The process creates yet another form of the “tragedy of the commons”. Everyone works harder and consumes more than they would if they all agreed to work less hard and consume less, but are unable to find a mechanism for enforcing such an agreement.⁴

But there are problems within problems. The use of automobiles is conspicuous and relies on an underpriced resource: oil. Add habits into the equation and a growing complementary infrastructure (gas stations, expanded network of highways), and we have a spiralling exploitation of natural capital that adds little to human well-being across time. The analysis points to the need for taxes and regulations on both conspicuous consumption and underpriced natural capital. Creating a culture of shaming for “anti-social” behaviour is not unknown in history. Today we are wary of any such practice; but devised with care, it could prove to be a useful complementary weapon for the problem of competitive consumption.

1.2. *Social Consumption and Conformism*

People also want to belong. In some spheres of our lives we adopt patterns of conspicuous consumption that reflect a desire to conform, not compete. Fads are brief occurrences of such patterns, but conformism can persist if it serves the need for social belonging (Bourdieu, 1984; Deaux, 1996).

Here I am not confining myself to cases where people merely desire to conform to their peer-group’s norm. It can be that people want to engage

⁴ Arrow and Dasgupta (2009) provides a formal proof. Schor (1998) contains an excellent narrative of competitive consumption and its consequences for work in the United States. The technically minded reader will recognise that competitive consumption in a market economy is akin to the Prisoners’ Dilemma in game theory.

in communal activities and identify commodities that serve as focal points. Commodities whose demand is in part an expression of the desire to relate to others have been called “relational goods” (Donati, 2011). In many cultures religious expenditures are built around them (Iannaccone, 1998; Ys-seldyk, Matheson, and Anisman, 2010). Club goods are other examples. Food and clothing and reading habits would appear to be driven at least in part by the human desire to belong (Sahlins, 1968; Bourdieu, 1984; Douglas and Isherwood, 1996; Warde, 1997; Pratt and Rafaeli, 1997; Warde and Martens, 2000). There are even cases where people join so as to show solidarity with their group even if they have no particular preference for the collective activities (joining protest marches, wearing conspicuous clothes). Unsurprisingly, Sunstein and Ullmann-Margalit (2001) call commodities that play an essential role there, “solidarity goods”. Hollinger (1996) observes that solidarity is what makes for a person’s social identity. As in the case of competitive consumption, the under-pricing of natural capital (a matter I come to below) would be expected to serve as a factor in determining which consumption practices prevail.

Conformism gives rise to an externality because each person’s choice of the amount of, say, a relational good, affects others’ choice of that good directly; and so on for all other people in the community. But conformist behaviour leads to a different social dynamic from competitive consumption. It can be that a community coordinates at one of many alternative consumption patterns. Some would be more intensive in their use of natural capital than others (frequent air travel for leisure as against forming reading groups). That carries with it the possibility that some potential outcomes are unambiguously better than others.⁵ However, unlike the case of competitive consumption, taxes and regulations would not be needed to improve matters. If people trust one another, a mere agreement would suffice. The problem here is one of co-ordination. One way to achieve the desired consumption behaviour would be to “nudge” one another so as to coordinate.

2. Environmental Resources

One underlying reason externalities are prevalent in humanity’s use of the natural environment is the latter’s tendency not to remain still. The wind blows, particulates diffuse, rivers flow, fish swim, birds and insects fly, and

⁵ For technically minded readers, the need to relate to others in market economies resembles “coordination games” in game theory. It will be recalled that such games possess multiple outcomes that can be unambiguously ranked in terms of their social desirability.

even earth worms are known to move. That makes property rights to prominent classes of natural capital difficult to define and enforce; which is another way of saying that environmental externalities abound. By property rights I mean not only private rights, but communitarian and public rights too. An absence of a tight set of property rights is the general reason why natural capital is typically underpriced in market economies and is regarded to be especially cheap in non-market economies. In extreme cases the market price of a piece of natural capital is nil even when it has considerable social worth. “Green” taxes would be a way to close the difference.

Two broad categories of environmental externalities may be distinguished: unidirectional and reciprocal. It is simplest to define them by considering illustrative examples.

2.1. Trade, Externalities, and Wealth Transfers

Externalities give us a reason to curb our enthusiasm for free trade. Imagine that timber concessions have been awarded in an upstream forest of a poor country by its government so as to raise export revenue.⁶ As forests stabilize both soil and water flow and are the habitat for birds and insects, deforestation erodes soil, increases water run-off downstream, and reduces pollination and pest-control in neighbouring farms. If the law recognizes the rights of those who suffer damage from deforestation, the timber company would be required to compensate downstream farmers. But compensation is unlikely when the cause of damage is many miles away and the victims are scattered groups of farmers. Problems are compounded because damages are not uniform across farms; their geography matters. Moreover, downstream farmers may not even realize that the decline in their farms’ productivity is traceable to logging upstream. The timber company’s operating cost would in those circumstances be less than the social cost of deforestation (the latter, at least as a first approximation, would be the firm’s logging costs and the damage suffered by all who are adversely affected). So the export would contain an implicit subsidy (the “externality”), paid for by people downstream. And I haven’t included forest inhabitants, who now live under even more straightened circumstances. The subsidy is hidden from public scrutiny, but it amounts to a transfer of wealth from the exporting to the importing country. Ironically, some of the poorest people in the exporting country would be subsidizing the incomes of the average importer in what could well be a rich country. That can’t be right.

⁶ The example has been taken from Dasgupta (1990).

2.2. *Pollution vs. Conservation*

Pollution and conservation have gone their separate ways in the economics literature; but pollutants are the reverse side of natural capital. Acid rains damage forests; industrial seepage and discharge reduce water quality in streams and underground reservoirs; sulphur emissions corrode structures and harm human health; and so on. The damage inflicted on each type of asset (buildings, forests, fisheries, human health) should be interpreted as depreciation. For the policy-maker the task is to estimate the depreciations.

By way of an example consider that damage to health caused by atmospheric pollution involves (a) loss in human productivity, (b) experiencing pain and discomfort, and (c) reduction in life expectancy. It is fortunate for humanity that good health offers the three benefits more or less as joint-products. But to the best of my knowledge, no one has estimated all three losses in studies of environmental pollution. The point remains though that there is no reason to distinguish resource management problems from pollution management problems. Roughly speaking, “resources” are “goods”, while “pollutants” (the degrader of resources) are “bads”. Pollution is the reverse of conservation.⁷

The mirror-symmetry between conservation and pollution is well illustrated by the atmosphere, which is both vital for human activity and a sink for pollutants. The atmosphere is a public good (if air quality is improved, we all enjoy the benefits, and none can be excluded from enjoying the benefits). It is also a common pool for pollution. That it is a public good means the private benefit from improving air quality is less than the social benefit. Without collective action there is underinvestment in air quality. On the other hand, as the atmosphere is a common pool into which pollutants can be deposited, the private cost of pollution is less than the social cost. Without collective action, there is an excessive use of the pool as a sink for pollutants. Either way, the atmosphere suffers from the “tragedy of the commons”.

3. **Reproduction**

There is a significant difference between fertility behaviour in rich and emerging economies on the one hand and poor countries on the other. They raise very different issues.

It is conventional today to worry about countries where the fertility rate has fallen below replacement rates. If the pattern continues for long, the age profile will become an inverted pyramid. Who will produce incomes

⁷ For a more extensive illustration of this way of looking at natural capital, see Dasgupta (1982).

when the bulk of the population becomes old? The worry presumes the working age to remain constant. That's a luxury that will have to go.

The problem is different in poor countries. I want to identify reproductive externalities in those societies, and I have Africa especially in mind.

It is useful to remind ourselves that the 17th-18th Century fertility transition in Northwest Europe has been traced to a then growing practice of establishing a new household on marriage. Couples had to have, by saving or transfer, sufficient resources to establish and equip their new household. The requirement led to late marriages (Hajnal, 1982) and meant that parents bore the cost of rearing their children. The fertility rate in England dropped to a low 4 in 1650-1700, which was a world where modern family-planning techniques were unknown and women were mostly illiterate (Coale, 1969). I stress that fact because in recent years demographic matters have been shunted aside by development economists and converted into the subject of female education. Below I show that other forces are at work in maintaining high fertility rates in poor societies.

3.1. Cost-Sharing

The fertility rate in sub-Saharan Africa remains well over 5 today. Population in sub-Saharan Africa is expected to treble to over 2 billion by 2050. Currently, the average annual income there is 1,200 international dollars.

There can be no question but that empowerment of women, a desirable end in itself, lowers fertility, other things being equal. There can also be no doubt that access to birth control facilities would help matters (Royal Society, 2012). But other things are not equal, and there are features of African societies that encourage high fertility.

Fosterage is a commonplace there. In parts of West Africa up to half the children have been found to be living with their kin at any given time. Nephews and nieces have the same rights of accommodation and support as do biological offspring (Caldwell and Caldwell, 1990). Fosterage is not adoption; it does not break ties between parents and children. The institution affords a form of mutual insurance protection in a region where formal insurance markets are non-existent. It is a wonderful, life-saving institution. But the institution does create a "problem of the commons": the private cost of rearing children becomes lower than the social cost.

Communal land tenure of the lineage social structure offers yet another inducement for men to procreate. Conjugal bonds are frequently weak, so fathers often do not bear the costs of rearing a child. Frequently, there is no common budget for the man and woman. Descent in sub-Saharan Africa is, for the most part, patrilineal and residence is patrilocal (an exception are the

Akan people of Ghana). Patrilineality, weak conjugal bonds, communal land tenure, and a strong kinship support system of children, taken together provide a powerful set of externalities lowering household well-being (Illiffe, 1987).

3.2. Conformity

As with consumption, traditional practices persist because of the desire to conform. One's peer group (kinship, village community) matters. That gives rise to a second category of externalities. Procreation in closely-knit communities is not only a private matter but also a social signal, influenced by both family experiences and the cultural milieu. Conformism means that every household's most desired family size increases with the average family size in the community.

Whatever the basis of conformism, there would be practices encouraging high fertility rates that no household would unilaterally desire to break. Such practices could well have had a rationale in the past, when mortality rates were high, rural population densities were low, the threat of extermination from outside attack was large, and mobility was restricted. But practices can survive even when their original purposes have disappeared. So long as all others follow the practice and aim at large family sizes, no household on its own wishes to deviate from the practice; however, if all other households were to reduce their fertility rates, each would desire to reduce its fertility rate as well (Dasgupta, 1993). The process here is very similar to the one involving conformism in consumption.

That said, society would not be expected to be stuck with high fertility rates forever. As always, people differ in the extent of their absorption of traditional practice. There would inevitably be those who, for one reason or another experiment, take risks, and refrain from joining the crowd. They are the tradition-breakers, and they often lead the way. Educated women are among the first to make the move toward smaller families. A possibly even stronger pathway is the influence that newspapers, radio, television, and now the Internet play in transmitting information about other lifestyles. The media are a vehicle by which conformism increasingly becomes based on the behaviour of a far wider population than the local community (Bongaarts and Watkins, 1996; Jensen and Oster, 2009).

3.3. Degraded Commons and Labour Needs

The poorest countries are in great part biomass-based subsistence economies. Much labour is needed even for simple tasks. Moreover, households in great numbers there do not have access to the sources of domestic energy available to households in advanced industrial countries; nor do they

have water on tap. In arid regions water supply is often not even close at hand; nor is fuel-wood near at hand when the forests recede. The relative prices of alternative sources of energy and water faced by rural households in poor countries are different from those faced by households elsewhere. In addition to cultivating crops, caring for livestock, cooking food and producing simple marketable products, household members have to spend as much as five hours a day fetching water and collecting fodder and wood. These are complementary activities and must be undertaken on a daily basis if the household is to survive. Labour productivity is low not only because manufactured and human capital are scarce, but also because natural capital is scarce. From the age of 6, children in poor rural households in the poorest countries mind their siblings and domestic animals, fetch water, and collect fuel-wood, dung (in the Indian sub-continent), and fodder. Mostly, they do not go to school. Not only are educational facilities in the typical school woefully inadequate, but parents also need their children's labour. In semi-arid regions of the Indian sub-continent and sub-Saharan Africa children between 10 and 15 years have been routinely observed to work at least as many hours as adult males.

The need for many hands can lead to a destructive situation when parents do not have to pay the full price of rearing their children but share such costs with their community. In recent years, mores that once regulated the use of natural capital have changed. In the past rural assets such as village ponds and water holes, threshing grounds, grazing fields, and woodlands have been owned communally. Communities protected their local commons from over-exploitation by relying on social norms, by imposing fines for deviant behaviour, and by other means. But the very process of economic development can erode traditional methods of control, the pathway to that being increased urbanization and mobility. Social norms are also endangered by civil strife and by the usurpation of resources by landowners or the State. Rules practiced at the local level have also not infrequently been overturned by central fiat. A number of States in the Sahel imposed rules which in effect destroyed communitarian management practices in the forests. Villages ceased to have authority to enforce sanctions on those who violated locally-instituted rules of use. State authority turned the local commons into free-access resources. Whatever the cause, as social norms degrade, parents pass some of the costs of children on to the community by over-exploiting the commons. This is another instance of a demographic problem of the commons.⁸

⁸ See Dasgupta (1993), Aggarwal, Netanyahu, and Romano (2001), and Filmer and Pritchett (2002).

4. Technology

Popular discourses on economic growth and development usually regard nature to be a fixed, indestructible factor of production. In fact nature consists of degradable resources. Agricultural land, forests, watersheds, fisheries, fresh water sources, estuaries, the atmosphere – more generally, ecosystems – are capital assets that are self-regenerative, but suffer from depletion or deterioration when they are over-used or toxified.

Entrepreneurs economize on the use of expensive inputs of production. Because natural capital is under-priced, research and development (R&D) is directed toward innovations that are rapacious in their use of environmental goods and services. The cumulative adoption of resource intensive technologies and consumption practices over the past two centuries has locked us into an infrastructure that will prove hard to dislodge. Taxes on the use of critical but degraded forms of natural capital (the atmosphere as a sink for carbon; biodiversity) will have to be augmented by subsidies for R&D in “clean” technologies. Marginal policy changes will be inadequate for kicking our production and consumption structure into a sustainable form.⁹

Discussion

Mainstream theories of growth and development ignore every one of the features of contemporary life I have sketched in this paper.¹⁰ But we should be sceptical of any theory of economic progress that places an overwhelming burden on an experience not much more than 250 years old. Extrapolation into the past is a sobering exercise: over the long haul of history (a 5000 years stretch, say, up to about 250 years ago), economic growth even in the currently-rich regions was for most of the time not much above zero. Until 1500 CE most people lived under the proverbial 2 dollars a day and world population remained well under 1 billion. Even though we live in an entirely different world now, the study of possible feedback between poverty, population growth, and the character and performance of both human institutions and natural capital remains absent in contemporary discussions.

The four sources of externalities that I have sketched in this paper, taken together, will prove to be an impediment to the realization of the idea of sustainable development. If we are to pay more than lip service to the idea, hu-

⁹ It may not be an exaggeration to suppose that, globally, nature’s services (including the service the atmosphere and the oceans provide in storing carbon) are underpriced to the tune of 3–4 trillion international dollars annually (Myers and Kent, 2000).

¹⁰ See for example, Helpman (2004) for an influential summary of the literature.

manity will have to find ways to cut back on our demand for nature's services. At a bare minimum that will require the consumption habits of people in the rich world to change substantially. Even a minimum concern for fairness would imply that the burden of that change should be borne by the 1.3 billion people or so in the rich world. That could in principle influence the desired consumption goals of the new middle classes in emerging economies. And that brings us back, full circle, to a central problem facing modern economies: How can we de-link aggregate consumption from employment?

We economists still know very little about the macroeconomic implications of economy-wide environmental policies. Applied economists mostly study taxes on externalities on a case-by-case basis. But externalities are present variously at local, regional, and global levels. Imagine that corrective taxes and subsidies were to be put in place by a government to combat externalities in a comprehensive manner. What would it mean nationally for output and employment?

The optimistic view is that resources would find themselves re-directed toward "green technologies", which are assumed to either exist in blueprints or expected to come into existence rapidly once venture capitalists and entrepreneurs put their minds to the task. It is then argued that the mix of technologies and the composition of household consumptions would come into line with changes in relative prices, but employment wouldn't be affected. This is the famous "win-win" view of environmental policy.¹¹

Macroeconomic models that include natural capital have mostly been designed to peer into the deep future (Dasgupta and Heal, 1979; Jones, 2004). The models assume the short run to be devoid of structural dislocations. Even the study of sectoral adjustments that could be expected to take place if environmental taxes were imposed in a country avoids modelling the structural problems of adjustment that would inevitably arise (Jorgenson *et al.*, 2013).

Problems are compounded when we imagine international efforts to counter environmental externalities. Barrett (1994, 2003) explained why in the absence of international transfers we shouldn't expect all countries to agree on optimum carbon taxes. His arguments extend naturally to global commons generally. But the theory of public economics urges countries to collaborate on an environmental policy (including taxes and subsidies)

¹¹ Starting with the *World Development Report* of 1992, the World Bank in its various publications has taken this line. Jorgenson *et al.* (2013) is a recent articulation of the view, albeit restricted to the imposition of carbon taxes in the US.

aimed at eliminating local, regional, and global externalities in a comprehensive package. To the best of my knowledge, no attempt has been made to uncover the structural problems the resulting shift in relative prices would create. We should expect there to be huge consequences to the distribution of income and employment within and across countries. But we don't know what they are likely to be.

Because natural capital is a stock, humanity can deplete it (either in quantity or in quality) for decades without feeling much global pain. And because extraction rates can exceed rates of natural regeneration for decades, the idea of "planetary boundaries" isn't useful. Several planetary boundaries have already been breached, but that hasn't moved governments or their citizens to act. There is abundant record of local disasters in recent decades in Africa, South Asia, and Latin America. That they may be a mirror to large-scale tipping points lying in wait is something most people don't like to acknowledge.

The absence of discussion on the tug of war being played out by humanity's drive for conventional economic growth and nature's frequent complaint about it is a sign that we think ecologists are wrong. But owing to the presence of widespread externalities, the world economic system doesn't have error-correcting mechanisms in place to avert large-scale societal meltdowns. Until we bring these matters on the agenda, policy analysis will remain crippled and sustainable development will continue to be a notion we admire but cannot put into operation.

References

- Aggarwal, R., S. Netanyahu, and C. Romano (2001), "Access to Natural Resources and the Fertility Decision of Women: The Case of South Africa", *Environment and Development Economics*, 6(2), 209-236.
- Arrow, K.J. and P.S. Dasgupta (2009), "Conspicuous Consumption, Inconspicuous Leisure", *Economic Journal*, 2009, 119 (541), F497-F516.
- Barrett, S. (2003), *Environment & Statecraft: The Strategy of Environmental Treaty-Making* (New York: Oxford University Press).
- Bok, D. (2009), *The Politics of Happiness: What Government Can Learn from the New Research on Well-Being* (Princeton NJ: Princeton University Press).
- Bongaarts, J. and S.C. Watkins (1996), "Social Interactions and Contemporary Transitions", *Population and Development Review*, 22(4), 639-682.
- Bourdieu, P. (1984), *Distinction: A Social Critique of the Judgment of Taste* (London: Routledge and Kegan Paul).
- Caldwell, J.C. and P. Caldwell (1990), "High Fertility in sub-Saharan Africa", *Scientific American*, 262(5), 82-89.
- Coale, A.J. (1969), "The Decline of Fertility in Europe from the French Revolution to World War II", in S.J. Behrman, L. Corsa, and R. Freedman, eds., *Fertility and Family Planning: A World View* (Ann Arbor, Michigan: University of Michigan Press).
- Dasgupta, P. (1982), *The Control of Resources*

- (Cambridge, MA: Harvard University Press). Indian edition: Oxford University Press, Delhi.
- Dasgupta, P. (1990), "The Environment as a Commodity", *Oxford Review of Economic Policy*, 6(1), 51-67.
- Dasgupta, P. (1993), *An Inquiry into Well-Being and Destitution* (Oxford: Clarendon Press).
- Dasgupta, P. (2001), *Human Well-Being and the Natural Environment* (Oxford: Oxford University Press).
- Dasgupta, P. and P. Ehrlich (2013), "Pervasive Externalities at the Population, Consumption, and Environment Nexus", *Science*, 19 April, Vol. 340, 324-328.
- Dasgupta, P. and G. Heal (1979), *Economic Theory and Exhaustible Resources* (Cambridge: Cambridge University Press).
- Deaux, K. (1996), "Social Identification", in T.E. Higgins and A.W. Kruglanski, eds., *Social Psychology: Handbook of Basic Principles* (New York: Guilford).
- Donati, P. (2011), *Relational Sociology: A New Paradigm for the Social Sciences* (London: Routledge).
- Douglas, M. and B. Isherwood (1996), *The World of Goods: towards an anthropology of consumption* (London: Routledge).
- Duesenberry, J.S. (1949), *Income, Saving and the Theory of Consumer Behavior* (Cambridge, MA: Harvard University Press).
- Ehrlich, P.R. and J. Holdren (1971), "Impact of Population Growth", *Science*, 171, 1212-17.
- Filmer, D. and L. Pritchett (2002), "Environmental Degradation and the Demand for Children: Searching for the Vicious Circle in Pakistan", *Environment and Development Economics*, 7(1), 123-146.
- Graham, C. (2009), *Happiness Around the World: The Paradox of Happy Peasants and Miserable Millionaires* (Oxford: Oxford University Press).
- Hajnal, J. (1982), "Two Kinds of Preindustrial Household Formation Systems", *Population and Development Review* 8(3), 449-494.
- Helpman, E. (2004), *The Mystery of Economic Growth* (Cambridge, MA: Belknap).
- Hirsch, F. (1977), *Social Limits to Growth* (London: Routledge).
- Hollinger, D.A. (2006), "From Identity to Solidarity", *Daedalus*, Fall, 23-31.
- Iannaccone, L.R. (1998), "Introduction to the Economics of Religion", *Journal of Economic Literature*, 36(3), 1465-1496.
- Iliffe, J. (1987), *The African Poor* (Cambridge: Cambridge University Press).
- Jensen, R. and E. Oster (2009), "The Power of TV: Cable Television and Women's Status in India", *Quarterly Journal of Economics*, 124(4), 1057-94.
- Jones, C.I. (2004), *Introduction to Economic Growth* (New York: W.W. Norton), 2nd edition.
- Jorgenson, D.W., R. Goettle, M. Ho, and P. Wilcoxon (2013), *Double Dividend: Environmental Taxes and Fiscal Reform* (Cambridge, MA: MIT Press).
- Layard, R. (2011), *Happiness: Lessons from a New Science* (New York: Penguin).
- MEA – Millennium Ecosystem Assessment – eds., R. Hassan, R. Scholes, and N. Ash – (2005a), *Ecosystems and Human Well-Being, I: Current State and Trends* (Washington, DC: Island Press).
- MEA – Millennium Ecosystem Assessment – eds., S.R. Carpenter, P.L. Pingali, E.M. Bennet, and M.B. Zurek (2005b), *Ecosystems and Human Well-Being, II: Scenarios* (Washington, DC: Island Press).
- MEA – Millennium Ecosystem Assessment – eds., K. Chopra, R. Leemans, P. Kumar, and H. Simmons – (2005c), *Ecosystems and Human Well-Being, III: Policy Responses* (Washington, DC: Island Press).
- MEA – Millennium Ecosystem Assessment – eds., D. Capistrano, C. Samper K., M.J. Lee, and C. Randsepp-Hearne – (2005d), *Ecosystems and Human Well-Being, IV: Multiscale Assessments* (Washington, DC: Island Press).
- Myers, N. and J. Kent (2000), *Perverse Subsidies: How Tax Dollars Undercut our En-*

- Environment and Our Economies* (Washington, DC: Island Press).
- Oswald, A.J. (1997), "Happiness and Economic Performance", *Economic Journal*, 107, 1815-1831.
- Pratt, M.G. and A. Rafaeli (1997), "Organizational Dress as a Symbol of Multi-layered Social Identities", *Academy of Management Journal*, 40(4), 862-898.
- Rees, W.E. (2001), "Concept of Ecological Footprint", in S.A. Levin, ed., *Encyclopedia of Biodiversity* (San Diego: Academic Press).
- Royal Society (2012), *People and the Planet* (London: Royal Society).
- Sahlins, M. (1968), *Tribesmen* (Englewood Cliffs, NJ: Prentice-Hall).
- Schor, J. (1998), *The Overspent American* (New York: Basic Books).
- Southerton, D. and A. Ulph, eds. (2014), *Sustainable Consumption: Multidisciplinary Perspectives* (Oxford: Oxford University Press).
- Sunstein, C.R. and E. Ullmann-Margalit (2001), "Solidarity Goods", *Journal of Political Philosophy*, 9(2), 129-149.
- Veblen, T. (1899, [1925]), *The Theory of the Leisure Class: An Economic Study of Institutions*. Originally published in 1899. Reprinted (London: George Allen & Unwin), 1925.
- Vitousek, P.M., P.R. Ehrlich, A.H. Ehrlich, and P. Matson (1986), "Human Appropriation of the Product of Photosynthesis", *BioScience*, 36(6), 368-373.
- Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo (1997), "Human Domination of Earth's Ecosystem", *Science*, 277(5325), 494-499.
- Warde, A. (1997), "Consumption, Taste, and Social Change", in *Consumption, Food, and Taste: Culinary Antinomies and Commodity Culture* (London: Sage).
- Warde, A. and L. Martens (2000), *Eating Out: Social Differentiation, Consumption, and Pleasure* (Cambridge: Cambridge University Press).
- Ysseldyk, R., K. Matheson, and H. Anisman (2010), "Religiosity as Identity: Toward an Understanding of Religion From a Social Identity Perspective", *Personality and Social Psychology Review*, 14(1), 60-71.
- Donati, P. (2011), *Relational Sociology: A New Paradigm for the Social Sciences* (London: Routledge).

POPULATION ET NATURE: ANTAGONISME OU CONCORDANCE? PEOPLE AND NATURE: ANTAGONISM OR CONCORDANCE?

■ GÉRARD-FRANÇOIS DUMONT

Résumé

De nombreuses théories présentent un antagonisme inévitable entre la population et la nature. Qu'elles soient anciennes ou contemporaines, il est possible d'en distinguer plusieurs usant de formulations diverses, mais concordantes. Après avoir pris connaissance de ces théories, qui seront résumées dans la première partie de ce texte, le scientifique doit se demander si, au moins jusqu'à ce jour, elles ont été confirmées ou infirmées par les faits. Selon que leur véracité sera établie ou non, il conviendra enfin d'en déduire quelques enseignements.

Abstract

Many theories have an inevitable antagonism between people and nature. Old or contemporary, it is possible to distinguish eight using various formulations, but consistent. After taking cognizance of these theories that will be summarized in the first part of this text, the scientist must ask whether, at least so far, they have been confirmed or refuted by the facts. According to their veracity is established or not, he finally agrees to deduce some lessons.

De nombreuses théories présentent un antagonisme inévitable entre la population et la nature. Qu'elles soient anciennes ou contemporaines, il est possible d'en distinguer au moins huit usant de formulations diverses, mais concordantes. Après avoir pris connaissance de ces théories qui seront résumées dans la première partie de ce texte, le scientifique doit se demander si, au moins jusqu'à ce jour, elles ont été confirmées ou infirmées par les faits. Selon que leur véracité sera établie ou non, il conviendra enfin d'en déduire quelques enseignements.

Les théories d'un antagonisme inévitable entre la population et la nature

Comme l'auteur qui demeure au centre de l'ensemble de ces théories est Malthus, nous utiliserons le mot "malthusianisme" pour les désigner. Le malthusianisme peut être défini comme une attitude craintive devant le

peuplement ou l'augmentation du nombre d'habitants sur un territoire donné, attitude craintive conduisant à prôner une restriction démographique. Toutefois, de nombreuses théories malthusiennes sont très antérieures à la première édition du livre de Malthus publié en 1798.

Les théories proto-malthusiennes

L'antagonisme inévitable entre la population et la nature apparaît dans des périodes où l'on sait que l'humanité comptait moins de 250 millions d'habitants, soit vingt-six fois moins que dans les années 2010. En effet, avant l'ère chrétienne, divers auteurs s'inquiètent d'une éventuelle croissance démographique que la nature ne pourrait satisfaire.

Par exemple, Platon, qui craint une surpopulation dans la cité, plaide pour la fixité démographique du peuplement et présente tout un ensemble de mesures publiques pour "ajuster le nombre des foyers au chiffre de cinq mille quarante".¹ Pour Platon, il faut autoritairement restreindre les naissances, si nécessaire, car "le nombre des foyers maintenant délimité par nous doit toujours rester le même, sans s'accroître". Aristote reprend les vues démographiques de Platon. Son souci de la loi et de l'ordre, principe essentiel, a pour conséquence que le peuplement ne doit pas lui porter atteinte. Il fixe l'âge au mariage et demande, si besoin est, le recours à l'avortement: "dans le cas d'accroissement excessif des naissances, une limite numérique doit dès lors être fixée à la procréation, et si des couples deviennent féconds au delà de la limite légale, l'avortement sera pratiqué".² Mais Aristote insiste davantage que Platon sur les risques d'insuffisances en cas de croissance démographique. Dans ce cas, écrit-il, il "arrivera fatalement que les enfants en surnombre ne posséderont rien du tout".³

Puis, en Occident, presque vingt siècles plus tard, au deuxième millénaire, dès que la pensée politique retrouve de l'autonomie par rapport à la doctrine religieuse, le souci de s'intéresser à la question démographique revient. Le risque de surpopulation, difficile à étayer pendant les siècles de dépopulation accompagnant la chute de l'Empire romain, réapparaît. La crainte que la nature ne puisse satisfaire les besoins des hommes est explicitée.

Par exemple, au XVI^e siècle, l'italien Giovanni Botero craint que, à un certain stade: "la puissance génératrice des hommes l'emporte sur la puissance nutritive des cités".⁴ En Angleterre, Francis Bacon⁵ se soucie de la possibilité

¹ *Les Lois*, V.

² *La Politique*, II, 6.

³ *La Politique*, II, 6.

⁴ Dans: *Causes de la grandeur et de la magnificence des cités*, paru en 1588.

de nourrir la population à une époque, la fin du XVI^e siècle, où l'Angleterre compte à peine plus de 4 millions d'habitants:⁶ "En règle générale, il faut veiller à ce que la population d'un royaume (surtout si elle n'est pas fauchée par les guerres) n'excède pas la production du pays qui doit la maintenir". Un demi-siècle plus tard, toujours en Angleterre, Thomas Hobbes partage un souci semblable en écrivant: "Quant à l'abondance de la matière, elle est limitée par la nature aux biens qui sortent de notre mère commune, à savoir la terre et la mer".⁷ Le risque d'une impossibilité pour la nature de satisfaire une population trop nombreuse n'est pas seulement évoqué en Europe. En Chine, alors que la population de ce pays compte environ 200 millions d'habitants, Hong-Liang-Ki écrit notamment en 1793: "La superficie des terres et le nombre des maisons demeurent toujours insuffisants tandis que le nombre de familles et des individus se trouvent toujours en excès".⁸

Quelques années plus tard, les qualités pédagogiques de Malthus donnent à la théorie de l'antagonisme population-nature une considérable diffusion. Son succès sera tel que la quasi-totalité des auteurs du XIX^e siècle, qu'il s'agisse de David Ricardo ou de Karl Marx, se prononceront sur cette théorie, comme "hantés par la loi de Malthus".⁹

La théorie de Malthus

Pour comprendre ce qui a conduit Malthus (1766-1834) à formuler sa théorie, il faut en rappeler le contexte historique et intellectuel. En 1601, la reine Elisabeth institue une loi des pauvres qui, par la suite, tombe en désuétude. Au XVIII^e siècle, diverses mesures sont prises pour redonner une efficacité à cette loi, dont une allocation aux pauvres, indexée sur le prix du pain. La charité privée est remplacée par une obligation pour le riche et un droit pour le pauvre. L'augmentation régulière du coût de cette législation, passant d'un million de livres en 1770 à bientôt quarante en 1800, suscite des interrogations. En particulier, des auteurs pensent que les allocations aux pauvres développent la pauvreté et ne les encouragent pas à surmonter la misère.

S'inscrivant dans cette veine, Malthus publie en 1798, sans nom d'auteur, un *Essai sur le principe de population*. Ses seize premières pages en forment l'exposé théorique. Malthus écrit: "Je pense pouvoir poser franchement

⁵ Dans son *Essai des séditions et des troubles*, 1598.

⁶ Bardet, Jean-Pierre, Dupâquier, Jacques, *Histoire des populations de l'Europe*, Paris, Fayard, tome 1, 1997.

⁷ Léviathan, 1651.

⁸ Dans un traité intitulé *Opinions*, publié en 1793; cf. *Population*, n° 1, 1960, p. 89-94.

⁹ Selon une formulation utilisée dans la *Revue d'histoire moderne et contemporaine*, 1954.

deux postulats: premièrement, que la nourriture est nécessaire à l'existence de l'homme; deuxièmement, que la passion réciproque entre les sexes est une nécessité et restera à peu près ce qu'elle est à présent". Compte tenu de ce que Malthus appelle "ces lois permanentes de notre nature", il en tire son principe en écrivant: "Je dis que le pouvoir multiplicateur de la population est infiniment plus grand que le pouvoir de la terre de produire la subsistance de l'homme".¹⁰ "Si elle n'est pas freinée, la population s'accroît en progression géométrique. Les subsistances ne s'accroissent qu'en progression arithmétique... Les effets de ces deux pouvoirs inégaux doivent être maintenus en équilibre par le moyen de cette loi de la nature qui fait de la nourriture une nécessité vitale pour l'homme".

L'homme ne peut s'exclure d'une réalité naturelle. Il lui faut manger pour vivre. Or, son instinct sexuel le conduit à augmenter les effectifs des générations au delà du niveau des subsistances disponibles pour la nourriture. Mais l'homme bénéficie sur les autres espèces d'un avantage, car il peut utiliser sa raison pour pallier les menaces de la loi de population, même si la raison ne peut annihiler la nécessité de respecter des limites. En particulier, Malthus souligne le rôle de la nuptialité comme mécanisme régulateur. Le retard des mariages, dans la mesure où, selon lui, la fécondité opère essentiellement dans le mariage, permet d'améliorer l'adéquation entre la nourriture et la population. Ainsi la loi de population suggère comme conséquence d'adapter la nuptialité aux subsistances.

L'*Essai* a surtout pour objet de dénoncer les effets pervers de la loi des pauvres. La redistribution des revenus ne permet pas d'augmenter les ressources disponibles et contribue au contraire à diminuer les ressources relativement au nombre des habitants. En effet, même si elles peuvent individuellement soulager l'intensité de certaines détresses, les lois des pauvres encouragent le mariage précoce, une descendance plus grande, et aggravent donc globalement les déséquilibres entre la population et ce qu'offre la nature. Les riches doivent donc exclure ces mouvements "de compassion et de bonté" qui prolongent la période de misère sans "prévenir l'action quasi permanente de la misère".

Dans la deuxième édition de 1803, Malthus reformule ensuite le principe sans hésiter à le clarifier par un énoncé quantitatif: "Prenant la population du monde avec un effectif quelconque, mille millions par exemple, l'espèce humaine s'accroîtrait comme la progression 1, 2, 4, 8, 16, 32, 64,

¹⁰ Thomas Robert Malthus, *Essai sur le principe de population*, 1798. Avant-propos de Jacques Dupâquier, Paris, réédition INED, 1980, p. 25.

128, 256, 512, etc., et les subsistances comme 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc. En deux siècles un quart, le rapport des populations aux moyens de subsistance serait de 512 à 10; en trois siècles, de 4 096 à 13; et en deux mille années, l'écart serait pratiquement incalculable, bien que la production, pendant ce temps, se fût accrue dans d'immenses proportions".¹¹

Puisque la loi de population conduit à des impossibilités, c'est qu'il existe des freins à l'augmentation de la population. Malthus distingue les freins actifs et les freins préventifs. Les freins actifs sont "ceux qui se présentent comme une suite inévitable des lois de la nature", c'est-à-dire la mortalité résultant de l'excès de population. Mais il existe également des freins actifs d'une nature mixte car ce sont des freins actifs "que nous faisons naître nous mêmes. Ce sont les guerres, les excès et plusieurs autres sortes de maux évitables". Les freins préventifs énoncés par Malthus sont "la contrainte morale" et "le vice". La contrainte morale, c'est "le fait de s'abstenir du mariage" et "la chasteté". Le vice, c'est le libertinage, c'est-à-dire les rapports sexuels dans la promiscuité, les "passions contraires à la nature", c'est-à-dire l'homosexualité, "la profanation du lit nuptial", c'est-à-dire l'adultère, et "tous les artifices employés pour cacher les suites de liaisons criminelles ou irrégulières", c'est-à-dire la limitation des naissances et les avortements provoqués.

Quel est l'intérêt de cette distinction entre freins préventifs et freins actifs? C'est qu'ils "doivent être en raison inverse l'un de l'autre". Autrement dit, leur combinaison doit aboutir en tout état de cause à former un obstacle à l'accroissement de la population. Si la fécondité est faible, la mortalité peut être faible. Si la fécondité est élevée, la mortalité doit être élevée. Le moyen humain de lutter contre la croissance excessive de la population est la limitation volontaire des naissances, mais pas par n'importe lequel artifices.

Après Malthus, le malthusianisme se déploie selon des formulations variées et demeure sous l'inspiration de la théorie précisée une première fois en 1798, même s'il propose des types de freins préventifs que Malthus aurait récusés.

Le malthusianisme économique

Certes, on aurait pu penser que le malthusianisme de Malthus était un trait essentiellement britannique de l'époque classique, et une sorte de réflexe naturel de la part de personnes habitant l'espace borné de cette île qu'est la Grande-Bretagne.

Pourtant, dans la première moitié du XIX^e siècle, précisément dès 1819-1820, l'économiste Jean-Baptiste Say (1767-1832) vulgarise en France la

¹¹ Malthus, *Essai sur le principe de population*, 1803. Réédition, Paris, Denoël-Gauthier, 1963, p. 20.

théorie de Malthus. Il fait connaître l'idée de Malthus selon laquelle le nombre des hommes a tendance à être supérieur à ce qui est souhaitable. En conséquence, la mortalité va être très élevée car la population va se proportionner impérativement à la quantité des produits. Mais l'homme étant un animal intelligent, il doit être capable d'éviter la brutalité de cet équilibre qui est normalement réalisé par le mécanisme de la mortalité. Say pense qu'il faudrait mieux gérer cette contrainte plutôt que laisser la surmortalité exercer son rôle équilibrant. Il propose donc de pratiquer une restriction volontaire des naissances, à laquelle il convient de substituer des épargnes. Say l'exprime dans un passage célèbre: "Les institutions les plus favorables au bonheur de l'humanité sont celles qui tendent à multiplier les capitaux. Il convient donc d'encourager les hommes à faire des épargnes plutôt que des enfants".¹²

Say souligne aussi son malthusianisme lorsqu'il insiste sur la nécessité de rendre possible l'émigration pour éviter la mort de certains par insuffisance de nourriture: "Il n'est pas plus sage de retenir les hommes prisonniers dans un pays que de vouloir les y faire naître. Toutes les lois contre l'émigration sont iniques: chacun a le droit d'aller où il se flatte de respirer plus à l'aise; et c'est respirer plus à l'aise que de subsister plus facilement. Veut-on par là conserver le nombre d'hommes que le pays peut nourrir, on le conservera sans ce moyen. Veut-on en avoir plus que le pays ne peut en nourrir, on n'y réussira point. Lorsqu'on empêche une population surabondante de sortir par la porte des frontières, elle sort par la porte des tombeaux".

Say considère donc l'épargne, investissement en capital physique, comme le seul outil de l'essor économique, antagoniste à la procréation. Il ignore que cette dernière pourrait aussi être un investissement dans le capital humain. Il demande donc de minorer la fécondité pour ne pas nuire au développement économique par une insuffisance d'épargne. Aussi, selon Say, l'homme avisé, celui qui privilégie l'épargne, devrait se substituer à l'homme qui procrée en se laissant soumettre aux lois de la reproduction. Notons que le pays de Say, la France, a exaucé son souhait notamment à la fin du XIX^e siècle et au début du XX^e siècle, avec une fécondité très faible,¹³ mais une épargne élevée massivement placée dans des emprunts russes de 1822 à 1917, emprunts russes jamais remboursés. J.-B. Say, qui croit en effet au revenu du capital, n'avait pas imaginé que celui-ci peut un jour s'évaporer pour des raisons politiques, faisant disparaître *ipso facto* le revenu qui en était

¹² Cours complet, 1828, VI^e partie.

¹³ Cf. par exemple: Baux, Jean-Pierre, "1914: une France démographiquement affaiblie", *Population & Avenir*, mars-avril 2014, n° 717.

attendu. Avec Say, la peur de conséquences dommageables de la procréation sur l'économie justifie un malthusianisme économique.

Au fil des décennies du XIX^e siècle et du début du XX^e siècle, le malthusianisme connaît de nombreux thuriféraires. Puis sa diffusion reprend une importance considérable à la fin des années 1960 et au début des années 1970 avec le malthusianisme des ressources.

Le malthusianisme des ressources

À cette période, le monde occidental est toujours dans les Trente glorieuses, selon la formulation de Jean Fourastié, ces trente années de reconstruction et de croissance ininterrompues postérieures à la Seconde Guerre mondiale. Ce même monde ne sait d'ailleurs pas que les Trente glorieuses vont se terminer au milieu des années 1970, lorsque le choc pétrolier va révéler la fragilité d'une économie industrielle qui a fini par vivre plutôt dans la facilité. Comme la croissance vient de durer pendant une longue période et qu'elle ne semble pas devoir s'arrêter, des auteurs s'inquiètent car ils considèrent que l'augmentation du nombre de consommateurs a des limites physiques.

En 1968, Paul Ehrlich compare la croissance démographique mondiale à la bombe atomique dans un livre intitulé *The demographic bomb*.¹⁴ Il annonce pour bientôt des famines très meurtrières et demande d'agir dans une extrême urgence pour éviter que la bombe démographique n'explose. Il propose en conséquence une réduction drastique du nombre des hommes. En 1972, quatre chercheurs du Massachusetts Institute of Technology, Donella H. et Dennis L. Meadows, Jorgen Randers et William W. Behrens III, répondant à la demande du Club de Rome, annoncent un risque d'apocalypse.¹⁵ Leur rapport, *The limits to growth*, 1972, s'inscrit dans le cadre des travaux sur "la situation difficile de l'humanité" (*The predicament of mankind*). Il s'agit, précise-t-on, "d'entreprendre les études de tendance d'un certain nombre de facteurs qui dérèglent notre société planétaire". Dans certains pays, comme la France, le rapport est traduit sous le titre "Halte à la croissance?"¹⁶ Mais le point d'interrogation est généralement oublié dans les citations. Le rapport affirme cinq tendances du monde moderne qui seraient les suivantes: l'industrialisation, la croissance de la population, la sous-alimentation, la disparition des ressources non-renouvelables et la détérioration de l'environnement. Il en conclut à la

¹⁴ Ballantine Press, New York.

¹⁵ *The limits to growth*, MIT Press, New York.

¹⁶ Fayard, Paris, 1972.

nécessité de limiter la croissance. Dans ce contexte, se crée aux États-Unis un mouvement zegiste (“zeg” signifiant *Zero Population Growth*), partisan d’une croissance démographique zéro.

Les deux livres cités ci-dessus, largement diffusés, prophétisent des catastrophes humaines et des désastres à un horizon proche, antérieur à la fin du XX^e siècle. Certes, le monde a connu nombre de vicissitudes dans le dernier tiers du XX^e siècle, mais les craintes d’Ehrlich ne se sont pas concrétisées. Toutefois, la veine des calamités démographiques restant néanmoins prometteuse, les déclarations, écrits et rapports qui en font état se sont multipliés, notamment de la part de certaines organisations qui ont besoin de justifier des budgets toujours plus gourmands.

En 1990, ne pouvant pas retrouver un titre aussi percutant que celui de 1968, Paul Ehrlich, qui a survécu aux malheurs imminents qu’il avait annoncés, publie un nouveau livre en reprenant la formulation *The population explosion* (L’explosion démographique).¹⁷ La lecture d’un autre livre, celui de Garrett Hardin,¹⁸ conduit à une conclusion unique: le diable a chaussé les bottes de la démographie. Le très populaire commandant Cousteau, si remarquable avec ses films montrant la belle harmonie des bancs de poissons dans *Le Monde du Silence*, s’inquiète de l’existence d’éventuels bancs d’hommes qui ne pourraient conduire qu’à la catastrophe, qu’au “plus fantastique génocide qu’on ait jamais connu”. Son vœu serait de ramener les habitants de la terre “à 600 ou 700 millions”,¹⁹ ce qui reviendrait à en supprimer près de 90%, seule mesure efficace, selon lui, pour les protéger contre eux-mêmes. En novembre 1991, le commandant Cousteau déclare au *Courrier de l’Unesco*: “Il faut que la population mondiale se stabilise et, pour cela, il faudrait éliminer 350 000 hommes par jour”.

Selon le malthusianisme des ressources, le problème est principalement quantitatif: la nature ne peut satisfaire les besoins d’un nombre accru d’hommes. Mais, parallèlement, se déploie un “malthusianisme écologique”,²⁰ qui s’inscrit plutôt dans une logique qualitative. La croissance démographique, due à la transition démographique ou à l’augmentation de la longévité, nuit à la nature et, donc, à l’écologie de la planète.

¹⁷ Ehrlich Paul et Ehrlich Anne H., *The population explosion*, Simon and Shuster, New York, 1990.

¹⁸ Hardin Garrett, *Living within limits*, Oxford University Press, 1933.

¹⁹ *Le Nouvel Observateur*, dossier n° 11, Paris, 1992.

²⁰ Par cette dénomination, nous entendons un malthusianisme qui prend prétexte de l’écologie pour se fonder, donc une interprétation naïve, à rebours de la véritable écologie.

Le malthusianisme écologique

Le mot écologie apparaît en Allemagne à la fin du XIX^e siècle. À l'origine, l'homme n'est pas dans son champ de recherche; ce n'est qu'à partir des années 1970 que la société humaine est intégrée dans le mot écologie et que la théorie écologique s'affirme. Cette dernière met "en avant la nécessaire protection de la nature impliquant l'exclusion de l'homme, de ses activités et des aménagements dans des espaces qui devaient être, selon les tenants de ces thèses, de plus en plus étendus. La population est alors considérée comme responsable de dégradations, de modifications voire de destructions des "grands équilibres" de la planète".²¹ Cette position de l'exclusion de l'homme est présente, au moins implicitement, dans de nombreux discours.

Pour protéger la nature des actions anthropiques, les applications consécutives aux demandes formulées, dès la fin du XIX^e siècle, par des mouvements écologistes, comme le Sierra Club aux États-Unis, pour la mise sous cloche d'espaces d'où les hommes sont exclus, se multiplient. Ces applications se traduisent par la création de parcs nationaux ou de réserves qui supposent l'élimination de toute présence humaine. Cela conduit à déplacer, parfois de façon violente, des populations locales qui deviennent des "déguerpies", comme elles se nomment en Afrique. On les chasse de leur territoire ancestral où se trouvaient leurs subsistances, leurs repères culturels et cultuels. Parfois, il faut ajouter à l'élimination de la présence humaine le refus de l'entretien du territoire. Cela conduit, par exemple dans la forêt de Fontainebleau, au sud de Paris, à des parcelles chaotiques où les arbres ne peuvent se régénérer. Le malthusianisme écologique peut donc déboucher à la fois sur des contraintes pour des populations déplacées de force et sur des difficultés pour parvenir à une protection effective des espaces "naturels". La protection de la nature est alors davantage sur le papier que dans la réalité.

L'un des auteurs de l'idéologie écologique, James Lovelock, le père de l'hypothèse Gaïa,²² selon laquelle l'ensemble des êtres vivants sur Terre serait ainsi comme un vaste superorganisme, s'est prononcé pour une réduction de la population mondiale à 500 millions d'individus. Une idée conforme à la pensée de Hans Jonas, qui faisait de l'homme un être à la fois prolifique et nuisible pour la nature.²³

²¹ Veyret, Yvette, "Quelques questions autour du développement durable", *Les cafés géographiques*, 29 septembre 2007.

²² Lovelock, James, *La Terre est un être vivant, l'hypothèse Gaïa*, Paris, Flammarion, coll. "Champs", 1999.

²³ Jonas, Hans. *Le principe de responsabilité*, 1979, Paris, « Champs », Flammarion, 1998.

En France, en 2009, un ancien ministre, Yves Cochet, demande la mise à mal de la politique familiale, une inversion du montant des prestations familiales à partir du troisième enfant au motif qu'un nouveau-né "aurait un coût écologique comparable à 620 trajets Paris-New York".²⁴ Donc, plus les humains sont nombreux, plus ils feraient subir de dommages à cette bonne vieille Terre. Allant plus loin, il participe à un livre collectif²⁵ qui vante le mode de vie de l'homme des cavernes d'il y a 10 000 ans, dont l'espérance de vie était pourtant inférieure à 30 ans.

Le malthusianisme intégral

D'autres auteurs donnent un sens intégral à l'antagonisme entre la population et la nature car ils pensent que tout homme participe des effets néfastes de l'humanité sur l'environnement. Et, selon eux, aucun progrès scientifique ne peut compenser ses effets. La population est alors considérée comme un mal absolu qu'il faut éradiquer. Ainsi, en 1991, apparaît aux États-Unis le mouvement *Voluntary Human Extinction Movement* (VHEMT), "mouvement pour l'extinction de l'espèce humaine". La tête pensante du mouvement, un enseignant qui vit dans l'Oregon, Les U. Knight (pseudonyme), s'est engagé dans le lobby écologiste depuis son retour du Vietnam, au début des années 1970, en militant dans le mouvement appelé *Zero Population Growth*. Depuis, il pense que la seule stabilisation démographique ne peut résoudre ce qu'il juge être une crise imminente. L'unique solution, décrète-t-il, est que "nous nous fassions totalement disparaître". La newsletter trimestrielle du VHEMT, intitulée "These Exit Times", échange des idées sur des thèmes comme la stérilisation de masse ou la contraception obligatoire.

L'humanité, selon ce mouvement, est une force de destruction à l'origine de chacun des problèmes écologiques: elle doit donc se faire biologiquement hara-kiri puisque toute activité humaine, de l'agriculture à l'urbanisation, en passant par l'usage d'un robinet ou d'un interrupteur, serait néfaste à la biosphère. Par conséquent, seule l'extinction pourrait réduire à néant les dégâts causés par l'humanité. Le mouvement propose donc purement et simplement que l'humanité cesse de se reproduire. Néanmoins, ses promoteurs ne vont pas jusqu'à mettre en œuvre leur propre suicide pour protéger la nature. Il ne se sentent pas concernés personnellement par leur objectif, puisque leur

²⁴ Cf. Gilles Finchelstein, *La dictature de l'urgence*, Paris, Éditions Fayard, 2011.

²⁵ *Moins nombreux, plus heureux. L'urgence écologique de repenser la démographie*, Paris, Éditions le Sang de la Terre, 2014.

campagne pour la suppression progressive de toute l'humanité diffuse le slogan: "Pussions-nous vivre longtemps et disparaître".

Les partisans du VHEMT abjurent donc la procréation et incitent leurs amis et leurs proches à en faire autant afin de supprimer les générations futures. Tout développement actuel ne peut donc nuire aux générations futures puisqu'il n'y en aura pas. "Chaque fois qu'un être humain décide de ne pas ajouter un nouvel être humain aux milliards grouillants qui occupent déjà cette planète dévastée, c'est une nouvelle lumière d'espoir qui jaillit des ténèbres", soutient le manifeste du VHEMT. "Quand chaque être humain aura choisi de cesser de procréer, la biosphère terrestre pourra enfin retrouver sa splendeur passée, et toutes les créatures survivantes seront libres de vivre, de mourir, d'évoluer, mais aussi, au bout du compte, de s'éteindre, comme c'est déjà arrivé tant de fois".

Et ce mouvement n'est pas l'expression brutale d'un sentiment marginal. Pour ne citer qu'un exemple, un ancien collaborateur du commandant Cousteau, Yves Paccalet, a publié en France un livre au titre évocateur: "L'humanité disparaîtra, bon débarras!".²⁶ Et, dans un entretien pour un hebdomadaire, il écrit: "La disparition (de l'homme), au fond, serait une bonne nouvelle"²⁷ puisque l'homme cesserait de porter atteinte à la nature.

Le malthusianisme climatique

Plus récemment, le 18 novembre 2009, un nouveau malthusianisme, le malthusianisme climatique, est né, à partir d'un rapport du Fonds des Nations unies pour la population (FNUAP-UNFPA) selon lequel la population mondiale ne saurait dépasser "un chiffre écologiquement viable". D'où le titre du journal *Le Monde*: "Limiter les naissances, un remède au péril climatique?" Le quotidien ajoute: "Il faut d'urgence aider les femmes à faire moins d'enfants pour lutter contre le péril climatique : c'est le message martelé par le rapport 2009 du FNUAP, selon lequel la natalité galopante des pays en développement est l'un des principaux moteurs du réchauffement et l'un de ses premiers risques".²⁸ *Le Monde* complète son article avec le commentaire suivant: "À trois semaines du sommet de Copenhague, le FNUAP tente ainsi d'imposer dans les débats une question démographique aussi absente des rapports du Groupe intergouvernemental d'experts sur l'évolution du climat (GIEC) que des négociations internationales".

²⁶ Paris, Arthaud, 2006.

²⁷ *Le Pèlerin*, juin 2007.

²⁸ 19 novembre 2009.

Enfin, toujours au début du XXI^e siècle, une nouvelle déclinaison du malthusianisme, le malthusianisme xénophobe, est apparu.

Le malthusianisme xénophobe

Certes, dans une certaine mesure, ce dernier avait déjà été formulé par Platon dans le cadre de son objectif de fixité démographique. Vingt-cinq siècles, plus tard, il réapparaît au nom de la “nature”.

Au sein de la grande association américaine d'amis de la nature qu'est le Sierra Club, une branche s'intitulant *Sierrans for US Population Stabilization* (SUSPS – pour la stabilisation de la population des États-Unis) est créée. Cette branche est notamment animée par Richard Lamm, ancien gouverneur démocrate du Colorado, et Paul Watson, qui fut un des fondateurs de Greenpeace. SUSPS considère que l'arrêt de l'immigration doit devenir la revendication prioritaire du mouvement écologiste, car l'écosystème américain ne pourrait plus supporter d'immigrants supplémentaires.²⁹ Dans son livre à succès, Diamond impute les dégradations environnementales en Californie à l'immigration, précisément à “la croissance de la population californienne” qui, écrit-il, “s'accélère, par suite presque entièrement de l'immigration et de la grande taille moyenne des familles des immigrants après leur arrivée”.³⁰

Selon un raisonnement identique, en octobre 2012, un groupe écologiste suisse, Ecopop, tout en s'affichant “contre toute xénophobie et racisme”, propose de limiter l'immigration afin de protéger la nature. Selon ce groupe, “si les migrants atteignent le niveau de vie des Suisses, ce développement n'est pas du tout durable”. Le malthusianisme xénophobe signifie qu'il faut distinguer les riches pratiquant l'entre-soi des immigrants ayant envie d'améliorer leurs conditions de vie, ces derniers étant dangereux pour la nature. Autrement dit, il faut que les pauvres restent pauvres car il n'est pas certain que leur enrichissement soit bénéfique pour la nature.

Ces multiples facettes du malthusianisme doivent être confrontées aux faits et à l'analyse géodémographique.

La vérification des théories

La première théorie à vérifier est, bien entendu, celle de Malthus.

²⁹ Cf. “Bitter division for Sierra Club on immigration”, *The New York Times*, 16 mars 2004.

³⁰ Diamond, Jared, *Effondrement. Comment les sociétés décident de leur disparition ou de leur survie*, Paris, Gallimard, 2006.

Malthus confirmé ou infirmé par l'histoire des deux derniers siècles?

Prenons l'intervalle énoncé par Malthus entre chaque donnée de progression de l'espèce humaine et des subsistances, soit 25 ans. Malthus précise aussi une durée d'étude, "deux siècles un quart", ce qui correspond, sachant que le livre de Malthus est publié en 1798, à la période 1800-2025. Le cœur du raisonnement malthusien, une croissance de l'espèce humaine plus forte que celle des subsistances, est-il confirmé? En réalité, nous savons aujourd'hui que, par suite de ce phénomène inédit appelé la transition démographique,

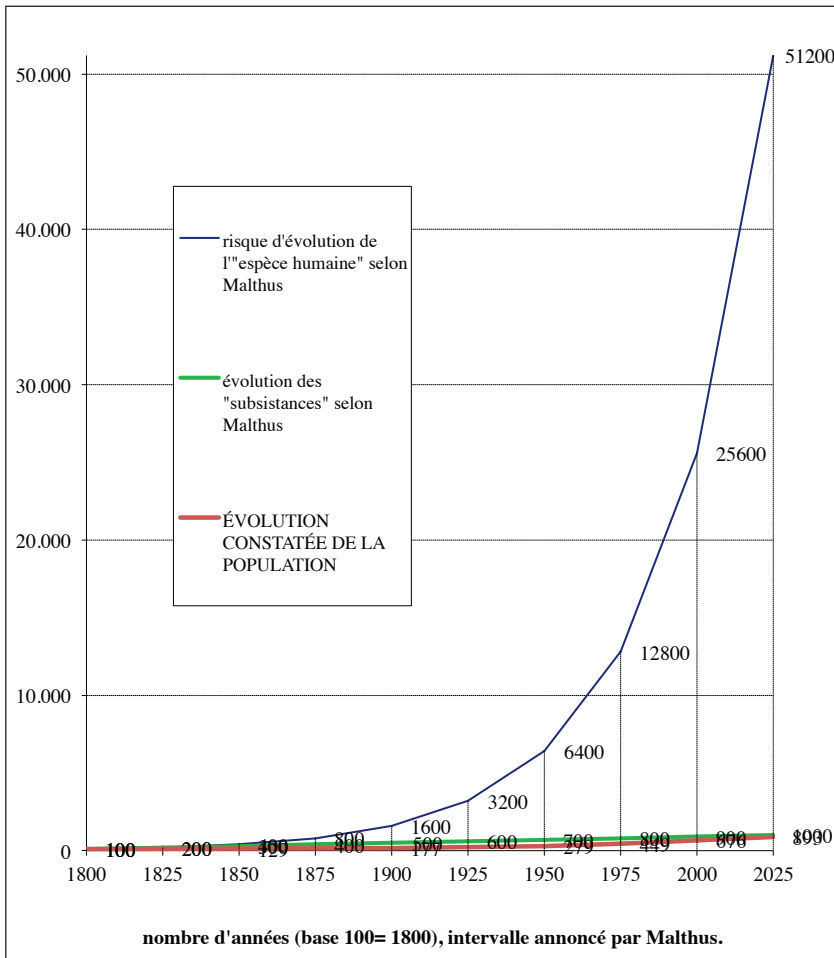


Figure 1. Le principe de population de Malthus selon l'intervalle énoncé par Malthus et l'évolution réelle de la population.

la population mondiale est passée de 906 millions en 1800 à 6 127 en 2000, la projection moyenne indiquant 8 095 millions en 2025. Le rapport entre 8 095 et 906 signifierait une multiplication de la population par 8,9, donc inférieure à la progression arithmétique des subsistances, que Malthus indique de 10. Donc l'hypothèse de croissance des subsistances de Malthus a été supérieure à celle de la population, pourtant inédite par son intensité dans l'histoire de l'humanité, puisqu'aucune autre période historique de même durée n'a enregistré une telle progression du nombre d'habitants.

Toutefois, il convient d'être indulgent avec Malthus. En effet, la progression géométrique de la population qu'il annonce avec des intervalles de 25 ans supposerait un taux de croissance annuel moyen de 2,8%, ce qui n'est jamais arrivé en moyenne mondiale, puisque le maximum atteint à la fin des années 1960 a été de 2,1%. Supposons donc comme intervalle une durée de 75 ans. Cette dernière correspond pour la population à un taux annuel moyen légèrement inférieur à 1%, précisément de 0,924%, en rap-

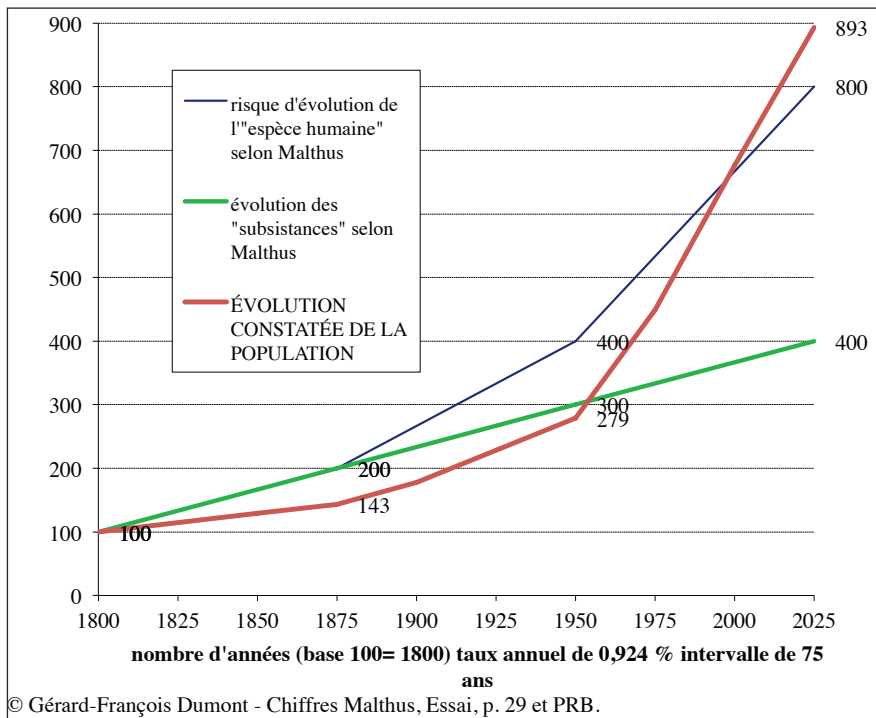


Figure 2. Le principe de population de Malthus selon un intervalle triplé et l'évolution réelle de la population

pelant, pour mémoire, que le taux de l'année 2013 est estimé à 1,2%.³¹ Selon le raisonnement de Malthus avec l'hypothèse de 75 ans, trois périodes doivent être analysées: 1800-1875, 1875-1950 et 1950-2025.

Aucun problème ne se pose pendant la première période (années 1800 à 1875) puisque l'espèce humaine et les subsistances augmentent dans les mêmes proportions, même si, bien entendu, des inégalités peuvent exister. Dans cette première période, la population a crû à un niveau inférieur aux craintes de Malthus. Faut-il penser que c'est parce que les populations ont suivi les prescriptions de limitation des naissances selon la contrainte morale prônée par Malthus? Il est difficile de le penser puisque, dans cette période 1800-1875, la croissance démographique a été beaucoup plus élevée qu'au XVIII^e siècle en raison de la hausse du taux de croissance dans les pays parcourant la première étape de la transition démographique, c'est-à-dire principalement les pays européens et d'Amérique du Nord. Dans cette première période, on peut penser que la population s'est enrichie, en raison d'une progression supérieure des subsistances, ce qui ressort d'ailleurs des excellents travaux de Angus Maddison.³²

Pour la période 1875-1950, les subsistances deviennent insuffisantes. Elles peuvent certes augmenter de 50%, mais l'espèce humaine s'accroît, selon Malthus, de 100% et, faute d'alimentation suffisante, sa mortalité sera élevée. Mais en réalité, dans cette deuxième période 1875-1950, la population s'est moins accrue que la hausse des subsistances escomptée par Malthus, donc la croissance géométrique de la population ne s'est pas concrétisée. En outre, le taux de mortalité a baissé.

Dans la troisième période (1950-2025), en considérant l'hypothèse moyenne de la population mondiale projetée en 2025, il n'en n'est pas de même. Cette population augmente à un rythme beaucoup plus rapide, passant de 2,5 milliards d'habitants en 1950 à 8,1 en 2025, surtout avec l'avancée de pays du Sud dans la transition démographique. C'est une multiplication par 3,2 de la population, supérieure au doublement craint par Malthus. Mais ce n'est nullement une "explosion démographique", selon l'expression trop couramment usitée, notamment par Ehrlich. En effet, la croissance démographique n'a pas le caractère "soudain et spectaculaire" qui justifierait cette

³¹ Sardon, Jean-Paul, "La population des continents et des pays", *Population & Avenir*, n° 715, novembre-décembre 2013, www.population-demographie.org/revue03.htm

³² Cf. Maddison, Angus, *L'économie mondiale: statistiques historiques*, Paris, OCDE, 2003; né le 6 décembre 1926 à Newcastle upon Tyne et mort le 24 avril 2010 à Neuilly-sur-Seine, Angus Maddison est un économiste et historien britannique, l'un des rares économistes à avoir étudié l'évolution mondiale par pays et zone géographique sur le très long terme.

image pyrotechnique mais s'explique par le processus de la transition démographique, déclenché par les progrès économiques et sanitaires que l'humanité est parvenue à déployer depuis la fin du XVIII^e siècle (progrès technique en agriculture, révolution industrielle, découvertes médicales et pharmaceutiques, développement de l'hygiène...).³³ En réalité, l'expression "explosion démographique" illustre une inculture démographique, malheureusement largement partagée, due à une méconnaissance des mécanismes de la science de la population, de la logique de la transition démographique ou des effets d'inertie propres à la démographie.

Si les subsistances s'étaient contentées de suivre une progression arithmétique dans la période 1950-2025, la sous-alimentation aurait empêché une telle augmentation. Cette dernière n'a été possible que parce que les subsistances ont augmenté plus que le rythme prévu par Malthus. Donc, l'humanité a su améliorer les méthodes culturales, la qualité des transports et du stockage des denrées, surtout des grains qui constituaient une grande source de pertes, dans des proportions considérablement plus élevées que la croissance arithmétique de Malthus.

Contrairement à la crainte de Malthus, depuis 1798, la croissance de la population s'est donc accompagnée d'une augmentation encore plus grande du volume et de la variété de la production.³⁴ Plus encore, l'augmentation moyenne de l'espérance de vie et de la qualité de la vie est totalement contraire à la théorie de Malthus.³⁵

Ainsi, on songe à la phrase de Proudhon prononcée au XIX^e siècle: "Il n'y a qu'un seul homme de trop sur la terre, c'est M. Malthus".³⁶ Et, pour le XX^e siècle, il faut se rapporter aux travaux d'Ester Boserup³⁷ (1910-1999)

³³ Dumont, Gérard-François, *Les populations du monde*, Paris, Éditions Armand Colin, deuxième édition, 2004.

³⁴ En outre, l'évolution dans certains pays dément un autre aspect de la théorie de Malthus selon laquelle "la population s'accroît inmanquablement là où les moyens de subsistance le permettent". En effet, la terre connaît de nombreux territoires, tout particulièrement en Europe, dont la population diminue sous l'effet d'une fécondité affaiblie, alors que les moyens de subsistance laissent des surplus très importants pour l'exportation. Cf. Dumont, Gérard-François, "Japon: les enjeux géopolitiques d'un "soleil démographique couchant", *Géostratégiques*, n° 26, 1^{er} trimestre 2010; "L'avenir démographique de l'Europe", *Questions internationales*, n° 57, septembre 2012; "Démographie: des rapports de force bouleversés", *Diplomatie*, Les grands dossiers n° 18, décembre 2013-janvier 2014.

³⁵ Dumont, Gérard-François, "Population et développement: la tentation malthusienne", *Agir, revue générale de stratégie*, n° 35, septembre 2008.

³⁶ *Système des contradictions économiques ou Philosophie de la misère*, 1846.

³⁷ Cf. notamment *Les conditions de la croissance agricole* (1965), traduction française, Paris, Flammarion, 1970.

montrant comment le développement économique et agricole peut être engendré par la pression créatrice permise par la croissance démographique.

Épuisement des ressources versus progrès technique

Quant aux prévisions du malthusianisme des ressources, elles ne se sont pas produites, ou du moins pas dans les délais annoncés, pour diverses raisons, à commencer par une sous-estimation des réserves concernant les ressources utilisées. Par exemple, les réserves connues de pétrole assuraient en 1938 les besoins pour 15 ans; en 1950, les réserves assuraient 25 ans, malgré un taux de consommation doublé; en 1972, on prévoyait 35 ans; en 2014, après les découvertes au Brésil ou le pétrole de schiste, les spécialistes indiquent une satisfaction des besoins pour une période encore plus longue, alors que les taux de consommation sont plus élevés et tandis qu'il reste nombre de recherches non encore effectuées.³⁸ Les experts constatent que le monde n'a cessé de voir se reculer le "pic pétrolier", c'est-à-dire le sommet de la courbe qui caractérise la production pétrolière. Cela ne veut pas dire qu'il ne sera pas atteint un jour, mais cela signifie que, depuis des décennies, la prévision de la datation du pic pétrolier a toujours été dépassée.

Ensuite, le malthusianisme des ressources omet l'innovation technologique, autrement dit le progrès technique dans l'utilisation des ressources, c'est-à-dire l'importance des possibilités d'économie de l'énergie. Un exemple: à la fin du XIX^e siècle, en s'appuyant sur les connaissances scientifiques de l'époque, le savant William Crookes prophétisait la famine pour les années 1930. Il affirmait notamment – et pour cela l'avenir lui a donné raison – que les nitrates du Chili s'épuiseraient. Mais, par contre, il n'avait pas imaginé que, dans le même temps, les hommes allaient trouver le moyen de fixer l'azote de l'air et d'inventer la génétique agricole. Autre exemple: entre 1962 et 1972, l'énergie nécessaire pour fabriquer une même quantité d'acier a diminué de 74%.

Troisième élément: les évolutions dans les modes de consommation ou dans les comportements des personnes. Par exemple, le tri initial des déchets ménagers permet d'augmenter le recyclage, tandis que divers procédés permettent de fabriquer de l'énergie à partir de certains déchets. Enfin, la lutte contre la pollution a remporté des succès, à l'exemple du développement

³⁸ Certaines étant suspendues à des décisions politiques ou géopolitiques. Par exemple, l'incapacité des cinq pays riverains de la mer Caspienne à s'entendre sur le partage des ressources maritimes ou les différends géopolitiques dans le canal du Mozambique freinent la recherche et l'exploitation pétrolières de cette mer.

du nombre et des technologies des stations d'épuration, qui explique par exemple l'amélioration de la qualité des eaux. L'amélioration des techniques urbaines³⁹ a démenti les craintes de John Graunt,⁴⁰ qui pensait que les villes allaient disparaître sous l'effet de la pollution. Il écrivait notamment à propos de la capitale anglaise, vingt fois moins peuplée qu'aujourd'hui: "Je me suis demandé si une ville, en devenant plus peuplée, ne devient pas, justement à cause de cela, plus insalubre. J'incline à croire que Londres est aujourd'hui plus insalubre que jadis en partie parce qu'elle est plus peuplée, mais surtout parce que, comme je l'ai entendu dire, on brûlait à Londres, il y a 60 ans, peu de charbon, et qu'aujourd'hui il est utilisé universellement".

Enfin, le malthusianisme des ressources ignore les progrès déjà réalisés et ultérieurement possibles sur les ressources renouvelables, comme le projet Desert Power 2050,⁴¹ selon lequel la transition vers un système électrique basé à plus de 90% sur les énergies renouvelables n'est pas seulement techniquement faisable mais également plus économique que si les trois régions méditerranéennes continuent de fonctionner séparément. Comme ce projet suppose d'intégrer les réseaux électriques de part et d'autre de la Méditerranée, sa concrétisation dépend essentiellement de décisions politiques et guère de contraintes technologiques.

L'humanité "durable" dans les derniers siècles

Les ordres de grandeurs sur lesquels se fonde le malthusianisme écologique pour dénoncer la croissance démographique sont incontestables. Par exemple une multiplication par presque quatre de la population dans le monde pour le seul XX^e siècle, peut paraître impressionnante. Mais cette multiplication n'est nullement due à une hausse de la natalité, mais à la diminution de la mortalité. Ainsi, la fécondité moyenne dans le monde a baissé considérablement, de plus de 5 enfants par femme au début des années 1950 à 2,5 dans les années 2010. En outre, la croissance démographique en cours au XXI^e siècle n'est nullement due à la hausse de la natalité, puisqu'elle baisse, mais essentiellement à des effets de vitesse acquise, et à l'augmentation escomptée de l'espérance de vie.

³⁹ Cf. Également Dumont, Gérard-François, "Ville, population et environnement", dans: Wackermann, Gabriel (Direction), *Ville et environnement*, Paris, Ellipses, 2005.

⁴⁰ *Observations Naturelles et Politiques, répertoriées dans l'index ci-après et faites sur les Bulletins de Mortalité*, Londres, 1662, réédition Ined, Paris, 1977.

⁴¹ "Agir maintenant pour l'énergie de demain" principaux résultats de l'étude stratégique "Desert Power 2050: Perspectives pour un système électrique durable dans la région EUMENA (Europe, Afrique du Nord et Moyen-Orient)", juin 2012.

En réalité, le monde des deux derniers siècles n'a pas connu une "croissance" démographique, mais plutôt un processus de "développement" démographique. Le monde contemporain a enregistré un changement démographique non seulement quantitatif, mais structurel, totalement inédit. En effet, la mutation du régime démographique intervenant pendant la période de transition démographique, si elle est effectivement marquée par un nombre accru des hommes, se caractérise surtout par une révolution⁴² des conditions démographiques de vie, avec l'effondrement des taux de mortalité infantile, infanto-adolescente et maternelle et le quasi-triplement de l'espérance de vie à la naissance dans nombre de pays. Il y a donc eu un incontestable "développement démographique", qui pourrait (devrait?) se poursuivre au XXI^e siècle dans les pays du Sud où sa réalisation n'est pas terminée.

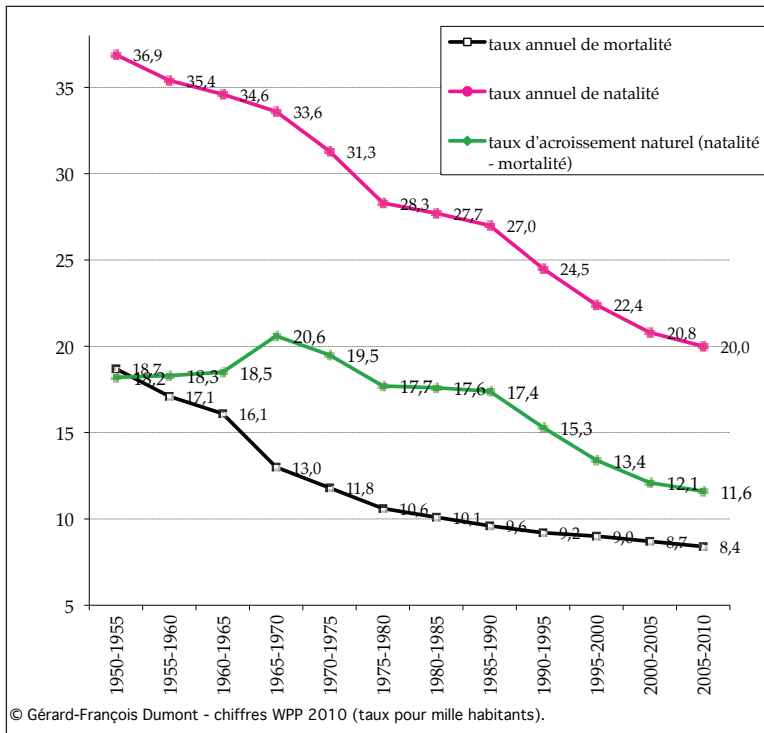


Figure 3. Le mouvement naturel dans le monde.

⁴² Comme l'avait noté dès 1934 Adolphe Landry dans: *La révolution démographique*, Sirey, Paris, 1934.

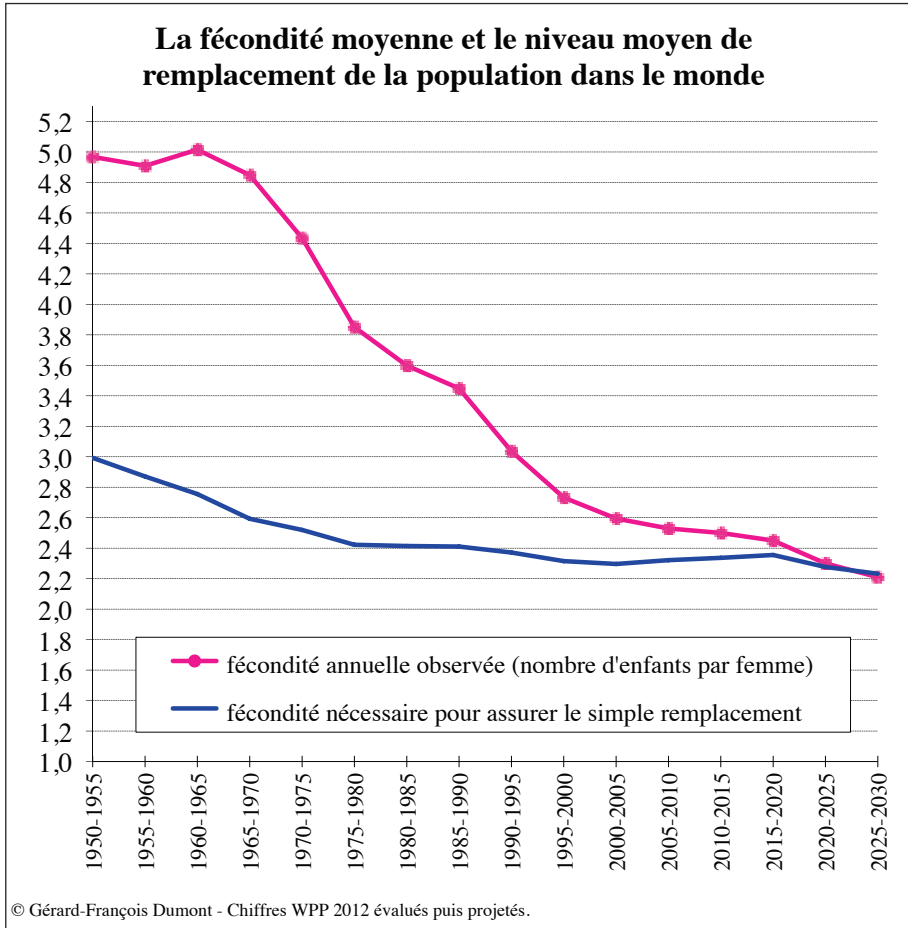


Figure 4. La fécondité moyenne et le niveau moyen de remplacement de la population dans le monde.

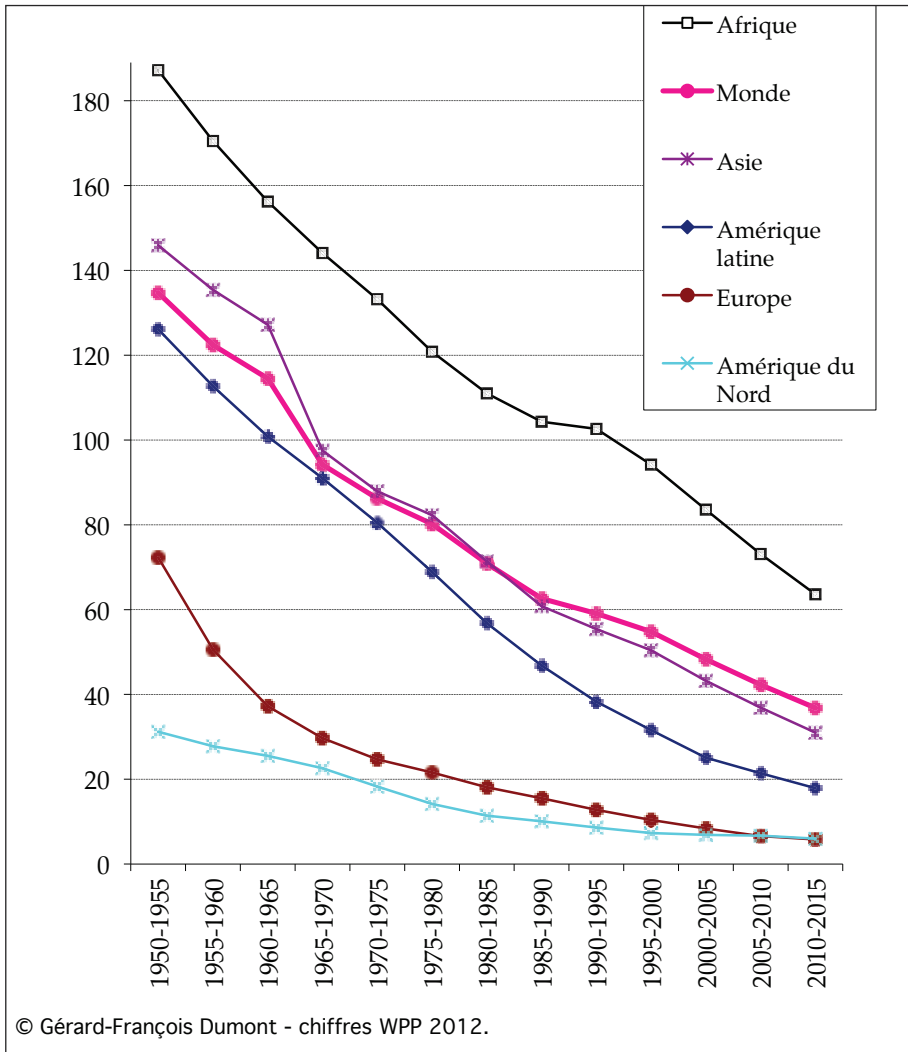


Figure 5. La baisse des taux de mortalité infantile selon les continents.

Peut-on pour autant parler d'une humanité "durable"? Autrement dit, le développement démographique de la période de transition démographique, incontestablement profitable aux générations de cette période ne nuit-il pas aux générations futures?

Il est difficile de faire des prévisions, surtout en ce qui concerne l'avenir, selon la boutade de l'humoriste Pierre Dac. Mais il est possible de savoir si la croissance inédite de la population dans le monde des deux derniers siècles a eu, à ce jour, des conséquences néfastes au regard des évolutions intergénérationnelles. Nous savons en effet que le taux moyen de croissance démographique dans le monde a augmenté au XIX^e siècle, puis au XX^e siècle, jusqu'à la fin des années 1960, et diminue depuis. En termes de développement durable,⁴³ la question qui se pose est de savoir si la croissance démographique, en élévation constante durant les décennies précédant le début de la décelération, a nui aux générations suivantes.

L'étude de deux indicateurs pertinents, l'espérance de vie à la naissance et le taux de mortalité infantile, permet de répondre à la question. Considérons l'évolution du monde dans les années 1950 à 1970. Pendant cette période, la planète a connu une forte dynamique démographique, sous l'effet des choix politiques, économiques, sanitaires et sociaux des différents gouvernements comme des comportements des populations. La synthèse de ces choix a été profitable aux générations vivant dans cette période puisqu'elles sont parvenues à réduire dans d'importantes proportions la mortalité infantile, ce qui a été l'un des éléments ayant permis l'augmentation de l'espérance de vie à la naissance. Ainsi, du début des années 1950 à la seconde moitié des années 1960, l'espérance de vie des hommes a continué de progresser de 45,9 à 55,1 ans, soit de près de 10 ans. Concernant les femmes, la hausse a été de 47,9 à 57,9 ans, soit également d'une dizaine d'années.

Peut-on dire que l'ensemble des moyens et des comportements ayant permis ces progrès pour des générations vivant dans les années 1950 et 1960 ont nui aux générations futures? La réponse est négative. En effet, non seulement les générations suivantes ont bénéficié des progrès réalisés en matière de baisse de mortalité infantile ou d'augmentation de l'espérance de vie, mais elles ont pu les améliorer. Cela signifie donc que le développement démographique s'est avéré durable. Les comportements, notamment hygiéniques, et les méthodes utilisées pour répondre à un développement qui satisfasse les besoins du moment n'a pas compromis "la capacité des générations futures de répondre aux leurs". Bien au contraire, les générations

⁴³ Wackermann, Gabriel (direction), *Le développement durable*, Paris, Éditions Ellipses, 2008.

suyvantes ont bénéficié des acquis⁴⁴ (vaccinations, pratiques de suivi médical, molécules pharmaceutiques, amélioration des réseaux sanitaires, alimentation plus variée, diminution de la pénibilité moyenne des métiers grâce au progrès technique...) apportés par les générations précédentes.

S'il n'est pas contestable que le développement démographique des deux derniers siècles a été "durable", ses conséquences au XXI^e siècle, avec une nouvelle augmentation, certes ralentie, du peuplement de la planète seront-elles "durables"?

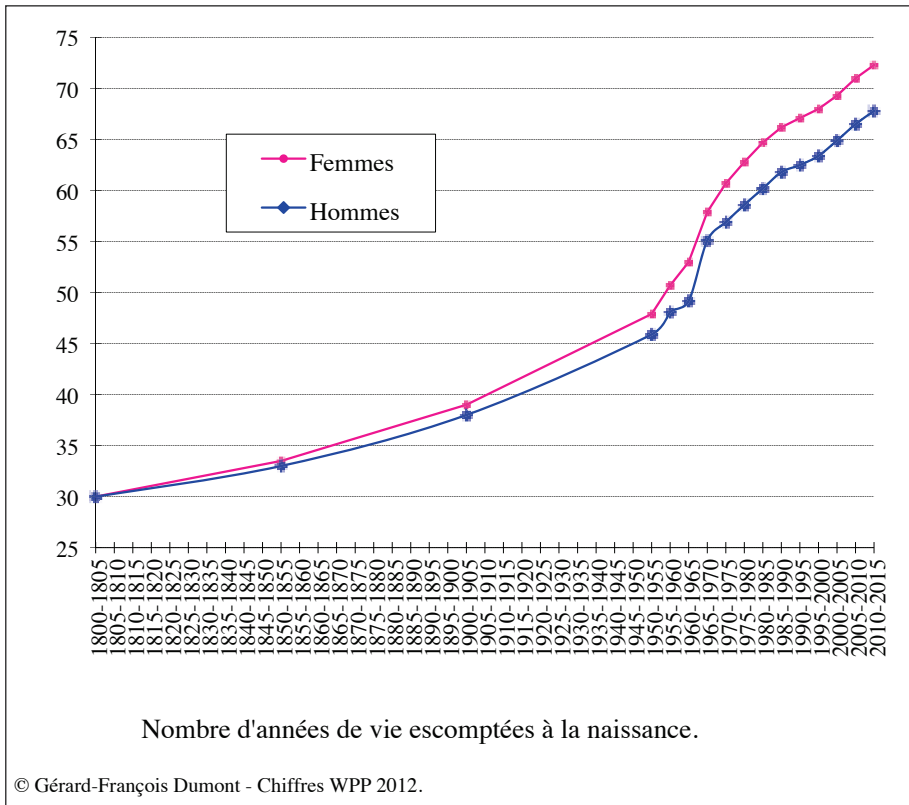


Figure 6. L'espérance de vie à la naissance dans le Monde

⁴⁴ Rappelons que nous raisonnons en moyenne mondiale. Le niveau des acquis, comme d'ailleurs les résultats obtenus pour la mortalité infantile ou l'espérance de vie, sont fort différents selon les pays et même selon les échelons infranationaux.

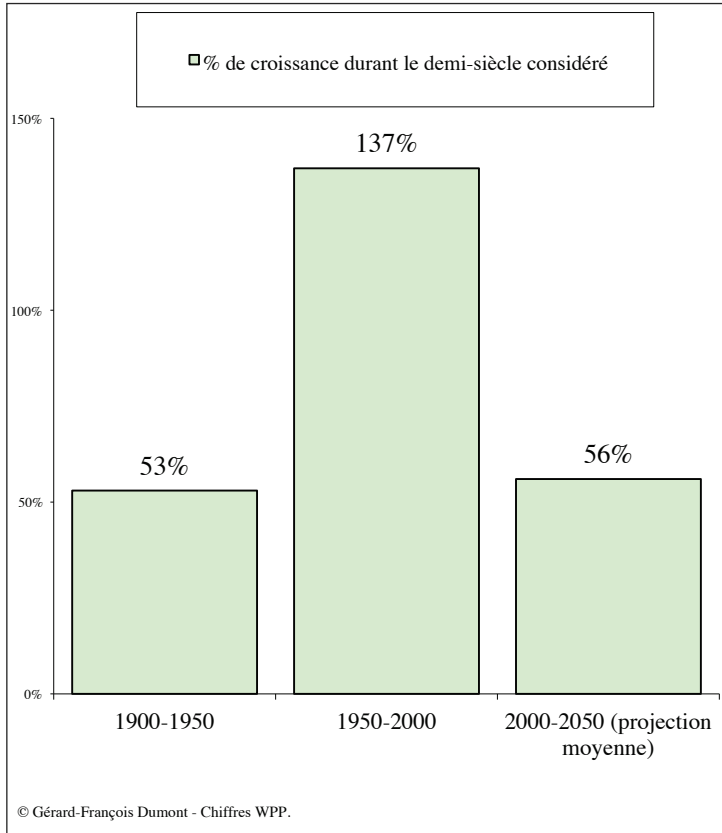


Figure 7. La mise en évidence de la décélération conforme à la logique de la transition démographique

Les risques pour l'environnement non proportionnels à la population

Le malthusianisme écologique s'inquiète de la poursuite d'une croissance démographique⁴⁵ au XXI^e siècle, en se fondant sur le postulat suivant: tout homme est un pollueur; toute augmentation du nombre d'habitants implique davantage de pollution. Pour le passé, si tel était le cas, si l'homme n'était qu'un pollueur et non également un être capable de susciter des pro-

⁴⁵ Croissance moyenne qui résulte d'évolutions très contrastées, Cf. Dumont, Gérard-François, "La mondialisation s'applique-t-elle en démographie? Tendances et perspectives pour le XXI^e siècle", *Population & Avenir*, n° 691, janvier-février 2009.

grès techniques conformes à une logique de développement durable, la croissance de la population dans le monde depuis deux siècles aurait fini par être enrayerée par une croissance homothétique de la pollution. Et cette dernière aurait causé en moyenne une surmortalité liée à la détérioration de l'environnement. L'espérance de vie n'aurait donc pu croître autant et aurait fini sans doute par reculer. De tels phénomènes ont pu et peuvent se produire localement, sur quelques territoires où un mauvais respect de l'environnement a pu ou peut aller jusqu'à déclencher des effets mortifères ou réduisant la longévité des hommes.⁴⁶ Mais ils ne se sont nullement généralisables sur l'ensemble des territoires ayant connu incontestablement les plus fortes croissances démographiques, les territoires urbains.⁴⁷ Cela tient à ce que de nombreux progrès techniques ont permis d'écarter des risques dus à la concentration de populations sur des territoires de superficie réduite.

Un regard complémentaire consiste à observer que la croissance démographique a inévitablement pour effet de densifier les territoires. Si la pollution est proportionnelle à la densité, elle devrait être incontestablement plus élevée sur des territoires denses et moins élevée dans les territoires peu denses. Pour examiner si ce raisonnement est juste, prenons l'indicateur des émissions de dioxyde de carbone⁴⁸ par habitant selon les pays, publié par l'Agence internationale de l'énergie. Cet indicateur prend en compte tout le dioxyde de carbone produit soit par la combustion de solides, de liquides ou de gaz, soit par la fabrication du ciment, exprimé en tonnes métriques (la tonne métrique est équivalente à 1 000 kilogrammes). Mais les émissions produites par la conversion d'utilisation de la terre ou à partir des carburants de soute utilisés dans le transport international ne sont pas incluses.

L'étude des résultats d'émissions de dioxyde de carbone suppose d'écarter deux débats. D'une part, on ne cherche pas ici à discuter des origines du réchauffement climatique, et donc de liens de causalité,⁴⁹ exclusifs ou non,

⁴⁶ À l'exemple de la surmortalité en Russie ou dans certains territoires chinois.

⁴⁷ Dumont, Gérard-François, "Ville, population et environnement", dans: Wacker-mann, Gabriel (direction), *Ville et environnement*, Paris, Ellipses, 2005.

⁴⁸ Rappelons que le CO₂ est produit lors de tous les processus de combustion.

⁴⁹ Question toujours discutée en dépit des rapports du GIEC, comme l'atteste le texte suivant: "La part humaine dans le réchauffement climatique n'est pas démontrée (nous vivons dans un interglaciaire, et nous venons de quitter le Petit Âge Glaciaire, qui s'est étendu du XIV^e siècle à la fin du XIX^e). Il est néanmoins très tentant d'attribuer les dommages non plus à la nature purement, mais à une forme de responsabilité collective, quand bien même les liens entre le climat et les processus physiques qui expliquent en partie les dommages observés ne sont en aucun cas des liens simples de cause à effet. Affirmer une série de relations simples de causalité entre les GES (gaz à effet de serre), l'évolution des tem-

entre les activités humaines et l'augmentation du CO₂. D'autre part, on ne s'interroge pas sur la qualité, le caractère inévitablement partiel ou la fiabilité de la précision des résultats affichés.

Considérons les 33 pays de l'OCDE, donc des pays ayant, *grosso modo*, un système économique de même nature fondé sur l'économie de marché. On pourrait penser que les pays les plus denses, donc ayant davantage de territoires "artificialisés" et disposant de moins de territoires "naturels", émettent davantage de CO₂ par habitant sous l'effet d'une population concentrée.

Les pays les plus denses de l'OCDE sont la Corée du Sud, avec 498 habitants/km², les Pays-Bas, 397, la Belgique, 354, Israël, 353, et le Japon, 338. Les pays les moins denses sont l'Australie, le Canada et l'Islande, avec chacun 3 habitants/km², puis la Norvège, 13, et la Finlande, 16. En terme d'émission de CO₂ par habitant, le chiffre le plus élevé s'observe au Luxembourg, 10^e pays par la densité (173), avec 20,1, puis en Australie (17,4), aux États-Unis, (16,9 tonnes de CO₂ par habitants et une densité de 32 habitants/km²), au Canada (15,37) et en Estonie (14,4 tonnes de CO₂ par habitant et une densité de 30 habitants/km²). Les écarts sont considérables selon les pays. Par exemple, au sein de l'Espace économique européen, la Suisse émet 5,07 et le Luxembourg 20,1.

Les données indiquent clairement que, dans les pays de l'OCDE, les émissions de dioxyde de carbone par habitant selon les États ne sont pas proportionnelles à la densité de la population.

La recherche d'une corrélation entre la densité des pays et l'émission de CO₂ par habitant débouche sur sa totale inexistence. En effet, le coefficient de corrélation est de 0,02265, soit un chiffre extrêmement bas, considérablement inférieur au coefficient qui montrerait une telle corrélation qui devrait être de 0,9.

pératures supposées moyennes à la surface de la planète, et l'évolution supposée des cyclones, par exemple, donc des dommages "subis" par l'Humanité, est purement scandaleux sur le plan du raisonnement scientifique". Pigeon, Patrick, "Contradictions et implicites liés à la nature en géographie", *Les cafés géographiques*, 19 janvier 2008.

	Pays	Émissions CO ₂ par habitant	Densité (habitants/km ²)	Population (millions)	Superficie (milliers de km ²)
1	Corée du Sud	11,81	498	49,8	100
2	Pays-Bas	10,45	397	16,7	42
3	Belgique	9,89	354	11,0	31
4	Israël	8,66	353	7,8	22
5	Japon	9,28	338	127,8	378
6	Royaume-Uni	7,06	258	62,7	243
7	Allemagne	9,14	229	81,8	357
8	Italie	6,47	202	60,7	301
9	Suisse	5,07	192	7,9	41
10	Luxembourg	20,10	173	0,5	3
11	Rép. Tchèque	10,73	133	10,5	79
12	Danemark	7,48	130	5,6	43
13	Pologne	7,79	123	38,5	313
14	France	5,04	118	65,1	552
15	Portugal	4,51	116	10,7	92
16	Hongrie	4,75	107	10,0	93
17	Slovénie	7,43	103	2,1	20
18	Autriche	8,13	100	8,4	84
19	Turquie	3,86	94	74,0	784
20	Espagne	5,86	91	46,1	506
21	Grèce	7,40	86	11,3	132
22	Slovaquie	6,22	69	5,4	79
23	Irlande	7,63	65	4,6	70
24	Mexique	3,96	56	109,2	1 958
25	Etats-Unis	16,94	32	312,0	9 629
26	Estonie	14,40	30	1,3	45
27	Chili	4,42	23	17,3	756
28	Suède	4,75	21	9,5	450
29	Nouvelle-Zélande	6,87	16	4,4	271
30	Finlande	10,32	16	5,4	338
31	Norvège	7,69	13	5,0	385
32	Canada	15,37	3	34,5	9 971
33	Islande	5,81	3	0,3	103

© Gérard-François Dumont – chiffres 2011 IEA et PRB.

Tableau 1. Densité de population et émissions de CO₂ par habitant dans des pays de l'OCDE.

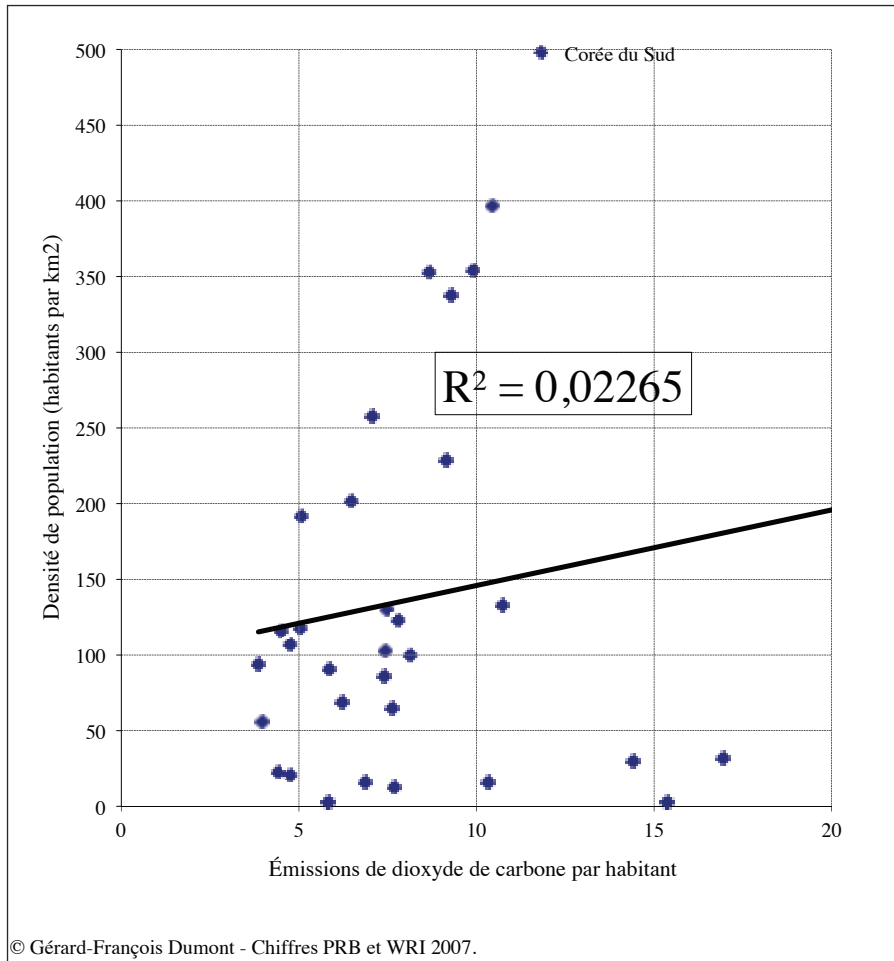


Figure 8. L'absence de corrélation entre la densité de population et les émissions de CO₂ dans des pays de l'OCDE.

Dans le reste du monde, les tonnes de CO₂ par habitant les plus élevées se constatent au Qatar (38,17), à Trinidad et Tobago (30,29), au Koweït (30,1), aux Antilles néerlandaises, au sultanat d'Oman, au Brunei, aux Émirats arabes unis et à Bahreïn. Leurs émissions élevées ne sont nullement corrélées à la densité de la population, puisque celle d'Oman est de 9 habitants/km² et celle de Bahreïn de 1 891.

Rang	Pays	Émissions CO ₂ par habitant	Densité (habitants/km ²)	Population (millions)	Superficie (milliers de km ²)
1	Qatar	38,17	170	1,9	11,0
2	Trinidad and Tobago	30,29	269	1,3	5,0
3	Koweït	30,07	157	2,8	18,0
4	Antilles Néerlandaises	22,48	239	0,2	1,0
5	Oman	22,31	9	2,8	310,0
6	Brunei	21,94	68	0,4	6,0
7	Émirats arabes unis	21,02	94	7,9	84,0
8	Luxembourg	20,10	173	0,5	3,0
9	Australie	17,43	3	22,8	7 741,0
10	Bahreïn	17,13	1 891	1,3	0,7
11	États-Unis	16,94	32	312,0	9 629,0
12	Gibraltar	16,66	310	0,0	0,1
13	Arabie Saoudite	16,28	13	28,1	2 150,0

© Gérard-François Dumont – chiffres 2011 IEA et PRB.

Tableau 2. Les pays du monde aux émissions de CO₂ par habitant les plus élevées. (supérieures à 16) et leur densité de population.

Il résulte que, à niveau de développement globalement comparable, les émissions de dioxyde de carbone par habitant ne dépendent ni de l'effectif des populations, ni de la densité de population des pays. Elles dépendent des capacités de bien ou de mal agir sur l'environnement.

Ainsi, les différentes théories malthusiennes se trouvent infirmées par l'analyse scientifique. Quels enseignements en déduire?

Les enseignements de la confrontation des théories avec le réel

Avant de répondre à cette question, il faut souligner le contresens de Malthus, pour qui une forte natalité entraînerait une forte mortalité, alors que la transition démographique montre que c'est l'évolution du niveau de la mortalité qui est largement explicative de celle de la natalité.

Le mirage de l'augmentation mortifère

De façon générale, l'augmentation de la population dans le monde n'est évidemment possible qu'avec des taux de mortalité plus faibles que les taux de natalité, pour dégager un taux d'accroissement positif. Or, les taux de mortalité ne peuvent être assez faibles que si les conditions sanitaires, sociales

et économiques le permettent. La population ne peut donc croître que si son alimentation et ses conditions de vie le rendent possible. Si les méthodes culturelles et les structures économiques et sociales ne permettent pas de garantir l'alimentation à une population plus nombreuse, les taux de mortalité seront très élevés, et la population ne croîtra pas.

Donc, considérant la projection moyenne de l'ONU,⁵⁰ adhérer à l'affirmation suivante: "La population mondiale dépassera 9 milliards en 2050", c'est inévitablement admettre le syllogisme optimiste suivant:

"La population mondiale va augmenter de 50 % au cours de la première moitié du XXI^e siècle.

Or, une telle augmentation de la population suppose des conditions économiques et sanitaires satisfaisantes.

Donc, au XXI^e siècle, les conditions économiques et sanitaires seront satisfaisantes".

Une augmentation significative de la population et de la mortalité en même temps est donc un mythe, car deux processus contraires ne peuvent pas se déployer ensemble. Ou la population augmente parce que l'humanité réussit à se nourrir, ou l'humanité ne parvient pas à se nourrir et la population ne peut pas augmenter. Ainsi, la population de l'Angleterre a été multipliée par quatre au cours du XIX^e siècle et l'alimentation a largement suivi. Pendant ce même XIX^e siècle, la population de l'Inde⁵¹ était stagnante parce qu'aucune transformation n'était intervenue. La population de l'Inde n'a commencé à croître, à compter des années 1920, que lorsque des transformations techniques (création de canaux d'irrigation...), économiques et sanitaires se sont produites.

Certes, le choix des informations diffusées dans les médias insiste plus sur les populations souffrant de famine que sur celles dont les conditions de vie s'améliorent. Les peuples heureux n'ont pas d'histoire, dit la sagesse des Nations. On a tendance à penser que la croissance démographique serait responsable des terribles difficultés humaines constatées dans certains pays. Or, en réalité, ni les famines ni les épidémies ne répondent à une malédiction que subiraient certains pays en développement. La famine est surtout un symptôme aigu des crises politiques et économiques et parfois même le résultat de politiques délibérées de la part de groupes en lutte ou de gouvernements.

⁵⁰ Dumont, Gérard-François, "Prospective: un Monde de 9 milliards d'humains?", *Population & Avenir*, n° 699, septembre-octobre 2010.

⁵¹ Dumont, Gérard-François, *Les populations du monde*, Paris, Éditions Armand Colin, deuxième édition, 2004.

Ainsi, ce n'est pas l'augmentation de l'effectif d'une population que l'on peut corrélérer avec les principaux lieux de famine des dernières décennies, mais davantage les troubles politiques. L'histoire contemporaine de nombreux pays (Cambodge, Somalie, Soudan, Mozambique, Liberia...) éclaire malheureusement cette réalité. Plus généralement, la mauvaise gouvernance est la raison majeure des difficultés du développement en dépit de potentialités parfois considérables: Madagascar, la Birmanie, le Zimbabwe ou le Congo RDC ne sont que des exemples parmi d'autres.

La situation démographique contemporaine que certains caractérisent par un excès d'habitants n'est donc pas le résultat d'une fatalité qui se serait abattue sur l'humanité. C'est, bien au contraire, la conséquence des progrès économiques, sanitaires et hygiéniques réalisés par cette humanité depuis deux siècles. Elle n'est pas non plus responsable de la pauvreté que subissent encore trop de peuples qui souffrent de mauvaises institutions, de politiques liberticides ou de systèmes de corruption. Certes, il existe incontestablement des inégalités et de la pauvreté notamment en raison des effets improductifs de certaines politiques ou d'injustices dans la répartition des richesses. Mais les moyens de subsistance, fruits de la terre et du travail des hommes, sont toujours, sauf cas particuliers localisés et de durée temporaire dus par exemple à des catastrophes naturelles ou à des gouvernances inadaptées,⁵² restés suffisants pour le nombre des hommes.

Pas de "ressources" sans innovation

Les craintes de surpopulation de la planète énoncées dans le passé se sont donc trouvées démenties. Mais cela ne signifie pas qu'elles n'aient aucune pertinence pour l'avenir. L'humanité ne finira-t-elle pas par être confrontée à un plafond de ressources? Pour répondre à cette question, il faut préciser la définition du mot *ressources*: "moyens matériels dont dispose ou peut disposer une collectivité".⁵³ Or, disposer, c'est "avoir l'usage", un usage qui peut se trouver fortement différent selon les capacités techniques. Par exemple, la Terre fournit depuis toujours les différents éléments entrant dans la composition du savon, mais l'homme n'a su les utiliser à des fins hygiéniques qu'il y a 4 500 ans, dans les territoires de la civilisation sumérienne. Au

⁵² Comme la famine en Somalie de l'été 2011, ainsi précisée par Pierre Salignon: "le principal facteur limitant les secours est... l'instabilité du pays". La famine sévit de nouveau comme résultat "d'un long processus de dégradation, associant des agressions climatiques répétées et les conflits qui ravagent le pays depuis le début des années 1990", *Le Monde*, 27 juillet 2011, page 7.

⁵³ Dictionnaire *Robert 1*, 1995.

moyen âge, en Europe, le savon est encore très peu répandu car c'est un luxe coûteux. Il faut attendre les progrès techniques du XIX^e siècle pour voir le prix du savon s'effondrer et permettre la généralisation de son usage, contribuant par exemple à la baisse de la mortalité maternelle et donc à l'augmentation de l'espérance de vie. Autrement dit, les éléments entrant dans la composition du savon ne sont devenus une ressource usitée pour l'ensemble de l'humanité que par suite de différentes innovations.

Autre exemple: la silice, dont la forme la plus familière est le sable, était une substance banale encore aux deux tiers du XX^e siècle. Elle est devenue une ressource essentielle depuis qu'elle est utilisée pour fabriquer des verres spéciaux ou les fibres optiques et, surtout, que son principal composant, le silicium (métalloïde semi-conducteur), est employé en électronique. Elle a notamment contribué à révolutionner les techniques de diagnostic médical et les télécommunications. Troisième exemple: les très basses températures existent depuis l'aube de l'humanité. Mais leur caractère de ressource utilisable n'a pris de l'ampleur qu'avec les cryotechniques, ou techniques du froid, lancées au XIX^e siècle par Charles Tellier, permettant de conserver et, donc, de stocker des denrées périssables, comme les fruits et la viande, puis de les transporter, à des coûts de plus en plus faibles.⁵⁴

D'autres exemples pourraient être mentionnés: le titane, élément abondant, intervient depuis une cinquantaine d'années à peine dans les matériaux composites, l'industrie aérospatiale, des prothèses chirurgicales. Le vent est exploité depuis des siècles par les Hollandais pour faire des polders; mais l'exploitation de l'énergie issue du vent, du soleil ou de la Terre (géothermie) vient à peine de commencer.

Un bien n'est donc une "ressource" pour l'homme qu'à partir du moment où l'homme sait le rendre profitable à de meilleures conditions de vie.

"Nature" mythifiée ou "nature" humanisée

En outre, les théories de l'antagonisme population-nature mythifient une nature qui n'a jamais existé. Certes, ce qui est "naturel" se définit comme "ce qui n'a pas été modifié par l'homme" ou ce qui est "propre au monde physique, à l'exception de l'homme et de ses œuvres". Or, contrairement aux croyances souvent répandues ignorant la géographie, il n'y a guère d'environnement "naturel". Le grand géographe Jean Demangeot titre son livre *Les milieux "naturels" du globe*,⁵⁵ les guillemets signifiant qu'il n'existe guère de mi-

⁵⁴ Schooyans, Michel, *Pour comprendre les évolutions démographiques*, Paris, APRD, 2011.

⁵⁵ Paris, Masson, 1984, 1^e édition suivie de nombreuses autres.

lieu “naturel” où l’homme ne soit pas intervenu. En France, le paysage de la Bourgogne, avec ces beaux vignobles s’étalant sur de douces collines, qui nous paraît “naturel”, est le fait d’un considérable travail de défrichage et d’aménagement, portant sur chaque cm², réalisé au moyen âge, sous l’impulsion des moines cisterciens. Les marais breton et poitevin (respectivement au nord et au sud du département de la Vendée), qui nous paraissent si “naturels” lors d’une promenade bucolique en barque, résultent d’un aménagement humain de marais insalubres. De même, l’actuelle forêt de Fontainebleau, moitié moins étendue en 1700 qu’aujourd’hui, résulte de l’action des hommes et notamment de “deux grandes vagues de plantation: la première de 1720 à 1794, avec garnissage de 5 000 hectares en feuillus et la seconde, de 1830 à 1847, avec reboisement de 6 000 hectares en pins”.⁵⁶ “Sa diversité paysagère relève de la combinaison des conditions du milieu et des multiples gestions appliquées depuis l’acquisition par le roi Robert, au début du XIe, de parcelles en “forêt de Brière”. Il en est de même actuellement des arbres classés comme “remarquables” et qui faisaient le bonheur des peintres de Barbizon. En 1853, ces derniers obtinrent 1 000 hectares de réserves biologiques intégrales dans lesquelles l’homme cesse d’intervenir afin de protéger les “vieilles futaies de chênes de Colbert”. C’est le résultat inverse qui s’est produit, avec l’élimination progressive du chêne. En effet, la cessation de toute intervention humaine engendre un accroissement du taux de recouvrement qui augmente l’ombrage des sous-bois et fait périr les jeunes plants de chênes héliophiles. En conséquence, les strates inférieures de la chênaie se sont trouvées envahies par des jeunes plants de hêtres sciaphiles, issus des semences des vieux hêtres restants, se substituant aux essences de chênes qu’on pensait préserver.

La forêt la plus étendue d’Europe occidentale, celle des Landes en Aquitaine, a été entièrement créée par l’homme à partir du XVIIIe siècle.⁵⁷ Dans les années 1980, les plans de chasse de la fameuse forêt polonaise de Bialowieza ont été retrouvés; ils prouvent l’action de l’homme. Située à l’Est de la Pologne à la frontière avec la Biélorussie, cette forêt a une histoire remarquable toujours liée à l’homme. Forêt de frontière entre le royaume de Pologne et le duché de Lituanie au XVe siècle, elle est surtout un territoire de chasse pour les rois de Pologne. Puis son exploitation devient intensive avec l’annexion russe en 1795, les incendies de 1811, et les dégâts occasionnés par le passage des armées

⁵⁶ Hotyat, Micheline, “La forêt de Fontainebleau”, in: Demangeot, Jean, *les milieux “naturels” du globe*, Paris, Armand Colin, 2000, 8^e édition.

⁵⁷ Le boisement des massifs dunaires, situés entre les étangs et la côte, est amorcé sous la direction de Brémontier. Au XIXe siècle, une loi de 1857 organise l’assainissement et le boisement en pins maritimes des landes insalubres de Gascogne sur 10 000 km².

napoléoniennes de 1812, puis avec l'approvisionnement en bois de navire jusqu'au milieu du XXe siècle. L'exploitation se traduit par la mise en place d'un grand parcellaire qui favorise la pratique de la chasse. En 1888, la forêt devient propriété des tsars et son exploitation est interrompue jusqu'à la Première Guerre mondiale, pendant laquelle de nombreuses coupes sont réalisées par les Allemands. Puis les Soviétiques la surexploitent pendant la Deuxième guerre mondiale. Seule la zone centrale est déclarée parc national en 1932, puis reconnue en 1977 comme réserve de la biosphère; elle est aujourd'hui inscrite sur la liste des sites du patrimoine mondial.⁵⁸ Toutes ces pratiques, encore perceptibles au travers des diverses trames qui sillonnent la forêt, prouvent qu'en dépit d'une reconquête décidée par l'homme depuis plus d'un demi-siècle, l'histoire est omniprésente.

En Allemagne, le plaisir que le voyageur éprouve lors d'une croisière sur le Rhin majestueux qui s'écoule dans l'ensemble schisteux rhénan tient aux multiples aménagements des berges et des coteaux effectués et entretenus par l'homme au fil de l'histoire.

Hors d'Europe, l'état et la capacité productrice des deltas de la Cauvery (ou Kaveri) et de Krishna-Godavery sur la côte orientale de l'Inde, dans le golfe du Bengale, tiennent à un travail permanent des hommes. Leur esprit d'entreprise est manifeste, chaque cyclone périodique provoquant des destructions matérielles étant l'occasion d'améliorer les conditions et les choix de production. Toujours en Asie, le charme de ces multiples terrasses qui ponctuent les pentes tient à leur agencement par l'homme. Un des sites les plus visités de la Chine, la Grande muraille, tient non seulement à sa qualité architecturale, mais au fait qu'elle magnifie la forme des montagnes qu'elle parcourt. En Amérique latine, la beauté du delta du Parana, aux portes de Buenos Aires, tient à un agencement et à un entretien constant des hommes.

Ainsi, les milieux "naturels" ne se pérennisent que grâce à une action volontariste de l'homme pour les préserver: aménagements de protection des deltas, de littoraux pour empêcher leur érosion, d'accès à des presqu'îles, reforestation de pentes pour contrecarrer l'érosion ou des avalanches, aménagements pour prévenir des inondations qui dévasteraient des milieux "naturels", etc. Les écosystèmes ne sont pas le fruit d'une nature spontanée, mais des actions de l'homme. Même les réserves biologiques ne peuvent être analysées sans tenir compte de l'action de l'homme antérieurement à la mise en réserve, ou des décisions de l'homme appliquées depuis.

Il n'y a guère de nature à l'écart des actions des hommes, ce qui signifie que la terre est très largement le résultat de l'interaction population-nature.

Il n'y a donc pas *a priori* d'antagonisme population-nature car ces deux termes sont totalement imbriqués. Les conditions de vie des humains dépendent de la manière dont la population aménage et entretient les milieux dans lesquels elle vit. Lorsque des populations agissent mal, par exemple en polluant les milieux, ceux-ci prennent leur revanche en détériorant leurs conditions de vie ou en aggravant les conséquences des catastrophes naturelles. Par exemple, les avalanches sont plus dangereuses là où les terres montagneuses sont délaissées par l'homme. C'est le problème des prairies d'altitude, dû aux plantes herbacées, qui, n'étant plus broutées, se développent sur plus de 70 cm de hauteur; sèches à la fin d'été, elles deviennent fortement glissantes. Lorsque les premières neiges tombent sur cette surface lisse, elles ont tendance à glisser; alors qu'une prairie d'altitude broutée ressemble à une brosse dure qui retient la neige. Cet exemple signifie que plutôt que de protection de l'environnement, il faudrait parler de gestion et d'entretien, ce qui suppose un peuplement pour effectuer ces tâches. Lorsque la densité de population est trop faible pour y satisfaire, l'entretien de l'environnement est souvent insuffisant.⁵⁹ En revanche, des efforts écologiques significatifs ont souvent été conduits dans les espaces les plus denses, comme les territoires urbains, ce qui explique que les nombreuses craintes sur le caractère mortifère des villes, comme celles de John Graunt,⁶⁰ ont été trouvées écartées, notamment grâce à l'urbanisme des réseaux.⁶¹ Autre exemple, la Suisse s'est lancée précocement⁶² dans le ferroutage moins polluant que les camions, en dépit des moqueries européennes d'alors.

Lorsque la densité se desserre, des risques de moindre entretien de l'environnement naissent. Ainsi, aux Pays-Bas, pays dont la densité moyenne de population est la plus élevée d'Europe,⁶³ le recul relatif du monde rural laisse apparaître de tristes polders en friches dont la vue désespérerait les milliers de néerlandais qui ont consacré leur vie, depuis plusieurs siècles, à aménager

⁵⁸ Arnould, Paul, Hotyat, Micheline, Simon, Laurent, *Les forêts d'Europe*, Paris, Nathan, 1997.

⁵⁹ Faus-Pujol, Maria Carmen, "Vieillesse de la population et dégradation de l'environnement", *Population & Avenir*, n° 652, mars-avril 2001.

⁶⁰ Graunt, John, *Observations naturelles et politiques répertoriées dans l'index ci-après et faites sur les bulletins de mortalité*, Londres, 1662, réédition Ined, Paris, 1977.

⁶¹ Dupuy, Gabriel, *L'urbanisme des réseaux*, Armand Colin, Paris, 1992.

⁶² Rappelons en particulier la votation le 20 janvier 1994 de "l'initiative des Alpes" organisant le transfert du trafic routier de transit sur le rail. Le ministre français de l'équipement, du transport et du tourisme regrettait alors que "la Suisse s'isole en se mettant à l'écart des grands courants économiques" et critiquait "cette solution simpliste et inadaptée"!

⁶³ Hormis certains micro-Etats.

ces terres. De façon générale, des polders mal entretenus ou surveillés ne peuvent qu'augmenter les effets nocifs d'éventuels risques naturels.

En fait, l'homme subit les contraintes élémentaires, parfois brutales, de la nature (excès de froid, excès de sécheresse, inondations, tremblements de terre, typhons...). Durant une longue période de l'histoire de l'homme, il a surtout subi ces difficultés et tenté de s'y adapter, avec pour seul objectif de survivre, et donc d'assurer la pérennité de l'espèce. Dans d'autres cas, la pression démographique a fécondé, face à une nature souvent peu favorable *a priori*, des civilisations alliant intelligence créatrice et travail: citons comme exemple l'aménagement du delta du Nil sous le règne des pharaons, la réalisation de rizières dans le delta du Mékong, l'aménagement de territoires pour prévenir les conséquences des risques naturels (barrages, systèmes d'écoulement des eaux, de surveillance des feux de forêt), ou pour les rendre fertiles, l'invention de procédés associant la qualité des productions et l'entretien de la nature (agriculture biologique)...

Lorsque les populations agissent de façon respectueuse en termes de développement durable, elles établissent une concordance population-nature. Condamner le genre humain au nom de la nature, comme l'avait fait Jean-Jacques Rousseau, est donc aberrant. Voltaire lui avait d'ailleurs répondu dans une lettre du 30 août 1755: "J'ai reçu, Monsieur, votre nouveau livre contre le genre humain. Il prend envie de marcher à quatre pattes quand on lit votre ouvrage. Cependant, comme il y a plus de soixante ans que j'en ai perdu l'habitude, je sens malheureusement qu'il m'est impossible de la reprendre. Et je laisse cette allure naturelle à ceux qui en sont plus dignes que vous et moi".

FOOD DEMAND, NATURAL RESOURCES, AND NATURE

■ JOACHIM VON BRAUN¹

Abstract

Solutions to the dilemma of satisfying the food demands of the current 7 billion people, including the hunger and unfulfilled food needs of about 2 billion poor people, while at the same time overcoming the loss of nature and adverse impacts on the environment, requires new actions. Transformative changes supported by science on the supply and demand side of the food equation, are needed. The selective emphasis in this paper is on the demand side. Excessive food consumption contributes to the destruction of nature and over-exploitation of natural resources, especially waters, soils and atmosphere. Three complementary approaches are proposed here to address this dilemma: (1) incentives for consumption change, controls, and regulations, (2) information, labeling, and nudging approaches to stimulate consumers' behavioral change, and (3) "biologizing" the economy, building economies around bio-based product- and process-innovations and reducing the dependency on fossil fuels. An appropriate code of ethics suggests that in a world of high and growing income inequality, more sharing is called for, and different sustainability standards should apply to rich and poor people: the rich must accept harder sustainability standards than the poor, be it through voluntary adjustments or regulations. A framework is presented that defines these broad directions more specifically.

1. Introduction: on food demand, nature, and the environment

The global population will be approaching 9 billion people in the next generation (UN 2007). This casts a long shadow over nature and environment, especially because the associated increases in food demands would further strain nature and natural resources (Godfray *et al.* 2010, Wheeler and von Braun 2013, IPCC 2007). Food demands differ widely by income, region, and culture. Preferences vary around the world: poor consumers demand more calories and long for more diverse diets. Middle class and rich

¹ Professor for Economic and Technological Change, and Director of Center for Development Research (ZEF), University of Bonn, Germany [jvonbraun@uni-bonn.de].

consumers demand “consumer friendly” (prepared) yet “wholesome” and “natural” foods.

The food system and the eco-systems are connected through forward and backward linkages along the food chains, fraught with various externalities. Backward linkages to the use of natural resources for food production are critical; externalities of processing and transportation play a significant role; disposal of wastes and by-products are important forward linkages and their related material flows shape adverse externalities with concentrations in peri-urban areas. Moreover, environmental impacts of human food demand are only part of the larger human impacts on “nature” as a whole.

“Nature” and “Environment” are not synonymous (at least in English, German, and Hindi). Nature (Natur, Prakrati) is understood as “the phenomena of the physical world collectively, including plants, animals, the landscape, and other features and products of the earth, *as opposed to humans or human creations*”, whereas Environment (Umwelt, Vatavaran) is “the natural world, as a whole or in a particular geographical area, especially *as affected by human activity*” (Oxford Dictionary 2014;² italics added). Nature is intrinsic, whereas environment provides (public) goods. People’s relationships with nature are shaped, in addition to resource use, by other interactions, including sensory, identity-related aspects and knowledge acquisition (Berghoefter *et al.* 2010). While laws of nature have considerable stability (i.e. genetics), changes in the shapes of nature have always occurred in the history of Earth, but until relatively recently happened independently of humans. Only since about two centuries human actions have become significant forces of influence on the shapes of the entire planetary nature, identified by Paul Crutzen (2002) as the age of “Anthropocene”.

Food demand impacts on nature, but there is also demand for nature. In fact, geographically there are many natures. In the more crowded and wealthy world, even an end of natures may occur, while environmental changes also create new natures. In this changing context and with rising incomes, the “natural” is in high demand, and that is especially so when it comes to food. The environmental change induced by humans’ food demand may be more or less sustainable, depending on modes of production technology, land and soil use, water use, biodiversity protection and conservation. While an environmentally sustainable food system may be more in harmony with nature, it still replaces “nature” as it used to be.

² <http://www.oxforddictionaries.com/definition/english/environment> (accessed on 5.4.2014).

While there is a competition between human food demand and nature, a general debate over “food first” versus “nature first” is not helpful without considering specifics of local circumstances and distributional effects, i.e. poverty. At national and international levels, there is neither an ethical nor an ecological foundation to put a nature protection before poor people’s survival. At a local level, e.g. in the context of preserving parks and nature reserves, people – nature conflicts are real, and need to be resolved through inclusion of local communities and their fair compensation for sustainable livelihoods.

2. Food Demand: Status, Trends, and Outlooks

This section takes a brief look at the food demand³ and highlights related environmental consequences. Assessing the food demand from an environmental perspective brings its supply side consequences more into focus. All relevant policies need to take note of the main drivers on the demand, supply and market sides (Figure 1).

Food demand is linked with environmental impacts in two interrelated ways: first, through the type of food products demanded, such as staples, proteins, animal products, i.e. the link here is via production levels and patterns, and, second, through food consumption preferences, which partly associate with storability, processing, waste, etc. (Foster *et al.* 2007).

Demand-side	=	Supply-side
Income growth		Investment in agric. technology
Population growth		Investment in agric. infrastructure
High and variable energy prices		Land and water availability
Biofuel subsidies and mandates		Costs of inputs and transport
Income inequality		Weather variability and climate change
Changing consumer preferences		
		Trade and markets
		Exchange rates
		Stock depletion
		Trade controls and protectionism
		Speculation and expectations

Figure 1. Food demand drivers in the context of the food equation. Source: Devised by author, adapted from von Braun (2012).

³ Demand, consumption and needs are different concepts. When reviewing food *demand*, i.e. the market purchases or otherwise acquired (say, by home production or by transfers) foods, we ought to distinguish this from food *consumption* (final personal use), and from food *needs* (dietary needs, which may be less or more of a diverse set of nutrients, not just desired or demanded, but needed according to requirements).

Demand

We need to keep in mind that the world is confronted with a diverse set of consumption and nutrition problems, especially of the poor (table 1). There is no one-size fits all to address this set of diverse issues ranging from hunger to obesity.

Undoubtedly, human consumption is large in proportion to biological material growth and profoundly affects the Earth's ecosystems. An aggregate measure of humanity's cumulative impact is the consumed share of the planet's net primary production (NPP). NPP is the net amount of solar energy converted to plant organic matter through photosynthesis (measured in units of elemental carbon). It represents the primary source for the world's ecosystems. Human appropriation of NPP is estimated at about 32 percent, with large regional variances (Africa 12 percent, Europe 72 percent; sources in Imhoff *et al.* 2004). This large share claimed by humans leaves less for other species, alters the composition of the atmosphere, reduces levels of biodiversity and constrains ecosystem services. NPP is implicitly traded in the form of food, feed, fibers, wood, and other bio-based materials, such as bioenergy. Increasing populations have increasing demands for NPP. Already in many regions of the world, high population densities are leading to significant losses of NPP and land degradation (Nkonya *et al.* 2011). Quite often, these areas with NPP losses are also those with higher levels of poverty, making the goal of providing for the food and nutrition needs of the poor more challenging (Nkonya *et al.* 2011).

Problems	Numbers of people	Consequences
Hunger (Under-Nutrition, calories)	ca. 0.8 Billion (crude estimate)	acute deficiency, political conflicts
Hidden Hunger (deficiencies in micronutrients, vitamins, iron etc.)	ca. 2 Billion (crude estimate)	diseases, reduced productivity
Children's under-nutrition (the first 1000 days)	ca. 165 Mill.	stunting, reduced physical, cognitive development. 3.1 Mio. death p.a.
Obesity and resulting chronic diseases	ca. 1 Billion	high costs of public health

Table 1. Nutrition Problems at Global Scale.

Trends

In the current decade, demand for most high-value and processed food items such as butter, milk, poultry, oilseeds, sugar are projected to grow between 20 and 25 percent (between 2010 and 2021); cereals are projected to grow between 15 and 20 percent. Growth will continue until mid-century. Not only diet quantities, but also quality is changing (Beatty *et al.* 2014, Unnevehr *et al.* 2010). Income, health and environmental impacts of consumption are particularly protracted in relation to livestock products (Steinfeld *et al.* 2006).

Expanding livestock production in developing countries is an important way to help poor people increase their incomes and improve their food security and nutrition. Micronutrient status among low-income people is strongly dependent on the consumption of animal products. However, excessive consumption of animal products and fats is also a part of growing obesity problems. As incomes rise, people tend to consume more meat and other animal products. To illustrate, North Americans and Europeans consume more than 83 kilograms of meat per person yearly, compared with 58 kilograms in Latin America, 28 kilograms in East Asia, and 11 kilograms in Africa. In the future all growth in demand for meat is expected to come from the developing countries. The projections by Msangi and Rosegrant (2011) suggest an increase to 77 kilograms in Latin America, 52 kilograms in Asia, and 24 kilograms in Africa by 2050.

Demand trends are affecting natural resources partly in opposite ways: first, some elements of world food demand are moving towards more efficient production in terms of land and water use, i.e. higher yielding grains (rice, maize) and more efficiently produced animal products; for example, poultry instead of beef: poultry production has expanded by a factor of 4 in the past five decades, while the more resource demanding global cattle herd has been stagnating recently. These shifts are caused by changes in relative prices. Secondly, however, diversification of world food demand away from grains and other staples towards higher-value products such as vegetables, fruits, meat, dairy, and fish, make the consumer baskets more resource-intensive, because these products require more land and water (feed for animals, irrigation, etc.; Hourya *et al.* 2014). The resource-saving structural demand transformation is by far out-weighed by this diversification and its pressures on the resources. Rising consumer incomes and population growth are among the long-run drivers that have led to the increase in food prices. Biofuel demand came on top of this and is estimated to have triggered a 30 percent increase of weighted average international grain prices from 2000 to 2007 (Rosegrant 2008).

Waste and Losses

There is significant waste and losses affecting the availability of food. Consumers are part of the problem and need to be part of the solution. Waste mainly occurs in rich countries at the consumer and retail ends of the value chain; losses occur mainly in low income and emerging economies at the beginning of the value chain, i.e. in farmers' fields, in handling, and storage. The factors encouraging food waste range from subsidies that promote inefficient food production to ill-designed regulations of food labeling, to discarding of valuable foods by wealthy consumers. Both, food waste and food losses are not trivial quantities (Kummu *et al.* 2012). The global volume of food losses and wastage is estimated by FAO (2013) to be 1.6 giga tonnes of "primary product equivalents", while the total wastage for the edible parts of food is 1.3 giga tonnes (total agricultural production for food and non-food uses is about 6 giga tonnes). The carbon footprint of food produced and not eaten is estimated to be about 3.3 giga tonnes of CO₂ equivalent, making food losses and waste a top emitter after USA and China (FAO 2013). Among the components of waste and losses, the top-most are wastage of cereals (in Asia), meat (even though volumes are comparatively low, but generating a substantial impact on the environment), and vegetables and fruit (a source of water loss in Asia, Latin America, and Europe; FAO 2013). It must be pointed out however, that calculation of wastes and losses in terms of tons is neither a sound ecological nor a useful economic concept, because very different resource losses and costs are hidden behind the various lost products. More comprehensive economic-ecological concepts of loss analyses are needed to design incentives and regulations for prevention of losses.

Supply

The responses to demand on the supply side are central for environmental consequences as already pointed out above. Today, technological change contributes about 70 percent to the overall world agricultural productivity growth (Fuglie 2010). Growth in output is no longer driven by increasing use of land, water and other inputs. The share of technological change in the output growth was less than 30 percent at the time of the Green Revolution in Asia in the 1960s and 1970s, which had shown that rapid increases in agricultural production are possible when technology is combined with much higher resource use and inputs (water, fertilizers). Nowadays, a more science- and innovation-based approach to sustainable agricultural productivity is called for. However, investments in agricultural science are currently not at a sufficiently high level to guarantee the increase

in agricultural productivity needed under the emerging scenario of lower resource availabilities. Global land use for agriculture has been more or less constant for about two decades. At the same time land degradation is progressing (Nkonya *et al.* 2011). Much of the environmental consequences of demand are through land use change. To halt global biodiversity loss, we need to halt cropland expansion, argues UNEP (2014). New forms of agricultural land use that facilitate biodiversity conservation should also be considered. According to UNEP scenarios, the demand driven expansion of global cropland area would overshoot the “safe operating space” for land use (UNEP 2014).

There are feedbacks between production, environment, and future consumption opportunities. A critical one in the long run may be the narrowing of diversity in crop species – partly driven by demand, partly by technology choices (Tilman *et al.* 2011). Over the past 50 years national food supplies worldwide became more similar in composition, correlated particularly with an increased supply of a number of globally important cereal and oil crops, and a decline of other cereal, oil, and starchy root species. Between 1961 and 2009, country-to-country variation of commodity composition (i.e., homogenization) decreased by about 69% (Tilman *et al.* 2011). As these trends into homogeneity may establish increased risks for food security in the future, e.g. by reducing resilience of crops and diminishing resources for plant breeding, they need to be addressed by *in situ* and *ex-situ* conservation of plant genetic resources and more open sharing of genetic resources across borders.

Prices

Addressing the dilemma of competition between food demand and nature simply by making food more expensive is not a solution, because of the critical livelihood role of food for nutrition and health of the poor. Land and water scarcity and constraints of other environmental resources can be expected to make production more expensive in the future and may lead to a food equation at higher price levels. Scenario outlooks suggest a 40 to over a 100 percent price increases for main staple food commodities by mid century (Msangi, Rosegrant *et al.* 2012). Low-income consumers are sensitive to high and variable food prices since a large proportion of their income is spent on food. Poor people’s responsiveness is also linked to liquidity and credit constraints as well as limited resilience to cope with shocks. Consumption response to food prices tends to be robust and predictable, with marked differences between rich and poor people. Estimates of consumer price responses to price changes in 114 countries show that

food demand in low-income countries is twice as responsive compared to middle- and high-income countries with price elasticity of about -0.6 for the former and about -0.3 for the latter (Seale, Regmi, and Bernstein 2003). As the poor spend up to 70 percent of their income on basic food commodities, increasing food prices can reduce real incomes dramatically, at least for net buyers of food items. Most of the poor are net buyers. The challenge of feeding the world's growing population has greatly increased. Since the time of notoriously high food prices in the 1870s, world population has increased more than five times (von Braun 2011).

Food shortages are manifested through increased volatility of prices (von Braun *et al.* 2014). Volatility of food prices has adverse effects on the prevalence of child nutrition. The food price spikes in 2007–08 and 2011 were partly caused by rising consumer demand due to population and income growth, coupled with factors such as high and variable energy prices, rise in use of grain for biofuels, slow agricultural supply response, and malfunctioning financial system and commodities markets (Tadesse *et al.* 2014). These causes can be broadly separated into slow onset forces, such as population growth, consumption change, and resource scarcity, on the one hand, and fast onset forces, such as acute production shocks or trade disruptions, on the other hand. The predictable slow onset forces reach tipping points, when they interact with fast onset forces, and translate into unpredictable market effects and food security crises. Policymakers are torn between high food prices which encourage agricultural production, and low food prices which benefit poor buyers of food. However, when food prices change implicit re-valuations of nature happens, because the food price change is passed on as an increased demand for land, water and other inputs, leading to losses in nature and putting more pressure on the environment.

In sum, the food demand challenges for environmental resources and nature need to be assessed in a context of supply-side and demand-side forces. The simultaneity of these forces, long-term lag structures, and the price effects of any supply and demand side actions for the poor are of considerable importance when attempting to internalize the externalities of food demand for the natural resources and for nature (von Braun, Gatzweiler 2014).

3. Frameworks for Actions and their opportunities and constraints

Reconciling consumption of food and nutritional needs with sustainable resource use and nature is not just a matter of making individual products and processes sustainable. A broader framework is needed and would integrate final demand for food (and other goods) with the related derived demand for environmental resources, and would embrace implications for

nature, i.e. integration between socio-economic and bio-physical framing. A whole set of different disciplines such as psychology, neuroscience, economics, politics, sociology, and anthropology need to be part of conceptualizing consumption, empirically test theoretical predictions, and use these to inform policy-makers across the private, and public sectors on how to make consumption more sustainable (Ulph and Southerton 2014). Drawing on diverse disciplines, three complementary approaches are proposed here to facilitate reconciliation of food demand with sustainable resources use and nature: (1) incentives for consumption change, controls, and regulations, (2) information, labeling, and nudging approaches to stimulate consumers' behavioral change, and (3) "biologizing" the economy, building economies around bio-based product and process innovations and reducing dependency on fossil fuels.

1) Incentives and regulations. The example of animal product demand

The impacts of high and increasing consumption of animal products on environmental resources use (land, water, and atmosphere), and on loss of nature (biodiversity, forests, landscape) are widespread. A call for cutting excessive meat consumption is justified, but its translation into action is difficult. Foley *et al.* (2011) compare basic food production (calories available if all crops were consumed by humans) and delivered food production (calories available based on today's allocation of crops to food, animal feed, and other products) and estimate the potential to increase food supplies by shifting 16 major crops to 100% human food. This, they state, could add over a billion tons to global food production (a 28% increase). They point out that such wholesale conversions of the human diet are not realistic goals, but that even incremental steps could be beneficial. Such calculations of potential savings of food through consumption change are useful to identify orders of magnitude, but more realistic estimates of the potential role of consumption change for sustainability must consider human behavior and market forces.

More comprehensive model-based analyses of the scope of consumption change for sustainable resource use demonstrate that any implementation of related policies must consider indirect effects through markets. Global substitution among some consumers who might cut their consumption versus others who might not is high, because of equilibrium price effects. For instance reduced meat consumption by rich segments of global society (i.e. in a scenario where in high-income countries, and Brazil and China meat consumption is cut to 50 percent below baseline levels by 2030) would reduce world meat prices by about 33 to 59 percent (depending on type of meat) but boost meat consumption in low income developing countries (e.g. in Africa and

some Asian countries) by about 50 percent (Rosegrant and Msangi 2011). Due to the overall cut in global meat consumption the pressure on environmental resources and nature would be reduced, but the reduction is only a small fraction of the reduced meat consumption in the high-income countries, together with China and Brazil.

While expectations of lower meat consumption might have a less than expected impact on the environment in the short term, this does not mean that steps in the direction of a more environmentally sustainable consumption should not be aggressively pursued. Ultimately, they are essential. There is, however, also evidence about the limitations of financial reward strategies to change nutrition behavior (Spahn *et al.* 2010).

2) Informing and nudging consumers. The example of footprints and labeling

Information and the capacity to process and respond to it are central for forming consumption behavior. Food-related behavior is formed early in life and adjusts slowly. Still, recent changes in consumer behavior are due in part to better health and diet information dissemination through educational programs, nutrition food labels, and the media. The knowledge about externalities of one's own consumption is rapidly expanding, too, at least among the wealthy and IT-connected populations. While consumers may also choose to be imperfectly informed if the price of the information is high relative to the perceived marginal benefit, the "excuse" of not having known about negative externalities of one's consumption patterns is diminishing.

Environmental footprint (EFP) analyses are mainly biophysical concepts. EEP analyses have evolved by product and by resource, such as CO₂ emissions or fresh water use of a certain product (Chenoweth *et al.* 2013; Tukker and Jansen 2006). Assessments are done over whole product life cycles. Such life cycle analyses (LCA) trace the physical flows of produce and by-products from used resources to production and consumption, including waste and reuse opportunities and post-consumption, relating consumption to the resource use and externalities. LCA is a useful approach for identifying gross environmental problems in a value chain and can help recognize points of entry for analyses of externalities. From a socio-economic perspective, LCA is not a satisfactory valuation and choices are not connected to any economic concept, consumer behavior remains in the dark, and distributional effects are not traced. Relevant information for consumers is difficult to distil from LCA, given the hugely diverse and fast changing consumer baskets and off-home food consumption components. Electronic self-monitoring of food consumption (with apps, etc.) is rapidly evolving, but so far mainly focused on personal health attributes, not environmental impacts. However, that can

change, and might actually assist in overcoming the so far mostly ineffective labeling attempts of environmental effects of consumption.

Alternatively to bottom up calculations of footprints, the top-down approach uses multi-country input-output tables to trace, for instance, water footprints across products, sectors and economies through product transformations and trade and thereby virtual water trade. It uses data on sectoral water use (within countries), inter-sectoral monetary transactions and trade between countries or regions (Munksgaard *et al.* 2005). These analyses are of huge interest for environmental policies. Multi-country interlinked input-output models can approximate a nation's direct and indirect water footprint. Lenzen *et al.* (2012) added a critical dimension to this type of economy-wide footprint analyses in the case of water by distinguishing the source of water from scarce and abundant water environments, and found that USA, Japan, Germany, France, UK, and Italy are the top five importers of water from water-scarce countries through their processing industries and final consumption.

When aiming for sustainable consumption, not only private consumption should be considered, but also government consumption through public procurement. National and local government procurement is a very large public expenditure item in rich economies. Rarely are environmental implications of the level and structure of this demand taken into account. It might actually send a strong signal to private consumption if government procurement would consider environmental effects explicitly in procurement policies and if that were to enter the political discourse.

3) *Biologizing the economy: the Bioeconomy Framework*

Single product and single resource environmental footprint analyses are neither sufficient, nor can they be embedded into a theoretically founded socio-economic framework of peoples' wellbeing such as developed by Dasgupta (2001). Moreover, all actors – consumers, retailers, producers, processors, and regulators – need to be captured in integrated frameworks that trace and optimize the nexus between demand and natural resource uses. Ideally, one would like to have a comprehensive environmental footprint assessment of all consumer items, composed of all relevant environmental public goods (atmosphere, water, soils, biodiversity) and powerfully communicate this information to consumers with the intent to facilitate adjustment to more sustainable consumption, be it through self-restraint or “nudging”, or incentives, or regulations. There are actually tendencies to move to such frameworks. In recent years numerous countries – mostly high income countries and some emerging economies – have designed and adopted bioeconomy strategies.⁴ Bioeconomy

understood as “biologisation” of the economy is a societal and economic strategy for sustainable consumption and production. It should not be misunderstood as “economizing nature” but to re-integrate nature into the economy. It is defined as the knowledge-based production and use of biological resources to provide products, processes and services in all economic sectors within the frame of a sustainable economic system (Bioeconomy Council 2013). Bioeconomy is driven by changed factor price structures and related price expectations, technological innovations, and changed consumer preferences.⁵ Bioeconomy draws not only on biomass as a basic resource, but includes innovation in biomass production; refinement in industrial biotechnology in the chemical industries is a critical part of bioeconomy, as is the utilization of carbon etc. generated from CO₂ or other sources as innovative raw materials. Bioeconomy entails an interlinked set of value chains forming the bioeconomy value web. This cuts across agriculture, food, forestry, fisheries, large parts of chemical and pharmaceutical industries, fiber and textiles, bio-based construction materials, and energy sector components. It also entails comprehensive re-carbonization of the biosphere (Lal *et al.* 2012).

Analytical frameworks of bioeconomy draw on systems approaches, in which drivers of the bioeconomy would be related to change in system components. Competition among goals and complementarities of instruments should be explicitly modeled. The usual limitations of systems modeling apply, for instance, difficulties of systems boundary definition, and dynamics of innovation and technological change. Bioeconomy must ultimately be understood in a context of larger changes of societal, technological, and economic transformations toward sustainable development strategies. The essence of such transformational strategies are not only technological (new science) and behavioral (adjusted consumption), but the central issue may very well be institutional, i.e. providing the frameworks and long-run incentives for industry and consumers to transition to sustainable economic systems, of which bioeconomy is a significant component.

Ethical-economic framing of consumption

Exploring food demand in the context of the above food equation and positioning demand in a bioeconomy context is helpful to identify synergies

⁴ Australia, Brazil, Denmark, Germany, EU Commission, Finland, Ireland, Canada, Malaysia, Netherlands, Russia, Sweden, South Africa, UK, USA.

⁵ *New Perspectives on the Knowledge-Based Bio-Economy*, Conference Report, European Commission, Brussels 2005.

and externalities and to identify strategic directions. But in order to guide food demand toward these desired directions, i.e. a) sharing the means to access food more with the food deficient poor, b) do no harm and respect for nature and c) environmental sustainability, some criteria are needed. This brings us to ethical considerations related to economics of food consumption and production (von Braun and Mengistu 2007). A framework for an equity-oriented attempt to reconcile valuation of choices of actions between food consumption, nature conservation, and use of natural resources shall be discussed. Other important ethical considerations, for instance consumption related to lack of animal welfare shall only be mentioned here.

Many societies have ethical foundations and principles related to food consumption, but they have hardly been transmitted into the study of food consumption economics. The lack of ethical perspective in food consumption results partly from the neglect of ethics in mainstream economic theory.⁶ The medical field has some similar ethical issues, comparable to those in the food and nutrition system, due to information asymmetries between suppliers and consumers (physicians and patients). But, unlike the food sector, the medical field has enjoyed a dynamic tradition of ethical dialogue since the days of Hippocrates. The long tradition of ethical discourse has enabled the creation of institutional mechanisms to mitigate the associated externalities of change and technological advancement (Stiglitz 2000, Arrow 1963).

Evaluating whether a deed, such as a certain consumption behavior, is ethical is not always a straightforward task, and there is a considerable disagreement on how exactly one should define ethical behavior.⁷ The ethical

⁶ Although the economics profession originates from both ethics and engineering, it has evolved concentrating heavily on the engineering approach (Sen 1987). Further, economic theory for long times largely ignored the environmental and social limitations that humans face (Barham 2002). “To understand the moral relevance of positive economics requires an understanding of the moral principles that determine this relevance” (Hausman and McPherson 1993). It is important for the economist to make his/her underlying value judgments (or “point of view”) apparent and clear in order to make them subject of discussion. As stated by Weber, “in the method of investigation, the guiding ‘point of view’ is of great importance for the construction of the conceptual scheme which will be used in the investigation” (Weber 1897). While the fundamental theorems of welfare economics contain a “do no harm” principle, they also distance welfare economics from ethics.

⁷ There are at least two opposing schools of thought. On one side, ‘Consequentialism’, to which the utilitarian school belongs, argues that a deed’s ethical value should be defined based on the consequences it brings with the ultimate objective being the maximization of welfare for all stakeholders. On the other side, (neo-) Kantian philosophers argue that an action is ethical if the individual feels he/she has the right or duty to execute such an

underpinning of the structure in Table 2 explicitly considers the need for sharing and implicitly considers past and current wealth related weights of environmental footprints. Reflections on the proposed structure in Table 2 would start from the premise, let long-term human wellbeing be determined by man-made capital (C_m), environmental resources (environmental capital: C_n), and the existence of nature (N, defined as in introduction above); whose and what food consumption should be brought in line with what sustainability criteria? Should all – the rich and the poor – adjust consumption by equal shares or if not, in what ways? These are questions that require ethical considerations and value judgments.

Whose and what food consumption	Group 1: Excessive food consumption by wealthy	Group 2: Balanced consumption by the food secure	Group 3: The under-consuming hungry and food deficient
Which sustainability paradigm ⁸	“very strong” N unchanged and $C_n = \text{constant}$	“strong” $C_n = \text{constant}$	“weak” $C_n + C_m = \text{constant}$
Substitutability between C_n & C_m	No	very limited	not limited
Discount rate	$DR \leq 0$	$DR \approx 0$	$0 < DR < \text{interest rate}$
What action to consider (examples)	limit human impact of related consumption activities (regulations re N; trace environmental footprints)	Efficient use and conservation of natural resources (apply environmental standards)	Efficient use of natural resources; incentives for conservation (taxes, benefit from payments for their eco-system services)

Table 2. What sustainability for what and whose food consumption? Some value judgments applying variant conditions of sustainability. Note: Let long-term human wellbeing assume to be determined by man-made capital (C_m), environmental resources (environmental capital: C_n), and the existence of nature (N).

action. This view derives from Kant’s “Categorical Imperative”, which defines an ethical action “as objectively necessary in itself, without reference to another end” (Kant 1785). In practice, this school of thought emphasizes obligation, duty and rules.

⁸ Adapting Pearce *et al.* (1996) concept of “very strong”, “strong”, “weak” sustainability.

The framing as presented in Table 2 is not without caveats: ethical issues may arise from externalities of behavior and from ethics itself. For instance, ethically founded consumption will have spillover effects to production and trade that may adversely impact others through price and income effects, which might have negative repercussions on poor producers. Basically, the framework suggests that those who are positioned in excessive consumption (Group 1) should be faced by strong sustainability criteria (be it through regulations or self-restraint), i.e. their consumption should not impact on nature, and substitutability between natural and man-made capital would not be accepted for / by them, neither would be discounting future value streams (discount rate at zero or below). These sustainability restrictions might come at a cost of their further economic growth. Group 2 would face less harsh environmental criteria for their consumption impact on nature and a less strong sustainability concept ($C_n = \text{constant}$). For the undernourished poor (Group 3), the least strict sustainability paradigm would apply, i.e. substitutability between natural capital and man-made capital. And actions would differ accordingly (see examples in bottom row (Table 2)).

4. Discussion of Implications

Policy directions

If the environmental externality problems of food demand were just a problem of wealthy people, solutions with taxation and regulation would in principle be rather easy. But any solution to the problem poses complex consequences because there are serious equity and poverty dimensions. The bundle of instruments for the three distinct but interrelated goals – healthy food consumption, sustainable use of natural resources, conservation of nature – needs to be efficiently applied in a well-targeted goals/ instruments framework. Assuming that there is one tool to achieve all three goals, say by cutting animal product consumption, will not work. Key areas for policy attention are:

1. All consumers need to know more about the implications of their consumption behavior for themselves, for others living far away from them, and for future generations. Creativity in labeling and consumer information is called for. More experimenting should be explored. Targeted taxes and regulations should not be excluded. Incentives and regulations need to go together with new efforts by civil society and cultural leaders, including churches, to change consumer attitudes to factor in consumption externalities, and cut waste.
2. Sharing the burden of adjustment in consumption to reduce negative consumption externalities for natural resources should be quite unequal.

Policies need to take account of the large wealth inequalities and of absolute poverty when attempting to correct the negative externalities of food consumption. “Food first” for the poor implies that much stricter sustainability criteria should apply to the wealthy than to the poor. This does not just relate to richer versus poorer nations but to richer versus poorer households within nations.

3. Much of the environmental impacts of food consumption need to be addressed on the production side. Producing more with less, i.e. sustainable intensification, is needed in agriculture. Prevention of soil degradation, sustainable water use, and zero or negative greenhouse gas emissions from agriculture are key targets for that. Technological innovations along the value chains, and new strategic orientation in a bioeconomy framework should be considered.

Research directions

Priority in food related research should remain the creation of new knowledge that can assist to end hunger and malnutrition problems. Consumers and the environmental externalities of their behavior have been under-researched. Key themes for public research in relation to that are:

Uncovering the determinants of consumer choices with respect to environment and health; assessing the effectiveness of positive ‘nudging approaches’; studying the impact of economic incentive systems for environmentally sustainable consumer behavior (e.g. incentives vs. taxes/fees).

Evaluating ‘natural experiments’ and implementing field experiments created to develop environmentally sustainable consumer behavior and related institutional regimes.

The scope and scale of biologizing the economy (bioeconomy) to facilitate reduction of the large environmental externalities of food consumption (and other consumption, such as related to housing and mobility) connected to fossil fuels, land, and water, and thereby assist a transition toward reconciliation of sustainability of humanity with sustainability of nature.

References

- Arrow, K.J. (1963). Uncertainty and the welfare economics of medical care. *The American Economic Review* 53(5): 941-973.
- Barham, E. 2002. Towards a theory of values-based labeling. *Agriculture and Human Values* 19: 349-360.
- Beatty, T.K., Lin, B.H., & Smith, T.A. (2014). Is Diet Quality Improving? Distributional Changes in the United States, 1989-2008. *American Journal of Agricultural Economics*, 96(3), 769-789.
- Berghoefer, U., R. Rozzi, and K. Jax. 2010. Many eyes on nature: diverse perspectives in the Cape Horn Biosphere Reserve

- and their relevance for conservation. *Ecology and Society* 15(1): 18. [online] URL: <http://www.ecologyandsociety.org/vol15/iss1/art18/>
- Bioeconomy Council of the Federal German Government (2013). Key Issues Paper of the Bioeconomy Council. Berlin.
- Chenoweth J., M. Hadjikakou, and C. Zoumides. 2013. Quantifying the human impact on water resources: a critical review of the water footprint concept. *Hydrol. Earth Syst. Sci. Discuss.*, 10, 9389–9433, 2013 www.hydrol-earth-syst-sci-discuss.net/10/9389/2013/
- Crutzen, P.J. (2002). Geology of Mankind. *Nature*, 415(6867), 23–23.
- Dasgupta, P. (2001), *Human Well-Being and the Natural Environment*. Oxford: Oxford University Press.
- FAO (2013). *Food Wastage Footprint – Impacts on Natural Resources*. Rome 2013.
- Foley, J.A., Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., ... & Zaks, D.P. (2011). Solutions for a Cultivated Planet. *Nature*, 478(7369), 337–342.
- FAO (2013) *The State of Food Insecurity in the World*. Rome.
- Foster, C., Green, K., Bleda, M., Dewick, P., Evans, B., Flynn, A., Mylan, J. (2007). *Environmental impacts of food production and consumption*. London: Department for Environment, Food and Rural Affairs.
- Fuglie, K.O. (2010) Total Factor Productivity in the Global Agricultural Economy: Evidence from FAO Data. Chapter 4, in: *The Shifting Patterns of Agricultural Production and Productivity Worldwide*. The Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames, Iowa. pp. 63–95.
- Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., ... & Toulmin, C. (2010). Food security: the Challenge of Feeding 9 Billion People. *Science*, 327 (5967), 812–818.
- Hausman, D.M., and M.S. McPherson. 1993. Taking ethics seriously: economics and contemporary moral philosophy. *Journal of Economic Literature* 31(2): 671–731.
- Imhoff, M.L., Bounoua, L., Ricketts, T., Loucks, C., Harriss, R., & Lawrence, W.T. (2004). Global patterns in human consumption of net primary production. *Nature*, 429(6994), 870–873.
- IPCC. Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch5s5-es.html
- Kant, I. 1785. *Fundamental Principles of the Metaphysic of Morals*. Translated by Thomas Kingsmill Abbott <http://etext.library.adeelaide.edu.au/k/kant/immanuel/k16prm/>
- Khourya Colin K., Anne D. Bjorkman, Hannes Dempewolf, Julian Ramirez-Villegasa, Luigi Guarino, Andy Jarvis, Loren H. Rieseberg, and Paul C. Struik (2014). Increasing homogeneity in global food supplies and the implications for food security. *Proceedings of the National Academy of Sciences*, 111(11), 4001–4006.
- Kummu, M., H. de Moel, M. Porkka, S. Siebert, O. Varis, P.J. Ward. (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertilizer use. *Science of the Total Environment* 438 (2012) 477–489.
- Lal, R., Lorenz, K., Hüttl, R.F., Schneider, B.U., & von Braun, J. (Eds.). (2012). *Re-carbonization of the Biosphere: Ecosystems and the Global Carbon Cycle*. Springer.
- Lenzen, M., Bhaduri, A., Moran, D., Kanemoto, K., & Bekchanov, M. (2012). The role of scarcity in global virtual water flows (No. 169). *ZEF Discussion Papers on Development Policy*.
- Msangi, S. & M. Rosegrant (2011). Feeding the Future's Changing Diets: Implications for Agriculture Markets, Nutrition, and Policy. 2020 Conference: *Leveraging Agriculture for Improving Nutrition and Health*. New Delhi, India

- Nkonya, E., N. Gerber, P. Baumgartner, J. von Braun, A. de Pinto, V. Graw, E. Kato, J. Kloos, T. Walter. (2011). *The Economics of Land Degradation. Towards an Integrated Global Assessment*. Development Economics and Policy, Band 66. Peter Lang.
- Pearce, D., K. Hamilton and G. Atkinson. (1996) Measuring sustainable development: progress on indicators. *Environment and Development Economics*. Vol. 1. February, pp. 85–101.
- Rosegrant, M. (2008). Biofuels and grain prices Impacts and policy responses. Testimony for the U.S. Senate Committee on Homeland Security and Governmental Affairs, May 7, 2008.
- Munksgaard J, Wier M, Lenzen M, and Dey C, (2005) Using input-output analysis to measure the environmental pressure of consumption at different spatial levels, *Journal of Industrial Ecology*, Vol. 9 (1–2), 169–185, 2005.
- Seale, James L., Jr., Regmi, Anita & Bernstein, Jason, (2003) International Evidence On Food Consumption Patterns, *Technical Bulletins* 33580, United States Department of Agriculture, Economic Research Service.
- Sen, A. (1987). *On ethics and economics*. New York: Basil Blackwell.
- Spahn JM, Reeves RS, Keim KS, Laquatra I, Kellogg M, Jortberg B, Clark NA. (2010) State of the evidence regarding behavior change theories and strategies in nutrition counseling to facilitate health and food behavior change. *J Am Diet Assoc*. Jun; 110(6):879–91.
- Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., & De Haan, C. (2006). *Livestock's Long Shadow: Environmental issues and options*. Food and Agriculture Organisation of the United Nations, Rome.
- Stiglitz, J.E. 2000. *Ethics, economic advice and economic policy*. Digital library of the Inter-American initiative on social capital, ethics and development. Washington, D.C.: Interamerican Development Bank
- Tadesse, G., Algieri, B., Kalkuhl, M., von Braun, J. 2013. Drivers and triggers of international food price spikes and volatility. *Food Policy*. Available online 5 October 2013. <http://dx.doi.org/10.1016/j.foodpol.2013.08.014>
- The Lancet*. (2013) Maternal and Child Malnutrition. August 2013.
- Tilman, D., Balzer, C., Hill, J., & Befort, B.L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences*, 108(50), 20260–20264.
- Tukker, A., and Jansen, B. (2006). Environmental impacts of products: A detailed review of studies. *Journal of Industrial Ecology*, 10(3), 159–182.
- UN (United Nations). (2007). *World population prospects: the 2006 revision*. New York, NY: United Nations Population Division
- UNEP (2014) *Assessing Global Land Use: Balancing Consumption with Sustainable Supply*. A Report of the Working Group on Land and Soils of the International Resource Panel. Bringezu S., Schütz H., Pengue W., O'Brien M., Garcia F, Sims R., Howarth R., Kauppi L., Swilling M., and Herrick.
- Ulph, A., D. Southerton (ed.). 2014. *Sustainable Consumption: Multi-Disciplinary Perspectives in Honour of Professor Sir Partha DasGupta*. Oxford University Press. Oxford.
- Unnevehr, L., Eales, J., Jensen, H., Lusk, J., McCluskey, J., & Kinsey, J. (2010). Food and consumer economics. *American Journal of Agricultural Economics*, 92(2), 506–521.
- von Braun, J. (2014). Aiming for Food and Nutrition Security in a Changed Global Context: Strategies for Ending Hunger. In: *Alternative Development Strategies for the Post-2015 Era*. Ed. J. Alonso, G.A. Cornia, and R. Vos. Bloomsbury Academic 2014.

- von Braun, J. and F. Gatzweiler (Eds.). 2014. *Marginality – Addressing the Nexus of Poverty, Exclusion and Ecology*. Springer Netherlands. <http://link.springer.com/book/10.1007%2F978-94-007-7061-4>
- von Braun, J. Bernardina Algieri & Matthias Kalkuhl (2014). World Food System Disruptions in the Early 2000s: Causes, Impacts and Cures. *World Food Policy*. Vol 1, Number 1; Spring 2014. pp 1-22.
- von Braun, J., and Mengistu, T. (2007). On the ethics and economics of changing behavior pp 181-200 in: Per Pinstrup-Andersen, Peter Sandøe (ed.) *Ethics, Hunger and Globalization – In Search of Appropriate Policies*. Springer Publ. New York, Heidelberg.
- von Braun, J. (2011). Increasing and More Volatile Food Prices and the Consumer. In: *The Oxford Handbook of the Economics of Food Consumption and Policy*. Ed. Jayson Lusk, Jutta Roosen, and Jason Shogren. 612-628.
- Weber, M. (Originally written in 1897). *Sociological writings*. Vol. 60. Heydebrand, W., ed. 1994 London, UK and New York, NY: Continuum Publishing.
- Wheeler, T., and von Braun, J. (2013). Climate Change Impacts on Global Food Security. *Science*. 2 August 2013, Vol. 341, No. 6145, pp. 508-513, DOI: 10.1126/science.1239402

SUSTAINABLE DEVELOPMENT GOALS FOR A NEW ERA

■ JEFFREY D. SACHS

I want to describe what I believe to be the central drama of our time. In many ways humanity has squandered the time it once had to adjust to environmental realities. Now our backs are up against the wall. As the Church says, we are living in history, and our generation's history is the threat of unprecedented, global-scale environmental catastrophe.

With a population of 7.2 billion, and an economic output measured at \$12,000 per person (in international prices), the \$90 trillion global economy is putting unprecedented strain on the world's ecosystems, climate, and biodiversity. The world economy is very roughly 250 times larger than it was at the start of the Industrial Revolution in the middle of the 18th century. The human impacts are similarly must more vast and dangerous than ever before.

The world's governments are currently attempting to negotiate a framework to help guide humanity through the very difficult environmental crises of our own making. I want to explain that global diplomatic process because I think it is vital that these negotiations be successful. And since global cooperation is fragile and tenuous, there is absolutely no guarantee of success. For that reason, I believe that this week's meeting is extraordinarily timely from the point of view of global diplomacy. We can give a big boost to the on-going talks.

Humanity has entered the Anthropocene: a new era of risk and possibility

As Professor Crutzen has taught us, we have entered a new environmental era on the planet, which he has helped to christen the *Anthropocene*. This new concept is deeply correct and, indeed, both startling and extremely important. We are now in a human-driven physical world. Sometimes the scientists say that humans have become the main "drivers" of planetary-scale change, but if we're "driving" we are certainly not paying attention to how we're driving! The global economy is changing the planet in extraordinarily dangerous ways and yet our political systems are displaying an almost complete inattention to these dangerous trends.

I'd like to refer to a statement of President John F. Kennedy, made half a century ago, because I think it applies to us today. In his inaugural address, Kennedy said, "For man holds in his mortal hands the power to abolish all

forms of human poverty and all forms of human life”. In essence, we are living in a time of extraordinary choice. Our technological capacity can be uniquely beneficial: we can end extreme poverty in this generation. Yet it can also be incredibly destructive, not only in the sense of the thermonuclear risk that President Kennedy referred to, but also to environmental destruction that threatens us in our generation.

How did we arrive at this dangerous point? We are the inheritors of two centuries of dramatic technological breakthroughs. Economic history shows an almost unchanging level and character of global economic activity over the course of centuries (even perhaps a couple millennia) up till around 1750. It is only in the last two and a half centuries that rapid economic growth in the modern sense has occurred, and this unprecedented economic growth has been the result of waves of technological change.

The biggest breakthrough came with James Watt (and his predecessor Thomas Newcomen), who first showed how to use fossil fuel – ancient solar energy stored in the form of coal, oil, and gas – for motive power. Watt’s steam engine and other fossil-fuel-using technologies that followed (e.g. the internal combustion engine and gas turbine) have fundamentally

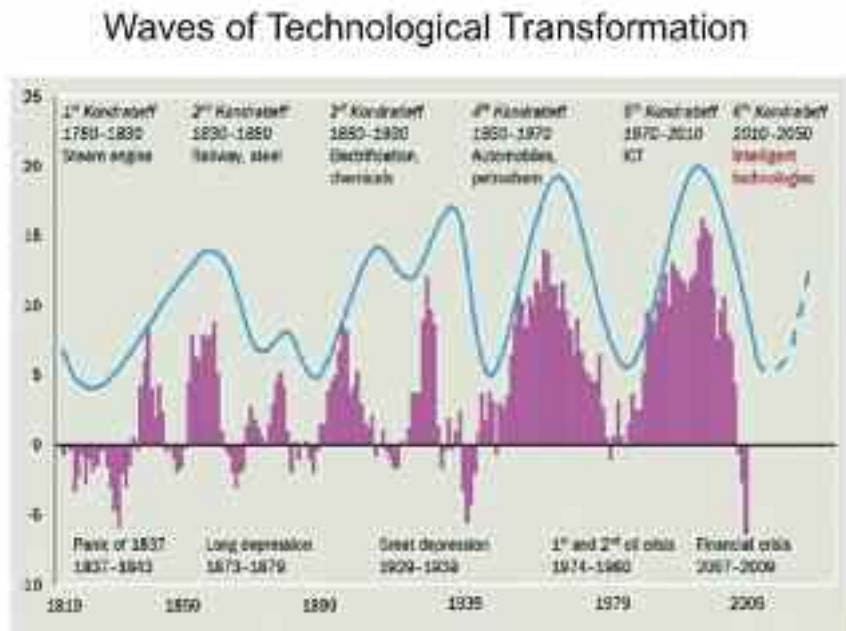


Figure 1. Kondratieff waves of technological transformation.

transformed the world economy, and now the planetary environment as well. Indeed, since Watt's steam engine (in 1776), there have been a series of fundamental technological advances sometimes called "Kondratieff waves" (Figure 1). For example, we are now living through the wave of the Digital Revolution, which is again reshaping the world economy.

These waves of technology have shaped the modern world, and the growing human impact on the environment. The path of total world output (sometimes called the Gross World Product, or GWP), is therefore unlike anything seen before the modern economic era. Figure 2 shows the best reconstruction we have of the long sweep of GWP. The essence of the picture is that history changed around 1800 (with the first Kondratieff wave and those that followed). Gross World Product has soared vertically, but we have not adjusted to this reality, either institutionally, morally, ethically, or cognitively. Yet this change has fundamental implications for how we live with each other and how we live with the planet.

The path of the global population (Figure 3) looks like almost the same curve as GWP, and it is indeed closely related. For the long stretch of human history the global population virtually remained almost unchanged. The change over centuries was so small that it was nearly imperceptible to those who lived at any time in the preindustrial age (except of course for rare episodes such as the Black Death in Europe). Yet after 1800 or so, the world's

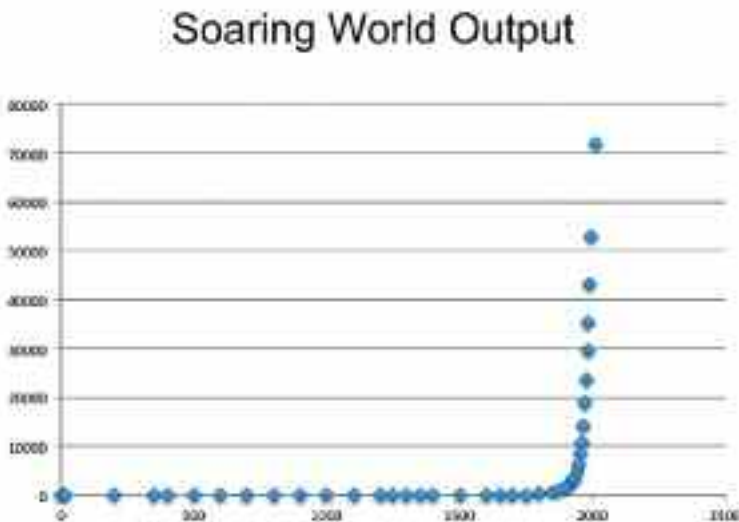


Figure 2. World Output.

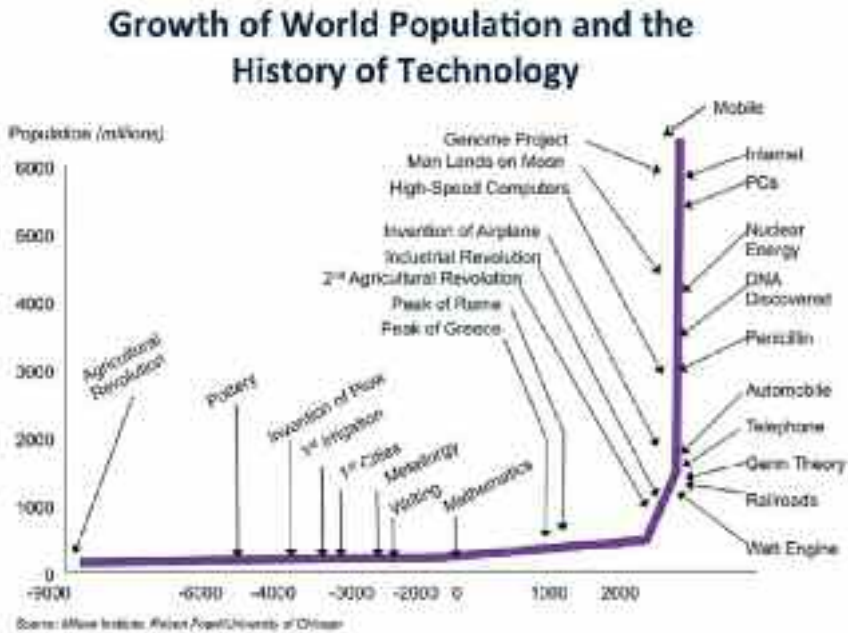


Figure 3. Growth of World Population and the History of Technology.

population began to soar. This is mainly (though not only) because the advances in global technology included the ability to grow vastly more food-stuffs to feed a growing world population. The result is that the global population has risen roughly eight-fold since 1800, from around 900 million to 7.2 billion people today.

Figure 4 shows another curve that looks similar. It is, indeed, another case of geometric growth. This one is *Moore's Law*, the doubling of the “transistor count” on advanced integrated circuits roughly every 24 months, a doubling process that has been occurring since the advent of integrated circuits around 1958. Moore's Law describes our generation's Kondratieff Wave, the Digital Revolution. The ability to store, process and transmit data in bits has improved by roughly one billion times since 1958. This great advance in digital technology is already transforming the world economy, the nature of jobs, and the pursuit of science in almost every sphere. The digital revolution gives us great technological power, both for good (to fight poverty) and alas also for bad (for example through more advanced spying or accelerated environmental catastrophe).

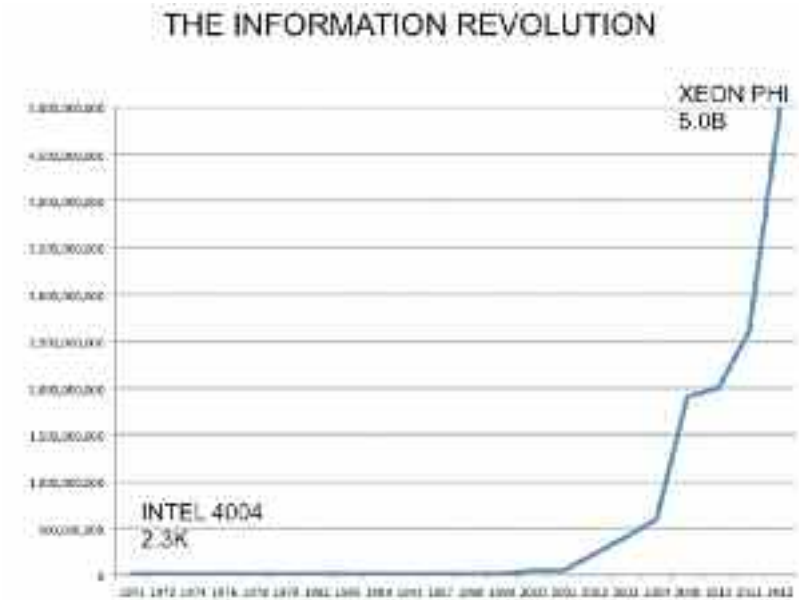


Figure 4. The Information Revolution.

The Result of the Technological Revolution is a
Fully Interconnected, Increasingly Urban,
Highly Productive Global Economy



Figure 5. The Connected Global Economy.

The cumulative result of the five Kondratieff Waves is a fully interconnected world economy and global society. These interconnections are depicted graphically in Figure 5. The white lines in the figure depict the global aviation routes; the blue lines depict the ocean-shipping lanes; and the green lines show the road networks. The bright white dots are major urban agglomerations. All in all, the world is deeply interconnected as never before. This is, of course, what is meant by “globalization” in our era.

There is of course much good news associated with this stunning technological progress. One piece of good news is that the global rate of extreme poverty has been falling significantly in the past two decades. China has been the greatest exemplar of that progress. China’s rate of extreme poverty, according to World Bank data, fell from around 60% in 1990 to around 12% in 2010. Overall headcount poverty (the proportion of households living below the World Bank’s poverty line) declined by more than half between 1990 and 2010, from around 43 per cent at the start of the period to around 21 per cent at the end of the period. This reduction of poverty represents a marvellous improvement in the quality of material life, and it is happening in many parts of the developing world, though most notably in Asia, and then in Africa since around 2000.

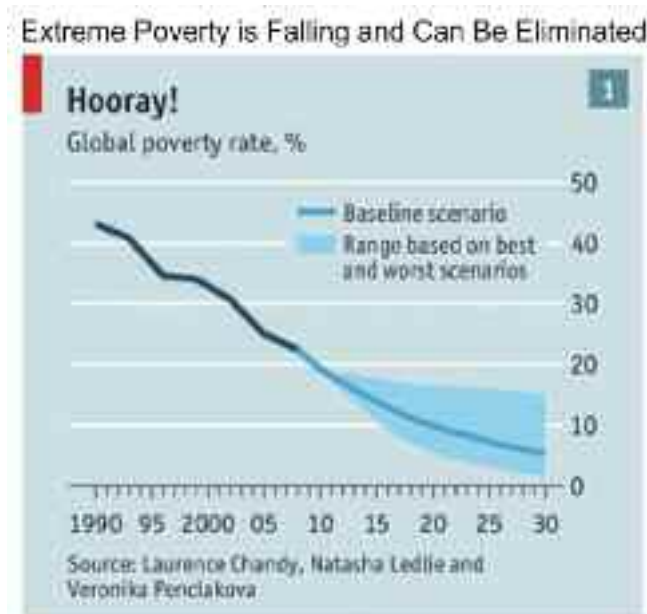


Figure 6. Extreme Poverty is Falling and Can Be Eliminated.

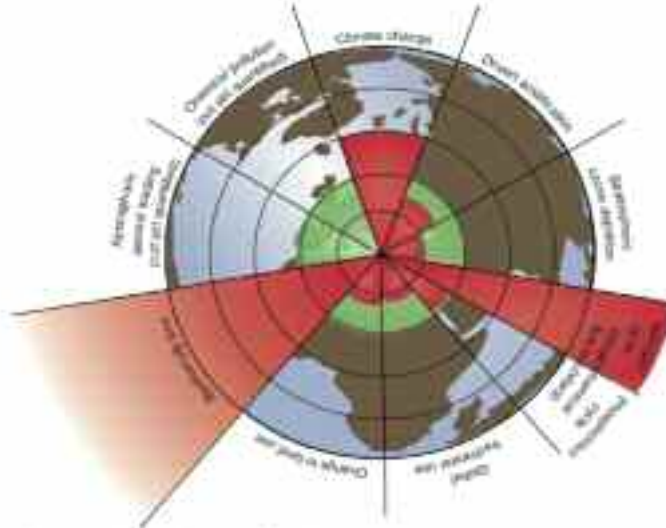
Yet the good news of economic advance is offset by considerable bad news as well. First, the economic progress has been unequal in its impacts and many of technological changes have caused major shifts in the distribution of jobs and incomes. For example, the demand for unskilled labour seems to have declined markedly in the last twenty years. This is in turn leading to higher youth unemployment, falling incomes of young people, and rising social stresses in many parts of the world. Figure 7 shows pictures of the police confronting young people in clashes in major cities all over the world. This unrest is becoming a nearly universal phenomenon.

Yet the global environmental impacts of global economic development are probably even graver than the social dislocations. As the result of massive economic growth and the neglect of the physical environment, humanity is “trespassing” on a number of key *Planetary Boundaries*. The phrase Planetary Boundaries, coined in 2009 by a group of world-leading ecologists, signifies various environmental thresholds that humanity is cross at great peril. These Planetary Boundaries are depicted in Figure 8. They include



Figure 7. Rising inequality, youth unemployment...

PLANETARY BOUNDARIES IN THE AGE OF THE ANTHROPOCENE



Source: Rockström et al 2009a

Figure 8. Planetary Boundaries.

human-induced climate change; human-induced acidification of the oceans; human-induced release of nitrogen and phosphorus into the environment (mainly from fertiliser use); massive freshwater depletion; massive deforestation and other land use changes; massive human-induced destruction of biodiversity; massive aerosol pollution (e.g. through burning of fossil fuels in major cities); and massive chemical pollution. The economic growth curve has turned up so steeply, and our environmental neglect is so severe, that humanity is crossing the safety boundaries of the planet.

And the dangers are evident in every part of the planet. Let me illustrate those dangers with a few recent photographs.

Figure 9 happens to show my own city, New York City, on the occasion of the Super-Storm Sandy that hit the northeast coast of the US in late October 2012. You can see the New York City police cars floating down 10th Street in downtown Manhattan. Yet New York City's flooding is not unique. Bangkok, Beijing, Belgrade and countless other cities have had similar massive floods in the past three years.



Figure 9. Manhattan, Hurricane Sandy.



Figure 10. Beijing enveloped in pollution.

Algal Bloom, Qindao, Shandong Province, 2013



Figure 11. Algal Bloom.

Figure 10 shows another planetary boundary: aerosol pollution. The photo is of Beijing in January 2014, when Beijing's air became so polluted that breathing the air became a major health risk. The best advice to Beijing residents was, "Don't breathe for the following three days!" The air in many Asian mega-cities is unsuitable for human health and safety. This air pollution can reduce life expectancy by several years.

Figure 11 is an illustration of eutrophication, the massive algal blooms (followed by hypoxic or "dead" zones) that result from the massive poisoning of rivers, estuaries, and coastlines by nitrogen and phosphorus fertilizers carried by rivers and groundwater from millions of farms to the coast.

Figure 12 shows a satellite image of what by some measure was the strongest land-falling tropical cyclone in modern history, Typhoon Haiyan of November 2013. This massive typhoon struck the Philippines and caused mass destruction, dislocation and loss of life. Such is our new world, one of increasingly frequent and intense climate-related catastrophes.

Another key kind of disaster are massive and increasingly frequent droughts that are plaguing so much of Africa and the Middle East (as well as the US state of California in recent years). I see these droughts in my development

By some measurements, Typhoon Haiyan (November 2013) was the most intense storm ever to make landfall

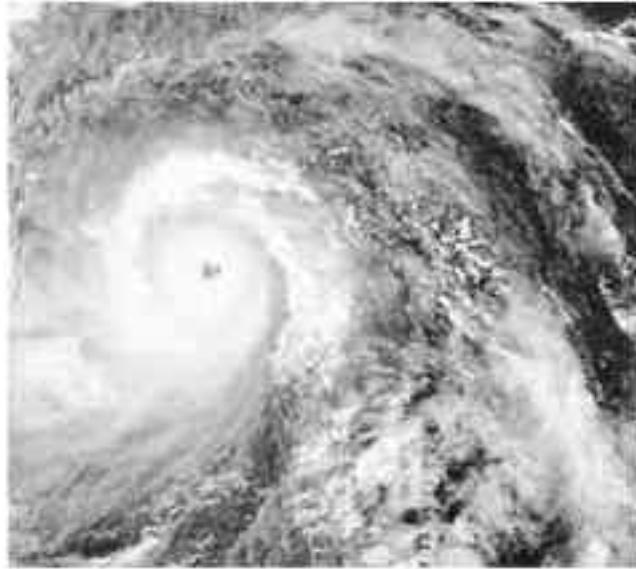


Figure 12. Typhoon Haiyan.

activities month by month, whether it's the Horn of Africa, Yemen, or the Sahel (Figure 13). Human-induced climate change seems to be contributing to falling precipitation and rising evapotranspiration in many parts of the world's drylands. The result is drought and in severe cases, famine. These increasing droughts are hitting against rising populations in these very places. The result is like the crossing of two scissor blades: falling rainfall on one blade, and rising populations on the other. As with the blades of a scissor, these contrasting trends are cutting society to the bone, threatening their health, food security, and political stability. Many drylands – Somalia, Yemen, and Syria to name three cases – are already succumbing to chaos.

Sustainable Development is the global concept to address this quite harrowing and unique reality of our time. Sustainable Development as a concept calls for a holistic and integrated vision of society, in which our economic objectives, such as ending extreme poverty, are put alongside our social objectives such as peaceful communities, stable families, and effective governance, as well as our environmental objectives of stopping climate change, controlling pollution, and protecting ecosystems and biodiversity. The shorthand goal of Sustainable Development is “Inclusive and Environmentally Sustainable Growth”.



Figure 13. Chad, 2012.

The concept of Sustainable Development came to public awareness 27 years ago through the World Commission on Environment and Development, most often called the Brundtland Commission (after its chair, Dr Gro Harlem Brundtland). The concept was then incorporated into the three multilateral environmental agreements reached at the Rio Earth Summit in 1992, on climate change, biodiversity and desertification. Yet the grim reality is that these three treaties have not worked. International law has not proven to be a match for the juggernaut of the world economy. In every environmental domain we are by far worse than we were in 1992.

When the world's governments met in June 2012 on the 20th anniversary of the Rio Earth Summit, at a meeting known as the Rio+20 Summit, the main challenge facing the governments was how to bolster sustainable development. In the key recommendation of the Summit, the world's governments called for a new set of Sustainable Development Goals (SDGs) to help guide the world during the next fifteen-year period from 2016 to 2030. One of the reasons for this interest in high-level SDGs was the relative success of another set of high-level goals, the Millennium Development Goals (MDGs), on which I've had the honour to advise former UN Secretary-General Kofi Annan and now UN Secretary-General Ban Ki-moon. The MDGs have played a critical role in drawing the global attention to extreme poverty. The

hope is that Sustainable Development Goals will similarly draw the world's attention to the dire challenges of sustainable development.

The key importance of the SDGs is that they invite the entire global society to become engaged in the Earth's future. The SDGs move us beyond the rarefied realm of global treaties – which involve mainly lawyers, diplomats, negotiators, and politicians – to the realm of global civil society. With the SDGs we have a global compass, a lodestar, a set of shared objectives, to help move the world towards sustainable development.

Please permit me to quote President Kennedy once again. In 1963, Kennedy successfully negotiated the first major peace treaty with the Soviet Union in the Cold War era: the Partial Nuclear Test Ban Treaty. In the course of pursuing that agreement, Kennedy described how a clear and shared goal may be a source of progress and inspiration: “By defining our goal more clear – by making it seem more manageable and less remote – we can help all people to see it, to draw hope from it and to move irresistibly towards it”.¹

The specific idea of Sustainable Development Goals is to combine society's goals of ending extreme poverty; increasing social inclusion with reduced inequality; and promoting the environmental sustainability of food systems, energy systems, ecosystems and biodiversity. All of this should be accomplished within a framework of global governance and partnerships needed to achieve the economic, social, and environmental aims.

I am now directing a process for UN Secretary-General Ban Ki-moon called the Sustainable Development Solutions Network (SDSN). The SDSN is a new global network of academia, civil society, and the private sector that works with the UN and with national and local governments both to set the SDGs and then to achieve them. The SDSN will work from 2016 to 2030, the period of the Sustainable Development Goals.

As one early phase of the SDSN work, the Leadership Council of the SDSN has made a recommendation to the UN General Assembly and Secretary General as to what the SDGS might be. The SDSN has recommended ten main goals, listed as follows:

- End extreme poverty
- Promote sustainable growth and jobs
- Education for all
- Social inclusion for all
- Health for all

¹ JFK, American University Speech, June 1963.

- Sustainable agriculture
- Sustainable cities
- Sustainable energy and climate change
- Sustainable biodiversity
- Good governance and global partnership

The SDGs are being negotiated now at the United Nations, and will be adopted in September 2015 at a summit of world leaders. So far, the UN General Assembly has narrowed the list to seventeen headline goals, very similar in fact to the SDSN list. I expect that the list of seventeen will be refined to around ten goals by the end of the process, very similar to those on the SDSN list. These ten or so SDGs will be accompanied by perhaps 30–40 targets (three to four targets per goal), and perhaps 100 numerical indicators that will be used to track progress towards the goals. The SDGs (and the targets and indicators) will be the subject of annual review by the UN member states.

Nothing about achieving global Sustainable Development will be easy. We are very, very close to losing the possibility of avoiding climate catastrophe. In 2010 the world's governments agreed to take action to avoid a 2°C rise of mean temperature above the pre-industrial level. We already have a 0.9°C increase, roughly half way to the globally agreed limit. If we continue with business as usual, the world's mean temperature is likely to rise by as much as 4°–6°C by the end of this century. This would likely prove to be calamitous. The only way to achieve the 2°C target will be through decisive cooperation among the world's major economies. A recent report of the SDSN, called the *Deep Decarbonization Pathways Project Report*,² shows how the 2°C goal can still be met, but only through a very deep and rapid transformation of the global energy system to low-carbon energy sources and uses.

The fact of the matter is that humanity is still rushing headlong towards multiple collisions with nature and with each other, within highly divided and unfair societies. And yet, we have the means to succeed; that is, to combine the end of poverty with social inclusion and environmental safety. The most essential quality for our survival will be a shared moral impulse to do the right thing: to protect each other and nature from our greed, scientific lack of understanding, and moral disregard and carelessness.

In conclusion, I believe the world desperately needs – and yearns for – a shared global ethics to underpin the forthcoming Sustainable Develop-

² Available online at <http://unsdsn.org/what-we-do/deep-decarbonization-pathways/>

ment Goals. The debate in New York is still very much a technical debate. It is mainly about international law, institutions, technologies, finance, and timetables. As of yet, it is only implicitly about values. We are still lacking an explicit and informed discussion of global ethics.

There is no doubt that the world is yearning for such a moral renewal. We see clearly the global response to Pope Francis's pronouncements. This is global, this is worldwide, this is across religions. I personally believe that the social doctrines of the Church offer a global inspiration on these issues, across the major religions. I refer to Church social teachings that, in my mind, are fundamentally in line with Sustainable Development and the SDGs.

The Preferential Option for the Poor is at the core of the concept of ending extreme poverty. Pope Paul VI's wonderful statement that "Development is the new name for Peace", is a similarly vital concept. The doctrine of the Universal Destination of Goods reminds us that a global market economy must be underpinned by ethics. The Church teaches us of the moral responsibility towards Creation, the importance of integral human development, and of the importance of subsidiarity in building institutions. (The SDSN recommends an SDG for urban areas in order to emphasize the important of communities and local governments).

In the final analysis, we do not face an economic, technological, or financial crisis. We face a moral crisis. If we can rally our spirit, the rest will follow. As Pope Francis has powerfully put it, we face the "Globalization of Indifference". The SDGs (and other global objectives) can help us to overcome that indifference. By engaging global society through clear global goals, and by infusing those goals with a shared moral underpinning, humanity in our time can step back from the environmental precipice. We can achieve prosperity, social trust, and a safe planet. Indeed, any other course of action would threaten our very survival. Our course must be one of hope, cooperation, compassion, and positive action.

III. ANTHROPOCENE: GLOBAL CLIMATE CHANGE

CLIMATE-SYSTEM TIPPING POINTS AND EXTREME WEATHER EVENTS

■ HANS JOACHIM SCHELLNHUBER AND MARIA A. MARTIN

Introduction

The climate system is a most delicate fabric of interwoven planetary components (such as the atmosphere, the oceans, the cryosphere, the soils, and the ecosystems) that interact through intricate physical, chemical, geological and biological processes (such as advection, upwelling, sedimentation, oxidization, photosynthesis, and evapotranspiration). The fascination for that system as an integral part of the nature surrounding us is as old as mankind. However, the scientific understanding of the climate system's make-up and dynamics, as well as the cultural perception of its vulnerability to human interference, are quite young: We eventually become aware of the fact that even slightly pulling one single string might have the potential to tear apart the entire fabric. Anthropogenic global warming, resulting from the industrial burning of gigantic amounts of fossil carbon, is an evident candidate for such a disruptive pull.

Thoroughly understanding the potentially devastating consequences of that warming is the key precondition for effective mitigation and adaptation measures. Unfortunately, scientific progress in the pertinent fields has been slow until fairly recently due to the intellectual challenges posed by the manifold nonlinearities characterizing the climate system. It seems, however, that we are now entering an exciting new research phase that will dramatically deepen and multiply our insights about non-regular climate behavior. So we have an interesting story to tell.

Our article roughly divides the nonlinearities field into two main camps, one embracing *extreme weather* characteristics and the other identifying *critical transitions* of vital Earth System components ("tipping elements"). It is important though to recognize that those camps are not independent. In fact, a number of links exist, some of which will be discussed here. And many more links will be explored before long. What we know for sure already, however, is that Nature and *Homo sapiens* are now entangled in a fateful relationship: The most successful species on Earth has begun to shape that very Earth, although without a master plan or botcher plot so far. Thus we have finally entered the *Anthropocene*, the geological age of humankind, as Paul Crutzen once famously put it (Crutzen 2002). Through innumerable

feedback mechanisms, the natural environment will react to human interference which will trigger massive counter-actions by our civilization (perhaps including so-called geoengineering measures), causing new and unforeseeable planetary side effects, and so forth. Whether this interactive dynamics tends to spin out of control or whether it can be directed to some stable equilibrium again, depends crucially on the nonlinearities involved and sketched in the following.

Human culture as we know it emerged through two great transformations, namely the Neolithic and the Industrial Revolution. The former was decisively favored by the exceptionally stable climatic conditions in the Holocene after the end of the last glacial period some 11,000 years ago (Figure 1). The development of agriculture, in turn, laid the foundation for rapid mechanization after 1750 that would not have happened, however, without the fortunate accessibility of fossil resources of exquisite energy density – mined in England first and on all continents later on. The overwhelming historic process of world-wide carbonization, which may be documented as the “c-story of humankind” (Figure 2), resulted not only in large-scale industrialization, but also helped to tap the immense human potential for creativity, discovery and progress for a better living. It appears like a sheer success story at a first glance, and yet it is not an untroubled narrative. For this carbonization of the world led to a multitude of negative externalities (as the economists would call them), not least the potential destabilization of the benign Holocene climate through the significant alteration of atmospheric greenhouse gas levels. As the latest IPCC Assessment Report demonstrates, the global mean surface temperature could rise above pre-industrial values by more than 4°C by 2100 under a business-as-usual scenario (RCP 8.5, Meinshausen *et al.*, 2011). As a consequence, our planet could be pushed into an uncomfortable realm, where many natural and cultural systems would be at risk of heavy stress, if not collapse.

Extreme Weather Events

Many of these risks were recently summarized in a flagship report by the World Bank (Schellnhuber *et al.*, 2012). One of the main findings of that report was that 5 σ -weather phenomena – that is, extreme meteorological events (like heat waves) that on average happen only once in about a million years under stationary environmental conditions – will occur practically every year in the tropics or subtropics if the world warms by 4°C. This most challenging scenario is actually foreshadowed already by shifts in extreme-weather regimes as observed in recent decades, largely consistent with the still moderate anthropogenic climate modification enforced so far.

This is epitomized by the world-wide increase in record-breaking monthly-mean temperatures (see, for instance, Figure 3, adapted from Coumou, Robinson, & Rahmstorf, 2013).

Yet the frequency, character and severity of meteorological disasters that struck especially the Northern Hemisphere over the last 20 years cannot be fully explained by the statistical effects associated with unfolding global warming. Thus, the changes observed are not just the direct result of an upward shift of the otherwise unmodified temperature distribution, an effect that already significantly enlarges the extreme-events area under the typical temperature distribution curve. Latest scientific analyses rather indicate that high-impact events, such as the Russian heat wave and the Pakistan deluge in 2010, are related to an insidious transformation of the jet stream system (Figure 4). The most important branch of this Earth-scale westerly wind field meanders in 7-12 km height above the mid-latitudes of the Northern hemisphere and separates cold and temperate air masses (see, for instance, Archer & Caldeira, 2008; Branstator, 2002). Occasionally, huge northward and southward bulges of the jet stream emerge from the underlying non-linear fluid dynamics, the so-called Rossby waves. In general, these waves get straightened out again within a few days, yet they also may get stuck through subtle quasi-resonance mechanisms between traveling and stationary planetary waves (Petoukhov *et al.*, 2013). As a consequence, blocking weather conditions can arise, favoring long-lasting heat waves and droughts or floods resulting from persistent precipitation patterns.

Observational data indicate that the frequency of such weather situations has markedly increased over the last two decades (Coumou *et al.*, 2014; Screen & Simmonds 2014). Moreover, there is theoretical and empirical evidence that the increase is related to the disproportionately strong Arctic warming (especially after the year 2000, see Figure 5) in response to anthropogenic radiative forcing (Francis & Vavrus 2012). For the shrinking temperature difference between the mid latitudes and the high latitudes tends to weaken the Northern jet stream, causing it to split up in two branches confining persistent wind patterns. This is, however, just one of the mechanisms involved in a most intricate wave dynamics (Petoukhov *et al.*, 2013; Palmer 2013).

Tipping Elements in the Climate System

The jet stream system itself can be perceived as one of the above-mentioned tipping elements within the Earth's climate system (Lenton *et al.*, 2008). They form a collection of crucial circulation patterns, geophysical processes, cryospheric entities, and large-scale ecosystems that may be pushed

into different modes of operation by massive human perturbation. The link between planetary waves and persistent extreme weather conditions, as sketched above, therefore illustrates how the anthropogenic switching of a defining component of the global environmental make-up trickles through the fabric of entangled climate processes down to the domain of our everyday experience. As indicated above as well, different tipping elements, like the Arctic sea ice and the Northern jet stream, seem to be intimately coupled via the anomalous decrease of wintertime sea-ice extension and the resulting shift in wind patterns (see, for instance, Petoukhov & Semenov, 2010, Francis & Vavrus, 2012). Identifying and quantifying those interactions belongs to the most exciting research challenges of this decade.

El Niño-Southern Oscillation (ENSO)

One of the most important tipping elements is the El Niño phenomenon, which is in turn the most conspicuous part of the so-called El Niño–Southern Oscillation (ENSO) pattern, a natural atmosphere–ocean seesaw dynamics in the tropical Pacific. The former can last for many months and sets in when trade winds that usually push higher-temperature upper-layer waters towards the west (into the “Pacific warm pool”) break down. Once the heated water is allowed to slosh back to the east, it gives rise to an anomalous ocean warming off the West coast of South America. Since this tends to happen around Christmas, Peruvian fishermen named the event after the infant Jesus. Note that El Niño is so persistent because atmospheric and oceanic processes conspire, under certain conditions, to bring about a self-amplifying pattern of air pressure systems and sea temperature domains. As a rule, “La Niña”, the cold sister of El Niño, starts to reign once that pattern collapses through stochastic mechanisms.

El Niño can trouble weather behavior around the globe and may wreak havoc in most distant regions. In the late 19th century, droughts and monsoon failures, floods and epidemic diseases like malaria, bubonic plague, dysentery, smallpox and cholera accompanied marked clusters of El Niño and opposing La Niña events, although an exclusive causal attribution is very hard to establish in this context. In the course of those tragic events, around 30–50 million premature deaths were counted in India, China and Brazil (Davis 2001, and Figure 6). The inhumane practices of late colonial exploitation aggravated the disaster, creating even more opportunities for grabbing territories from the “inferior peoples in the South” and for cementing the political rule of the North.

Due to its dominating role in natural climate variability, the ENSO pattern is subject of many topical studies. A recent paper has argued that ex-

treme El Niño episodes will become more frequent with unabated global warming (Cai *et al.*, 2014). In order to avoid the worst negative impacts of such events, for instance on agriculture, fisheries, public health and tourism, early prediction through advanced scientific methods plays a key role. Until recently however, reliable forecasts became available only about 6 months before the onset of an El Niño which is often insufficient for effective preparedness and resilience measures. A novel prediction method (Ludescher *et al.*, 2013, 2014), relying on a network analysis of teleconnections (links) between site temperatures in the El Niño basin and the rest of the Pacific, allows to forecast those events at least one year ahead with a 3-in-4 probability (Figure 7). Thorough data evaluation with powerful complex-systems methods suggests that a cooperativity transition tends to happen as a precursor/trigger phenomenon of the East Pacific warming anomaly. This very approach has projected a 2014 El Niño appearance as early as 17 September 2013 (see again Figure 7).

Excursus: A Commitment to Global Change

The extremely long lifetime of anthropogenic CO₂ in the atmosphere – a significant fraction remains airborne for a thousand years or longer (see, for instance, Archer & Brovkin, 2008) – makes it important to assess slow climatic changes as well. These might not be easily discernible for laypeople (or even experts), yet they will strongly affect human civilization in the longer term. Due to their insidiousness such processes within the Earth system pose very specific risks. In the following, we sketch a few of those “slow threats”.

Even if, in the year 2300, anthropogenic greenhouse gas emissions finally drop back to zero after a business-as-usual path with 4°C global warming by the end of this century (RCP 8.5), CO₂ will only very slowly disappear from the atmosphere. As a result, temperatures will fall only by 1 to 2°C during this millennium (Zickfeld *et al.*, 2013). In that scenario, thermal expansion of the ocean waters *alone* will cause a sea-level rise of 1.6 meters until the year 3000 and still continue. As an early response to anthropogenic radiative forcing, sea level has already been elevated by about 0.2 m since the beginning of the 20th century (mostly due to thermal expansion so far), and the rise is likely to accelerate (IPCC WG1 2013). In the longer term, over the course of 2000 years or so, the major contribution will stem from ice sheet melting on Greenland and Antarctica (see below). Using both computer simulations and sediment data, one can expect sea level rises by at least 2 meters per degree of warming (Levermann *et al.*, 2013). This illustrates that past and current human interference with the climate system represents a severe commitment to global change that can hardly be undone.

Delicate Giants at the Poles

Among the most precarious tipping elements are therefore the huge ice sheets on Greenland and Antarctica, which may start to disappear in an irreversible manner once certain critical thresholds (“tipping points”) with respect to key environmental parameters are transgressed. Although this disappearance is expected to happen on timescales of hundreds to probably thousands of years, red lines may soon be reached or even have been crossed already.

For the Northern ice sheet on Greenland, the most determinant parameter is the surface temperature, which, in contrast to most of Antarctica, is high enough to instigate melting. In Greenland, the melt water can reach the base of the ice through huge moulins and lubricate the sediment upon which the ice sheet is moving. This effect enhances the speed of the ice streaming towards the ocean, where it can be affected by warmer water temperatures too. Surface melting also reduces the reflectivity of the ice, leading to further warming through increased absorption of solar radiation. Yet the quintessential mechanism which introduces a strongly nonlinear – and possibly irreversible – decay of the ice sheet is the surface-mass balance-height feedback: Even if, in the long term, global temperatures drop back below a threshold that initiated that nonlinear process, the reduced elevation of the ice surface is now exposed to milder temperatures and therefore still favors melting and possibly prohibits regrowth. A strong scientific underpinning of the political 2°C guardrail was associated with the idea to prevent the climate system to cross pertinent tipping points. Unfortunately, recent research suggests that the critical threshold for the subsistence of the Greenland ice sheet might be as low as 1.6°C global surface warming (Robinson *et al.*, 2012; Ridley *et al.*, 2010).

The Antarctic ice sheet, on the other hand, is especially susceptible to a particular environmental parameter: Since a large fraction of the ice is flowing into the ocean forming huge floating ice shelves, the sheet can be degraded from the lateral margins by rising water temperatures. As the ice shelves are weakened, either by melting from below or disintegration due to melt ponds at the surface and successive crack formation, they lose their ability to hold back the kilometer-thick ice further inland. For instance, the disintegration of the Larsen B ice shelf in 2002 over the course of only two months increased the speed of the glaciers feeding it by factors ranging from 2 to 8 (Rignot *et al.*, 2004; Scambos *et al.*, 2004; Rott *et al.*, 2011).

This tangle of processes can lead to a self-sustained ice loss if certain topographical conditions are fulfilled (Figure 8): If the ice rests on bedrock below sea-level and the bed is deeper towards the center of the ice sheet, the ice flow increases as the ice retreats, leading to even further retreat (“Ma-

rine Ice Sheet Instability”, known as MISI; for a review regarding West Antarctica, see, e.g., Joughin & Alley 2011). These topographical conditions are typical for the West Antarctic ice sheet (Figure 9) which holds enough ice to raise global mean sea level by 3.3 meters (Bamber *et al.*, 2009). The most recent research (Joughin, Smith & Medley 2014; Mouginot, Rignot, & Scheuchl 2014) implies that a tipping threshold towards such an unhalted retreat might already have been crossed in West Antarctica. Even parts of the East Antarctic ice sheet – so far believed to be utterly stable – might “tip”, once a critical ice plug near the coast melts away and thereby “uncorks” the basin upstream which would lead to additional 3–4 meters of global sea-level rise (Mengel & Levermann 2014).

Sea-level rise is especially critical in the tropics and sub-tropics (see Schellnhuber *et al.*, 2012) for several reasons. On the one hand, the ocean waters there will soar by up to 20% more than in the global mean. This is to a large extent due to a basic physics effect: Massive loss of ice near the poles reduces the regional gravitational pulling power on the surrounding ocean water, releasing lots of near-by waters for distribution at lower latitudes. On the other hand, because of high population densities and often inadequate urban planning, coastal cities in developing countries are particularly vulnerable to sea-level rise in concert with other impacts of climate change. This was demonstrated in a most woeful way by typhoon Haiyan when it struck the Philippines in November 2013 (Vidal & Carrington 2013).

Sustainability as a Joint Venture of Humanity and Nature

The central theme of the PAS-PASS workshop, “Sustainable Humanity, Sustainable Nature”, ultimately raises the question whether there is such a thing as a “global tipping point” (Figure 10). There have been recent studies and speculations (Shakhova *et al.*, 2013; Rothman *et al.*, 2014; Whiteman *et al.*, 2013; van Huissteden *et al.*, 2011; Walter Anthony *et al.*, 2012) on thawing-emissions feedback processes involving the continental permafrost areas (especially in Siberia and boreal America) and the ocean shelves, where immense amounts of the strong greenhouse gas methane have been assembled and locked up for millions of years by physicochemical processes. Depending on the specifics of those processes, significant parts of the soil and sediment methane could be remobilized or converted, resulting in major releases of greenhouse gases in addition to the direct anthropogenic emissions (Schneider von Deimling *et al.*, 2012; Lenton 2012). In the very worst case, such a dynamics could conspire with other feedback mechanisms (like, e.g., tropical forest die-back) to bring about something that might qualify as an outright or partial “run-away greenhouse effect”. The scientific evi-

dence for that scenario is very shaky, yet this is a research frontier that urgently needs to be advanced over the next years. Even the persistence, after due scrutinization, of a, say, 2%-probability for a global tipping series of events triggered by human interference with nature should not be acceptable, since the losses risked would be beyond any measure.

From the natural science perspective, there are many *thinkable* (not necessarily *likely*) scenarios, where cascades of large-scale nonlinear events are triggered by the tipping of one crucial climate system element. This could eventually activate other tipping elements that are linked to the first one through causal relationships in space and time. The disintegration of an ice shelf followed by the collapse of the mother ice sheet, as explained above, is just one example in this context. That process might significantly affect the thermohaline circulation in the oceans (Rahmstorf 2002; Clark *et al.*, 1999; Marcott & Clark 2011; Clark *et al.*, 2002; Hu *et al.*, 2009) which could, in turn, change regional climate conditions and thus act back onto ice shelves elsewhere or heavily modify the subsistence conditions for marine ecosystems (Kuhlbrodt *et al.*, 2009).

From the social perspective, we would like to frame the argumentation with a “sustainable development cartoon” (Figure 11), recently introduced by the German Advisory Council on Global Change (WBGU 2014). This cartoon tries to visualize a complex narrative in a very simple way. Traditional development dynamics in line with a dull continuation of the “c-story of humanity” (see Figure 2) are contrasted with an alternative pathway guided by the overarching “Sustainable Development Goal” (SDG) of “safeguarding Earth system services”. This goal is designed to protect the natural foundations of human progress while fostering poverty eradication and social cohesion across our planet. For the sake of illustration, our cartoon unfolds in mobility-emissions space, epitomizing the modern relationship between economic demands (such as moving people and goods in space) and environmental externalities (such as releasing heat-trapping exhaust gases). All data indicate that the relationship considered is strong indeed. However, we could as well tell our story in a space spanned by the two variables “meat consumption” and “soil erosion”.

We depict the world population in this chart by a cloud of coins, each representing 100 million individuals. The coin material (gold, silver, copper) provides a (highly nonlinear) wealth metric. The current situation (A_0 and B_0 , respectively, in Figure 11) is characterized by a grossly disparate distribution of wealth/income, where the richest people (in practically any country!) also cause the highest per-capita greenhouse gas emissions. The conventional paradigm, dominating the development economics discourse

since the 1950s, aims at simply shifting this rather stretched cloud in a diagonal way by pumping even more fossil fuels into the global industrial metabolism: The rich will become disproportionately richer by this, but even the extreme poor will eventually benefit and get access to basic services such as mobility. So the theory goes, at least.

Even if this theory were intrinsically correct (in spite of mounting evidence against it; see the contribution of J. Stiglitz in this report), it would pathetically neglect the negative externalities accompanying climate change: When greenhouse gas emissions go through the roof in such a brute-force development scenario, dangerous global warming cannot be avoided anymore. In view of the 2°C guardrail and the associated finite carbon budget available for global civilization (WBGU 2009), the average per-capita & per-annum emissions allowance over the next fifty years is around 2–3 tons CO₂ eq. Our cartoon reflects the evident point that the diagonal upward stretching of the human cloud pushes the majority of the global population far into the non-sustainable realm (A₁). As a result, the entire situation becomes highly unstable and prone to “socioeconomic tipping events”, as especially the poor have no means to cope with the dire impacts of climate change resulting from ever-rising greenhouse-gas emissions. Disparities grow further and further; eventually, the entire overstretched social fabric may come apart, as sketched in the cartoon (A₂).

There is an alternative to this gamble with nature and humanity though, as outlined in the right-hand part of Figure 11. In this scenario, the rich do not lead the global population into the non-sustainable domain beyond the 2–3 tons line, but are the first to *bend back* from greenhouse gas emissions (associated with mobility in our example)! In other words, the affluent become those change agents who ensure that the global population aims at respecting the climate guardrail on average (B₁). The reasons for such a “division of labor for sustainability” are compelling, since the rich (i) contribute by far the most to climate destabilization up to now, and (ii) have all the means to adopt lifestyles (e.g., working at home office) and technologies (e.g., electric cars) which are better for the environment. That avant-garde move should enable the less affluent to gain leeway in order to develop towards a better living standard in due course. This means that while leapfrogging unsustainable energy schemes is an option, in principle, for every society and every individual anywhere, *the responsibility for clean development is not with the poor, but with the wealthy.*

Note that humankind literally comes around in the final stage of our sustainability cartoon (B₂), where some of the more affluent people even pioneer negative-emissions mobility (using biofuels produced with carbon

capture & sequestration techniques, for instance). In consequence, disparities get reduced rather than increased. Social stretching and potential rupture is not only avoided but reversed, and world society is closing ranks within a safe operating space (Rockström *et al.*, 2009).

Let us end by emphasizing that great transformational changes lie ahead of us in either case – whether we choose to pursue “business as usual” as long as possible or to adopt “sustainable development” as soon as necessary. “Don’t think that nothing happens, if nothing happens!”, as the German Chancellor Angela Merkel put it recently (paraphrased from the WBGU-Symposium 2012). Humankind is currently distorting the fabric of the climate system without fully understanding its making, thereby risking to sever critical links and to cause major discontinuities and disruptions. Research, science and education will play a decisive role in making the right choice, not least by providing robust evidence about the risks *and* the opportunities involved. In particular, the knowledge enterprise can outline powerful solutions and strategies for reconciling nature and humanity. This will require, however, to also transform our thinking about the world: “Problems cannot be solved with the same mindset that created them” (Albert Einstein).

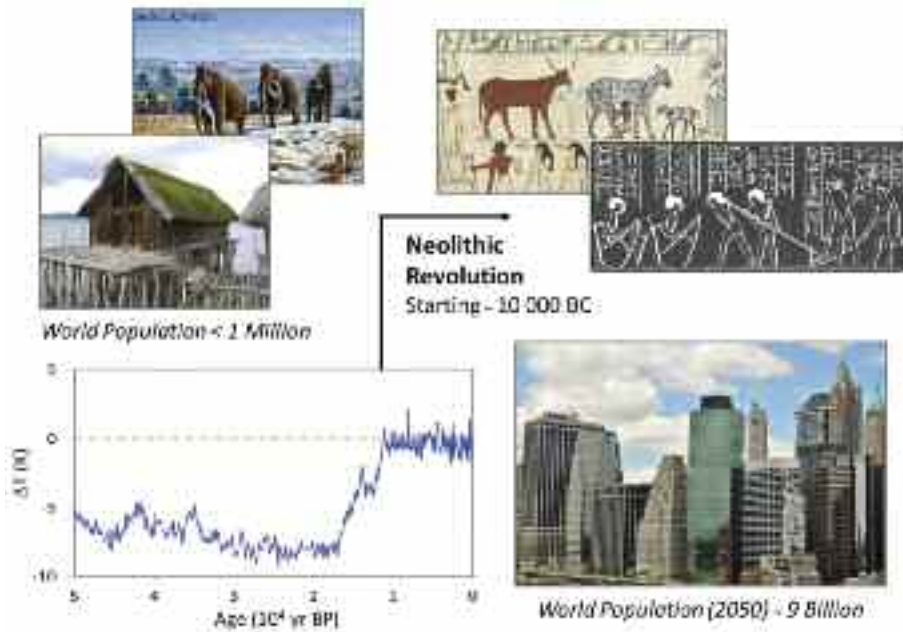


Figure 1: The Neolithic Revolution in the Holocene. With the onset of the stable climate of the Holocene some 12 000 years ago, small groups of human hunters and gatherers wandering the continents were given the opportunity to settle down. They practiced agriculture and domestication of plants and animals, but also transformed their societies into a more efficient system based on division of labor and trading. This change in life style allowed for the world population to eventually surpass the small number of less than a million individuals. The next major transformation was to ignite in the mid-18th century in Britain (Figure 2).

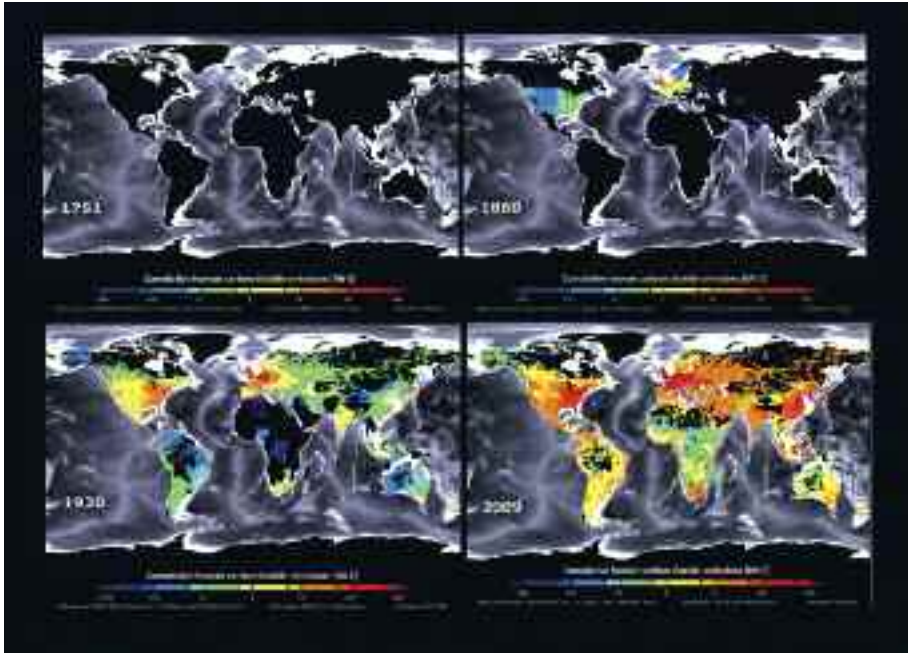


Figure 2: The “C-Story of Humankind”: Cumulative Human Carbon Dioxide Emissions since the Industrial Revolution. Income, population density and cumulative emissions of carbon dioxide have undergone a remarkably parallel development since the industrial revolution, which originated in the textile industry of Lancashire, England, around 1760 and initiated the use of coal for manufacturing processes. The transformation of first the production and subsequently the transportation sector to a carbon-based economy initially spread to Western Europe and the United States. Later, around the beginning of the 20th century, the cumulative emissions of CO₂ become also significant for the overseas colonies and China. The current situation reflects the foundation of modern living on fossil carbon around the globe. For an animated version please refer to the web link in the bibliography (PIK 2013).

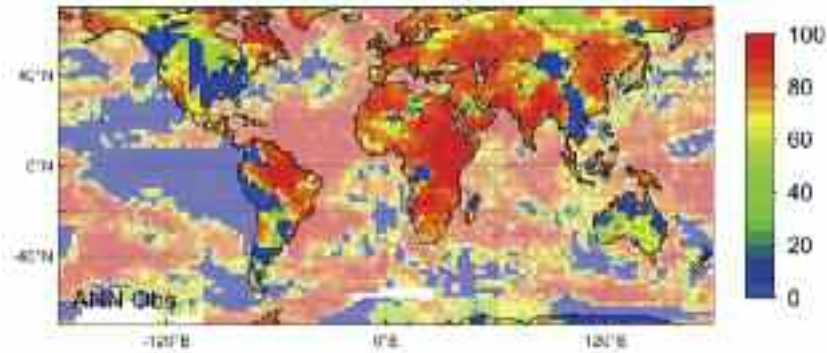


Figure 3: Heat Records due to Climate Change. Record-breaking monthly mean temperatures occur more often than could be expected from natural variability. The probability that such events in the last decade are due to climate change is about 80% in the global average (Coumou *et al.*, 2013).

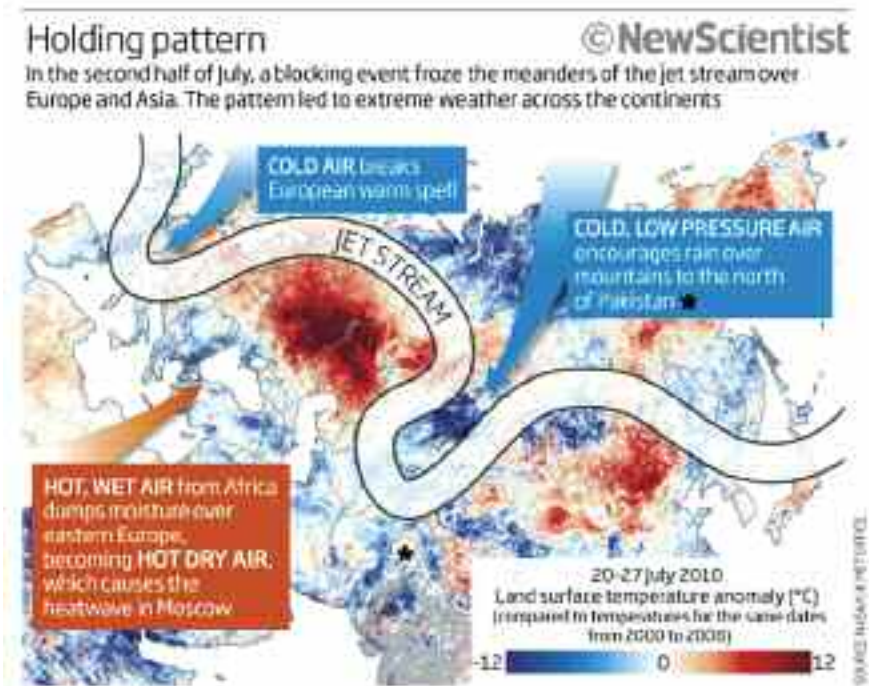


Figure 4: Synchronicity of Extreme Events. The Russian heat wave and the Pakistan flooding in 2010 are examples of synchronous extreme events that are tied to a blocking event in the atmosphere: the path of the jet stream freezes and high and low pressure systems stabilize resulting in constant local weather conditions for several weeks.

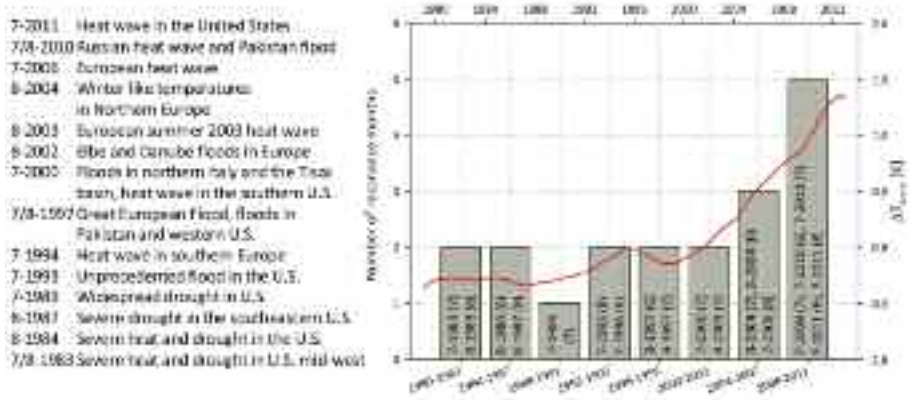


Figure 5: Increase in Quasi-Resonance Events. The increasing difference of surface warming between the Arctic and in the rest of the Northern Hemisphere (red line) as well as the number of July and August resonance months (grey bars, Petoukhov *et al.*, 2013) are associated with extreme weather events (Coumou *et al.*, 2014).

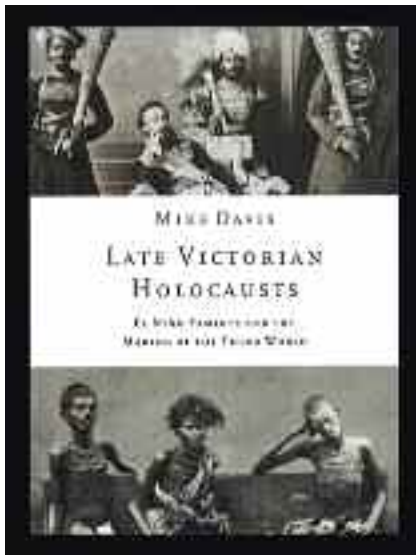


Figure 6: Worldwide Historical Consequences of ENSO Events. In the late 19th century, around 30-50 million premature deaths in India, China and Brazil were related to droughts and monsoon failures, floods and epidemic diseases. Historian Mike Davis attributes the resulting “climates of hunger” to the El Niño-Southern Oscillation (Davis 2002).

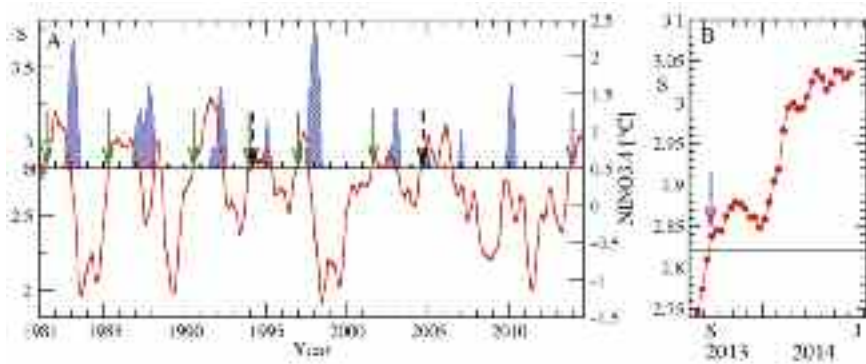


Figure 7: A Novel Method of Forecasting El Niño Events. The link strength S , describing teleconnections of temperatures between the El Niño basin and the rest of the Pacific (red curve), can be used as a very early warning bell for El Niño events (blue shaded areas) ringing at least one year ahead: If the link strength crosses a certain threshold from below (arrows) it is followed by an El Niño in three out of four cases (Ludescher *et al.*, 2013, 2014).

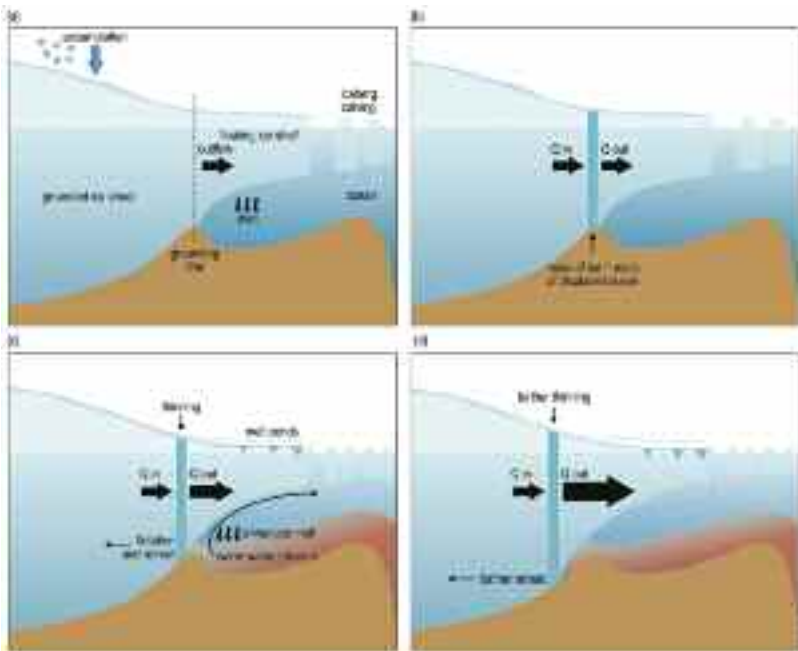


Figure 8: The Marine Ice Sheet Instability. The Marine Ice Sheet Instability (MISI) is the process leading to a potentially unstable retreat of a grounding line. (a) Profile of a marine ice sheet (b) Ice flux at the grounding line in steady state (c) Stronger outflow is triggered by ice-shelf melting and the grounding line starts to retreat. (d) Self-sustained retreat of the grounding line (IPCC WGI, box 13.2, Figure 1, 2013).

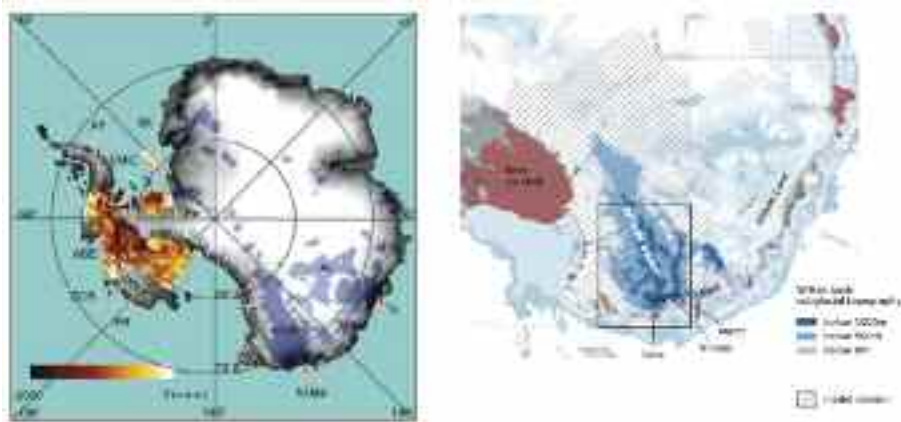


Figure 9: The Tipping Potential of the Antarctic Ice Sheet. Marine regions of the Antarctic ice sheet (i.e., areas where the ice sheet rests on a base below sea level, compare Figure 8) are potentially unstable. Left Panel: The marine West Antarctic ice sheet (red and orange colors) holds enough ice to raise sea level by 3.3 meters (Bamber *et al.*, 2009). The Wilkes Basin in East Antarctic could be subject to self-sustained ice loss as well if a critical ice plug near the coast is removed which would lead to additional 3-4 meters of global sea-level rise (Mengel & Levermann 2014).



Figure 10: A Global Tipping Point? Methane release from ex-permafrost regions and oceanic shelves in the Arctic due to warming is a potential trigger for a runaway greenhouse effect: A self-enhancing process could set in because methane is a powerful greenhouse gas causing further warming and thus enhancing methane release even more.

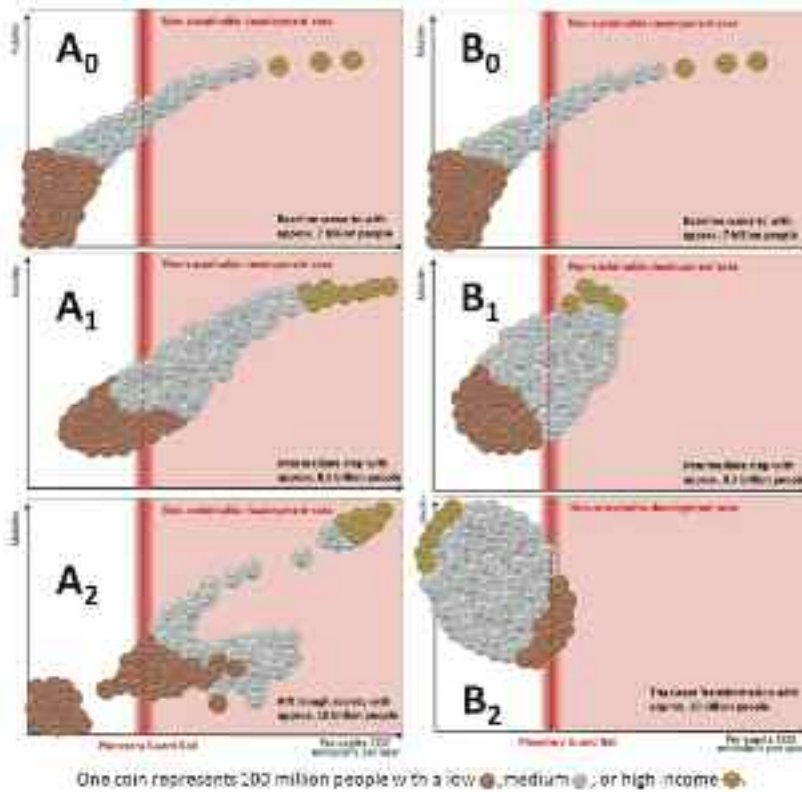


Figure 11: Alternative Development Paths. In this “development cartoon” prepared for WBGU (2014), income distribution, population development, per capita CO₂ emissions and wealth (represented here by the development indicator mobility) and their interrelations are all lined out for two alternative development strategies: While the traditional development paradigm (A₀-A₂) prescribes a shift towards a more carbon intensive lifestyle for everyone (A₁), a sustainable path (B₀-B₂) both reduces poverty and the carbon intensity of the lifestyle of the wealthy (B₁). Society therefore has the choice to either pursue traditional development strategies with the risk of tipping and breaking apart, not least because of the negative externalities of climate change (A₂), or to embrace the route to a Great Transformation, closing ranks and reaching global sustainability for both nature and humanity (B₂).

Bibliography

- Archer, C.L. & Caldeira, K., 2008. Historical trends in the jet streams. *Geophysical Research Letters*, 35(8), pp. 1–6.
- Archer, D. & Brovkin, V., 2008. The millennial atmospheric lifetime of anthropogenic CO₂. *Climatic Change*, 90(3), pp. 283–297.
- Bamber, J.L. *et al.*, 2009. Reassessment of the Potential Sea-Level Rise from a Collapse of the West Antarctic Ice Sheet. *Science*, 324(5929), pp. 901–903.
- Branstator, G., 2002. Circumglobal Teleconnections, the Jet Stream Waveguide, and the North Atlantic Oscillation. *Journal of Climate*, 15(14), pp. 1893–1910.
- Cai, W. *et al.*, 2014. Increasing frequency of extreme El Niño events due to greenhouse warming. *Nature Climate Change*, 4(2), pp. 111–116.
- Clark, P. *et al.*, 2002. The role of the thermohaline circulation in abrupt climate change. *Nature*, 415(February), pp. 863–869.
- Clark, P., Alley, R. & Pollard, D., 1999. Northern Hemisphere ice-sheet influences on global climate change. *Science*, 286, pp. 1104–1111.
- Coumou, D. *et al.*, 2014. Quasi-resonant circulation regimes and hemispheric synchronization of extreme weather in boreal summer. *Proceedings of the National Academy of Sciences*, submitted.
- Coumou, D., Robinson, A. & Rahmstorf, S., 2013. Global increase in record-breaking monthly-mean temperatures. *Climatic Change*.
- Crutzen, P.J., 2002. Geology of mankind. *Nature*, 415(6867), p. 23.
- Davis, M., 2002. *Late Victorian Holocausts – El Niño Famines and the Making of the Third World*, Verso.
- Francis, J.A. & Vavrus, S.J., 2012. Evidence linking Arctic amplification to extreme weather in mid-latitudes. *Geophysical Research Letters*, 39(6), p. L06801.
- Hu, A. *et al.*, 2009. Transient response of the MOC and climate to potential melting of the Greenland Ice Sheet in the 21st century. *Geophysical Research Letters*, 36(10), p. L10707.
- Van Huissteden, J. *et al.*, 2011. Methane emissions from permafrost thaw lakes limited by lake drainage. *Nature Climate Change*, 1(2), pp. 119–123.
- IPCC WGI, 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. T.F. Stocker *et al.*, eds., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Joughin, I. & Alley, R.B., 2011. Stability of the West Antarctic ice sheet in a warming world. *Nature Geosci.*, 4(8), pp. 506–513.
- Joughin, I., Smith, B.E. & Medley, B., 2014. Marine Ice Sheet Collapse Potentially Underway for the Thwaites Glacier Basin, West Antarctica. *Science (New York, N.Y.)*, 735.
- Kuhlbrodt, T. *et al.*, 2009. An Integrated Assessment of changes in the thermohaline circulation. *Climatic Change*, 96(4), pp. 489–537.
- Lenton, T.M., 2012. Arctic climate tipping points. *Ambio*, 41(1), pp. 10–22.
- Lenton, T.M. *et al.*, 2008. Tipping elements in the Earth's climate system. *Proceedings of the National Academy of Sciences*, 105(6), pp. 1786–93.
- Levermann, A. *et al.*, 2013. The multimillennial sea-level commitment of global warming. *Proceedings of the National Academy of Sciences*, 110(34), pp. 13745–50.
- Ludescher, J. *et al.*, 2013. Improved El Niño forecasting by cooperativity detection. *Proceedings of the National Academy of Sciences*, 110(29), pp. 11742–5.
- Ludescher, J. *et al.*, 2014. Very early warning of next El Niño. *Proceedings of the National*

- Academy of Sciences*, 111(6), pp. 2064–6.
- Marcott, S. & Clark, P., 2011. Ice-shelf collapse from subsurface warming as a trigger for Heinrich events. *Proceedings of the National Academy of Sciences*, 108(33), pp. 13415–13419.
- Meinshausen, M. *et al.*, 2011. The RCP greenhouse gas concentrations and their extensions from 1765 to 2300. *Climatic Change*, 109(1–2), pp. 213–241.
- Mengel, M. & Levermann, A., 2014. Ice plug prevents irreversible discharge from East Antarctica. *Nature Climate Change*, 4(May), pp. 451–455.
- Mouginot, J., Rignot, E. & Scheuchl, B., 2014. Sustained increase in ice discharge from the Amundsen Sea Embayment, West Antarctica, from 1973 to 2013, pp. 1576–1584.
- Palmer, T.N., 2013. Climate extremes and the role of dynamics. *Proceedings of the National Academy of Sciences*, 110(14), pp. 5281–2.
- Petoukhov, V. *et al.*, 2013. Quasiresonant amplification of planetary waves and recent Northern Hemisphere weather extremes. *Proceedings of the National Academy of Sciences*, 110(14), pp. 5336–5341.
- Petoukhov, V. & Semenov, V.A., 2010. A link between reduced Barents–Kara sea ice and cold winter extremes over northern continents. *Journal of Geophysical Research*, 115, p. 11 PP.
- PIK, 2013. The C-Story of Human Civilization. Available at: <https://www.pik-potsdam.de/services/infodesk/cstory>
- Rahmstorf, S., 2002. Ocean circulation and climate during the past 120,000 years. *Nature*, 419(6903), pp. 207–14.
- Ridley, J. *et al.*, 2010. Thresholds for irreversible decline of the Greenland ice sheet. *Climate Dynamics*, 35(6), pp. 1049–1057.
- Rignot, E. *et al.*, 2004. Accelerated ice discharge from the Antarctic Peninsula following the collapse of Larsen B ice shelf. *Geophysical Research Letters*, 31(18), pp. 2–5.
- Robinson, A., Calov, R. & Ganopolski, A., 2012. Multistability and critical thresholds of the Greenland ice sheet. *Nature Climate Change*, 2(4), pp. 1–4.
- Rockström, J. *et al.*, 2009. A safe operating space for humanity. *Nature*, 461(7263), pp. 472–5.
- Rothman, D.H. *et al.*, 2014. Methanogenic burst in the end-Permian carbon cycle. *Proceedings of the National Academy of Sciences*, 111(15), pp. 5462–7.
- Rott, H. *et al.*, 2011. The imbalance of glaciers after disintegration of Larsen-B ice shelf, Antarctic Peninsula. *The Cryosphere, Volume 5, Issue 1, 2011*, pp. 125–134, 5, pp. 125–134.
- Scambos, T.A. *et al.*, 2004. Glacier acceleration and thinning after ice shelf collapse in the Larsen B embayment, Antarctica. *Geophysical Research Letters*, 31, p. L18402.
- Schellnhuber, J. *et al.*, 2012. Turn Down the Heat: Why a 4°C Warmer World Must be Avoided. *World Bank*.
- Schneider von Deimling, T. *et al.*, 2012. Estimating the near-surface permafrost-carbon feedback on global warming. *Biogeosciences*, 9(2), pp. 649–665.
- Screen, J.A. & Simmonds, I., 2014. Amplified mid-latitude planetary waves favour particular regional weather extremes. *Nature Climate Change*.
- Shakhova, N. *et al.*, 2013. Ebullition and storm-induced methane release from the East Siberian Arctic Shelf. *Nature Geoscience*, 7(1), pp. 64–70.
- Vidal, J. & Carrington, D., 2013. Is climate change to blame for Typhoon Haiyan? *The Guardian*.
- Walter Anthony, K.M. *et al.*, 2012. Geologic methane seeps along boundaries of Arctic permafrost thaw and melting glaciers. *Nature Geoscience*, 5(6), pp. 419–426.
- WBGU, 2014. Human progress within planetary guard rails. A contribution to the SDG debate. *Policy Paper*, 8.
- WBGU, 2009. Solving the climate dilemma: The budget approach. *Special Report*.

- WBGU-Symposium, 2012. Towards Low-Carbon Prosperity: National Strategies and International Partnerships, (May).
- Whiteman, G., Hope, C. & Wadhams, P., 2013. Vast costs of Arctic change. *Nature*, 499(7459), pp. 401-3.
- Zickfeld, K. *et al.*, 2013. Long-Term Climate Change Commitment and Reversibility: An EMIC Intercomparison. *Journal of Climate*, 26(16), pp. 5782-5809.

AN OCEANOGRAPHIC PERSPECTIVE

■ WALTER MUNK

I have spent my career trying to *understand* ocean processes such as waves, tides, tsunamis, ocean circulation, and climate. We have learned a lot, but we have a lot to learn. I will give a very abbreviated account of recent findings. The next step is to use our understanding (limited as it may be) to develop a sensible interaction with the planet and all its marine and terrestrial inhabitants; this is the more difficult task. An absolute prerequisite is for natural scientists to work together with those concerned with social sciences and ethics. I am grateful to the organizers of this conference for bringing these groups together.

1. History

Astronomers and Geophysicists began studying climate change long before the discovery of greenhouse gases. Newtonian perturbations in the orbits of Sun, Earth, and Moon are associated with severe, but somewhat predictable climate changes. From 20,000 to 10,000 years ago the Earth emerged from its last ice age. The transition consisted of melting continental ice sheets with an attendant global sea level rise (GSR) of 100 m in 100 centuries, followed by a current relatively stable epoch. By the 20th century GSR had slowed from 1 m/cy to 0.1 m/cy. When I first arrived at Scripps in 1939, the prevailing view was that the ice age cycle was coming to an end and that we were heading towards a new ice age; how clever of civilization to combat this danger by releasing a little CO₂ into the atmosphere... *or maybe not!*

2. Variability & Prediction

By the start of the 21st century, the GSR had doubled from 0.15 to 0.30 m/cy. The traditional GSR was based on the measurements from a global distribution of tide gauges. Tide gauge records are difficult to interpret as the gauges are attached to the “solid” earth which moves up and down nearly as much as the mean sea level. (In Venice, for example, the sinking of San Marco by 0.20 m/cy needs to be added to a global 0.30 m/cy for a total sea level rise of 0.5 m/cy; a serious consideration when evaluating the effectiveness of the Venice Gates).

By the end of the 20th century, the dependence on classical tide gauges was replaced by satellite altimeters that measure sea level relative to the center of the Earth. The observed doubling in GSR coincided with a transition of observing technique, very suspicious. Some years ago when oceanographers switched from Nansen bottles to bathythermographs for measuring temperature the ocean suddenly warmed! (It has since been proven by Australian oceanographer John Church that the 21st century GSR acceleration was real).

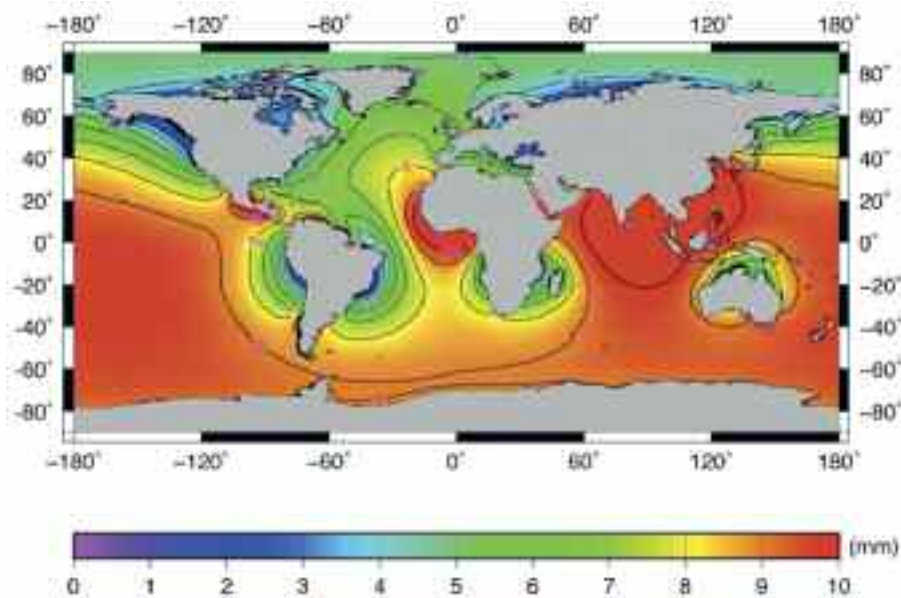


Figure 1. Annual Sea Level “Fingerprint” measured by the GRACE satellite mission (Velicogna personal communication). The removal of snow from Greenland is associated with an elastic rise in landmass, yielding low values in the *relative* rise of sea level in the area. (Courtesy of Isabella Velicogna).

The 20th century value of 0.15 m/cy was primarily due to the melting of glaciers and continental ice sheets. Would it approach the 1 m/cy rate experienced from 200 to 100 centuries ago? A major contribution to the acceleration comes from the melting of the Greenland icecap, with a total capacity of 10 m GSR (as compared to 100 m for the Antarctic). Monitoring the two icecaps has become a major issue. Fortunately the GRACE satellite configuration offers a timely and elegant solution for accurate meas-

urements of the change in snow mass (Figure 1). Grace consists of two identical spacecraft flying in an identical polar orbit 500 km above the Earth, separated by 200 km, measuring changes in the distance between them to an accuracy of 0.01 mm. As the twin GRACE satellites circle the globe 15 times a day, they sense minute variations in Earth's gravitational pull. When the first satellite passes over a region of slightly stronger gravity, it is pulled slightly ahead of the trailing satellite. This causes the distance between the satellites to increase. The first spacecraft then passes the anomaly, and slows down; meanwhile the following spacecraft accelerates, then decelerates over the same point. By measuring the constantly changing distance between the two satellites and combining that data with precise GPS positioning one can construct a detailed map of Earth's mass anomalies.

GRACE measurements show a disturbing acceleration of Greenland glaciers melting. A linear extrapolation yields 1,850 and 1,000 gigatons/year loss for Greenland and Antarctica, respectively, by the end of this century. The corresponding values of global sea level rise are 0.52 and 0.28 mm/year for a total of 0.8 mm/year (0.8 m/century), close to the 1 m/century experienced at the end of the last ice age. But I cannot emphasize enough that there is no physical basis for assuming a uniform acceleration; it could be smaller, it could also be larger!

3. Feedback

The difficulty with predicting GSR is the expectation of powerful feedbacks (negative and positive) which may cancel (or double) GSR for decades at a time. The most immediate feedback is the polar floating ice field, which is rapidly shrinking, and one of these days will lead to an ice-free Arctic summer. When? Estimates vary between a few years (Peter Wadhams) and a few decades (Ola Johannessen). While the melting of FLOATING ice does not directly affect sea level (Archimedes Principle), it has a powerful effect on the albedo; ice is more reflective than water. The disappearance of the floating ice sheet is accompanied by rapid ocean warming and acceleration in the melting of adjacent Greenland glaciers previously discussed. On the other hand, a warmer ocean with enhanced evaporation is associated with increased cooling by increased cloudiness. These are conflicting feedbacks.

Then there is the problem of the melting of permafrost and the release of trapped methane. I would not be surprised if changes in wind stress lead to significant variations in the Gulf Stream, but I don't know whether these changes will be up or down. Changes in ocean circulation are associated with rapid changes in LOCAL sea level. A fair summary is that feedbacks

are not well understood and can lead to some big surprises. Climate change and associated side effects are not smooth monotonic processes; their high variability makes it difficult to persuade society to take them as seriously as they must be taken.

4. Human Interference with Radiation Balance

There is a radical new development: humanity is not only the victim of climate change; we are the perpetrators (Paul Crutzen calls the present era the Anthropocene). As such, we have the ethical obligation to mitigate unfavorable climate change. The temperature of the planet is subject to a very sensitive balance between incoming and outgoing radiation. Disturbing the balance by just a few watts per square meters significantly changes the climate. This happens naturally by well-understood orbital perturbations. Human transgressions have now resulted in the uncontrolled release of greenhouse gases into the atmosphere, upsetting the critical radiation balance.

I think I express the view of the majority of experts who have studied this problem with the following statements:

- A generational transition from fossil energy to other energy sources (solar, wind, nuclear...) is within the technological competence of our civilization, and could go a long way towards halting further imbalance of the planet radiation budget.
- To accomplish this will require international collaboration on an unprecedented scale.
- The restoration to pre-industrial standards and, thus, the sustainability of our planet, depends largely on ocean mixing, which has a millennium time scale.*

5. Closing With a Ray of Hope

I promised to end with a ray of hope. Will you permit me to speculate along lines where others in this audience have far more experience.

Brian Tucker was one of my Geophysics Ph.D. students at Scripps in 1975. Tucker has devoted his career to the reduction of casualties from natural disasters. His company *GeoHazards International* has worked for 23 years in 20 countries. I believe what he has learned is relevant to our task.

*The time scale for mixing the ocean is of the order L^2/Nu where L is the ocean mixing depth and Nu the turbulent diffusivity. For $L = 1000\text{m}$ and $\text{Nu} = 5 \times 10^{-5} \text{ m}^2/\text{s}$ the time scale is 700 years!

1. Tucker (2013) has considered the history of three severe earthquakes in developed vs. developing countries.

	Chile (developed)	Haiti (developing)
1960	M(9.5): severe casualties	
2010	M(8.8): 0.1% casualties	M(7.0): 11% casualties

After a magnitude 9.5 earthquake in 1960, Chile embarked on a robust earthquake safety program, developing and enforcing modern building codes. During the same period, Haiti, lulled by two centuries of seismic quiescence and hampered by poverty, disregarded earthquake risk.

In 2010 large earthquakes struck both countries. How did the resulting losses compare?

- 0.1% of Chilean citizens who experienced severe shaking died.
- 11% of Haitian citizens who had experienced equivalent shaking died.

The Chilean effort had been enormously successful: their buildings were 100 times less lethal than the Haitian buildings.

2. Tucker evaluated Chile's safety program and determined:

- The cost of PREPAREDNESS and PREVENTION was one twentieth the cost of RESPONSE, RECOVERY and RECONSTRUCTION for somewhat equivalent results:

A shilling of PP is worth a pound of RRR

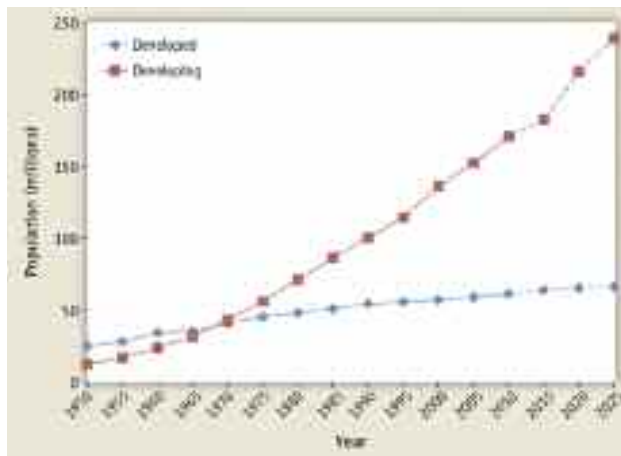


Figure 2. Increasing urban earthquake risk for developed and developing countries (Tucker 2013). Fifty-year increase in the population of the 25 most populous cities that are within 100 km of a seismic fault capable of generating a Mag 7 earthquake (Courtesy *Science Magazine*).



Figure 3. Coastal housing in Port-au-Prince, Haiti, a developing country.

3. Figure 2 shows the total population since 1950 of “developing” and “developed” cities, selected from the world’s 50 most populous cities that are located within 100 km of a fault capable of generating an earthquake with $M \geq 7$. Over the past 60 years, the number of people exposed to strong earthquake shaking in cities in developed countries has grown from 25 to 70 million, in developing countries from 15 to 240 million! Accounting for changes in both population and the quality of seismic-resistant construction suggests that over this period, the relative earthquake risk for cities in developing countries, compared to that of cities in developed countries, has increased by 2 to 3 orders of magnitude. Figure 3 (Port-au-Prince) is an example of such a megacity in a developing country.

Figures 4 and 5 depict two selected sites at LOW and HIGH TIDES

The tidal rise in sea level is well predicted, providing a six-hour window for a leisurely evacuation.

Large tsunamis can be of equivalent amplitude, but they are not yet predictable and the time for evacuation is short. Think of the dry and flooded coastlines pictured above as being separated by an interval of only 15 minutes! We need to make progress in earthquake and tsunami predictions and develop tsunami-warning systems with designated escape routes. Some low-lying areas are building mounds to which people can more readily escape.

LOW TIDE at 1 P.M.**HIGH TIDE at 5:50 P.M.**

Figure 4. St. Mary's Lighthouse, Whitley Bay, Northumberland, 17 and 20 September 2008 (Photos by Michael Marten).

LOW TIDE at 12 Noon**HIGH TIDE at 8 P.M.**

Figure 5. Perranporth, Cornwall, 29 and 30 August 2007 (Photos by Michael Marten).

At the opposite extreme is an equivalent rise in sea level associated with global warming. The evacuation time is now measured in centuries, giving adequate opportunity for an orderly and fiscally responsible transition. Low lying areas should be converted from dense housing to parklands with flood-resistant vegetation.

Multimega coastal cities in developing nations are a disaster waiting to happen. Here again, Preparedness and Prevention are far more effective and affordable than emergency response.

References

Tucker, Brian 2013. Reducing Earthquake Risk. *Science* 341, 1070-1072.

Velicogna, Isabella (in preparation). Ice Sheets and Land Water Mass Contribu-

tion on Seasonal, Inter-annual and Long-term Regional Sea Level from GRACE, in SAR and Regional Climate Model Output (University of California, Irvine).

▶ IV. COMPETING DEMANDS ON NATURE AS A SOURCE

CAN WE “SAVE” THE OCEAN?

■ NANCY KNOWLTON

From Unbounded Optimism to Overwhelming Despair

When people first settled the coasts, near the dawn of mankind, the ocean was both a source of food and a source of fear. With time, the fear decreased, the benefits grew, and the ocean became a great highway linking the continents, a source of great wealth as its riches were extracted, and a convenient rubbish dump. Throughout these many millennia it was inconceivable that humans could change the ocean through their activities – it was simply too vast. In 1884, Thomas H. Huxley wrote that “Probably all the great sea-fisheries are inexhaustible; that is to say that nothing we do seriously affects the number of fish...”. Even as late as 1955, “The Inexhaustible Sea” was written by Francis Minot.

And vast the ocean still is, covering 71% of the earth’s surface and representing perhaps 95% or more of the habitable biosphere, numbers that become achingly real when we try to find the remains of a jet lost on the ocean floor. Yet despite its almost incomprehensible size, the ocean is now a strikingly different place from that experienced by our distant and even more recent ancestors, thanks to our actions. Indeed, it is so different that we find it difficult to imagine how it once was – a place where cod could be scooped out in baskets and sailors could navigate by the sounds made by turtles. Our failure to recognize how much the ocean has changed is due to the phenomenon of shifting baselines – we redefine what was “normal” (and hence how much has changed) based on how the world was during childhood (Jackson *et al.* 2011).

It is only recently, thanks in part to the new field of historical ecology, that we have begun to grasp what we have lost. Today, in the era now known as the Anthropocene, we live with an ocean much diminished by our actions:

- The vast majority (perhaps 90%) of predatory fish have been taken from the ocean (Myers and Worm 2003). The consequences spread far beyond the fish – the loss of their vital roles in ecosystems have caused coral reefs to be smothered by seaweeds and seagrasses to succumb to disease (Jackson *et al.* 2001).
- Entire habitats are under threat, with 35% of mangroves (Valiela *et al.* 2001), 61% of living coral (Jackson 2008), 29% of seagrass beds (Waycott

et al. 2009), and 85% of oyster beds (Beck *et al.* 2011) severely damaged or gone.

- Thanks to nutrient pollution, dead zones so devoid of oxygen that almost nothing can live have proliferated around our coastal seas, at last count numbering more than 400 (Diaz and Rosenberg 2008).
- Invasive species brought to foreign shores by aquarists, aquaculture and ships have spread to all but 16% of marine ecosystems (Molnar *et al.* 2008), with lionfishes eating what few fish remain in the Caribbean, and smothering seaweeds taking over the Mediterranean.
- The oceans are getting inexorably warmer (0.4° C since the 1950s) thanks to the emissions of carbon dioxide, with consequences already seen in shifting species ranges and coral reefs that bleach and die (Doney *et al.* 2012).
- A substantial proportion of the carbon dioxide released to the atmosphere has already dissolved in the ocean, causing ocean acidity to rise by 26% (Doney *et al.* 2012), and studies suggest more profound changes will come in the future (Fabricius *et al.* 2014).
- Although complete extinctions have to date been limited in the ocean, perhaps no more than 21 species in total (del Monte-Luna *et al.* 2007), many species are effectively extinct in terms of the ecological roles that they play, and untold numbers may already be doomed due to “extinction debts”.
- And last but certainly not least, human welfare has suffered, including an economic loss of 50 billion US dollars annually from mismanaged fisheries alone (World Bank and Food Agriculture Organization 2008).

The seemingly never ending onslaught of bad news about the ocean has led to a profound attitude shift in the public and even among many marine scientists over the last half century, from unbounded optimism to overwhelming despair. Indeed we seem to have gone from thinking that the ocean is too big to hurt to thinking that the ocean is too big, and too far gone to help.

Moving Beyond the Obituaries

A number of years ago, I founded the Center for Marine Biodiversity and Conservation at the Scripps Institution of Oceanography. The centerpiece of the educational program was a 10-week summer course, which

we kicked off with horror stories about the ocean. Year after year, we watched our eager young charges mentally (if not physically) slump in their chairs, as the scope of destruction was painted in grim detail.

Eventually I started to question the wisdom of what we were doing. The contrast between human medicine and conservation (or planetary medicine, if you will) was striking – medical students are taught how to make and keep people healthier while we were teaching our students how to write ever more refined obituaries of nature.

Others working in the field of conservation have also come to the conclusion that messages of doom and gloom do not, on their own, motivate people to behave in a more nature-friendly fashion (Knight 2013) – recognition of a problem needs to be coupled with ideas or examples of solutions. Nevertheless, it is doom and gloom that still dominates too much of the conservation conversation. This is perhaps unsurprising in the public realm, where “if it bleeds, it leads” remains the prevailing dictum in the newsroom. It is perhaps more surprising that even professionals in the field of ocean conservation are often unaware or at least silent on the subject of the many successes that have occurred. Indeed, at times it seems as if a reverse form of the shifting baselines syndrome is at work, where we forget how bad things once were.

And so began the “Beyond the Obituaries” project, collecting stories of success in ocean conservation, and it is a sampling of these that I wish to share with you today. These stories of success are important not only as a source of inspiration and guidance for those who wish to bring the ocean back to health. One critical lesson we have learned is that because the ocean suffers from multiple stressors, tackling those that can be addressed now, in particular local problems such as overfishing and pollution, can provide a measure of resilience to those threats that are tougher in the short term to reduce, in particular the rising concentrations of carbon dioxide in the atmosphere.

So while I am by no means oblivious to the enormous threats that still face ocean life and ecosystems, I would prefer to focus on elements of the positive. Perhaps most importantly for this particular gathering, some of the most striking examples of success come from small groups of people with little money succeeding through the power of community in bettering the health of the ocean and their own well-being. Below I review some of the strategies being used to protect and restore the health of the ocean.

Protecting Species

Hunting and fishing of ocean life was the first way humans substantially affected the ocean, and harvesting remains the most influential of all human

impacts (Jackson *et al.* 2001). In our history we have first sought out big creatures, and because big creatures often reproduce slowly, they are very vulnerable to humans with spears, harpoons and guns. Some did not survive the onslaught – the great auk, the sea mink, and the Caribbean monk seal are no longer with us. Steller’s sea cow was exterminated a mere 27 years after its discovery (Turvey and Risley 2005).

Yet some of most striking success stories concern these large charismatic species (Lotze *et al.* 2011). There are numerous examples of success stories in groups as diverse as whales, turtles, seabirds and sharks, although as Lotze and colleagues stress, recovery can take decades in long-lived species and complex ecosystems, some species fail to recover in response to conservation measures, and only rarely have “pristine” numbers been regained. In some cases harvesting has been largely or entirely banned because numbers were so critically low or because public attitudes about hunting specific types of organisms shifted (e.g. marine mammals, some shorebirds).

Most recently, wildlife scarcity has shifted the economics of harvesting such that organisms are now much more valuable alive than dead (e.g. Anderson *et al.* 2011, although with some unfortunate counter examples in highly prized fishes like the bluefin tuna). Where hunting is inadvertent and species are being killed accidentally as bycatch, changes in fishing technologies can help, although good relationships among fishers, scientists and managers, monitoring and enforcement are required for success (Cox *et al.* 2007).

We are currently in the midst of a fascinating change in the attitudes toward and actions associated with the protection of sharks. Shark numbers have been decimated, in large part associated with the lucrative trade in shark fins, made worse by the fact that sharks, unlike fishes, typically have very slow reproductive rates. Fins were once de rigueur for any high-prestige Asian banquet, but alarm at plummeting numbers and disgust with the practice of dropping finless-but-still-living sharks back into the ocean to slowly die is creating an environment of rapid change. Bans in shark fishing, shark finning, and the sale of shark fins have been increasing around the world. Particularly on coral reefs where tourism dollars can dominate the economy of developing countries, sharks have been shown to be far more valuable swimming than in a net (a single shark in a popular dive site has been estimated as worth \$35,000 annually, and in the Maldives shark-based ecotourism contributes >30% to the Maldives’ GDP; Gallagher and Hammerschlag 2011). But even in areas where shark tourism is not a major activity, appealing to environmental ethics has been a powerful tool at a variety of scales, ranging from cities to countries.

Protecting Spaces

Marine Protected Areas, or more broadly ocean zoning, is a key component of many if not most marine conservation plans. The general logic is relatively straightforward, although the details often are not. But put simply, the concept is that just as on land, in the ocean we need to protect some places completely and regulate human activities in others. The problems stem from 1) trying to determine the best mixture of activities for what areas, 2) getting local cooperation, without which enactment and compliance is effectively impossible, and 3) determining how to make such plans financially sustainable. It remains the case that only a small fraction of the world's ocean habitat is truly protected, and about 60% of the ocean remains outside of any Exclusive Economic Zone (EEZ) (Orbach 2003). Yet this is an area of many successes as well.

The Great Barrier Reef (GBR) of Australia is often touted as the gold standard of ocean zoning. The product of years of negotiations with stakeholders, in 2003 a zoning plan that protected more than 33% of the marine park from all fishing was announced. In many ways the GBR is a success story (McCook *et al.* 2010). In particular, devastating outbreaks of crown of thorns starfish are lower, and numbers of fish and abundance of coral has increased in no-take areas. Yet despite the large area protected (exceeding the 30% that is often cited as an optimistic goal for the world as a whole), there are still signs of trouble, particularly in areas close to human populations. Notably, there has been a 50% loss of live coral cover between 1985 and 2012 due to a large extent to cyclones, coral bleaching, and predation by crown of thorns starfish, the latter probably fueled by nutrients from agricultural runoff (De'Ath *et al.* 2012). This illustrates that particularly in areas with large rainfall, linkages between land and sea require that adjacent lands be managed as well. Recent controversial approval of an expanded coal port within the park also illustrates how successes need constant support, as there is always the potential for things to get worse again.

The story of Cabo Pulmo, Mexico presents an interesting counterpoint to the story of the GBR (Aburto-Oropeza *et al.* 2011). In this case a small village banded together thanks to the visionary leadership of a local leader, who became convinced that unsustainable fishing was destroying their future. The Cabo Pulmo Marine Park was established in 1995, and by 2009 fish biomass had increased by 463%; notably, during the same time interval there were no increases in fish biomass for the federally managed marine parks. These biological outcomes were accompanied by a substantial increase in local income as well. The latter was driven primarily by small-scale tourism, which in 2006 generated 18,000 USD per capita for the 30 people involved,

an amount significantly above the per capita Gross National Income of Mexico. Now a UNESCO World Heritage Site, it still remains, like the Great Barrier Reef, vulnerable, ironically in this case due to its own success, with continuing pressure to build mega-resorts in the immediate vicinity.

Replicating the successes of these marine protected areas is a widely held goal in marine conservation. The biggest challenge is often determining how to weather the initial declines in local incomes associated with protection before the benefits of recovered fish populations and tourism are established. Fortunately, the benefits often exceed the costs within as little as five years (Sala *et al.* 2013), with benefits derived from both increased catches and tourism; the latter typically exceed the former where dive-related tourism is feasible.

Harvesting for the future

Although protecting species and the places where they live from human harvesting are important strategies for marine conservation, they cannot be the only solution. The sea is a critical source of protein for over two billion people, and managing that harvest sustainably is an essential challenge to meet. Here too there are welcome examples of success.

Fisheries experts have long known that harvesting at moderate rates yields higher returns and a stable future. The problem has been achieving these sustainable harvest levels through mechanisms that are broadly acceptable to fishing communities. One approach has been the issuing of individually owned fishing rights, often referred to as catch shares, much as taxis are regulated in some cities through the issuance of taxi medallions. A wide-ranging review of this strategy suggests that catch shares can have substantial beneficial effects (Costello *et al.* 2008). There are, however, governance challenges associated with such things as setting the appropriate prices and numbers of permits based on stock assessments.

In developing countries, centrally controlled efforts to manage fishing levels are often less successful, and data are also often inadequate (Costello *et al.* 2012). In such cases Territorial Users Rights for Fishing (TURFs) and fisheries cooperatives have in a number of cases proved remarkably successful. A well-documented example is that of the Chilean fisheries for locos, a small but highly prized intertidal snail that became severely overfished. With the establishment of locally managed fisheries, however, numbers have rebounded and are indeed as high in areas managed by TURFs as they are in no-take areas (Gelcich *et al.* 2010). Moreover, other aspects of ecosystem health have improved as well.

Making fishing less destructive is also a strategy for conservation success. Sea floor trawling is the poster child of destructive fishing, and many chal-

allenges remain (Puig *et al.* 2012). However, the selective banning of gill nets in the near shore waters of coastal California has led to several impressive recoveries (Pondella and Allen 2008). The use of fish traps in tropical waters that allow small or narrow fish to escape or for traps to decompose if lost (to eliminate ghost fishing) has considerable potential (e.g. Johnson 2010).

On land, we have largely replaced hunting and gathering with agriculture, and in the ocean aquaculture is an increasingly important source of marine food, providing close to 50% of the world's seafood. Unfortunately, many of the initial aquaculture efforts caused considerable problems of their own, including local pollution and overfishing of food for aquacultured species. Now, however, methods in many places have greatly improved, with the potential to safely reduce pressure on wild stocks. This has led to calls to use a variety of methods to encourage aquaculture sustainability (Bush *et al.* 2013).

Reducing Pollution

Pollution is often the first thing that comes to mind when people are asked about threats to the environment. Oil spills, because of the spectacular scenes of death and destruction that result, are often listed by the public as the number one threat to the ocean. Similarly, photographs of dead seabirds whose guts are filled with cigarette lighters, ignite widespread disgust and increasing attention to the problem of plastic marine debris (Derraik 2002). Beach clean-ups are popular activities, but clearly this is a problem that needs to be addressed at the source. In 2002 in Ireland, a 15 Euro cent tax was introduced and resulted in a 90% reduction in the use of plastic bags, as well as associated reductions in litter, and has been popular with the public as well (Convery *et al.* 2007). Plastic bag bans or taxes are increasingly spreading throughout the US and elsewhere.

DDT was once one of the most damaging pollutants globally, but it is now banned in many parts of the world. The toxic crisis caused by this pesticide was described by Rachel Carson in *Silent Spring*, a book that in many ways launched the environmental movement in the United States. Birds at the top of the food chain suffered catastrophic nest failures because accumulated DDT caused thinning of eggshells. The power of Carson's book led to a banning of the use of DDT in the US in 1972, and with it the recovery of many birds, including the magnificent fish-eating osprey (whose recovery was also aided by other restoration efforts) (Henny *et al.* 2010). These birds are so common now that they are unremarkable, and today many people are unaware of how perilously dire their situation once was.

One of the biggest pollutants in coastal seas are things that in small amount aren't harmful at all, namely nutrients. The widespread application

of large amounts of fertilizers even far from the ocean has led to eutrophication and dead zones. These are places where nutrients fuel an explosion of single celled algae in the plankton that then die and become food for bacteria, which in turn suck all the oxygen out of the water. Around the world the numbers of dead zones – places where oxygen is so low that no complex animal life can survive – is currently tallied at over 400 (Diaz and Rosenberg 2008). Though the numbers of dead zones continues to increase, there are moves afoot to limit the flow of nutrients into rivers and hence the sea. One particularly simple strategy is to plant strips of forest along rivers and streams, where they suck up the nutrients before they get to the water (Committee on Environment and Natural Resources 2010).

Restoring Habitats

Marine communities are often structured by what are called ecosystem engineers, the large organisms that create the three-dimensional structure upon which other organisms depend. When organisms like seagrasses, shellfish, mangroves, or corals disappear or are greatly reduced, meaningful conservation depends on restoring these critical organisms. Once restored, the rest of the community can often rebound unaided. This may seem simple, but untold millions have been spent on failed restoration efforts. The first rule of thumb is that whatever was responsible for the loss of the engineers in the first place must be eliminated first. In some cases, conditions must even be hyper-restored (that is made more favorable than they were previously) or restored in a large scale fashion, because a state change has occurred that impedes recovery.

For example, elimination of oysters results in large, silty expanses that can be easily stirred up, smothering any new oysters that naturally recruit or are placed in restoration efforts. As a consequence, restoration must be done on a large scale, creating substantial three-dimensional structure in order to overcome the changed situation (Schulte *et al.* 2009). After decades of decline, genuine success in oyster and other shellfish restoration is being seen. These efforts have the advantage of not only returning a complex habitat but also filtering and cleaning seawater that flows over these biogenic reefs. Restoration typically depends on not only replacing the organisms that have been lost, but also restoring the conditions that favor their growth and reproduction. Pollution abatement and fishing controls are thus often components of restoration efforts.

Sometimes habitat restoration involves not rebuilding depleted species but rather eliminating invasive ones. This is hard to do, unfortunately, and essentially impossible once invasive species have become established. The

overwhelming of native seagrass beds in the Mediterranean by the invasive alga *Caulerpa*, and the rapid establishment of the invasive lionfish throughout Caribbean waters are but two examples. An ounce of prevention is worth a pound of cure.

Why Reducing Local Impacts Now Matters

I have focused in this paper on threats that can be reduced by local actions. This is not to demean the extraordinary severity of global threats, in particular the consequences of increasing concentration of carbon dioxide in the atmosphere. But reducing local threats makes it easier for organisms and communities to deal with the effects of global change, either by increasing resistance or resilience. For example, unstressed coral reefs appear to be better able to resist disease and to have larger numbers of juvenile corals, suggesting higher potential recovery rates from disturbances that cannot be prevented (Sandin *et al.* 2008). Thus local actions buy marine organisms, communities, and the humans that depend on them valuable time, while the global community slowly coalesces around the challenges associated with switching from a carbon-based economy. The more we can encourage taking such local actions, the more time we will have. In the end, then, this is a matter of replicating small solutions to achieve a global scale. Entities that work at local scales have an enormous role to play in facilitating this process, so that conservation becomes a global passion rather than an elite pastime.

Bibliography

- Aburto-Oropeza, O, B Erisman, GR Gal-land, I Mascarenas-Osorio, E Sala, E Ezcurra. 2011. Large recovery of fish biomass in a no-take marine reserve. *PLoS One* 6: e23601.
- Anderson, RC, MS Adam, A-M Kitchen-Wheeler, G Stevens. 2011. Extent and economic value of manta ray watching in Maldives. *Tourism in Marine Environments* 7: 15-27.
- Beck, MW, RD Brumbaugh, L Airoidi, A Carranza, LD Coen, C Crawford, O De-Feo, GJ Edgar, B Hancock, MC Kay, HS Lenihan, MW Luckenbach, CL Toropova, G Zhang, X Guo. 2011. Oyster reefs at risk and recommendations for conservation, restoration, and management. *Bio-science* 61: 107-116.
- Bush, SR, B Belton, D Hall, P Vandergeest, FJ Murray, S Ponte, P Oosterveer, MS Islam, APJ Mol, M Hatanaka, F Kruijssen, TTT Ha, DC Little, R Kusumawati. 2013. Certify sustainable aquaculture? *Science* 341: 1067-1068.
- Committee on Environment and Natural Resources. 2010. Scientific assessment of hypoxia in coastal waters. Interagency Working Group on Harmful Algal blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.
- Convery, F, S McDonnell, S Ferreira. 2007.

- The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental Resource Economics* 38: 1-11.
- Costello, C, SD Gaines and J Lynham. 2008. Can catch shares prevent fisheries collapse? *Science* 321: 1678-1681.
- Costello, C, D Ovando, R Hilborn, SD Gaines, O Deschenes, SE Lester. 2012. Status and solutions for the world's unassessed fisheries. *Science* 338: 517-520.
- Cox, TM, RL Lewison, R Zydalis, LB Crowder, C Safina, AJ Read. 2007. Comparing effectiveness of experimental and implemented bycatch reduction measures: the ideal and the real. *Conservation Biology* 21: 1155-1164.
- De'Ath, G, KE Fabricius, H Sweatman, M Puotinen. 2012. The 27-year decline of coral cover on the Great Barrier Reef and its causes. *Proceedings of the National Academy of Sciences* 109: 17995-17999.
- Del Monte-Luna, P, D Lluch-Belda, E Serviere-Zaragoza, R Carmona, H Reyes-Bonilla, D Auriolles-Gamboa, JL Castro-Aguirre, SA Guzman del Proo, O Trujillo-Millan, BW Brook. 2007. Marine extinctions revisited. *Fish and Fisheries* 8: 107-122.
- Derraik, JGB. 2002. The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin* 44: 842-852.
- Diaz, RJ and R Rosenberg. 2008. Spreading dead zones and consequences for marine ecosystems. *Science* 321: 926-929.
- Doney, SC, M Ruckelshaus, JE Duffy, JP Barry, F Chan, CA English, HM Galindo, JM Grebmeier, AB Holloway, N Knowlton, J Polovina, NN Rabalais, WJ Sydeman, LD Talley. 2012. Climate change impacts on marine ecosystems. *Annual Review of Marine Science* 4: 11-37.
- Fabricius, KE, G De'ath, S Noonan, S Uthicke. 2013. Ecological effects of ocean acidification and habitat complexity on reef-associated macroinvertebrate communities. *Proceedings of the Royal Society B* 281: 20132479.
- Gallagher, AJ and N Hammerschlag. 2011. Global shark currency: the distribution, frequency, and economic value of shark tourism. *Current Issues in Tourism* 14: 797-812.
- Gelcich, S, TP Hughes, P Olsson, C Folk, O Defeo, M Fernandez, S Foale, LH Gunderson, C Rodriguez-Sickert, M Scheffer, RS Steneck, JC Castilla. 2010. Navigating transformation in governance of Chilean marine coastal resources. *Proceedings of the National Academy of Sciences* 107: 16794-16799.
- Henny, CJ, RA Grove, JL Kaiser, BL Johnson. 2010. North American osprey populations and contaminants: historic and contemporary perspectives. *Journal of Toxicology and Environmental Health B* 13: 579-603.
- Jackson, JBC. 2008. Ecological extinction and evolution in the brave new ocean. *Proceedings of the National Academy of Sciences* 105: 11458-11465.
- Jackson, JBC, MX Kirby, WH Berger, KA Bjorndal, LW Botsford, BJ Bourque, RH Bradbury, R Cooke, J Erlandson, JA Estes, TP Hughes, S Kidwell, CB Lange, HS Lenihan, JM Pandolfi, CH Peterson, RS Steneck, MJ Tegner, RR Wagner. 2001. Historical overfishing and the collapse of coastal ecosystems. *Science* 293: 629-638.
- Jackson, JBC, K Alexander, E Sala. 2011. *Shifting Baselines*. Island Press, Washington, DC.
- Johnson, AE. 2010. Reducing bycatch in coral reef trap fisheries: escape gaps as a step towards sustainability. *Marine Ecology Progress Series* 415: 201-209.
- Knight, AT. 2013. Reframing the theory of hope in conservation science. *Conservation Letters* 6: 389-390.
- Lotze, HK, M Coll, AM Magera, C Ward-Paige, L Airoli. 2011. Recovery of marine animal populations and ecosystems. *Trends in Ecology and Evolution* 26: 595-605.

- McCook, LJ, T Ayling, M Cappo, JH Choat, RD Evans, DM de Freitas, M Heupel, TP Hughes, GP Jones, B Mapstone, H Marsh, M Mills, FJ Molloy, CR Pitcher, RL Pressey, GR Russ, S Sutton, H Sweatman, R Tobin, DR Wachenfeld, DH Williamson. 2010. Adaptive management of the Great Barrier Reef: a globally significant demonstration of the benefits of networks of marine reserves. *Proceedings of the National Academy of Sciences* 107: 18278-18285.
- Molnar, JL, RL Gamboa, C Revenga, MD Spalding. 2008. Assessing the global threat of invasive species to marine biodiversity. *Frontiers in Ecology and the Environment* 6: 485-492.
- Myers, RA, B Worm. 2003. Rapid worldwide depletion of predatory fish communities. *Nature* 423: 280-283.
- Orbach, M. 2003. Beyond the freedom of the seas: ocean policy for the third millennium. *Oceanography* 16: 20-29.
- Pondella DJ and LG Allen. 2008. The decline and recovery of four predatory fishes from the Southern California Bight. *Marine Biology* 154: 307-313.
- Puig, P, M Canals, JB Company, J Martin, D Amblas, Galderic Lastras, A Palanques, AM Calafat. 2012. Ploughing the deep sea floor. *Nature* 489: 286-290.
- Sala, E, C Costello, D Dougherty, G Heal, K Kelleher, JH Murray, AA Rosenburg, R Sumaila. 2013. A general business model for marine reserves. *PLoS One* 8: e58799.
- Sandin, SA, JE Smith, EE DeMartini, EA Dinsdale, SD Donner, AM Friedlander, T Konotchick, M Malay, JE Maragos, D Obura, O Pantos, G Paulay, M Richie, F Rohwer, RE Schroeder, S Walsh, JBC Jackson, N Knowlton, E Sala. 2008. Baselines and degradation of coral reefs in the Northern Line Islands. *PLoS One* 3: e1548.
- Schulte, DM, RP Burke, RM Lipcius. 2009. Unprecedented restoration of a native oyster metapopulation. *Science* 325: 1124-1128.
- Turvey, ST and CL Risley. 2009. Modelling the extinction of the Steller's sea cow. *Biology Letters* 2: 94-97.
- Valiela, I, JL Bowen, JK York. 2001. Mangrove forests: one of the world's threatened major tropical environments. *BioScience* 51: 807-815.
- Waycott, M, CM Duarte, TJB Carruthers, RJ Orth, WC Dennison, S Olyarnik, A Calladine, JW Fourqurean, KL Heck, AR Hughes, GA Kendrick, WJ Kenworthy, FT Short, SW Williams. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences* 106: 12377-12381.
- World Bank and Food and Agriculture Organization. 2008. *The Sunken Billions: Economic Justification for Fisheries Reform*. The World Bank, Washington DC

TROPICAL FORESTS, FOR RICHER AND FOR POORER

■ JEFFREY R. VINCENT

This chapter provides an economic perspective on the importance of tropical forests to global humankind. It starts by reviewing trends in global forest areas, to provide context for the issues discussed in subsequent sections of the chapter. Important trends include not only the outright loss of forest cover, or deforestation, but also a second trend that has been overshadowed by deforestation, forest degradation. The chapter then discusses the economic importance of tropical forests, both to the citizens of the countries where they are located and to the rest of the world. That discussion emphasizes several points: the industrial forest sector's typically small share of GDP belies the substantial contribution of tropical forests to household incomes in poor rural areas; tropical forests provide global public goods related to climate stabilization and biodiversity conservation; and tropical forests are increasingly concentrated in higher-income developing countries, which is raising the value that domestic populations within tropical countries place on protecting their forests. The chapter closes by reviewing evidence on the effectiveness of the three main types of programs that have been implemented to reduce tropical deforestation and degradation: protected areas, community management rights, and payments for ecosystem services. The main conclusions are that the evidence base is narrow and that research on the effectiveness of forest conservation programs needs to broaden its geographic scope, consider impacts on not only deforestation but also degradation, and become more economic in the sense of evaluating the benefits and costs of programs and not only their impacts measured in physical terms.

Although the chapter focuses on tropical forests, available information often pertains to forests in developing countries, not all of which are in the tropics. The overlap between tropical regions and developing regions is close enough, however, that any errors that result from basing inferences about tropical forests on information about forests in developing countries are likely to be inconsequential, at least for the issues considered in this chapter. And in any event, throughout the chapter I will make clear the types of forests to which I am referring: tropical, developing-country, or otherwise.

Trends in tropical deforestation and degradation

Global forests face two major threats, deforestation and degradation. *Deforestation* refers to the conversion of forests to other land uses, mainly agriculture. During 2000–2010, a net total of 5.3 million hectares of forest was converted to other uses annually, for a deforestation rate of 0.13% per year (Table 1). With one exception (Australia), all of the countries with large losses in forest area during this period were tropical developing countries (FAO 2010b, p. 21). At a pantropical level, large-scale and small-scale agriculture were about equally important drivers of forest conversion 1990–2000 (UNEP, FAO, and UNFF 2009, p. 22). Large-scale agriculture for such crops as oil palm, rubber, and soybeans was relatively more important in Asia and Latin America, while small-scale agriculture for subsistence and cash crops was relatively more important in Africa.

Degradation results mainly from the harvesting of forests for timber and fuelwood. Harvesting, on its own, generally does not result in deforestation in the sense of complete and permanent loss of tree cover (Geist and Lambin 2001). A harvested forest contains fewer trees than the original forest, however, and its ecological processes may take decades or even centuries to recover (Rey Benayas *et al.* 2009). In these senses, it is in a degraded state compared to the original, pre-harvest forest. The best available global measure of forest degradation is the loss in area of primary forests: “forests of native species in which there are no clearly visible signs of past or present human activity” (FAO 2010b, p. 11). Primary forests are also known as virgin or old-growth forests. As of 2010, about a third of the world’s forests were primary (FAO 2010b, p. 26), with most of the area being in the tropics (FAO 2010b, p. 55). During 2000–2010, global primary forest area declined by 4.2 million hectares annually, or 0.37% per year (Table 1). As with deforestation, most of the decline occurred in tropical developing countries. Note that the global hectareage degraded according to this measure was not much less than the global hectareage deforested during the same period: degradation ran nearly neck-and-neck with deforestation in absolute terms. But because most of the world’s forests are not primary, degradation outraced deforestation in percentage terms.

Degradation shows fewer signs of slowing down than deforestation does. In both absolute and relative terms, deforestation was much lower during 2000–2010 than 1990–2000, when global forest area declined by 8.2 million hectares annually, or 0.20% per year. The chief explanation for the slowing of global deforestation between the two decades is a reversal of the trend in forest area in Asia, from net loss to net gain: mainly in China, but also in India and Vietnam (FAO 2010b, p. 18, 21). In contrast, degradation barely slowed

Table 1. Status and trends in total forest area and primary forest area. Source: FAO (2010b, Tables 2.3, 2.4, 3.1, and 3.3).

a. Total forest area

Region	Area (2010) <i>million ha</i>	Change: 2000–2010		Change: 1990–2000	
		<i>million ha/yr</i>	<i>%/yr</i>	<i>million ha/yr</i>	<i>%/yr</i>
Eastern & Southern Africa	268	-1.84	-0.66	-1.84	-0.62
Western & Central Africa	328	-1.54	-0.46	-1.64	-0.46
East Asia	255	+2.78	+1.16	+1.76	+0.81
South & Southeast Asia	294	-0.68	-0.23	-2.43	-0.77
Central America	19	-0.25	-1.19	-0.37	-1.56
South America	864	-4.00	-0.45	-4.21	-0.45
World	4033	-5.21	-0.13	-8.32	-0.20

b. Primary forest area

Region	Area (2010) <i>million ha</i>	Change: 2000–2010		Change: 1990–2000	
		<i>million ha/yr</i>	<i>%/yr</i>	<i>million ha/yr</i>	<i>%/yr</i>
Eastern & Southern Africa	6	-0.06	-0.88	-0.06	-0.78
Western & Central Africa	28	-0.52	-1.66	-0.50	-1.47
East Asia	25	-0.17	-0.46	-0.11	-0.63
South & Southeast Asia	81	-0.35	-0.29	-0.24	-0.41
Central America	4	-0.05	-1.52	-0.07	-0.98
South America	624	-3.10	-0.46	-2.96	-0.46
World	1102	-4.67	-0.37	-4.19	-0.40

between 1990–2000 and 2000–2010: the decline in global area of primary forests during 1990–2000 was 4.7 million hectares annually, or 0.40% per year.

Economic importance of tropical forests

From an economic standpoint, deforestation and degradation are “problems” only if forests matter to human well-being. Conventional national accounting measures suggest that global forests contribute little to global economic output. According to estimates reported in FAO (2009, p. 70), the sum of value-added in roundwood production (i.e., timber harvesting), wood processing (e.g., lumber, plywood), and pulp and paper processing accounted for just 1% of global GDP in 2006. Moreover, this percentage has declined fairly steadily since 1990, when it was about 1.5%. The forest sector would thus appear to be a small and declining sector of the global economy.

Conventional national accounts do not record all of the economic contributions of forests, however. The amounts just cited refer only to the value-

added associated with harvesting and processing wood and wood fiber as industrial raw materials. Forests provide many other goods and services in addition to this (Fig. 1 in Croitoru 2007). For example, fuelwood accounts for about the same global harvest volume as does timber (FAO 2010a, p. 7), but its value is not fully reflected in GDP because it is often a subsistence product collected by local households. Forests are also a source of many other subsistence products, including game, wild fruits, and medicinals. Villagers, pastoralists, and ranchers in countries around the world graze livestock in forests. Forests provide a variety of nonextractive services; for example, they serve as locations for recreation, and they protect water quality. Some forest-related services are global public goods. Two that have attracted particular policy attention are carbon sequestration, which helps mitigate global climate change, and biological diversity, whose sheer existence can be valued by individuals in other parts of the world who never expect to visit the forests that harbor it.

Valuing nontimber goods and services

The development of theoretically sound methods for valuing nonmarket goods and services has been one of the central concerns of environmental and resource economists for the past half-century (Mäler and Vincent 2005, Freeman, Herriges, and Kling 2014). Many studies have applied these methods to tropical forests. A late-2013 search of forest-related keywords (“forest”, “rainforest”, “woodland”, “trees”, “endangered species”) in the leading global database on valuation studies, the Environmental Valuation Reference Inventory (EVRI; www.evri.ca/Global/Home.aspx), returned 117 studies having been conducted in developing countries. Already two decades ago, Lampietti and Dixon (1995) conducted a global review of the much smaller number of forest valuation studies that had been conducted in developing countries at that time, along with similar studies conducted in developed countries. They found that the sum of nontimber values was about the same as timber value in developing countries and about twice the timber value in developed countries (Table 2). Hence, the total economic value of forests was about two to three times the timber value.

The most rigorous cross-country forest valuation study to date is probably a study of countries in the Mediterranean region by Croitoru (2007). That study is worth considering here despite its nontropical focus, because it attempted to value an even wider range of nontimber goods and services than did the studies available to Lampietti and Dixon, adding carbon values and grazing values to the list. Due to the combination of these additional nontimber values and a smaller estimate of timber values, it reported a

Table 2. Relative importance of timber and nontimber values within total economic value of forestland. Source: author calculations, based on information presented in indicated sources.

Good or service	Lampietti & Dixon (1995):		Croitoru (2007):
	Developing countries	Developed countries	Mediterranean countries
Timber	50%	33%	20%
Fuelwood and minor forest products	31%	0%	25%
Grazing	n.e.	n.e.	10%
Recreation, sport hunting, fishing	7%	56%	17%
Watershed services	5%	5%	11%
Carbon sequestration	n.e.	n.e.	5%
Passive use (option and existence values)	7%	7%	13%

n.e.: not estimated by authors.

higher ratio of total value to timber value than did Lampietti and Dixon: about five (Table 2). The results of these two studies suggest that the annual global economic contribution of the world's forests, inclusive of nontimber values, can be crudely estimated by multiplying the global GDP share cited earlier by a factor of two to five. The resulting estimate remains very small, just 2-5 % of global GDP. Forests still appear to be relatively unimportant in macroeconomic terms, even after accounting for nontimber values.

Tropical forests and rural livelihoods

This crude estimate might well be accurate at a global level, but it is a highly misleading indicator of the economic importance of forests in specific locations. In particular, forests can be very important to human well-being at a local scale in rural areas of tropical countries. The Economics of Ecosystems and Biodiversity (TEEB), which is a global initiative hosted by the United Nations Environment Program (UNEP), has usefully compared conventional GDP shares for the aggregate agriculture, forestry, and fisheries sector to estimates of the "GDP of the poor", which focuses on the contributions by forests and other local ecosystems to the livelihoods of poor rural households in those countries (TEEB 2010, p. 15). TEEB reported estimates for three large developing countries, Brazil, India, and Indonesia. The conventional GDP shares ranged from 6% to 17%, but the shares for the "GDP of the poor" were much larger: 47% in India, 75% in Indonesia, and 89% in Brazil. The numbers of people involved were large too: according to TEEB's estimates, 20 million in Brazil, 99 million in Indonesia, and 362 million in India.

Other evidence confirms that forests are important to local livelihoods in developing countries. The fact that fuelwood accounts for half of global wood harvest hints at forests' major role as a local energy source. Solid biomass, mostly fuelwood, accounts for more than 40% of household energy consumption in most countries in Sub-Saharan Africa and many countries in Central America and Southeast Asia (UNEP, FAO, and UNFF 2009, pp. 30–31). As of 2000, nearly two billion people in Asia and more than half a billion people in Africa relied on biomass for cooking and heating (UNEP, FAO, and UNFF 2009, pp. 31).

The Poverty Action Network of the Center for International Forestry Research (CIFOR) recently completed a comprehensive study on the contribution of forests to total household income (including subsistence) in rural areas of tropical and subtropical developing countries (Angelsen *et al.* 2014). The study surveyed nearly 8,000 households in more than 300 villages in 24 tropical and subtropical countries. All the villages had moderate to good access to forest resources, which characterizes many villages in tropical and subtropical countries. The mean share of forest income was 10–40% in most of the villages. Forest income was split about equally among three product categories – fuelwood (including charcoal), food and medicinals, and building materials (somewhat small than the other two categories) – and it was about five times larger than income from other local environmental sources, such nonforest wildlands (grasslands, bushlands, wetlands), fallows, and wild plants and animals harvested from croplands (Table 3).

Tropical forests and global public goods

The forest sector's small share of conventional global GDP therefore obscures the great importance of tropical forests to rural households. It also obscures the large contributions of these forests to two global environmental public goods: the stability of the earth's climate, and the preservation of biological diversity. According to the latest report of Working Group III of the Intergovernmental Panel on Climate Change (IPCC 2014b, p. 7), forests accounted for about a tenth of global greenhouse gas emissions in 2010. Most of these emissions were from deforestation and forest degradation in tropical countries. In fact, forests in temperate and boreal regions of North America and Eurasia have been net carbon "sinks" for decades, due to expanding forest areas and growth of the trees within them (UNEP, FAO, UNFF 2009, p. 36).

Tropical and subtropical moist forests ("rainforests") are the most biologically rich terrestrial ecosystems in the world, providing habitat for some 20,000 known vertebrate species (UNEP, FAO, UNFF 2009, p. 39) and millions of

Table 3. Sources of total household income in rural areas of tropical and subtropical countries. Source: Angelsen *et al.* (2014, Table 1).

Income category	Global	Africa	Asia	Latin America
Environmental	27.5%	30.1%	22.0%	32.1%
Natural forests	21.1%	20.5%	18.4%	28.5%
Other ecosystems	6.4%	9.6%	3.7%	3.6%
Crops and livestock	41.0%	43.9%	42.3%	30.2%
Wages	15.2%	10.7%	17.6%	22.6%
Other	16.3%	15.3%	18.1%	15.1%

invertebrate and plant species. Other types of tropical and subtropical forests provide habitat for fewer but still large numbers of vertebrate species, about 7,000 for dry broadleaf forests and 4,000 for coniferous forests. Although these numbers are smaller than for tropical and subtropical moist forests, they are larger than for the corresponding forest types in temperate and boreal zones: about 4,000 species for temperate broadleaf and mixed forests, 3,000 species for temperate coniferous forests, and only 1,000 species for boreal forests. The risk of species extinctions is higher in tropical forests than in temperate and boreal forests for the same reasons that carbon emissions are higher in tropical forests, namely higher rates of deforestation and degradation.

Policy debates about greenhouse gas emissions and biodiversity losses in tropical forests have tended to focus more on deforestation than does forest degradation. This is perhaps natural, given that deforestation entails more dramatic ecological changes than degradation does. A degraded forest is still a forest, after all. The global environmental impacts of forest degradation in the tropics are attracting increased attention, however. This is apparent from the evolution of the acronyms for the United Nations' lead initiative to reduce greenhouse gas emissions from tropical forests. This initiative was initially known as RED, for Reduced Emissions from Deforestation. It then took a tentative step beyond deforestation by becoming RED(D), with the parenthetical "D" standing for degradation. It fully embraced degradation in 2008, when it became simply REDD.

Research confirms that the degradation of tropical forests can have a large impact on both greenhouse gas emissions and biodiversity losses. The most careful large-scale comparison of greenhouse gas emissions from tropical deforestation and degradation is probably a study by Asner *et al.* (2010) in the Peruvian Amazon. The study took detailed carbon measurements in a landscape spanning 4 million hectares by integrating data from satellites, airborne sensors, and field plots. It found that degradation was responsible

for a third of forest-related greenhouse gas emissions during 1999–2009, with deforestation responsible for the balance.

The best available information on the effects of deforestation and degradation on tropical biodiversity is a meta-analysis by Gibson *et al.* (2011), which analyzed 138 studies conducted at 92 sites in 28 tropical countries. It confirmed that primary tropical forests contain significantly more biodiversity than not only sites that have been deforested (active and abandoned croplands, pastures, and plantations) but also ones that have been degraded (selectively logged forests, secondary forests, agroforestry). According to the measure that Gibson *et al.* developed to compare the disparate biodiversity indicators reported in the original studies, the effects of deforestation ranged from 0.5 to 1.1 while the effects of degradation ranged from 0.1 to 0.7, with larger values indicating greater biodiversity losses and the median effect across all types of disturbance being 0.5.

Tropical countries and the value of public goods from forests

Unlike the rural poor who benefit from the contributions of tropical forests to their livelihoods, many of the beneficiaries of global public goods provided by tropical forests live in Europe, North America, and other developed regions, outside the countries where the forests are located. This is the rationale for programs like REDD and the Global Environment Facility, which channel funding from developed countries to developing countries in support of projects that reduce deforestation and degradation. A major concern within the global conservation community is that international flows of funding are below the amounts required to achieve the 2020 biodiversity protection targets set by the UN Convention on Biological Diversity (UNEP 2012), in addition to being below the commitments made by developed countries at the 1992 Earth Summit (Miller, Agrawal, Roberts 2012). UNEP (2012) estimates that a total investment of \$74–121 billion is required during 2014–18, while Miller, Agrawal, and Roberts (2012) estimate that the actual flow of biodiversity aid has averaged \$1.1 billion since 2002.

The fact that global environmental public goods associated with tropical forests have beneficiaries outside tropical countries does not mean that they do not also have beneficiaries within those countries, however. Information in the latest report of IPCC Working Group II (IPCC 2014a) indicates that tropical countries will benefit greatly if dangerous levels of climate change are avoided. They will avoid losses in agricultural productivity, increased morbidity and mortality from climate-related illnesses, and damage to coastal cities from sea-level rise.

In the case of biodiversity, in a recent paper my coauthors and I draw attention to the increasing concentration of tropical forests in relatively wealthier developing countries and the resulting impact on forest protection values (Vincent *et al.* 2014). As of 2010, countries that the World Bank classifies as upper-middle-income (UMI) – the “richest” developing-country tier – accounted for about half of total forest area across all tropical countries. They accounted for an even larger share of primary forest area in tropical countries, 80%. Only nine tropical countries were in this group in 1990, but the number had grown to 27 by 2010. To be sure, most tropical countries are not in this group, and even UMI tropical countries have large numbers of poor households. Yet, it is more and more misleading to equate “tropical countries” with “poor countries.”

My coauthors and I investigated the implications of this trend for forest protection values and conservation finance by compiling and analyzing information from a large number of cross-country datasets and our own large-scale population survey in Malaysia. We found evidence that demand for forest protection by the populations of tropical countries has risen significantly as incomes have grown in these countries. More interesting, we found evidence that the increased public demand has outstripped increases in the creation and funding of protected areas. People in tropical countries, especially UMI tropical countries, want more forest protection than their governments are supplying. This imbalance suggests that domestic funding raised within UMI tropical countries could play a larger role in closing the funding gap for tropical forest conservation.

Results of the Malaysian survey reveal that citizens of that particular UMI country value forest protection to a large extent because they value the preservation of threatened and endangered species found in the forest. They value forest protection even when it does not benefit them more directly, for example by enhancing recreational opportunities or mitigating floods (although they value those uses, too). This “passive use” value is different from the more tangible contribution of tropical forests to household livelihoods, which is also important in poor rural areas of Malaysia. Tropical forests can thus benefit both richer and poorer households in the developing countries where they are found, though not necessarily for the same reasons.

Addressing tropical deforestation and degradation

Programs aimed at reducing tropical deforestation and degradation fall into three major categories: protected areas, community management rights, and payments for ecosystem services. Each of these programs encompasses a larger forest area than it did twenty years ago. *Protected areas* restrict the use of forestland

to varying degrees, in some cases prohibiting conversion but allowing timber harvesting (e.g., national forests) and in other cases prohibiting both activities (e.g., national parks). During 1990–2010, the area of forests designated for protection of biodiversity increased by about a tenth in Africa, a third in Asia, and more than a factor of two in South America (FAO 2010a, p. 6). *Community management rights* aim to strengthen incentives for sustainable forest management by giving local communities more authority to determine who is allowed to use the forest and how they can use it (Ostrom 1990, Baland and Platteau 2003). During 1990–2005, the area of public forest managed by local communities nearly quadrupled in developing countries, approaching 200 million hectares (FAO 2010b, p. 126). Nearly all of this increase occurred in South America. *Payments for ecosystem services* (PES) compensate forest owners for refraining from converting or harvesting forests, depending on the specific PES program, with the payments coming from beneficiaries of ecosystem services provided by the forests (Engel, Pagiola, and Wunder 2008). UN-REDD is an example of a global PES program aimed at tropical forests. Most domestic examples within tropical countries pertain to watershed services. As of 2011, there were 113 active watershed payment programs in developing countries, with another 53 in development (Bennett, Carroll, and Hamilton 2013, pp. x–xi).

Evaluating program impacts

Determining the impact of forest conservation programs is important for designing more effective responses to deforestation and degradation, but it is not easy (Ferraro and Pattanayak 2006, Joppa and Pfaff 2010). One cannot simply compare the deforestation rate in a particular location before the introduction of a program to the rate afterwards, because an observed decrease in the deforestation rate could be due to other factors. For example, introduction of a program might happen to coincide with a weakening of demand for agricultural commodities, which made conversion of forests to agriculture less profitable. For similar reasons, one cannot simply compare the deforestation rate in the program location to the rate in a location where the program has not been implemented. The two locations might differ in ways besides the presence or absence of the program, and one or more of those differences could also influence the rate.

Economists have developed a suite of methods that address these challenges for programs in general (not specifically conservation programs) and isolate the impact of a program from other factors that potentially confound it (Ravallion 2008; Imbens and Wooldridge 2009). These impact evaluation methods are being increasingly applied to forest conservation programs. A recent review of such applications by Miteva *et al.* (2012a) turned up several

pertinent findings, all of which point toward the evidence base for conservation effectiveness being narrow and somewhat shaky. The total number of applications to forest conservation programs is still small, less than a dozen studies for each of the three program categories. Studies on PES programs cover just three countries, all in Latin America. The situation is little better for protected areas: in-depth studies have been conducted for just four countries, two in Latin America and two in Asia, in addition to a couple of broader-brush cross-country studies. African applications of impact evaluations exist only for community management rights. The literature is also narrow in terms of the conservation outcomes evaluated. No study has evaluated the impact of a given program on both deforestation and degradation. In fact, no study has evaluated the impacts of protected areas or PES programs on degradation;¹ all of the studies on protected areas and PES programs have evaluated impacts only on deforestation.

Given the narrowness of this information base, caution is required when drawing general conclusions about the effectiveness of forest conservation programs. Miteva *et al.* (2012a) conclude that evaluations of protected areas “seem to suggest that PAs [protected areas] are effective at stalling deforestation” (p. 75), at least in terms of achieving “modest reductions” (p. 69). Evidence is “less consistent” (p. 79) for community management rights, where there is “limited evidence” of a “positive impact on forest degradation” (p. 75; i.e., the programs reduced degradation), and PES programs, where studies “tend to find reduced deforestation and increased reforestation” (p. 77) but with the effects on deforestation being smaller than for protected areas (p. 79).

It is therefore currently not possible to state with any confidence the relative contributions of different forest conservation programs on the substantial reduction in tropical deforestation that occurred between 1990–2000 and 2000–2010. This task is made more difficult by the time periods analyzed by many of the studies that have evaluated these programs being restricted to just a few years during the 2000s (see Tables 1 and 2 in Blackman 2013). It is even less possible to say anything definitive about the role of these programs in reducing degradation, which most of the studies have ignored.

Making impact evaluations more economic

Impact evaluation research has the potential to generate insights that can make forest conservation programs more effective, but to achieve this

¹ One study on protected areas examined impacts on forest fires, a proxy for degradation.

potential it must broaden its scope in terms of the countries considered, the time periods analyzed, and the outcomes evaluated (in particular, degradation in addition to deforestation). It also needs to change in another way: it must become more economic (Vincent, in review). It must consider the benefits and costs of the programs evaluated and not just the programs' impacts on physical outcome measures such as area deforested, which is the normal practice. The reason physical measures are inadequate is straightforward: a program that reduces deforestation by only a small amount could still be economically justified if the forest thereby preserved provides goods and services whose value exceeds the program's costs. By the same logic, a program that reduces deforestation less than an alternative program could still be the better program if its benefits exceed its costs by a greater margin.

The potential discrepancy between physical and economic outcome measures is related to the heterogeneity of tropical forests. I have alluded to heterogeneity at several points in this chapter: for example, in the distinction between primary forests and other forests, differences in species numbers across different types of tropical forests, and varying contributions of forests to rural livelihoods. Heterogeneity affects both the benefits that tropical forests provide to humans and the costs of protecting or managing forests to supply those benefits. A study by Pattanayak and Kramer (2001) on a reforestation program in Ruteng National Park in Indonesia provides a dramatic example of the influence of forest heterogeneity. The authors investigated the effect of reforestation on streamflow available for use by farmers downstream from the park. They found that the effect varied greatly across the 37 watersheds in the park: it increased streamflow by large amounts in some watersheds and by small amounts in others, it actually *decreased* streamflow in about half of the cases. Clearly, a meaningful evaluation of the reforestation program would need to account for the fact that reforestation sometimes benefited farmers and sometimes harmed them (and this is what Pattanayak and Kramer did). Information on just the program's impact on area reforested would serve little purpose.

Miteva *et al.* (2012a) report that the focus of impact evaluation research on forest conservation programs is shifting toward the consideration of heterogeneous effects. This shift is in the right direction. Their review also offers evidence that this research has not entirely ignored economic outcomes: several studies have measured the impact of protected areas on poverty in their vicinity. This outcome measure is obviously an important one, given the role of forests in rural livelihoods. Almost entirely missing from the literature, however, is the measurement of outcomes related to any of the forest-related val-

ues that motivate the creation of conservation programs in the first place: to pick the three most obvious examples, carbon sequestration, biodiversity protection, and watershed services. A pair of studies on Indonesia by Miteva *et al.* (2012b, c) is a rare exception. The literature also suffers from “a glaring lack of cost data” (Ferraro, Hanauer, Miteva *et al.* 2013, p. 6).

Much work remains to close the gap between the impact evaluation research that has been done on forest conservation programs and the more economically relevant research that is needed to understand the effectiveness and efficiency of these programs and how they can be improved. Closing this gap is vital, given the value of tropical forests to human populations both in the countries where they are found and beyond.

References

- Angelsen, A., *et al.* 2014. Environmental income and rural livelihoods: a global-comparative analysis. *World Development*.
- Asner, G.P., *et al.* 2010. High-resolution forest carbon stocks and emissions in the Amazon. *Proc. Natl. Acad. Sci. USA* 107:16738–16742.
- Baland, J.M., and J.P. Platteau. 2003. Economics of common property management regimes. In K.G. Mäler and J.R. Vincent, eds., *Handbook of Environmental Economics, Vol. 1: Environmental Degradation and Institutional Responses*. Elsevier, Amsterdam.
- Bennett, G., N. Carroll, and K. Hamilton. 2013. *Charting New Waters: State of Watershed Payments 2012*. Ecosystem Marketplace, Washington, D.C.
- Croitoru, L. 2007. How much are Mediterranean forests worth? *Forest Policy and Economics* 9:536–545.
- FAO. 2009. *State of the World's Forests 2009*. UN Food and Agriculture Organization, Rome.
- FAO. 2010a. *Global Forest Resources Assessment 2010: Key Findings*. UN Food and Agriculture Organization, Rome.
- FAO. 2010b. *Global Forest Resources Assessment 2010: Main Report*. UN Food and Agriculture Organization, Rome.
- Engel, S., S. Pagiola, and S. Wunder. 2008. Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65:663–674.
- Ferraro P.J., M.M. Hanauer, D.A. Miteva, *et al.* 2013. More strictly protected areas are not necessarily more protective: Evidence from Bolivia, Costa Rica, Indonesia, and Thailand. *Environ Res Lett*. DOI 10.1088/1748-9326/8/2/025011.
- Ferraro, P.J., and S. Pattanayak. 2006. Money for nothing? A call for empirical investigation of biodiversity conservation investments. *PLoS Biology* 4(4):e105.
- Freeman, A.M. III, J.A. Herriges, and C.L. Kling. 2014. *The Measurement of Environmental and Resource Values: Theory and Methods*. RFF Press, Washington, D.C.
- Geist, H.J., and E.F. Lambin. 2001. What drives tropical deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. *LUCC Report Series No. 4*. Department of Geography, University of Louvain, Louvain-la-Neuve, Belgium.
- Gibson, L., *et al.* 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. *Nature* 478:378–381.
- Imbens, G.W., and J.M. Wooldridge. 2009. Recent developments in the economet-

- rics of program evaluation. *J. Econ. Lit.* 47:5–86.
- IPCC. 2014a. Summary for policymakers. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA.
- IPCC. 2014b. Summary for policymakers. In *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA.
- Joppa, L., and A. Pfaff. 2010. Reassessing the forest impacts of protection: the challenge of nonrandom location and a corrective method. *Annals of the New York Academy of Sciences* 1185:135–149.
- Lampietti, J.A., and J.A. Dixon. 1995. To see the forest for the trees: a guide to nontimber forest benefits. *Environment Department Paper No. 13*. World Bank, Washington, D.C.
- Mäler, K.G., and J.R. Vincent, eds. 2005. *Handbook of Environmental Economics, Vol. 2: Valuing Environmental Changes*. Elsevier, Amsterdam.
- Miller, D.C., A. Agrawal, and J.T. Roberts. 2012. Biodiversity, governance, and the allocation of international aid for conservation. *Conservation Letters* 6:12–20.
- Miteva, D.A., S.K. Pattanayak, and P.J. Ferraro. 2012a. Evaluation of biodiversity policy instruments: what works and what doesn't? *Oxford Review of Economic Policy* 28:69–92.
- Miteva, D.A., S.K. Pattanayak, and B.C. Murray. 2012b. Protected areas and ecosystem services in Indonesia. Working paper, Duke University.
- Miteva, D. A., B.C. Murray, and S.K. Pattanayak. 2012c. Factors determining the effectiveness of protected areas in preserving mangroves in Indonesia: a quasi-experimental impact evaluation. Working paper, Duke University.
- Ostrom, E. 1990. *Governing the Commons*. Cambridge University Press, Cambridge, UK.
- Pattanayak, S.K., and R.A. Kramer. 2001. Worth of watersheds: a producer surplus approach for valuing drought mitigation in Eastern Indonesia. *Environment and Development Economics* 6:123–146.
- Ravallion, M., 2008. Evaluating anti-poverty programs. In T. Schultz and J. Strauss, eds., *Handbook of Development Economics, Volume 4*. North-Holland, Amsterdam.
- Rey Benayas, J.M. et al. 2009. Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *Science* 325:1121–1124.
- TEEB. 2010. *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature – A Synthesis of the Approach, Conclusions and Recommendations of TEEB*. UNEP, Nairobi.
- UNEP/FAO/UNFF. 2009. *Vital Forest Graphics*.
- Vincent, J.R. In review. Impact evaluation of forest conservation programs: benefit-cost analysis, without the economics.
- Vincent et al., J.R. 2014. Developing countries may be willing to pay to protect their own tropical rainforests. *Proc. Natl. Acad. Sci. USA*.
- UNEP. 2012. Full assessment of the amount of funds needed for the implementation of the Convention for the sixth replenishment period of the trust fund of the Global Environmental Facility. UNEP/CBD/WG-RI/4/INF/10 (www.cbd.int/wgri4/documents/).

THE PROMISE OF MEGA-CITIES: MOVING FROM DESPAIR TO HOPE

Urban Informality and the Favelas of Rio de Janeiro

■ JANICE PERLMAN

“Change is not only a question of doing things better but of doing better things”¹

Living the urban reality

It is widely accepted today that cities are a positive force in global development and that the future of the planet depends on the future of its cities. Urban life provides opportunities to *do things better* and *to do better things*. It holds the promise of improving the quality of life for the migrants and, even more so, for their children and grandchildren.

Global urbanization is the expression of freedom of choice – it is rural people “voting with their feet” by coming to cities to start life anew – often risking all they have to do so. While the growth of cities in Western Europe and the Americas has leveled off, the growth of cities in Asia and Africa is still rising and is re-shaping our geo-political, social and environmental landscape. Cities are growing by some 70 million people a year or 1.4 million people a week. That means that a city the size of the size of Venice is added every day and one the size of Munich is growing anew every week. Currently over 51% of the world’s population is urban and that percentage is expected to grow to 60% by 2030 and 70% by 2050.

This is good news for several reasons. The concentration of people in dense urban agglomerations frees up land for other uses, as opposed to sprawling suburban subdivisions that eat up land, raise the costs of infrastructure networks and the delivery of social services and increase pollution through home to workplace commuting. The urban half of the world’s 7 billion inhabitants occupies only 2.7% of the land area of the planet. This frees up more space for feeding our population (which is also taking up less land area as technologies improve) and for natural habitats, which are proving so vital to our survival.

¹ Aleem Walji, Director, Innovation Labs, WBI, author of *Striking Poverty*.

There is also a strong correlation between the degree of urbanization and the level of economic development and between the rate of urbanization and the rate of growth in incomes and per capita GDP.

After decades of denial, it is now undeniably clear that virtually all the world's population growth in the coming decades will be urban growth in the cities of the developing countries. And that growth will be concentrated in self-built shantytowns, squatter settlements and slums, known as *informal settlements*. There are already one billion people living in these stigmatized communities and their numbers are expected to double by 2030 and triple by 2050. This means that in just over one generation, one out of every three people on the planet will be living informally – either within the city limits or on the urban peripheries.

These informal settlements fill a pressing need. Neither the private housing market nor the public sector has been successful in providing shelter for new migrants at prices within their reach. They have to fend for themselves by finding unused land and building their homes and communities as best they can. The informal sector grows not because residents are getting “free” public housing or urban amenities, but because cities, especially mega-cities, offer greater choice and opportunity. As this author and others have been arguing since the 1960s, *squatter settlements are not the problem, they are the solution*.

Shacks on invaded lands currently house about 40% of the urban population in developing countries. To accommodate the anticipated population growth over the coming decades will require 35 million units per year or some 96,150 additional homes per day. These will largely be self-help structures built on vacant land, off the street grid and without urban infrastructure or city services.

Research has shown the persistent failure of public policy efforts to stem the tide of city-ward migrants or limit urban growth. Those who come are often the most able with the highest aspirations and achievement needs. Policies such as rural development, closed city policies, zoning restrictions, growth poles and new capital cities have proven unsuccessful in *keepin' 'em down on the farm* once they've seen the equivalent of Paris on their TV. Investment in rural electrification, roads and factories only speeds up the outmigration to the largest cities. Closed city policies work only in “command and control” states such as Cuba, Russia, China, and South Africa during apartheid – and even there, not very effectively. All of them had or have large “floating” populations – unregistered individuals and families – living below the radar.

This means that the “city-as-citadel” is increasingly being beset by the perceived irritation of sharing space with poor migrants from the country-

side – and their families. They share not only physical space but economic, political, cultural, social and ecological space as well, despite all efforts to prevent this. Due to proximity they share the air they breathe, the water they drink, and the soil, including any contaminants that pollute them when so many people are excluded from water, sanitation and solid waste management. Iron grates may provide a sense of safety but no such barriers separate rich and poor from environmental ills.

As a consequence, cities are deeply divided and beset by conflicting claims over whose interests will be served. The struggle over the contested territory and assets of the city and its surroundings is the core issue, played out in public policy and popular protests, whether in terms of access to housing, land, education, health care, transportation or green space. But the city is not a zero sum game, and there are myriad opportunities to expand the pie and distribute its fruit more widely if the short-term demands of the electoral cycle and “impatient capitalism” are overridden by the long-term benefits of social peace, economic growth, and conviviality resulting from an inclusive city.

Experience shows that there is a 25-year lag time between ideas and implementation. It took decades for research on urbanization and squatter communities to be reflected in public policy. From the 1960s research showing that squatter removal and relocation to public housing was a disaster to the first on-site upgrading project by the World Bank took over a decade (1972) and it took another 15 years for national and local governments to follow suit. With the mounting challenges facing cities today we cannot afford to wait another generation for new knowledge to inform the decision-making process.

Our collective ability to integrate informal communities into urban, life and to include the energy and intelligence of their residents as part of the solution, will determine the security and prosperity of our urban future.

Tapping into the potential of the new urban citizens

Mega-cities, those urban agglomerations with ten million people or more, are the most attractive to city-ward migrants and their energy has a strong magnetic pull. As size increases, opportunities proliferate, new kinds of jobs are created and new opportunities appear. As shown in the map below, there are 26 mega-cities today and another 10 about to join the club.

In large cities throughout Asia, Africa and Latin America, squatter settlements have been growing and continue to grow at a faster pace than the city as a whole, starting in the post WWII years. Depending on the level of urbanization, this growth is due to different combinations of incoming migrants

and natural reproduction. In either case, local authorities are confronted with increasing deficits in housing, infrastructure, and urban services.

With limited municipal budgets and regional natural resources reaching the limits of their carrying capacity, the one resource that is in abundance is being overlooked – that is human capital. Growing cities are filled with job seekers who are unemployed or underemployed. As I laid out in my earlier book, *The Myth of Marginality*, the new urban migrants are not the proverbial “bottom of the barrel” but the “cream of the crop” – the ones with the smarts, motivation and aspirations to try something new. They were called “marginal elements” but they were actively marginalized by systemic stigma and exclusion. In fact they were the ones who often worked the longest hours for the lowest wages under conditions that other workers would not tolerate.

One policy opportunity is to see how to re-combine the constrained budgets and natural resources with the abundant human talent to create a virtuous cycle. A good example of this is the Zabaleen in Cairo that turned two problems – lack of income and too much garbage – into a solution. By separating the garbage and selling it to intermediaries in bulk, they earned pennies on the ton, but when they turned it into crafts through weaving, metalworking or melting and casting, they provided livelihoods for the entire community, reduced garbage, replaced donkeys with trucks for solid waste collection and enabled the residents to build decent housing and send their children to school. Other such innovative approaches can be found in every large city if the search is done at the grassroots level and they can be supported by public policy or scaled up by other communities who adapt the idea. In fact, that is precisely the process that we facilitate through our transnational non-profit organization, The Mega-Cities Project, Inc.

Since the recent election of Bill de Blasio as Mayor of NYC, there have been numerous articles in the New York Times, Financial Times, Wall Street Journal, and The Economist about the “tale of two cities” and the negative effects of inequality. For those of us who have worked in international urban development over the past several decades, this is not news. We know first hand the opportunity cost of marginalizing the energetic go-getters and creative problem-solvers living in “irregular settlements”.

Blocking the natural evolution from shantytowns to thriving working class communities and perpetuating the “divided city” is detrimental to urban development and stability. Excluding the urban poor means lost of labor power, productivity; consumer spending and participatory democracy. It also erodes public safety, personal security and resilience to climate change. Urban inequality and lethal violence are related – to have safe streets

The Poverty-Environment Nexus: 6 Lessons from 20 Mega-Cities

(1) There can be no global ecological sustainability without urban ecological sustainability.

- Concentration of the human population in cities is a necessity. Not only do the economies of scale create energy and resource efficiencies, but also, if the entire landmass of the planet were divided into individual household plots, there would be no space left for either agriculture or natural wilderness areas.
- Circular rather than linear systems: As cities concentrate pollution and environmental degradation, transforming the urban metabolism through circular rather than linear systems is the key to reversing our global environmental deterioration. We need to re-use our water and waste streams, and utilize what is now discarded as productive resource.

(2) There can be no urban environmental solution without alleviating poverty. The urban poor tend to occupy the most ecologically fragile areas of our cities, such as steep hillsides, low-lying swamplands, or adjacent to hazardous industries. In addition, their lack of resources often prohibits them from having adequate water, sewage, or solid waste management systems. Without alternative locations and income for basic needs, their survival will be pitted against environmental needs.

(3) There can be no lasting solutions to poverty or environmental degradation without building on bottom-up, community-based innovations. Since creativity was not distributed along lines of race, class, or gender, experts and policymakers are not always the best source of system-transforming innovations. The most creative and resource-efficient solutions to urban problems tend to emerge at the grassroots level, closest to the problems being solved. And, without local participation in implementation, even the best ideas are doomed to failure.

(4) There can be no impact of scale without sharing what works among leaders and scaling up into policy. While small may be beautiful, it's still small and the problems are enormous. In order to have meaningful impact, micro-initiatives need to be replicated across neighborhoods and cities through peer-to-peer learning or incorporated into public policy frameworks.

(5) There can be no urban transformation without changing the old incentive systems and "rules of the game". Since every sector of urban society holds a de facto veto on the others, local innovations can never achieve scale with cross-sectoral partnerships involving government, business, NGOs, academia, media, and grassroots groups. We need to create a climate conducive to experimentation, mutual learning, and collaboration.

(6) There can be no sustainable city of the 21st Century without social justice and political participation, as well as economic vitality and ecological regeneration.

and a secure investment climate, a city needs to embrace conviviality, not add more police.

Research on natural disasters, such as hurricanes, shows that the speed and success of recovery is not determined by wealth or governing institutions, but by the degree of community cohesion and civil society organization. Creative breakthroughs in music, art, theater, design and film often arise from “alternative spaces” and become the vanguard for mainstream cultural trends, not only in their own cities but nationally and internationally. The creative city combines large scale, high density, diverse populations in close proximity to one another, freedom to fail and reward for risk. We need the “other” for stimulation and new ways of thinking.

Urban innovations don’t always come from large budgets, from financing “exposure visits” or from the elaborate hosting of delegations from other cities. Many of the breakthroughs are home grown from the bottom up and then taken to scale. But to me the greatest price for exclusion is the loss of the *intellectual capital* that will be critical to solving the complex problems of our times. Ignoring the brainpower of the bottom billion of the world’s population may be the greatest liability of exclusion. We cannot afford to “throw away” this potential or miss it through lack of opportunity.

Only by working towards inclusive cities can we move towards safe and sustainable cities that can attract investment and create a convivial quality of life. The linkages between cities, environment and poverty are shown in the box.

The Case of Rio de Janeiro, Brazil

Latin America is the most urbanized region in the world with 77% of its population living in cities. Brazil is the most urbanized country in the region and in the world, with 84% of its population living in cities (compared with the United States which has 80.5). The growth of Brazilian cities in the decade from 2000–2010 slowed down to 1.63%, while favelas grew at an annual rate of 4.2%, increasing Brazil’s favela population from 6.5 to 11.4 million people. There are 161 countries in the world with national populations lower than the favela population in Brazil.

Each of the nine metropolitan regions of Brazil has sizeable favela populations, but Rio has the dubious distinction of having the largest number of favelas, favela residents and favela sizes. Rio has about 1,200 identifiable favelas that have been clustered into 763 larger complexes. They house roughly 1.4 million residents, which is 23% of Rio’s population. The next largest favela population is in Sao Paulo, which has 1,280,400 favela residents.

Rio’s urban growth spurt began in the 1950s and since then the growth of favelas has outpaced the growth of the city as a whole in every decade.

The one exception was the 1970s when an estimated 700,000 people were forcibly evicted from their favela communities under the policies of the military dictatorship. Even as Rio's growth rate slowed to barely 3% in the past decade, the favela population grew by 28%.

Re-democratization at the end of the dictatorship in 1985, turned favela removal into a political liability as political parties and candidates competed for votes. Eradication policies gave way to on-site upgrading. The *Favela-Bairro* program, launched in Rio in 1995, became widely known as one of the most ambitious upgrading programs worldwide. The program invested US\$180 million to *integrate favelas into the fabric of the city through infrastructure upgrading and service increases*. It reached 253,000 residents in 73 small and mid-sized favelas.

The new Constitution of 1988 and the City Statute in 2001 guarantee the right to decent housing and introduced the "right to the city" and mandated participatory planning at the local level. In fact in Sao Paulo, squatters occupying an abandoned office building in the decaying downtown recently won a court case enabling them to stay, based on the right to the center of the city.² Here again, Brazil was positioned as a leader of progressive urban policy.

More recently two massive urban investments have been made in Rio's favelas – the PAC (Program for Accelerated Growth) and the UPP (Units of Pacifying Police). Initiated in 2007, at the height of Brazil's economic surplus, PAC invested US\$306 billion over three years to solve long-overdue infrastructure issues as well as prepare for the upcoming mega-events, the World Cup coming up this June, 2014, and the Olympics in 2016. Its Slum Upgrading component in Rio is targeted to the largest favela complexes, but is a source of controversy since the residents have no voice in how the funds will be used. The second phase, PAC 2, began in March 2010, with funding of US\$582 billion from 2011 to 2014.

The UPP, meaning "Units of Pacifying Police", was initiated in 2008 by Rio's Governor Sergio Cabral and his State Public Security Secretary, Jose Beltrame, with the goal of the state re-taking control of the favela territories from the drug traffic. This is carried out through the full time occupation of the favelas by trained and armed military police. It has now reached 38 favelas at expenditure of about \$360 million dollars annually.

² The New York Times, *Immigrants Stir New Life Into São Paulo's Gritty Old Center*, Simon Romero, April 14, 2014 continues with the story of a decadent city center.

Today, some twenty years after the start of Favela-Bairro, and considering all of the investments over the past few years, we are seeing the fragility of favela claims, particularly for those in desirable locations proximate to the sites for the World Cup and Olympics. The residents are once again engaged in a desperate struggle against eviction. This is happening now in the oldest favela in Rio, the Morro de Providencia, and in several other favelas located next to the sites of the sports events. Just as this article was being written the demolition began in a favela called Vila Autodromo, which has been fighting for three years for the right to remain and working with university students and NGOs. Their alternative plan for on-site consolidation and upgrading recently won the Deutsche Bank Urban Age Award, but nonetheless, the bulldozers are there.

I wrote a poem a few years ago to express what cannot be conveyed by research alone:

Why I love favelas

Favela is life; favela is love. Favela is freedom, friendship and feijoada. Favela is people persevering. It is laughter and tears, life and death – only a hairs’-breadth apart. It is a place where the unexpected is expected and spontaneity is the norm. It is not all pain, poverty, and passivity. It is people living their lives amid a civil war.

Giving Voice to the Disenfranchised

When I was an undergraduate anthropology student I did fieldwork in rural villages in the Northeast of Brazil. I was trying to understand how young people develop their worldview and aspirations for their lives. What I discovered was a dramatic change with the introduction of the transistor radio into these villages, which happened while I was there. From then on, all the young people could talk about was going to the big city “where the action was”. That set me on a course of a forty-year study, starting with my doctoral research in 1968-’69 by following migrants as they came into the city of Rio de Janeiro.

During that time I lived in three of Rio’s favelas for six months each. Working with a group of Brazilian students, I interviewed 750 people: 200 randomly selected men and women (16-65 years old) and 50 leaders in each location. This was at the height of the military dictatorship in Brazil. In fact, I had to flee the country towards the end of the study, when I learned I had been accused of being “an international agent of subversion”, the only possible explanation of why an American would be spending so much time in favelas.

The findings from that study became the basis of my book, *The Myth of Marginality* (University of California Press). I kept in touch with the friends

I had made there and the families in whose homes I had lived. Thirty years later I embarked on a re-study, which began with the painstaking location of the surviving study participants. Using some unconventional methods, I was able to find 41% of the 750 original study participants.

Our re-encounter was a powerful emotional experience on both sides. It was joyful and poignant. We laughed and cried. People had gone through a lot in these 30 years and were eager to tell their stories and be heard. They wanted to bear witness, to give testimony, to be understood.

They were also excited to see me again, the young “hippie-looking”, “hard-working” American who had lived among them and shared their daily lives at a time when even bus and taxi drivers were afraid to stop too near to their communities. They were eager to learn about my life story. Was I married? Did I have children? Where was I living? What was I doing?

With a team of Brazilian researchers, I re-interviewed each of them, using an updated form of the same survey instrument and life history matrix. Then we interviewed 368 of their children (who were about the same age as the original sample in '68) and 208 of their grandchildren.

One of the first observations was that the favelas had not been a trap, but for many, a stepping-stone towards formality. Only 1/3 of the original participants had remained in the favela where I had met them; about a fourth had been removed to public housing when their community had been eradicated. By the grandchildren's generation, about half were living in the formal sector, either as renters or as owners in peripheral areas.

It was also obvious that there had been enormous gains in the individual consumption of household goods and in the collective consumption of urban services. Almost all of the houses had electricity and running water, indoor toilets (although not necessarily connected to a sanitation system) and nearly all were made of permanent building materials. Many homes even had air conditioners, plasma TVs, washing machines and other amenities.

There were also impressive gains in educational levels. Illiteracy declined from 72% of the fathers and 94% of the mothers of my original sample, to 45% among them, to 6% among their children to ZERO among their grandchildren. A fourth of the grandchildren had completed Secondary School as compared to none of the original interviewees; and 11% were at university. But, these gains were not fully reflected in their jobs: whereas 85% of children had more education than their parents, only 56% had better jobs. And there was higher unemployment. As the graph below shows, after the first 3 years of school, the income gap between people in favelas and in the rest of the city grew with every additional year of schooling.

That is one reason why in the re-study, people were less likely to say that education was the key to a successful life and much more likely to say WORK – whether informal or formal. The stigma of living in a favela was a strong barrier to being hired. In fact, over the generations stigma by skin color and gender decreased radically, but the stigma of place remained high – the highest basis for discrimination. That was only made worse by the drug-related violence that started growing into the favelas after the return of democracy in 1985. The turf wars among competing drug gangs and the battles between the gangs and the police (less well armed) led to an extraordinarily high level of deaths. About 20% of the people interviewed had lost a family member to homicide.

The fear of removal had been replaced by the fear of dying in the crossfire by what Brazilians call a “bala perdida” – lost bullet. This led to a drastic drop in community unity and in the level of trust in ones neighbors; factors that had helped people cope with daily difficulties of life on the edge. People absorbed the ideology of democracy but were only pseudo-citizens as police neither protected them nor acknowledged their rights under the law. The young people who are the best educated and the most likely to have Internet access are the most cynical about politics and the least participatory.

In my new book, *Favela: Four Generations of Living on the Edge in Rio de Janeiro* (Oxford University Press), I trace these patterns showing them through the lives of the people and families who I am closest to in each community. The last chapter is about the quest for personhood and dignity. The sense of exclusion has gotten worse over time, not better. One of my friends from the first study put it this way:

Janice, when I first met you, I thought that if I got a good job, worked hard, married well, limited my family to two children, gave them a good education, and continued to work after retirement, that I would be gente. But I did all of that and I am “light years away”.

One of the key challenges for our urban future is to master ‘The Art of Inclusive Cities’ and make sure that the “invisible” young men and women in the slums of today, are treated as “gente” so that they may become our leaders tomorrow.

► V. COMPETING DEMANDS ON THE CRYOSPHERE

GLACIERS AS SOURCE OF WATER: THE HIMALAYA

■ ANIL V. KULKARNI

Introduction

The Himalayan region has one of the largest concentrations of glaciers. Major rivers such as Indus, Ganga, Brahmaputra and their numerous tributaries originate from the glacier bound terrain. The contribution of glacier melt in annual stream runoff is substantially higher in Indus basin as compared to Ganga and Brahmaputra (Immerzeel *et al.*, 2010, Singh and Jain 2014). However, well-developed canal network in the Indus basin produces almost 96% and 26% of food production of Pakistan and India respectively (RBI report 2011, Khan *et al.*, 2010). Therefore changes in runoff pattern in Indus basin due to melting glaciers can significantly influence the water and food security of India and Pakistan. Recent studies suggest that rapid mitigation of Green House Gas (GHG) emission i.e. shift from RCP 8.5 pathways to RCP 2.6 could help in conserving Himalayan glaciers and also help in maintaining present pattern of stream runoff (Chaturvedi *et al.*, 2014).

Observed changes in Himalayan glaciers

In Indian Himalaya, glacier inventory is carried out by numerous agencies and based on data as topographic maps, aerial photographs and satellite images. Our best estimate for areal extent of glaciers in the Indian Himalaya is $25,041 \pm 1726$ sq. km (Kulkarni and Karyakarte 2014). In the Himalaya, the glacier covered area is approximately 60,054 sq. km (Bajracharya and Shresta, 2011). The estimated total glacier water stored in Indian Himalaya is 3600 to 4400 Gt (Kulkarni and Karyakarte 2014).

The observations on glacier retreat and possible reasons behind these changes are important to assess future changes in the Himalayan glaciers. In Himalaya, extensive investigations have been carried out to estimate the loss in glacier length and areal extent. The long-term retreat of 81 glaciers, where position of terminus is measured using field data, suggests mean retreat of 621 ± 468 m between year 1960 to 2000 (Kulkarni and Karyakarte 2014). The large standard deviation suggests large variation in the glacier retreat in different regions (Figure 1).

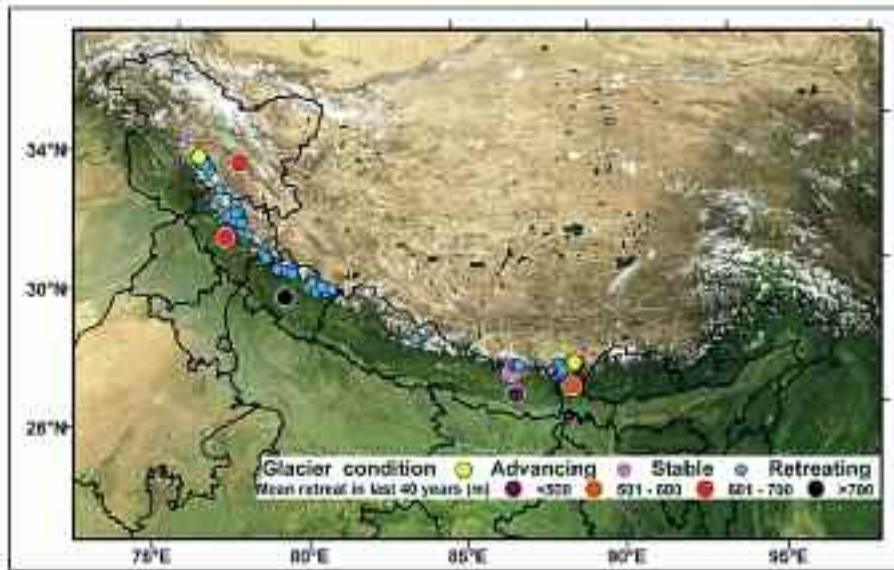


Figure 1. Location of glaciers and amount of retreat between 1960 and 2000. The data suggest that except three, all remaining glaciers are retreating. Limited field data is available in Karakoram, Bhutan and Arunachal Pradesh.

The loss in area is mapped for almost 11,000 sq. km in the Himalayan (Figure 2). The studies suggest almost 4–30% overall loss in glacier area in the last 40 years, depending upon numerous terrain and geomorphological parameters. The field and satellite based investigations suggest that most of the glaciers in the Himalaya are retreating except in Karakoram (Tobias *et al.*, 2012; Scherler *et al.*, 2011). However, conclusions based on monitoring of only the snout could be misleading, as slope and length can influence retreat, even if loss in mass is the same. This was used to explain differential rate of retreat of Zemu and Gangotri glaciers (Venketesh *et al.*, 2011). In addition, if glacier snout is covered by debris, it can decrease melting at the snout but continue to have increased melting at higher altitudes leading to fragmentation or disintegration of glaciers (Kulkarni *et al.*, 2007). This phenomenon has now been observed not only in the Himalaya, but also in other parts of the world (Zemp *et al.*, 2009).

In order to understand changes in rate of retreat in Indian Himalaya, we have undertaken a program to monitor glacier changes in Baspa and Tista Basins in western and eastern Himalaya, respectively. The investigation has shown that the rate of retreat has accelerated in the present decade. In the

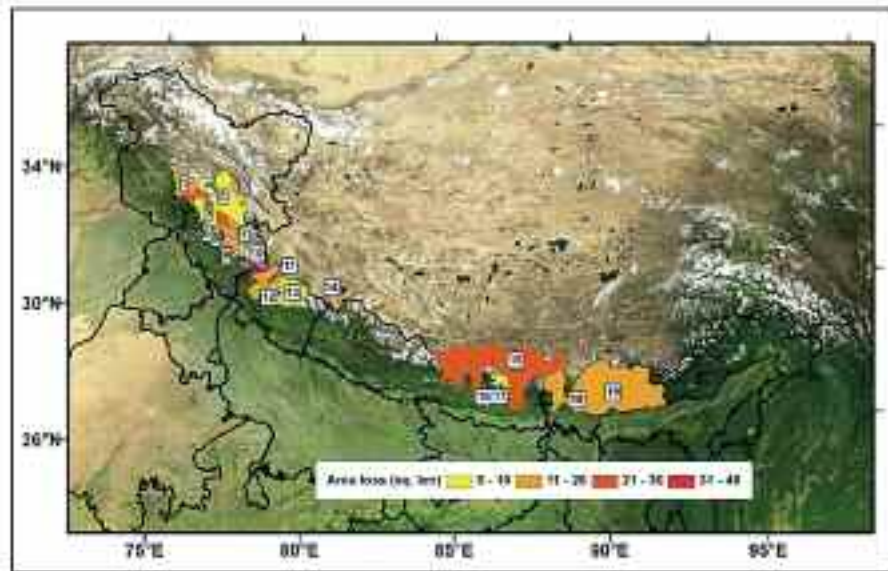


Figure 2. Glacial area loss (%) in different regions of the Himalaya from 1960 to 2000. The loss in glacier area is estimated using satellite images. The name of basins and regions are 1. Bhut, 2 Zasker, 3 Kang Yatiz Massif, 4 Warwan, 5 Miyar, 6 Bhaga, 7 SamudraTapu, 8 Chandra, 9 Parbati, 10 Baspa, 11 Bokriani, 12 Bhagirathi, 13 Alaknanda, 14 Naimona'nyi region, 15 Mt. Everest region, 16 AXo10, 17 Sagarmath national park, 18 Tista, 19 Bhutan Himalaya.

Western Himalaya increase in temperature and decrease in snowfall was observed, suggesting influence of global climate change (Shekar *et al.*, 2007). However, retreat could have also been influenced by regional factors, in addition to global climate change. A total glaciated area of 173 km² was mapped in Baspa Basin (Fig 3). In year 2009, Baspa region experienced extensive forest fire and northern Indian biomass burning resulting in deposition of black carbon. The mean drop in reflectance due to deposition of black carbon in the accumulation area was observed to be $21 \pm 5\%$ and maximum drop as high as $50 \pm 5\%$ resulting in accelerated rate of retreat. The study suggested that anthropogenic activity can influence glacier mass balance (Kulkarni *et al.*, 2013). In case of Sikkim, a total glaciated area of 202 km² was mapped. The rate of retreat was observed to be higher in present decade. This acceleration is possibly due to the formation of glacier lakes. The presence of debris and subsequent differential melting has resulted in the formation and expansion of supraglacial lakes. Further, the merging of these lakes over time has led to the development of large moraine-dam

lakes (Basnett *et al.*, 2013). These investigations suggest that in addition to temperature and precipitation changes, regional factors like formation of moraine dammed lakes and deposition of black carbon are playing an important role in glacier retreat.

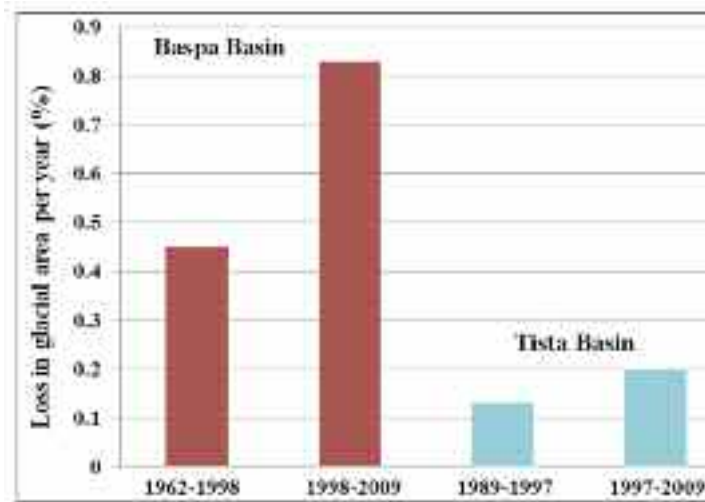


Figure 3. The rate of retreat in Baspa Basin was observed to be 0.45% per year between 1962 to 1998 and it has increased by 1.55 times after 1998 i.e., 0.83% per year.

Glacial response to climate change

The response of glaciers to the ongoing climate change is complex and the impact of projected climate change on KH glaciers is poorly understood. An erroneous statement by the Intergovernmental Panel on Climate Change (IPCC) on the fate of Himalayan glaciers further highlighted this knowledge gap. Therefore, this study focuses on the potential future changes in glacial mass balance in the KH region, where now reliable glacier inventory data is available. The impact of future climate change on the glaciers in the Karakoram and Himalaya (KH) was investigated using Coupled model inter-comparison project model (CMIP5) multi-model temperature and precipitation projections and a relationship between glacial accumulation-area ratio and mass balance. CMIP5 based climate change projections over the KH region were estimated under different Representative Concentration Pathways (RCP) for 2030s, 2050s and 2080s

The study provided a 'broad order-of-magnitude' estimate of the glacial mass balance towards the end of the 21st century. The current i.e., year 2000

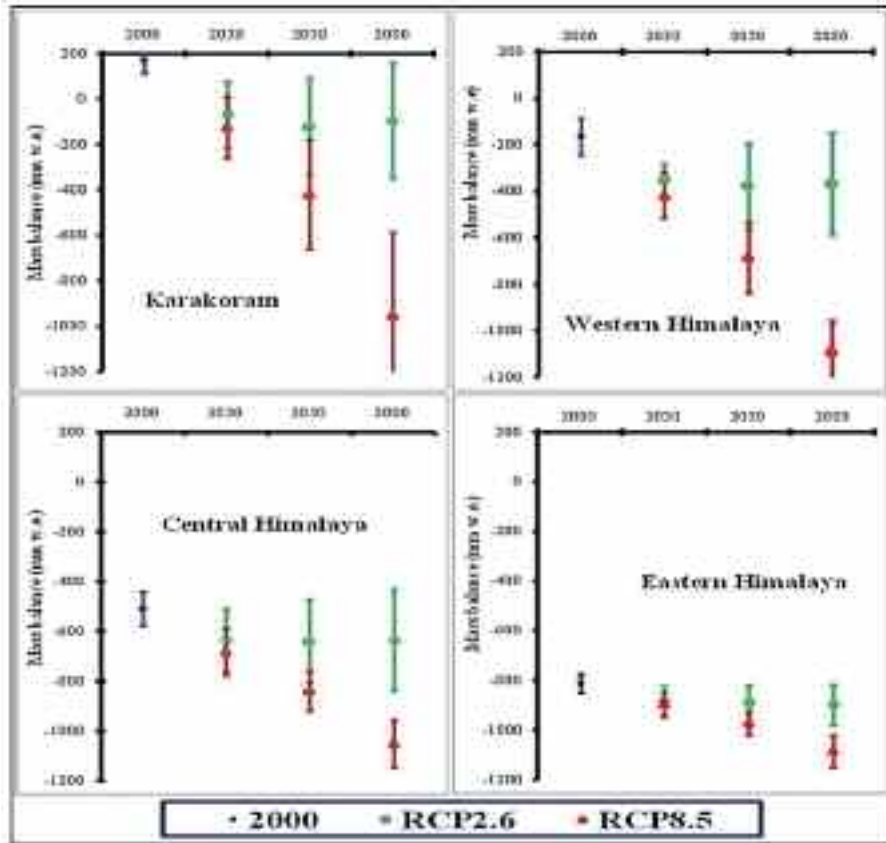


Figure 4. Glacier mass balance for year 2000 and the impact of climate change on the glacial mass balance of Karakoram-Himalaya under RCP2.6 and RCP8 for year 2030, 2050 and 2080 (Chaturvedi, 2014).

glacial mass loss was estimated as $-6.6 \pm 1 \text{ Gt yr}^{-1}$. The mass loss is projected to increase to -12 ± 1 and $-14.4 \pm 1 \text{ Gt yr}^{-1}$ in 2030s, and -12 ± 2 and $-35.5 \pm 2 \text{ Gt yr}^{-1}$ in 2080s, under the RCP 2.6 and RCP 8.5 scenario, respectively. The analysis clearly suggests that a rapid mitigation of Green House Gas emissions i.e. a shift from the RCP 8.5 pathway to RCP 2.6 could prevent more than 16% of the KH glaciated area from 'eventual disappearance' towards the end of this century. Therefore, present pattern of stream runoff and availability of water resources could be largely maintained, if lower emissions pathways are followed in future.

References

1. Bajracharya, S. and Shrestha, B. (eds) (2011), *The status of glaciers in the Hindu Kush-Himalayas*, ICIMOD
2. Basnett S, Anil V. Kulkarni and Tobias Bolch, 2013 The influence of debris-cover and glacial lakes on the recession of glaciers in Sikkim Himalaya, India, *Journal of Glaciology*, Vol. 59, No. 218, 1035-1046.
3. Chaturvedi R.K., Kulkarni A., Karyakarte Y., Joshi J., Bala G., (2014), Glacial Mass Balance Changes in the Karakoram and Himalaya based on CMIP5 Multi-Model Climate Projections, *Climatic Change*, DOI 10.1007/s10584-013-1052-5.
4. Immerzeel W.W., Beek L.P.H., Bierkens M.F.P., (2010), Climate Change Will Affect the Asian Water Towers, *Science*, 328:1382-1385
5. Khan S.B., Ahmad F., Sadaf S., Kashif R.H., *Crops area and production (by districts) (1981-82 to 2008-09)*, Volume I (2010), Food and cash crops, Government of Pakistan, Statistics Division, Federal Bureau of Statistics (Economic Wing), Islamabad.
6. Kulkarni A.V. and Yogesh Karyakarte, 2014, Observed changes in Himalaya glaciers, *Current Science*, 106(2), 237-244.
7. Kulkarni A.V., I.M. Bahuguna, B.P. Rathore, S.K. Singh, S.S. Randhawa, R.K. Sood and Sunil Dhar, 2007, Glacial retreat in Himalaya using Indian Remote Sensing Satellite Data, *Current Science*, 92(1), 69-74.
8. Kulkarni A.V., G. Vinay Kumar, H.S. Negi, J. Srinivasan, and S.K. Satheesh, 2013, The effect of black carbon on reflection of snow in the accumulation area of glaciers in the Baspa basin, Himachal Pradesh, India, *The Cryosphere Discussions*, Vol 7, issue 2, pp, 1359-1382.
9. Scherler D., Bookhagen B. and Strecker M.R., Spatially variable response of Himalayan glaciers to climate change affected by debris cover, *Nature Geoscience*, 2011, 4, 156-159.
10. Shekhar, M.S., H. Chand, S. Kumar, K. Srinivasan and A. Ganju, 2010, Climate-change studies in the Western Himalaya, *Annals of Glaciology*, 51(54), 105-112.
11. Singh P. and Jain S.K., (2009), Snow and glacier melt in the Satluj River at Bhakra Dam in the western Himalayan region, *Hydrological Sciences*, 47, 93-106.
12. Reserve Bank of India (RBI) report (2011), *State-Wise Production of Foodgrains and Major Non-Foodgrain Crops*, available online http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/023T_BST130913.pdf
13. Tobias Bolch, Anil Kulkarni, Andreas Kääb, Christian Huggel, Frank Paul, Graham Cogley, Holger Frey, Jeffrey S. Kargel, Koji Fujita, Marlene Scheel, Markus Stoffel, Samjwal Bajracharya, 2012, The state and fate of Himalayan Glaciers, *Science*, 336, 310-314.
14. Venkatesh T.N., A.V. Kulkarni, and J. Srinivasan, 2012, Relative effect of slope and equilibrium line altitude on the retreat of Himalayan glaciers, *The Cryosphere*, 6, 301-311.
15. Zemp, M., Hoelzle, M. and Haerberli, W. Six decades of glacier mass balance observations – a review of the worldwide monitoring network. *Annals of Glaciology*, 2009, 50: 101-111.

THE POLAR REGIONS

■ PETER WADHAMS

In a time of universal deceit, telling the truth becomes a revolutionary act
George Orwell

I underestimated the risks. The planet and the atmosphere seem to be absorbing less carbon than we expected, and emissions are rising pretty strongly. Some of the effects are coming through more quickly than we thought then
Lord Stern (Observer, London, 27 Jan 2013, at 2013 World Economic Forum)

Abstract

The Arctic sea ice cover is retreating at a rate which greatly exceeds the predictions of climate models. Instead of basing further predictions on observed ice data, climate modellers still persist in using discredited models, which fail to predict the present state of change, as a basis for projecting future sea ice change in fora such as IPCC where these predictions will be used by policy makers. This is disingenuous and is directly aimed at inducing complacency. We examine the implications of sea ice retreat predictions and also the possible implications of a large-scale methane outbreak from the Arctic sea bed as a consequence of sea ice retreat. We find that the likely cost to society of such an outbreak, some 60 trillion dollars over 100 years, exceeds by several orders of magnitude the supposed economic benefits of sea ice retreat due to easier Arctic navigation and oil exploitation.

Introduction

The session in which this paper is presented is entitled “Competing demands on the cryosphere” and we have already heard about glaciers as sources of water. You will have heard about the accelerated de-icing of our planet due to global warming, and the effect that the increasing rate of mass loss from the Greenland ice sheet, the Antarctic ice sheet and subpolar glaciers is having on global sea levels. Before the end of this century many scientists are predicting a global sea level rise of 1 m or more, though IPCC takes a more conservative position. As many authors have shown (e.g. Houghton, 2004), a rise in mean sea level, serious in itself, conceals a worse effect in that if a community does not have the ability or resources to increase the height of flood defences, the *frequency* of catastrophic flood events increases disproportionately. A case in point is that of storm surges in the

Bay of Bengal, where there is no possibility of raising flood defences in the intricate waterways of coastal rural Bangla Desh. You will also have heard about how the role of glacier water in regulating water flow to low lying areas is disrupted if that glacier is subject to rapid decay. In this talk, therefore, I will focus on another set of rapid changes that are occurring in the cryosphere, and their implications for human life. I will talk about *sea ice*, in particular Arctic sea ice, and indicate what is happening to it, what the further implications of this are for global climate, and what we can do to mitigate the effects.

I am conscious of the Holy Father's serious statement that "today no one in our world feels responsible; we have lost a sense of responsibility for our brothers and sisters". As Prof. Dasgupta has shown, this extends to economists failing to acknowledge that climate change is a major factor in the economic future of the world, and as Prof. Kennel has shown, it includes a reluctance to take the steps needed to mitigate the inevitably increasing impact of climate change on the planet. With respect to sea ice, I will show that not only is Arctic sea ice retreating at an unprecedented rate which will lead to its disappearance in summer in a very short time, but that this involves a cluster of positive feedback effects which will make the impact much greater than simply a loss of ice, and will in fact make the Arctic to a great extent the driver of future change. If we are to take the Holy Father's warning seriously, then we must embrace an understanding and acceptance of the magnitude of the climate challenge, and be ready to take immediate action, treating this as the single biggest threat to Man's future.

Sea ice

The rapidly changing Arctic Ocean ice cover

From the time when I first sailed through the Northwest Passage in 1970 (Wadhams, 2009), to today, the Arctic has been transformed. A central ocean which was permanently ice-covered and where seasonal variations happened only in the subpolar seas has changed with bewildering speed into an ocean where significant summer ice retreat occurs, exposing its wide continental shelves to the power of the sun. Soon the Arctic ice cover will resemble that of the Antarctic – extensive in winter, but almost non-existent in summer. A ship entering the summer Arctic today from Bering Strait finds an ocean of open water in front of her. The top of the world now looks blue instead of white from space; a profound change. It is the summer changes which have created the potential for catastrophic feedback effects which may represent a serious threat to the planet.

Since the Industrial Revolution, the Arctic has been warming more rapidly than any other region of the globe (IPCC 2007, 2013; AMAP, 2011), with an amplification factor of 2–4 over the planet as a whole, which is increasing (Screen *et al.*, 2012). Average air temperatures at 60–90°N have risen by 2°C since 1980. The rapid warming, combined with related factors such as ice–albedo feedback (Perovich and Polashenski, 2012), and higher ocean heat flux (Shimada *et al.*, 2006), are major contributors to a reduction in summer (September) sea ice extent from 7 million km² in the 1970s to only 4.2 million in 2007. A brief recovery was followed by a further shrinkage in 2012 to 3.4 million km² with a further recovery in 2013.

This summer retreat has been accompanied by a significant decrease in sea ice extent in other seasons (Stroeve *et al.*, 2012), also by changes in ice type, especially a dramatic reduction in multi-year ice (Comiso, 2012); a decline of more than 40% in sea ice mean thickness (Rothrock *et al.*, 1999); a reduction of 73% in pressure ridge frequency between 1976 and 1996 (Wadhams and Davis, 2000); and changes in ice dynamics (Rampal *et al.* 2009). Some coupled models predict an ‘ice-free’ Arctic summer by 2040 (e.g. Holland *et al.*, 2006; Wang and Overland, 2009), while others (Maslowski *et al.*, 2012; Schweiger *et al.*, 2012) predict an ice-free September within a very small number of years, before 2020 and possibly as early as 2015. Analysis of thickness leads to greater alarm. The PIOMAS project (Pan-Arctic Ice–Ocean Modeling and Assimilation System) at University of Washington examined sea ice volumes (making use of submarine data and interpolation rather than just ice extent), and found an “Arctic death spiral” (fig. 1) as the ice volumes at all seasons of the year spiral in towards zero (an ice-free Arctic). An empirical extrapolation from these data show the September figure reaching zero in 2015 or 2016 and neighbouring months (July, August, October, November) set to follow not long afterwards. We have to note that IPCC and many government institutions such as the UK Meteorological Office persist in ignoring these data and making use solely of models to insist, in the face of the evidence, that summer sea ice will persist for several decades. There has seldom been a more glaring disagreement between models and data – nor a more puzzling persistence in the use of discredited models (fig. 2).

The reasons behind this dramatic loss of sea ice are not fully understood, as the mechanisms involved are a complex interplay of atmospheric, sea ice and ocean processes, with strong feedbacks. Many of these processes are inadequately represented in large-scale sea ice models. The Arctic sea ice changes are associated with profound changes in the Arctic marine system, with increased periods and areas of open water, increased fresh water input,

increased input of solar radiation, increased surface ocean temperatures, an enhanced underwater light climate, an altered nutrient supply into the euphotic zone and a significant, but yet to be understood, change in ecosystem dynamics (Carmack, 2007; Wassmann *et al.*, 2011). At this point we should note that Antarctic sea ice is not showing this rapid downward trend in area; in fact the area is slowly increasing. We concentrate on the Arctic because the trend is so rapid, and also because Man's direct impact on the Antarctic is limited by the Antarctic Treaty, which prohibits commercial exploitation.

Positive feedbacks – albedo

Of special concern are positive feedback loops, where a change in sea ice extent initiates another undesirable or unexpected change. In the Arctic we are already aware of at least two such loops. The albedo of open water of 0.1 compares to 0.5–0.7 for melting ice, and it has been recently estimated (Pistone *et al.*, 2014) that the loss of area of summer sea ice between the 1970s and 2012 has caused a global albedo decrease equivalent to one-quarter of the effect of all the carbon dioxide added to the atmosphere by man during that period. This is a “fast feedback” because its effect is immediate.

The sea ice–albedo feedback is enhanced by faster spring snow melt in Arctic coastal lands as sea ice recedes, probably due to warmer air masses moving over the coastal lands from the sea; already in 2012 we saw a 6 million km² negative area anomaly in June compared with 1980. This will itself create a feedback of similar magnitude to that discussed by Pistone *et al.*, so if we put them together the overall ice/snow–albedo feedback is adding 50% to the direct global heating effect due to CO₂ addition, showing how the Arctic can become a driver of, rather than just a responder to, global change.

The second major feedback that we consider below is the seabed methane feedback. However, before doing so we should mention that sea ice retreat has been coupled with an enhanced melt rate for the Greenland ice sheet (due to warmer air surrounding Greenland in summer), and also (Francis and Vavrus, 2012) it has been suggested that Arctic warming and sea ice retreat have been the cause of a slower speed of progression of Rossby waves in the upper atmosphere, one result being an increased probability of extreme weather events that stem from prolonged persistence of the weather system in one mode, e.g. drought, flooding, cold weather and heatwaves. The possibility is that the exceptional winter and spring weather experienced in North America and Europe during the last three years may be linked to Arctic sea ice loss. At the moment this is a plausible possibility, but not a definite conclusion.

Positive feedbacks – the methane threat

The removal of the ice cover takes away a vital air conditioning system for the Arctic. So long as some ice is present in summer, however thin, the near-surface water temperature cannot rise above 0°C, since any warmer water would lose heat in melting ice. With the ice gone, the surface water can warm up by several degrees in summer (satellites have shown 7°C and shipborne surveys up to 7.5°C, Bates *et al.*, 2013), and over the shallow continental shelves (50-100 m deep) this heat reaches down to the seabed. This melts offshore permafrost, frozen sediments which have lain there undisturbed since the last Ice Age. The thawing offshore permafrost triggers the release of plumes of **methane** gas from the disintegration of unstable solid methane hydrates which had been sealed into the sediment by the permafrost cap. Since the significant uncovering of the shelf seas started only in about 2005 this phenomenon is probably a new effect in the postglacial history of our planet.

Methane is a greenhouse gas 23 times as powerful as CO₂ though shorter-lived in the atmosphere. Russian-US summer expeditions since 2004 have observed extensive methane bubble plumes in the Laptev and East Siberian Seas, growing in extent in the most recent years. The atmospheric methane level globally is rising after a few years of stability, with the Arctic identified as the main source (Shakhova *et al.*, 2010ab, 2013). Atmospheric methane (CH₄) is the most important greenhouse gas after water vapour and carbon dioxide. The largest natural source is the decomposition of organic matter in swamps and other wetlands (104 Tg/yr, or 20% of total source 520 Tg/yr) and the largest man-made source is enteric fermentation from domestic animals (90 Tg/yr, or 17%). Another natural source is chemical reactions from the actions of termites, while a major methane resource lies under the oceans in the form of methane hydrates. Other man-made sources include leaks from natural gas pipelines and other aspects of coal and oil production including fracking; the cultivation of rice (because of rotting vegetation in the rice paddies); landfill sites; and waste treatment. Tropospheric chemistry dominates as a sink (448 Tg/yr, or 88% of the total sink), with oxidation of methane to CO₂ in the atmosphere being the main reaction, and the lifetime of a methane molecule in the atmosphere being estimated at 8-10 years. Global mean CH₄ concentration more than doubled after the 1850s, from a postglacial stable value of 700-800 ppb to a value of 2800 ppb by the end of the 20th century, a relatively more rapid growth rate than CO₂ which has only increased by 50%. From 2000 the methane level flattened off and stabilized until 2008, when it started to grow again. This coincides with the time when the decline of Arctic sea ice accelerated (Comiso *et al.*, 2012).

Despite its much lower concentration in the atmosphere than CO₂, methane makes a substantial addition to overall climate change because it is a much more powerful greenhouse gas. Latest IPCC estimates (2013) are that CH₄ contributes 0.97 W m⁻² to radiative forcing while CO₂ contributes 1.68. Per unit mass, methane is 23 times as powerful as CO₂ when measured over a 100 year period; this is called its global warming potential (GWP). Since methane persists in the atmosphere for only about 8–10 years after emission, its GWP when measured over this period is much greater than 23; figures of 100–200 have been quoted. It is clear that a sudden release of a large quantity of methane would have a huge, if short-lived, impact on climate.

Is methane emission due to accelerate?

Shakhova, the leader of the Russian-US expeditions to the East Siberian Sea (ESS), estimated (2010a) that 50 Gt of methane are likely to be emitted from the East Siberian Shelf during the next few years, a conservative estimate based on her estimate that the total volume of methane trapped in the ESS sediments amounts to 720 Gt. Whiteman, Hope and Wadhams (2013) undertook to estimate what this emission would mean in terms of global warming and economic cost to the world. An emission of 50 Gt is assumed to take place over 2015–2025. The warming estimate was based on a standard model of response to methane emissions and yielded a warming which peaks at 0.6°C in 2040 (fig. 3), a large increase in projected warming levels, especially as, in response to the nature of methane, the effect is concentrated in the years immediately after emission which are years in which CO₂-induced warming is still gathering strength.

The economic analysis was based on the PAGE09 integrated assessment model which was used in the Stern (2007) review of climate change costs for the UK Government as well as for a more recent analysis conducted for the Asian Development Bank. The finding was that total costs (based on factors such as sea level rise, changes in agricultural productivity, changes in transport and industrial practices) amount to 60 trillion dollars over 100 years, an average exceeding 1 trillion dollars per year. A later analysis (presented at the AGU Fall Meeting, San Francisco, December 2013) showed that if the same amount of methane is emitted more slowly, the total costs end up being slightly higher, because the climate impact is being exerted at a time when the economic cost of climate change is greater, per unit of additional warming.

These results are of enormous importance for two reasons:

1. They show the invalidity of arguments which point to the advantages of sea ice retreat in terms of transport and oil exploration being easier.

2. They show that we are living in a fools' paradise if we imagine that future climate warming can be projected based only in a linear way on CO₂ emissions. The reality is that new feedbacks come into play at certain critical points, which accelerate warming and may end up dominating the future pattern of global change. We have pointed to two which are emerging merely from Arctic sea ice retreat – albedo feedback and methane feedback. Albedo feedback is real and definite and is increasing global warming by 50%. Methane feedback is postulated for the near future and will, in the short term, more than double the warming rate.

The most serious result, from the moral standpoint with which we approach this Workshop, is that these predictions are being ignored by the very body, IPCC, which was established to warn the world of dangerous climatic change. A benign interpretation is that IPCC in AR5 has gone a long way in issuing a more serious warning than ever before about the rate of climate change, and feels that warning about further accelerations might be invidious. But the problem is that many policy makers, planners, economists and philosophers, such as some of the distinguished people presenting papers at his meeting, base their view of forthcoming warming on IPCC predictions. If those predictions are too complacent, the conclusions may have to be changed. For instance, a common view is that, morally and economically, we must reduce our carbon emissions at a rapid rate in order to save the world from dangerous climate warming. I wish that I could agree with this view but my own conclusion, based only on unconsidered Arctic feedbacks, is that even a rapid reduction in CO₂ emissions will not work in time, so we must seriously and urgently consider emergency methods which could slow down the rate of warming and give us time to change to a new paradigm of living on this planet – that is, the use of geoengineering techniques, repugnant as these are to many people.

References

- AMAP (2011). *Snow, water, ice and permafrost in the Arctic* (SWIPA). Oslo: Arctic Monitoring and Assessment Programme (AMAP).
- Bates, N.R., M.I. Orchowska, R. Garley and J.T. Mathis (2013). Summertime calcium carbonate undersaturation in shelf waters of the western Arctic Ocean – how biological processes exacerbate the impact of ocean acidification. *Biogeochemistry*, 10, 5281-5309.
- Carmack, E.C. (2007). The alpha/beta ocean distinction: A perspective on freshwater fluxes, convection, nutrients and productivity in high-latitude seas. *Deep Sea Research II*, 54(23), 2578-2598.
- Comiso, J. C. (2012). Large decadal decline of the arctic multiyear ice cover. *J. Climate*, 25(4), 1176-1193.
- Francis, J.A. and S.J. Vavrus (2012). Evidence

- linking Arctic amplification to extreme weather in mid-latitudes. *Geophysical Research Letters*, 39, L06801 doi:10.1029/2012GL051000.
- Holland, M.M., C.M. Bitz, and B. Tremblay (2006). Future abrupt reductions in the summer Arctic sea ice. *Geophys. Res. Lett.*, 33, doi:10.1029/2006GL028024.
- Houghton, Sir John (2004). *Global Warming: The Complete Briefing*. 3rd edn. Cambridge University Press.
- IPCC (2007, 2013). 4th Assessment (2007), 5th Assessment (2013). *Climate Change: The Physical Science Base*. Cambridge University Press.
- Maslowski, W., Kinney, J.C., Higgins, M., and A. Roberts (2012), The future of Arctic sea ice. *Ann. Rev. Earth Plan Sci.*, 40, 625–65.
- Perovich, D.K., and C. Polashenski (2012), Albedo evolution of seasonal Arctic sea ice, *Geophysical Research Letters*, 39(8), L08501, doi:10.1029/2012GL051432.
- Pistone, K., I. Eisenman and V. Ramanathan (2014). Observational determination of albedo decrease caused by vanishing Arctic sea ice. *Proc. Nat. Acad. Sci.*
- Rampal, P., J. Weiss, D. Marsan, and M. Bourgoïn (2009), Arctic sea ice velocity field: General circulation and turbulent-like fluctuations, *Journal of Geophysical Research*, 114, C10014, doi:10.1029/2008JC005227.
- Rothrock, D.A., Y. Yu and G.A. Maykut (1999). Thinning of the Arctic sea-ice cover. *Geophys. Res. Lett.*, 26(23), 3469–3472, doi:10.1029/1999GL010863.
- Schweiger, A., R. Lindsay, J. Zhang, M. Steele, H. Stern and R. Kwok (2012). Uncertainty in modeled Arctic sea ice volume. *Journal of Geophysical Research*, 117(8). doi 10.1029/2011JC007084.
- Screen, J.A., C. Deser and I. Simmonds (2012). Local and remote controls on observed Arctic warming. *Geophys. Res. Lett.*, 39, L10709, doi:10.1029/2012GL051598.
- Shakhova, N.E., V.A. Alekseev and I.P. Semiletov (2010a). Predicted methane emission on the East Siberian Shelf. *Doklady Earth Sciences*, 430(2), 190–193.
- Shakhova, N., I. Semiletov, A. Salyuk, V. Joussupov, D. Kosmach and O. Gustafsson (2010b). Extensive methane venting to the atmosphere from sediment of the East Siberian Arctic Shelf. *Science*, 327, 1246–1250.
- Shakhova, N., I. Semiletov, I. Leifer + VIII (2013). Ebullition and storm-induced methane release from the East Siberian Arctic shelf. *Nature Geoscience*, doi:10.1038/NNGEO2007.
- Shimada, K. et al. (2006). Pacific Ocean inflow: influence on catastrophic reduction of sea ice cover in the Arctic Ocean. *Geophysical Research Letters*, 33, L08605.
- Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. Cambridge University Press.
- Stroeve, J.C. et al. (2012). The Arctic's rapidly shrinking sea ice cover: a research synthesis. *Climate Change*, 110(3), 1005–27.
- Wadhams, P. (2009). *The Great Ocean of Truth*. Melrose, Books, Ely. Also Hudson-70, the first circumnavigation of the Americas. *Oceanography*, 22(3), 227–235.
- Wadhams, P. (2012). Arctic ice cover, ice thickness and tipping points. *AMBIO*, 41, 23–33.
- Wadhams, P. and N.R. Davis (2000). Further evidence of ice thinning in the Arctic Ocean. *Geophys. Res. Lett.*, 27(24), 3973–3975, doi:10.1029/2000GL011802.
- Wang, M. and J.E. Overland (2009). A sea ice free summer Arctic within 30 years. *Geophys Res Lett.*, 36(7), L07502.
- Wassmann, P., Duarte, C.M., Agusti, S., and Sejr, M.K. (2011). Footprints of climate change in the Arctic marine ecosystem, *Global Change Biology*, 17(2), 1235–1249.
- Whiteman, G., C. Hope and P. Wadhams (2013). Vast costs of Arctic change. *Nature*, 499, 401–403.

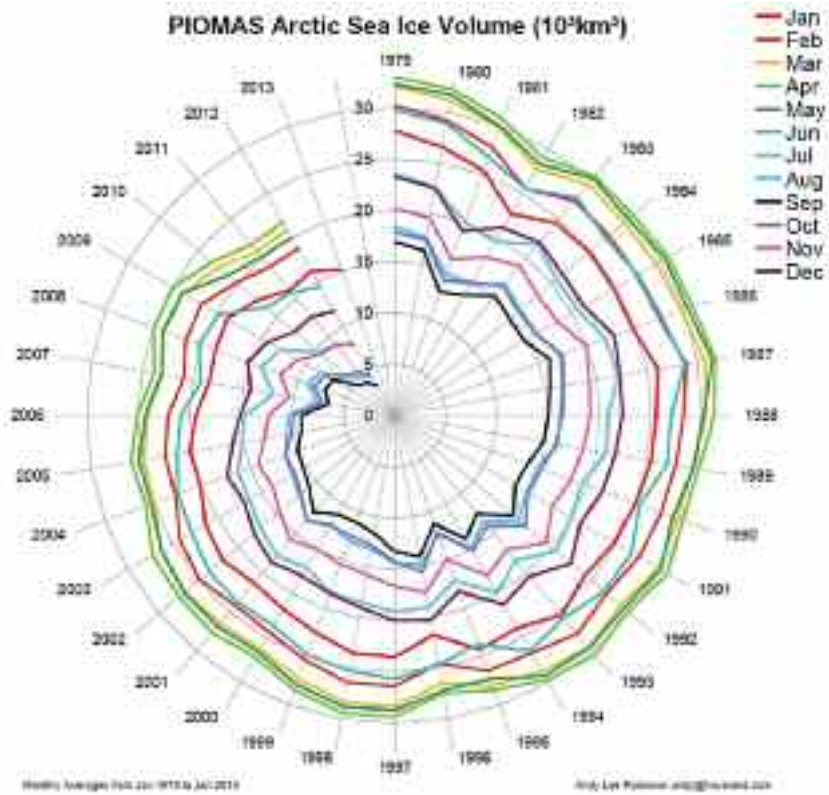


Figure 1. The “Arctic death spiral”. The volume of sea ice in the Arctic Ocean in every month of the years 1979-2012, from the data-based PIOMAS model of the University of Washington (Andy Lee Robinson).

Figure SPM.7 (FIGURE SUBJECT TO FINAL COPYEDIT)

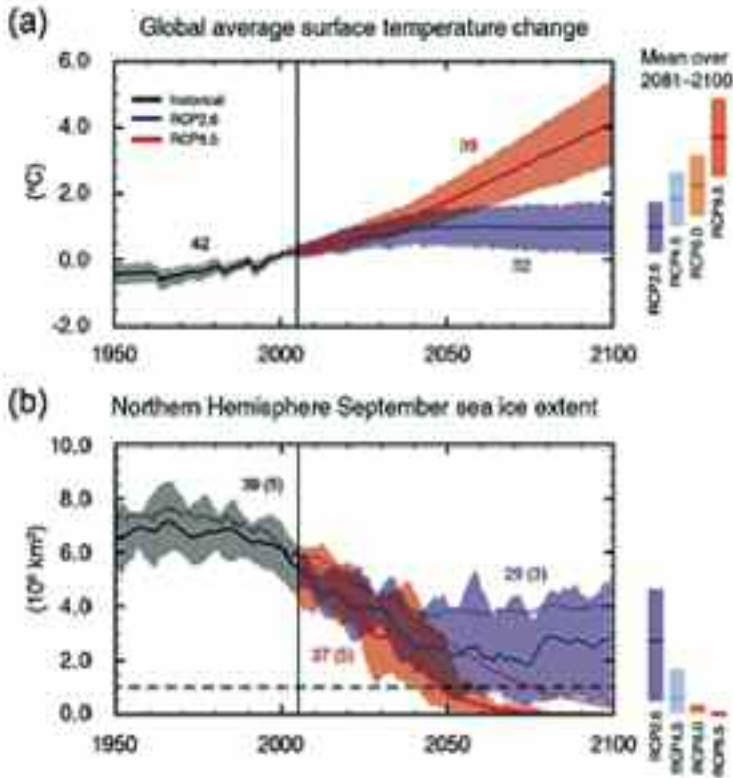


Figure 2. Figure SPM.7 from the Summary for Policymakers of the 5th Assessment Report of the Intergovernmental Panel on Climate Change. Part (b) is an example of presentation of data and model projections in a way which achieves a misleading impression. The bold black vertical bar of 2005 does not separate data on the left from model projections on the right, as one might expect, but “modelled historical evolution using historical reconstructed forcings” on left from model projections on the right. The transition in 2005 avoids showing data from 2006-2012 where very rapid declines in area occurred. The two projections are from IPCC scenarios RCP8.5 and RCP2.6. RCP, or “Representative Concentration Pathway” is approximately total anthropogenic radiative forcing in the year 2100 relative to that in 1750 before the Industrial Revolution. 8.5 watts per sq m is roughly “business as usual” and shows a decline to zero in 2050 and a decline to 3.4 million sq km in 2030 – an area already reached in 2012. 2.6 watts per sq m is generally agreed to be unattainable, since radiative forcing was already 2.29 in 2011 and rising fast. Yet it is shown (in blue) as a plausible scenario in which the sea ice actually recovers some area before the end of the century. This figure is likely to be read uncritically because this is a summary for policymakers, not part of the scientific report.

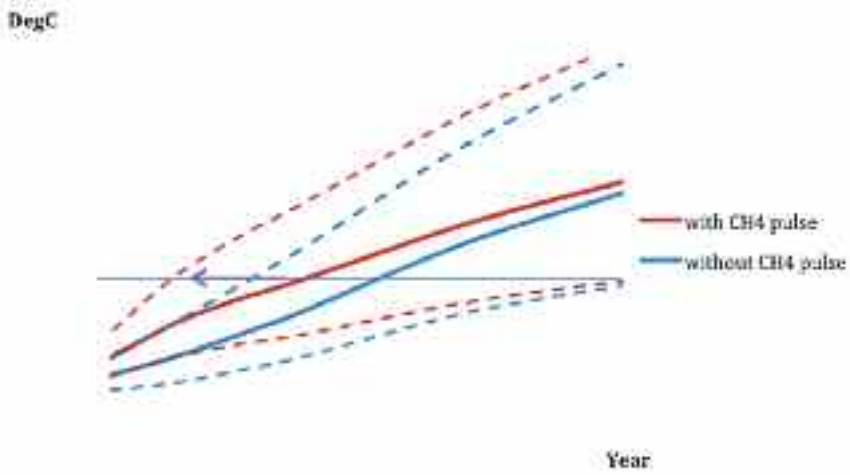


Figure 3. Projected global temperature changes up to 2100 as affected by a 50 Gt methane pulse taking place from 2015 to 2025 (after Whiteman, Hope and Wadhams, 2013). Solid line is a business-as-usual scenario, dashed lines are high and low emission scenarios.

▶ VI. COMPETING DEMANDS ON THE BIOSPHERE

GREEN FIELDS: FEEDING THE HUNGRY, RAISING THE POOR AND PROTECTING NATURE IN AFRICA

■ ROBERT (BOB) SCHOLES

Abstract

Several of the key branching-points on the road to a sustainable human future in the 21st century will play out on the continent of Africa. This is for several reasons: Africa is the last continent to begin its demographic transition, therefore much of the future growth in the human population will take place there; Africa is the last place with large areas of agriculturally-suitable soil and climate conditions for major extension of croplands; and many aspects of inequity, from global to local scales, find expression there. This convergence of factors presents threats of highly undesirable outcomes for the global climate, biodiversity loss, widening poverty, hunger and disempowerment. It also offers opportunities to embark on a different development path with much more optimistic consequences. An advantage of being last in the development sequence is that it is possible to learn from those who have been before – Africa commences its phase of rapid change with more available knowledge than at any time in the past. Will the same dysfunctional dynamics that have unfolded in the past and in other places continue to dominate in the future in Africa, or will it be possible to transition to a better path? What would it take to do so?

The New Scramble for Africa

Large parts of tropical Africa are on the cusp of major social and land transformation. In the next three decades the continent will be in a comparable situation to the Amazon and Southeast Asia over the past three decades: the locus of major conversion of forest to croplands, simultaneous migration of people into cities, and potentially large and rapid improvements in nutrition and income. These rapid changes, which are already underway, have both internal and external drivers.

The world as a whole faces a substantial food crisis by mid-century (Beddington *et al.* 2011). The increase in the global population from the current 7.2 billion to an estimated 9–10 billion by the second half of the century (United Nations 2013) will inevitably increase demand, but less so than the shift in dietary preferences among the billions of people propelled

by the wave of human development in South and East Asia. As incomes increase, there is a seemingly inexorable increase in demand for animal proteins – beef, pork, mutton, poultry and fish – whose production requires larger areas of land than diets predominantly based on vegetable proteins. Furthermore, the rising cost of energy, and the risks to the climate posed by fossil fuel use, are driving and increased allocation of land to bioenergy crops. As a result, it is estimated that global agricultural production will need to increase by about 70% above 2010 levels by mid-century (FAO 2009), equivalent to about 1.8% per year. A similar doubling was achieved between 1960 and 2000, partly due to crop breeding and agronomic improvements (a third to three quarter of the effect was due to the vastly increased use of synthetic fertilisers), but to a large degree by expansion of the global cropped area, from 12.8 million km² in 1960 to 48.9 million km² in 2010 (Faostat 2014). While continued incremental improvements in crop genetics can be expected, the returns on effort are diminishing as the fundamental ceiling of biological potential is approached. The unintended consequences of high fertiliser use are now becoming apparent, in climate impacts and the eutrophication of inland and coastal waters. Therefore it is unlikely that the necessary increase in global agricultural production will occur on the current cropland footprint. Lateral expansion of the cropped area is inevitable; and the most likely location is sub-Saharan Africa.

The last major world region that combines high-potential soils with suitable climates for agriculture is in Africa, and specifically the nearly eight million km² (not all arable) that lie between the wet equatorial rainforests and the Sahara desert to the north, and between the rainforests and the Kalahari desert to the south. The rainfall in this zone is above the cropping limit of 600 mm/y, but less than the approximately 1500 mm that supports rainforests but is also associated with high cloud cover, swampy and nutrient-impooverished soils, making it less suitable for short-duration crops. The landforms are mostly high granitic plateaus with deep soils, which while acid and deficient in nutrients such as phosphorus and nitrogen, can be made highly productive through liming and fertilisation. They naturally support savanna woodlands, rather than closed evergreen forests. In south-central Africa (the Angola-to-Tanzania belt) the landscape is relatively sparsely populated, partly because of the historical presence of tsetse fly and the trypanosomiasis it carries, and partly due to soil nutrient deficiencies. The equivalent zone north of the equator, the Guinea-to-Sudan belt, is relatively densely populated and much is already under low-input-low-output agriculture.

The recent well-publicised ‘land grabs’, (Oxfam 2011: allegedly 0.33 million km² in the 2001–2011 period) involving countries and large cor-

porate agribusiness interests from outside Africa, are a manifestation of the realisation that land resources are globally limited, and that Africa offers the last opportunities. The soils and climates in the areas described above are very similar to those in the *cerrados* of Brazil, which underwent rapid transformation to soybean and maize cultivation between 1970 and the present. With known, tested and available agricultural technologies, a similar transformation is likely in Africa. It brings with it substantial opportunities to address longstanding African issues of undernourishment, poverty and ill health. The journey to more diversified, higher-income economies worldwide has generally started with agricultural development. However, the linked land and social transformation also holds the possibility of accelerating climate change, loss of biological diversity and ecosystem services, and increased social inequity and conflict.

Demographic Dividend or Population Explosion?

Populations worldwide grew dramatically when the pre-modern balance between high birth rates and equally high mortality (especially among juveniles) was upset by a reduction in death rates, largely driven by improved sanitation, and secondarily by improved medical care and nutrition. The experience, again worldwide and across cultures and circumstances, is that the birth rate gradually falls to equilibrate with the new expectations of survival and longevity. This process takes several generations. It is accelerated by improved wellbeing, specifically education and economic opportunities for women. Most regions of the world have gone through this ‘demographic transition’ or are in the midst of it; most of sub-Saharan Africa has not. It can therefore be predicted, with a high degree of confidence, that the population of sub-Saharan Africa will rise from its present 800 million to about 2 billion by about mid-century (United Nations 2007), a growth rate of about 2.6% per annum.

At the same time as growing overall, Africa (like other developing countries, and like the developed countries before them) is undergoing rapid urbanisation. The urban growth rate is about 3.9% per annum, the highest in the world. The cities growing fastest are often not the largest ones currently: Ouagadougou, Niamey, Kampala and Dar es Salaam are among the emerging metropolises, joining Kinshasa, Lagos, Luanda, Abidjan, Addis Ababa and Nairobi.

The urban migration is apparently driven by the usual combination of diminishing livelihood opportunities in rural areas coupled with better access to jobs and services in urban areas, dire as those might be. A third element is increasingly common – the movement to the cities of domestic

and international refugees, displaced by lawlessness in failed states, environmental disasters such as famines and floods, or by the loss of access to lands on which they formerly lived.

Rapid population growth is typically seen as a challenge to those responsible for job provision, education, food security and the avoidance of environmental degradation. Those more focussed on the availability of labour and the growth of markets see it much more positively. Countries with static and aging populations find it increasingly difficult to service the needs of the elderly, and can only grow their economies through technical innovation. The large cohort of young people in fast-growing Africa, on the other hand, represents a potential market for goods, from beer to cell phones, the demand for which has already saturated elsewhere in the world. This is the 'demographic dividend'. A third viewpoint is that, in the event that economies do not grow at a commensurate rate, a large pool of unemployed young men is often a precursor to violent conflict.

Darkest Africa: a worst-case scenario

This scenario is an extrapolation of tendencies currently underway, and the unfolding in Africa of patterns that were displayed elsewhere in the world. In this scenario, a self-serving and corrupt political elite alienate large portions of the land from those who currently live there and turn them over to better organised, wealthier actors (either international or national) whose objectives are overwhelmingly the maximisation of short-term shareholder profit. The government agencies charged with the enforcement of environmental and social welfare regulations are understaffed, under-resourced and under-trained to exercise their responsibilities effectively, and the legal system is insufficiently strong to defend the rights which are infringed. Because of the uncertainties of tenure and the absence of a land ethic, agricultural development is unplanned and deliberately ignores social and environmental externalities, while enjoying positive externalities such as tax holidays and subsidies on agricultural inputs. The fullest possible portion of the land concession is converted to agriculture, as quickly as possible, with export of high value timber and burning of the rest, resulting in a large transfer of carbon dioxide to the atmosphere.

Since the local agricultural markets are weak, the production is devoted to globally-traded commodities such as cereals, industrial starches, sugar and soybean, many of them destined for use in biofuels and animal feedlots, rather than human consumption. The farm scale is very large, and since the management is technically complex, it is dominated by expatriate skills. A small fraction of the displaced rural population finds employment in low-

paid, unskilled tasks on-farm and an even smaller fraction in skilled positions such as machine operators. The remainder join the urban poor, leaving only the elderly and the very young in the rural areas, scratching a living from small plots wherever they can settle. The shrinking area of woodland landscape is cut over repeatedly for charcoal production for use in the towns, a trade that is facilitated by the building of roads to supply inputs to the farms and to take their produce to the coast for export.

The cultivars used are bred specifically for the scale and type of agriculture, and sourced from one of a small group of seed producers. They are not viable for use outside this context and are generally not fertile in the second generation. Fertilisation (and irrigation, where irrigation is used to bridge dry seasons) is at the level which will result in maximum enterprise profit. This is well in excess of the amount of nutrients taken up by the plants, so the surplus is emitted as the powerful greenhouse gas nitrous oxide, and accumulates in the groundwater and rivers. Since the price of the water used for irrigation is just the price of pumping it out of the river, inefficient forms of irrigation are used, leading to flow reductions in the rivers and their pollution with silt, salts and nutrients in the return flows. River, lake and coastal fisheries decline as a result. Tropical pests and weeds are combatted with large doses of biocides, often using products whose use has been discontinued in developed countries. The explosion of seed-eating birds is combatted by aerial spraying of the wetlands where they nest. Large herbivores and primates are incompatible with the cropping system, so they are shot on farmland and restricted to national parks, where they are poached by the rural poor.

There is a great increase in agricultural production, but the largest part of the value addition is captured by the corporations who operate the value chain, and by the elite who service them. The commodities produced are exported in near-raw form, except in cases where it makes sense to process them under a lax set of environmental or health regulations. There is a proliferation of industrial-scale feedlots and poultry production facilities, with wastes producing methane in open lagoons and spilling into the rivers.

This development path is clearly detrimental to both natural resources and to the welfare of a large number of people. Its proponents justify their actions by arguing that exploitation is a necessary first phase of development – there must be wealth accumulation, economies of scale and globally competitive terms of trade. Natural capital will be drawn down temporarily, but will be restored once the overall wealth level increases, and with the growing appreciation for nature by the urban population. However, that time never comes in Africa, because the overloaded cities do not manage to enter a virtuous

cycle of rising education, improving education and improving services. Instead they polarise into gated communities of the wealthy, in a sea of lawless slumlands. Exporting the environmentally-damaging industries to the developing world is no longer possible, because this is the end of the line.

Living Landscapes: a more positive vision

We have the knowledge and tools to take a different path to the one painted above. Rather than repeat mistakes, African leaders can choose to leapfrog or bypass them. Africans, as much as anyone, deserve the chance to reduce the number of undernourished people and to provide economic benefits to the poor; denial of the opportunity to use their natural resources to achieve these ends amounts to a different kind of injustice. But it needs to be done with an eye to sustainability and equity.

In this scenario, several million hectares of Africa undergo a 'green revolution', leading to sustained higher agricultural production, agro-industries, better infrastructure, reduced hunger and rising incomes. However, it happens in an integrated way, rather than haphazardly, and within the social and environmental limits determined by experience elsewhere in the world. Critical ecosystem service resource areas are protected from the start, and within the landscapes that are prioritised for transformation, corridors of semi-natural ecosystems remain. The agriculture is diverse in scale, tenure and product, and there is an emphasis on value addition and nutritional security. There are commercial-scale farms interspersed with family-scale enterprises, sharing infrastructure; many are devoted to vegetable, fruit and timber crops. The landscape is multi-functional, providing food, fibre, fuel, water, biodiversity habitat and amenity. There is a net movement of people to regional towns and cities, where development is also planned and integrated with urban agriculture, green spaces and water, energy, health and education service provision. The economy is diverse, including agriculture, mining, manufacturing, services and tourism, and both the absolute number of poor and the relative levels of inequality are declining.

What will it take to reach a sustainable African future?

The Living Landscapes scenario makes several assumptions: that a combination of a spreading awareness of rights in Africa, the growth of a skilled middle class, and international ethical pressures reduces the power of elites and their clients to help themselves to resources in Africa; that good governance and rule-of-law become the norm; and that international economic and political circumstances permit the space for Africa to develop. A market-led approach is the one most likely to unlock and spread the benefits, but it needs

to be within a framework of social responsibility. The key issue is that the surpluses generated from the exploitation of the abundant African natural capital must be retained in Africa and efficiently converted to social capital.

The first step is to base the spatial pattern of agricultural development (including its location, scale and spatial arrangement) on a sound knowledge of the resource potential of the landscape, rather than to allow it to occur haphazardly. The potential is defined both in terms of agricultural productivity and in terms of the other ecosystem services it presently or potentially supplies – such as timber, water and wildlife habitat (Scholes and Biggs 2003). These potentials are not homogeneously distributed in the landscape at any scale. Therefore it is possible to achieve better tradeoffs between competing land-uses, by placing the developments where they achieve most benefit for least cost. The techniques to do so have been developed for the converse problem – trying to protect fragments of biodiversity in already largely transformed landscapes (Murgulis and Pressey 2001) – but it can achieve more by being applied before development, to the optimal placement of areas which are to be transformed. The logic applies at scales all the way from global (growing crops where they are best suited, rather than where history or subsidies promote them, means that the global production per unit land can be maximised), through the national (defining priority development nodes and protected area networks) to the landscape (leaving buffers around rivers to help suppress floods and absorb pollutants).

The second insight involves a clear understanding of the form and nature of tradeoffs when a given parcel of land is transformed to cropping. Most of the *in situ* loss of biodiversity and non-agricultural services occurs with the act of transformation (Green *et al.* 2005). The further loss of local natural capital and biodiversity as agricultural intensification proceeds on the transformed land is relatively smaller. The off-site impacts, on the other hand, rise with agricultural intensification, also in a non-linear way. Typically they increase steeply above a certain point – for instance the point at which crop growth can no longer absorb the applied nutrients efficiently, or where applied irrigation exceeds the profile water holding capacity. The benefits of intensification in terms of crop yield generally show the opposite non-linear pattern – they rise most steeply for the initial increments of inputs, and then saturate as other factors become limiting. Therefore a window exists for intensification, where the onsite benefits outweigh the offsite costs; furthermore, the onsite benefits (within this window, in terms of increased production) spare the highly detrimental transformation of further land area. Therefore agricultural intensification *per se* is not the problem, but inappropriate intensification – either too much or too little – is.

The third step is to place natural resource-based development within a strongly equity and rights-based framework, and establishing the institutional machinery to enforce it. Firstly, the minimum benefit flows from nature are recognised as a right of all people in the country, both now and in future. About a fifth of the land and ocean area needs to be set aside as protected areas, both for the protection of biodiversity and to ensure flows of critical ecosystem services, in a targeted way rather than just using those fragments seen as useless for other purposes. Minimum ecological flow regimes in rivers must be established and water, food and air quality standards must be enforced. Secondly, the distribution of benefits accruing from the use of natural resources must be made broad-based. This can be achieved by ensuring that use allocations are transparent, law-based, recognise valid prior use rights, and have a fair mechanism for subsequent redistribution. The playing field in terms of access to capital and skills needs to be levelled through the formation of cooperatives, co-ownership and extension schemes. Resource rentals must be set and adjusted to permit reasonable return on capital, effort and risk; but not to encourage wasteful use and windfall profits. The income generated from resource rentals should accumulate in a sovereign fund, whose profits are used to protect and restore natural capital and grow social capital, particularly through education. Thirdly, externalities must be minimised by ensuring that the cost of off-site damages accrue, as far as possible, to the account of those who caused them and benefited from the actions.

To achieve this outcome, most of the internal and external interest groups will need to modify long-cherished notions. The conservation community will need to accept that Africa as a giant game reserve or climate buffer for the rest of the world is neither viable nor equitable; that large areas of natural vegetation will be transformed; and some species and wilderness will be lost. The development community will need to abandon its fixation with the ideal of a self-sufficient peasant farmer, using only organic production techniques; and accept larger scale, more intensive enterprises as a necessary part of the equation.

References

- Beddington J, Asaduzzaman M, Fernandez A, Clark M, Guillou M, Jahn M, Erda L, Mamo T, Van Bo N, Nobre CA, Scholes R, Sharma R, Wakhungu J. 2011. *Achieving food security in the face of climate change: Summary for policy makers from the Commission on Sustainable Agriculture and Climate Change.*
- CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org/commission.
- FAO 2009. *How to feed the world in 2050.* United Nations Food and Agriculture

- Organisation, Rome.
- FAOStat. 2014 *Global database of agricultural areas*, <http://faostat.fao.org/> accessed 8 April 2014.
- Green, RE, SJ Cornell, JP W Scharlemann and A Balmford. 2005. Farming and the Fate of Wild Nature *Science* 307, 550-555. DOI: 10.1126/science.1106049
- Oxfam 2011. *Land and power. The growing scandal surrounding the new wave of investments in land* ISBN 978-1-84814-970-0 in September 2011.
- Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. *Nature* 405, 243-253 <http://dx.doi.org/10.1038/35012251M3>
- Scholes, RJ and R Biggs (eds). 2004. *Ecosystem services in southern Africa: a regional assessment*. CSIR, Pretoria.
- United Nations 2007. *Demographic Yearbook 2003*. Demographic Yearbook (Ser. R), No. 34 ISBN 13: 9789210510974 836 pp. United Nations, Department of Economic and Social Affairs.
- United Nations 2013. *World Population Prospects: the 2012 Revision*. Vol. 1 and 2. United Nations Department of Economic and Social Affairs.

STABILITY OF COASTAL ZONES

■ MARCIA MCNUTT

Introduction

Throughout most of Earth's history, the coastline has been a very dynamic feature. Throughout most of human history as well, the coastline has been constantly shifting (Figure 1a). Only if we view sea level on the time scale corresponding to the rise of civilization has it been approximately stable (Figure 1b). It may not be that a stable shoreline was necessary for the flourishing of civilization, but the simple fact is that cities established themselves with firm roots on the edge of that steady shoreline, and to date have not had to accommodate the dramatic moves as have been the norm throughout most of geologic history.

Currently about 40 percent of the global population lives in the coastal zone,¹ with the proportion rising each year as society becomes more urban. This is the fraction of humanity at risk if sea level should rise dramatically and from hurricanes, storm surges, and other climate-related phenomena. The latest IPCC report on climate change impacts² places "death or harm from coastal flooding" as the number one risk from climate warming, and estimates that the current investment in adaptation to sea level rise is orders of magnitude less than what it needs to be to address the critical problem: a rapidly expanding population of poor living within reach of ever rising seas.

The future is uncertain if sea level departs dramatically from the current Holocene stable state, as is currently feared to be the case from anthropogenic release of CO₂. Throughout most of geologic history, sea level has been closely correlated with CO₂, which gives ample reason for concern.

Contributions to Sea Level Rise

A number of very different factors contribute to sea level rise (Figure 2). Two of the most important are the melting of grounded ice sheets, such as mountain glaciers and the ice sheets on Greenland and Antarctica, and thermal expansion of the ocean. Each of these two factors contributes nearly equally to the current observed rate of sea level rise. A third factor

¹ Defined as living within 100 km of the shoreline, see http://sedac.ciesin.columbia.edu/es/papers/Coastal_Zone_Pop_Method.pdf

² Intergovernmental Panel on Climate Change, Working Group 2, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, <http://www.ipcc.ch/report/ar5/wg2/>

contributing to contemporary sea level rise is the depletion of aquifers that ultimately transfers that water from deep underground to the ocean. It is estimated that as much as 6 percent of the current sea level rise could be attributed to this effect,³ and it would be larger if not for the effects of dams delaying that flow to the sea.

A number of other effects cause regional variability in sea level, and can locally have magnitudes just as large. One of the most important is dynamic ocean topography maintained by ocean currents. Climate change is expected to change land-sea thermal gradients, which in turn may intensify or weaken western boundary currents. For example, the Gulf Stream locally raises sea level by 2 meters in the western Atlantic. This effect is therefore especially important for any coastlines bordering major current systems, and can confound our ability to accurately predict the details of future sea level rise at any one location. The effect of changes in currents can make sea level rise much worse, or much less, than the global average.

Another significant effect is vertical tectonics. A number of coastlines, such as the US Pacific northwest, Japan, New Zealand, the west coast of South America, Indonesia, and portions of the Mediterranean, border active fault lines with a vertical component of slip on the faults. For example, the January 2010 earthquake in Haiti was responsible for co-seismic subsidence of the shoreline of one meter near Port au Prince (Figure 3). That is equivalent to more than 500 years of sea level rise at current rates happening in just a few seconds. Of course, there are other hazards associated with co-seismic slip such as falling buildings and tsunamis as well, and often these active margins produce net uplift of the coastal plain. Currently, however, we are unable to predict the tectonic component to sea level adjustment on human time scales with any certainty along these active margins.

Sedimentary processes are also important in understanding how a shoreline responds to sea level rise. If rivers can deliver an adequate supply of sediment to the coastal zone where the materials are distributed by along-shore currents, shore lines can under certain circumstances keep pace with sea level rise through aggradation (Figure 4). In far too many cases, these natural processes have been altered through construction of dams, sea walls, and other man-made structures which obstruct the nourishment of shorelines, leading to erosion and failure to keep pace with rising seas. As dams have become silted and have lost their original function of water storage,

³ Konikow, Contribution of global groundwater depletion since 1900 to sea-level rise, *Geophys. Res. Letts.* 38, 17, 2011 DOI: 10.1029/2011GL048604.

there has been a rising movement for dam removal to restore natural water flows with a number of benefits to wildlife and coastal protection through sediment supply to starved margins.

Locally in ice covered areas a rather large effect that must be accounted for is rebound from the removal of the ice. For example, the shoreline of Greenland, rather than being inundated, will actually emerge from the ocean should the Greenland ice cap melt, on account of isostatic rebound of Earth's solid surface in response to the unloading of the weight of the ice. The flow of rock in the solid state deep in Earth's asthenosphere toward the uplifting region produces a further subsidence in the region peripheral to the rebounding area, actually accelerating sea level rise in areas adjacent to the former glaciated areas. This phenomenon has been well documented and calibrated from the retreat of the Wisconsin glaciers, and is expected to be noticeable should the Greenland icecap melt as accelerated rates of sea level rise over the global average in Europe and North America.

Finally, many ocean islands are underlain by volcanic pedestals built on subsiding seafloor as tectonic plates age and thermally contract. Although the rate of thermal contraction of the seafloor is slow on human time scales (maximum rates of 0.04 cm/year) and small relative to the other effects discussed (cumulatively currently 0.30 cm/year as an average globally),⁴ it adds to the other causes of sea level rise mentioned above, making ocean islands particularly susceptible.

Challenges in Predicting Future Sea Level Rise

While the past correlation between CO₂ in Earth's atmosphere and sea level appears compelling, predicting the details of future sea level rise on human time scales is particularly challenging. With the number of people potentially at risk, and the amount of the coastal plain that could be inundated in the next century or two, it is desirable to know how fast one might need to retreat from the shoreline. If the predictions of future sea level rise err on the side of being too fast, then one may abandon shoreline-dependent facilities before it is necessary to do so. If one errs on the side of predicting a sea level rise that is too slow, then one may not have planned a retreat that is fast enough, such that facilities are hastily abandoned when they still have useful life.

The difficulty with predicting sea level rise is that, to begin with, locally it is the sum of the many effects discussed above, not all of which can be

⁴ <http://oceanservice.noaa.gov/facts/sealevel.html>

predicted with some or any certainty (e.g., where future earthquakes will occur, what the details of future ocean circulation will be). Another challenge is that sea level rise is a derived quantity from climate predictions of temperature, and even the projections for temperature have uncertainties which are difficult to quantify.⁵ For example, the current predictions of future temperature rise are an “envelope” of what the various models project, from the most optimistic to the most pessimistic, not formal error bounds on any one much less the ensemble of all of the models. The models themselves are unlikely to be completely independent, having had at least some aspects of their codes in common over the decades that they have been developed. They all depend on assumptions on Earth’s albedo and cloud physics, two of the most uncertain elements of radiative forcing. The codes themselves tend to be only approximations of the true physics: they include parameters such as “eddy viscosity” which aren’t real, but are designed to make the model ocean behave as is observed. In addition, to make the models more efficient, approximations are made to some of the calculations – representing them as smooth functions rather than computing each grid point individually.

All in all, the known physics of the green house effect coupled with the long-term observed rise in atmospheric CO₂ correlated with rates of fossil fuel use means that there is very high confidence that global temperatures will surely rise in the coming decades. But exactly how fast is difficult to predict because the net carbon budget is a small difference between very large sources and sinks. Even attempting to predict the temperature trend over the last decade or two has uncovered some surprises, such as the recent “pause” in warming attributed to oceanic absorption of heat.⁶

“No Regrets” Actions

Estimates are that even with a commitment so far not evident to decarbonizing the energy system, it would take several decades to transform the global complex energy delivery network from one based on fossil fuels to one based on renewable and other forms of non-CO₂ emitting energy

⁵ Bader, David; Covey, Curt; Gutowski, William; Held, Isaac; Kunkel, Kenneth; Miller, Ronald; Tokmakian, Robin; and Zhang, Minghua, *Climate Models: An Assessment of Strengths and Limitations* (2008). US Department of Energy Publications. Paper 8. <http://digitalcommons.unl.edu/usdoepub/8>

⁶ England *et al.*, Recent intensification of wind-driven circulation in the Pacific and the ongoing warming hiatus, *Nature Climate Change*, 4, 222–227 (2014) doi:10.1038/nclimate2106

sources. Given that reality, it appears that the world is destined to experience some appreciable amount of sea level rise, and must be preparing now for that eventuality. There are three basic strategies for approaching this problem:

1. Plan an organized retreat from the sea where inundation is inevitable;
2. Fortify high-value investments that cannot quickly retreat to buy time;
3. Restore natural processes to allow shorelines to keep pace with sea level rise.

One example of a planned retreat is the current project at Alligator River National Wildlife Refuge (Figure 5) in North Carolina. Over one million acres will be inundated over the next few centuries as sea level rises over this low-lying coastal plain. The project, which involves the Nature Conservancy, US Fish and Wildlife Service, and other partners, provides natural baffling ability of oyster reefs to reduce the amount of energy reaching the shoreline and to promote sediment accretion behind the reef. There will also be wildlife corridors to allow an orderly migration inland of endangered species such as the red wolf.

The communities that commit to long-term planning and zoning taking into account sea level rise will avoid unnecessary costs and high-value losses from inappropriate location of expensive infrastructure, such as airports and hospitals. For example, selective conversion of coastal property to parks and open space as parcels become available for purchase (especially after natural disasters such as hurricanes) can be an effective way to retreat from rising seas.

There will be some high-value investments that will need protection. It is up to society to say what is worth armoring against rising seas. Certain cultural icons will likely make the list, such as the Statue of Liberty. But what about low-lying areas of cities, such as the SOMA area of San Francisco (Figure Z)? Virtually the entire city of New Orleans?

Finally, we need to restore coastal processes. Free-flowing rivers deliver sediment to the coast, which then gets redistributed to shorelines by along-shore currents. Under some conditions shorelines can build to keep pace with rising seas. However, we have drastically reduced the sediment load to the coastal zone by building dams, and altered along-shore transport by building jetties and sea walls. The Elwha Dam in the Pacific Northwest of the US is an example of a dam that had become silted up and outlived its usefulness for water storage. It is now in the process of being dismantled to restore the natural flow of the river sediment to the coastline. This dam removal project is being closely monitored both in the near term as the pulse of sediment which was stored behind the dam arrives and in the long term as the river regains steady state.

Concluding Thoughts

Experts who study the psychology of threats, such as Dan Gilbert from Harvard, point out the reasons why humans are too slow to react to the threat of climate change:⁷

- Climate change lacks a human face: there is no “bad guy” to which we can direct our attack;
- It doesn’t violate our moral sensibilities: CO₂ is an odorless, tasteless gas;
- It is not perceived as an immediate threat: the problem is still too far in the future, even though in truth we must start taking action today;
- Climate change proceeds at a slow rate: as a species our senses are not attuned to gradual changes.

For this reason, public education for all who live in the coastal zone of the risks and the actions needed to build resiliency are badly needed. Shoreline-dependent facilities, such as sea terminals, should be designed with rising seas and planned obsolescence, and inland migration in mind. Young children should begin from the time they are small to view the shoreline as a place they visit for recreation, camping, and for viewing wildlife, but not a place to put down deep roots.

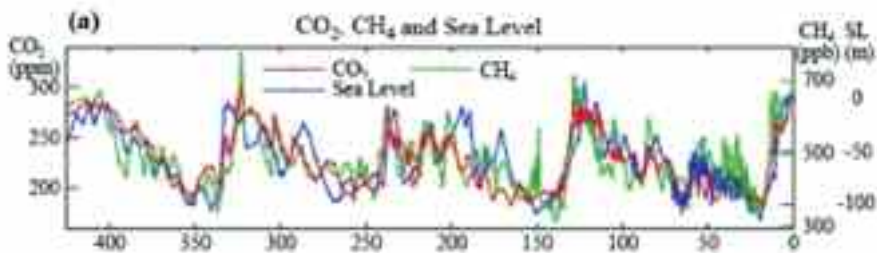


Figure 1. (a) Relationship between carbon dioxide (CO₂, methane (CH₄), and sea level for the Cenozoic (from Hansen *et al.*).⁸ For comparison, Neanderthals lived 200 to 300 thousand years ago. Homo sapiens emerged as a species ~400 to 250 thousand years ago. (b) Detail of Holocene sea level. Data from Fleming *et al.*,⁹ Fleming,¹⁰ and Milne *et al.*¹¹ For context, the Great Pyramids were built 2470 BC, the city of Babylon flourished about the same time. By 8000-7000 BC, farming was firmly established in Mesopotamia.

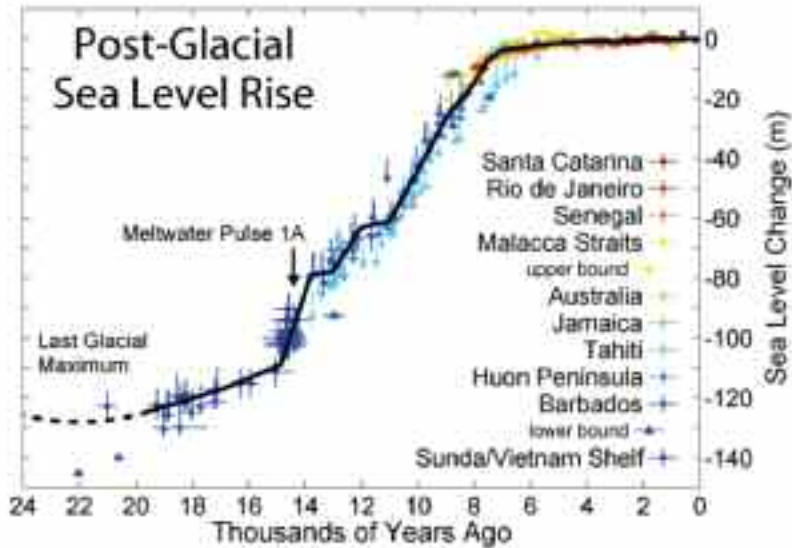
⁷ Presentation at Pop!Tech 2007, see http://www.peopleandplace.net/media_library/video/2009/3/23/responding_to_the_threat_of_climate_change

⁸ Hansen, J. *et al.*, Target CO₂: Where should humanity aim? http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf

⁹ Fleming, K., P. Johnston, D. Zwartz, Y. Yokoyama, K. Lambeck and J. Chappell (1998). “Refining the eustatic sea-level curve since the Last Glacial Maximum using far-

Thousands of years before present

(b)



and intermediate-field sites". *Earth Planet. Sci. Lett.* 163 (1-4): 327-342. DOI:10.1016/S0012-821X(98)00198-8

¹⁰ Fleming, K. (2000). *Glacial Rebound and Sea-level Change Constraints on the Greenland Ice Sheet*. Australian National University. PhD Thesis.

¹¹ Milne, G., A. Long and S. Bassett (2005). "Modelling Holocene relative sea-level observations from the Caribbean and South America". *Quat. Sci. Rev.* 24 (10-11): 1183-1202. DOI:10.1016/j.quascirev.2004.10.005



Figure 2. National Geographic’s “If All the Ice Melted”,¹² while raising awareness to the threats of sea level rise, contains a large number of inaccuracies concerning the details of what actually would happen. It is a “fill up the bathtub” model of melting ice, and does not account for first-order effects such as thermal expansion of the ocean and rebound of formerly ice-covered regions.

¹² <http://ngm.nationalgeographic.com/2013/09/rising-seas/if-ice-melted-map>

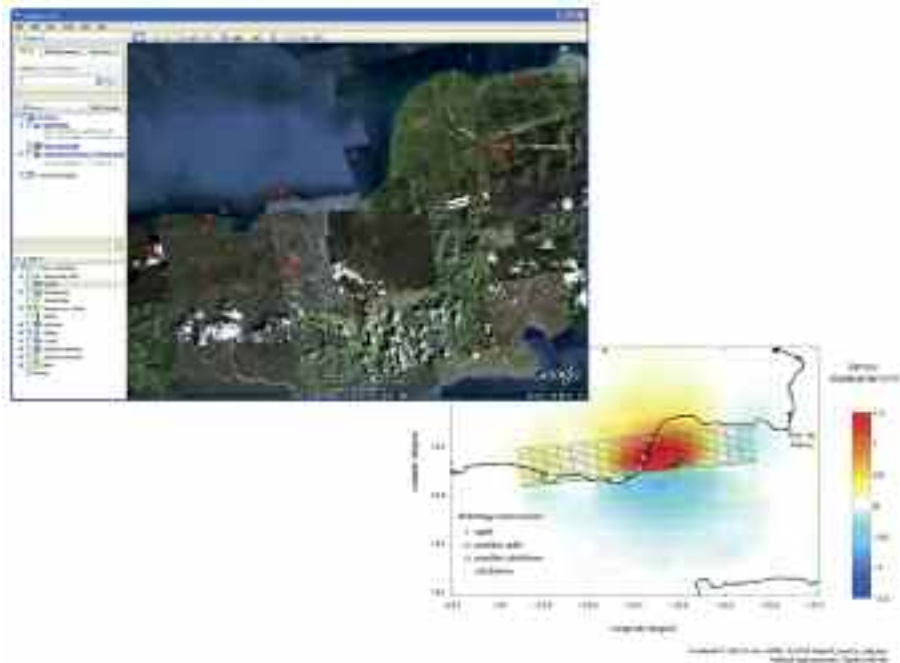


Figure 3. Revised source model from Gavin Hayes (USGS – National Earthquake Information Center) matches the imagery-based observations of coastal uplift and subsidence by Rich Briggs (also USGS-NEIC). The figure is from Ross Stein (USGS-Menlo Park). The image is a screen capture from Google Earth, which has an imbedded layer pulling in USGS earthquake locations updated every 5 minutes, part of an ongoing partnership with Google out of Menlo Park. Co-seismic displacement was shoreline near Port au Prince subsiding more than 1 m relative to the ocean. Figure courtesy of David Applegate, USGS-Reston.

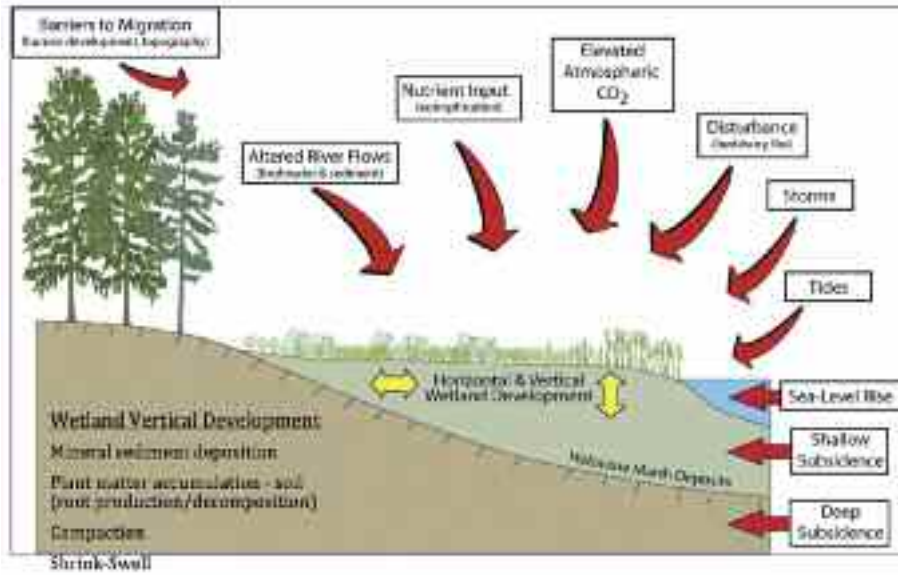


Figure 4. Cartoon illustrating horizontal and vertical wetland growth (yellow arrows) in response to coastal processes. Red arrows show threats to shoreline aggradation.



(a)



(b)

Figure 5. The Alligator River, NC project. (a) Location of wildlife refuge along the Atlantic coast of North Carolina. (b) Planned interventions to facilitate an orderly retreat from the rising sea.

► VII. SOCIETY'S RESPONSE TO CURRENT UNSUSTAINABLE GROWTH

WHY HAVE CLIMATE NEGOTIATIONS PROVED SO DISAPPOINTING?

■ SCOTT BARRETT

I'm grateful to the organizers for proposing this question for my title, because it's important. People often complain that the climate negotiations have been disappointing, only to wring their hands and say that we must do better. But unless we know the *reasons* why the negotiations have been disappointing, we won't know *how* to do better. Using a medical metaphor, if our diagnosis of the illness is wrong, our recommended treatment is unlikely to heal the patient. Indeed, the wrong treatment may only make the patient sicker.

One of the striking things about the climate negotiations is that the negotiators have admitted that they have failed to meet their own goal.

In the Framework Convention on Climate Change, adopted in 1992, parties agreed that atmospheric concentrations of greenhouse gases should be stabilized "at a level that would prevent dangerous anthropogenic interference with the climate system". Later, in the non-binding Copenhagen Accord adopted in 2009, countries recognized "the scientific view that the increase in global temperature should be below 2 degrees Celsius". Finally, in Cancun in 2010, the parties to the Framework Convention reaffirmed this goal, but added that it may need to be strengthened, limiting temperature rise to 1.5°C.

After Copenhagen, countries submitted pledges for reducing their emissions. However, analysis by Rogelj *et al.* (2010) shows that even an optimistic reading of these pledges implies that mean global temperature will surpass the 2°C temperature change target.

The negotiators agree with this assessment. In Durban in 2011, they noted "*with grave concern* the significant gap between the aggregate effect of Parties' mitigation pledges in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with having a likely chance of holding the increase in global average temperature below" the agreed threshold. Rogelj *et al.* (2010: 1128) describe this behaviour as being "equivalent to racing towards a cliff and hoping to stop just before it".

Note that the Copenhagen pledges are voluntary. It's possible that they'll be exceeded. As bad as things look now, they could turn out to be worse.

The problem isn't disagreement about what should be done. Support for the 2°C goal is universal. The problem is that this is a global goal. Every-

one is responsible for meeting it, meaning that no country is responsible for meeting it. Limiting climate change requires very broad cooperation. It requires *collective action*.

The reason collective action has eluded us so far is that reducing emissions is a prisoners' dilemma game. Each country is better off when *all* countries reduce their emissions substantially. But each country has only a small incentive to reduce its *own* emissions.

The Kyoto Protocol asks some countries to reduce their emissions beyond "business as usual", and so confronts the prisoners' dilemma head on. But Kyoto has failed in its mission to limit emissions.¹ The Copenhagen Accord, by focusing on the need to avoid "dangerous" climate change, has tried to reframe the problem. Will Copenhagen succeed? Reframing is the right strategy. But we need a different framing. Although my main purpose is to explain why the negotiations have been disappointing, I also want to suggest how an understanding of this failure can provide insights into how we might do better. Countries are currently trying to negotiate a new kind of climate agreement for adoption in 2015. My paper ends by suggesting how a different framing of the climate collective action problem could turn the negotiations around. The climate negotiations needn't be as disappointing as they have been so far.

The "dangerous" climate change game

Here is a way to think about the "dangerous" climate change game. Let's say that there exists a red line for "danger", and that countries know what this red line is. For example, it might be the 2°C goal. Let's also say that the impact of crossing this threshold is expected to be so severe relative to the costs of staying clear of it that all countries, collectively, prefer to stay clear of it. Then it's obvious what countries should do if they act collectively: they should limit concentrations of greenhouse gases to avoid crossing the red line.

The problem, of course, is that countries don't act collectively. They're sovereign. They act independently. So, we should ask: What *incentives* do countries have to stay within the good side of the red line?

Under reasonable assumptions, the game I have just described is not a prisoners' dilemma. It's a "coordination game" with two Nash equilibria (Barrett 2013).² In one, countries stay just within the "safe" zone. In the

¹ See, especially, research by Aichele and Felbermayr (2011), discussed later in this paper, which takes into account the effect of Kyoto on trade "leakage".

² In a coordination game, people want to do what others are doing. A car may be driven on the left or right side of the road. So, on which side of the road should you

other, they breeze past the tipping point, making catastrophe inevitable. In general, game theory has trouble predicting how countries will behave in a coordination game. However, since the “bad” Nash equilibrium is so obviously bad, staying within the red line is focal (Schelling 1960). Moreover, with the help of a treaty, countries can virtually guarantee that they will coordinate around the “good” Nash equilibrium.

Here is how the treaty should be written. It should assign to every country an emission limit, with each country’s limit chosen to ensure that, when all the limits are added up, concentrations stay within the “safe” zone. The limits should also be chosen to ensure that every country is better off staying within its assigned limit, given that all the other countries stay within *their* assigned limits. Finally, the agreement should only enter into force if ratified by every country.

The beauty of such a treaty is that it makes every country pivotal. If every other country behaves as required, each country has an incentive to behave as required. The reason: even the slightest slip up guarantees catastrophe.

This treaty, like all good treaties, transforms the game. In the treaty participation game, every country has a dominant strategy to participate. Why? Every country has nothing to lose by joining. If the agreement fails to enter into force, each country would be free to act as it pleased. If the agreement were to enter into force, however, then it would be binding on all parties, and catastrophe would be avoided – the outcome every country prefers. Every country is thus always better off participating.

How would the emission limits for individual countries be chosen? This is the bargaining problem. If countries were “symmetric”, bargaining would be simple. Technically, a wide variety of allocations would satisfy the requirements I described above, but an equal allocation would be focal, and for that reason is to be expected. Asymmetry makes bargaining more complex, but so long as collective action promises all countries an aggregate gain, there will exist an allocation of responsibility that will be acceptable to every country (this allocation won’t be unique and may require side payments, but these are relatively minor points compared with the imperative to avoid catastrophe).

drive? The answer depends on where everyone else is driving. In Italy, it’s obvious that you should drive on the right. In the UK, it’s obvious that you should drive on the left. These different outcomes (driving on the left and driving on the right) are each a “Nash equilibrium”. Given that others are driving on the left (right), each driver chooses to drive on the left (right).

The threat of catastrophe simplifies the negotiation problem. It makes each country's promise to stay within its agreed limits *credible*.

The vulnerability in this game isn't the behavior of the countries. It is the credibility of the *science* – in particular, the science of locating the critical tipping point.

In the dangerous climate change game, it would be irrational for any country to exceed its assigned amount of emissions when doing so would cause atmospheric concentrations to cross the catastrophic tipping point. In this case, free rider deterrence depends on the credibility of *Nature's* threat to tip a critical geophysical system. Yes, in the dangerous climate change game, Nature is an important player.

The importance of scientific uncertainty

What would countries need to do collectively to prevent dangerous climate change?

The Copenhagen Accord says:

To achieve the ultimate objective of the Convention to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, we shall, recognizing *the scientific view that the increase in global temperature should be below 2 degrees Celsius* [emphasis added], on the basis of equity and in the context of sustainable development, enhance our long-term cooperative action to combat climate change.³

Why defer to the “scientific view”? The reason is that it simplifies the negotiations. It allows negotiators to bargain over individual country shares.

However, while scientists warned of “climate disaster” before the Framework Convention was adopted (see, in particular, Mercer 1978), I think the Framework Convention caused scientists to focus on this question at least as much as previous scientific research caused negotiators to focus on it.

Reference to “*the scientific view*” [emphasis added] implies that there is strong agreement among scientists about the threshold. There isn't. The only “scientific view” that I detect in the literature is that thresholds are likely to exist.⁴

³The Copenhagen Accord was written somewhat hastily, and this temperature target is identified without reference to a base level of temperature. In Cancun the following year, negotiators clarified that the temperature reference target was the pre-industrial level.

⁴Rapid changes in temperature have been observed in the paleoclimatic record, an example being the Younger Dryas; see Broecker (1997).

Although temperature thresholds are uncertain, the uncertainties involved in choosing a target are even greater than this. The Framework Convention specifies the target in terms of concentrations, not temperature, and converting temperature to concentrations introduces an additional layer of uncertainty – something known as “climate sensitivity” (Roe and Baker 2007). Moreover, we don’t know the quantity of global emissions (expressed, perhaps, as a cumulative sum) needed to meet any particular concentration target, due to uncertainty in the carbon cycle. For example, there is uncertainty about how much of the CO₂ emitted will be taken up by soils and the oceans. The fifth assessment report by the Intergovernmental Panel on Climate Change calculates a global “budget” in terms of cumulative emissions that will keep temperature change within 2°C, but all of these values are probabilistic. Even if we knew for certain that 2°C were the true red line for climate change (and we don’t know this), countries would have to decide how to balance the cost of reducing emissions with reductions in the risk of crossing the red line.

The dangerous climate change game with uncertain thresholds

Uncertainty about the threshold for “danger” changes the climate change game fundamentally.

Consider a very simple game – no treaty. In stage 1, countries choose their emission levels independently. In stage 2, Nature chooses the tipping point. When making their choices in stage 1, the players know the probability density function for the tipping point. What they don’t know is which value under this function will be chosen by Nature – the “true” value for the tipping point.

An example will make this clear. Rockström *et al.* (2009) argue that atmospheric CO₂ concentrations should be constrained “to *ensure* [emphasis added] the continued existence of the large polar ice sheets”. They note that the paleoclimatic record implies “that there is a critical threshold between 350 and 550 ppmv”, and interpret this as saying that if concentrations are limited to 350 ppmv, then the ice sheets will be preserved, whereas if concentrations rise to 550 ppmv, then the ice sheets will be lost. In between these values there is a chance that the ice sheets will disappear, with the probability increasing with the concentration level. (For reference, last month’s reading from Mona Loa was about 399.65 ppmv; at the start of the industrial revolution, concentrations were about 280 ppmv; when the Framework Convention was adopted they were 356 ppmv).

Assume that the probability density function is uniform over the range (350, 550).⁵ Assume also that the expected aggregate benefit of reducing the threat of catastrophe exceeds the cost. What should countries do? Under reasonable assumptions (Barrett 2013), the collective-best outcome is to limit concentrations to 350 ppmv. This implements the “precautionary principle”. Acting independently, however, countries have incentives to reduce emissions only up to the point where their expected *individual* marginal benefit equals marginal cost – under reasonable assumptions, a substantially smaller value. Indeed, very simple calculations show that it will probably pay individual countries to abate so little that they will blow right past the critical threshold. They will cross the 550 ppmv line, guaranteeing catastrophe.

You might think this is just theory and that country representatives wouldn't be this dumb. I think there are good reasons to take the prediction seriously.

Astrid Dannenberg and I have tested these predictions in the experimental lab with real people playing for real money (Barrett and Dannenberg 2012). Putting people into groups of 10, we find that when the threshold is certain, 18 out of 20 groups avoid catastrophe.⁶ By contrast, when the threshold is uncertain, catastrophe occurs with probability 100% for 16 out of 20 groups and with probability no less than 80% for the rest.⁷

How sensitive are these results? Intuitively, there should exist a critical amount of uncertainty such that if uncertainty were greater than this amount, catastrophe would be bound to occur, whereas if uncertainty were less than this, catastrophe would be avoided. This is exactly what the theory predicts (Barrett 2013), and in further experiments (Barrett and Dannenberg 2014a), Astrid Dannenberg and I have shown that this result is also robust. To the left of a critical “dividing line” for threshold uncertainty, we find that catastrophe is avoided with high probability almost all the time. Just to the right of the dividing line, by contrast, catastrophe occurs with proba-

⁵ This means that the probability that the threshold lies between 350 and 400 ppmv is the same as the probability that the threshold lies between 400 and 450 ppmv, between 450 and 500 ppmv, and between 500 and 550 ppmv. It also means that the probability that the threshold lies below 350 or above 550 ppmv is zero.

⁶ In each of the two failing groups, just one individual, a bad apple, caused the trouble, pledging to contribute his or her fair share and then choosing to contribute nothing.

⁷ Interestingly, theory predicts that uncertainty about the *impact* of crossing a critical threshold should make no difference to collective action (Barrett 2013), another prediction confirmed in the experimental lab (Barrett and Dannenberg 2012). It is only uncertainty about the tipping point that matters, and this is a purely scientific matter.

bility 100%. This research suggests that negotiators can't rely on science to solve their collective action problem. Even the new science of "early warning signals" won't be able to shrink uncertainty by enough to transform the behavior of nation states.

This research is helpful, I think, because it is completely consistent with the behavior we are observing in the real world. As noted before, countries have agreed to limit temperature change to 2°C, but they have pledged emission reductions that virtually guarantee overshooting of this target.

If the science of climate change were much more certain, the prospect of catastrophe would give countries the discipline they needed to act in their collective-best interest. It would make the dangerous climate change game a coordination game. Scientific uncertainty makes the emission reductions game a prisoners' dilemma. The most important thing about a prisoners' dilemma is that the collective-best outcome cannot be sustained by non-cooperative behavior. It requires enforcement, something that the international system is very bad at doing.

A climate Doomsday Machine

It is tempting to consider an analogy to nuclear arms control. Herman Kahn (1961: 107) proposed construction of a Doomsday Machine, a device whose function is to destroy the world. This device is protected from enemy action (perhaps by being situated thousands of feet underground) and then connected to a computer, in turn connected to thousands of sensory devices all over the United States. The computer would be programmed so that if, say, five nuclear bombs exploded over the United States, the device would be triggered and the world destroyed. Barring such problems as coding errors (an important technical consideration), this machine would seem to be the 'ideal' [deterrent]. If Khrushchev ordered an attack, both Khrushchev and the Soviet population would be automatically and efficiently annihilated.

A Climate Doomsday Machine would connect all the world's nuclear bombs to a computer, which in turn would be linked to a sensor at the top of Mona Loa in Hawaii. This is where readings are taken of atmospheric concentrations of greenhouse gases. Today, as noted before, the concentration level is about 400 ppmv. The computer could be programmed to destroy the world should this level top, say, 500 ppmv. With the trigger for catastrophe being certain, theory and experimental evidence strongly suggest that this device would give the world all the encouragement needed to stay within 500.

Of course, I'm not seriously proposing this. The proposal is unacceptable.⁸ However, the idea behind it is worth thinking about. The Doomsday Machine is a purely strategic device. Its sole purpose is to change the incentives countries have to rein in their emissions and save the world from dangerous climate change. It works by transforming the prisoners' dilemma into a coordination game. Thinking about it begs the question: Are there *acceptable* strategic approaches that could have a similar effect? I shall return to this point later in the paper.

Framing reconsidered

Has a focus on "dangerous" climate change really made no difference? Under certain conditions, theory suggests that uncertainty about the threshold could mean that behavior won't change at all, even though the consequences of failing to act will be much worse because of the threat of catastrophic climate change (Barrett 2012).

But is this result to be believed? Many predictions of analytical game theory are disproved in the experimental lab. For example, cooperation in a prisoners' dilemma typically exceeds the Nash equilibrium prediction (though the level of cooperation declines rapidly as the players learn that their efforts to cooperate are not reciprocated). In a one-shot test of the theory, Astrid Dannenberg and I found that cooperation was higher for the prisoners' dilemma with an uncertain threshold for "catastrophe" compared to a prisoners' dilemma without any risk of "catastrophe" (Barrett and Dannenberg 2014b). This suggests that, given the risk from "dangerous" climate change, the wording of Article II of the Framework Convention has probably helped (though it is the real risk rather than the wording that would affect behavior). Unfortunately, our experiment also showed that the additional cooperation wasn't enough to prevent catastrophe from occurring.

Strategies of reciprocity

My description of the dangerous climate change game left out the role of an international agreement. I explained before that a treaty could change the incentives in the game with a certain threshold, ensuring coordination. Could a treaty help overcome the incentive to free ride when the threshold

⁸ Nor did Kahn recommend the Doomsday Machine: "If one were presenting a military briefing advocating some special weapon system as a deterrent . . . the Doomsday Machine might seem better than any alternative system; nevertheless, it is unacceptable". (Kahn 1961: 104-105).

is very uncertain? Theory suggests that an agreement would help very little (Barrett 2013). The reason is the difficulty of enforcing an agreement to limit emissions.

Atmospheric concentrations of CO₂ are determined by the aggregate behavior of *all* countries (as mediated by the carbon cycle). Strategies of reciprocity work very well in two-player games. They work less well when the number of players is large.

In the climate change game, how many players really matter? Some countries are bigger emitters than others. However, the top ten emitters account for only about two-thirds of total emissions, and stabilizing concentrations requires driving global net emissions to zero, necessitating the engagement of nearly *all* countries.⁹

The temptation to free ride is further aggravated by the high marginal cost of reducing emissions substantially. It is sometimes argued that reducing emissions is cheap. If this were true, however, collective action would be easy.

Another problem is the lack of correlation between a country's contribution to emissions and its vulnerability to climate change. To illustrate, William Nordhaus (2011) has calculated that the "social cost of carbon" is more than twice as large for Africa, a continent of more than 50 states, as it is for the United States. Moreover, this gap is growing. Yet, Africa's emissions are tiny when compared to those of the United States. Africa is both more vulnerable to climate change and less able to prevent it from occurring.

Finally, globalization amplifies the incentives to free ride. Abatement by a single country or coalition of countries will tend to shift emissions towards the countries that fail to act – a phenomenon known as "leakage".

It is well known that infinitely repeated play of the prisoners' dilemma can allow the full cooperative outcome to be sustained as a (subgame perfect) Nash equilibrium, provided discount rates are sufficiently low. The reason is that, should a country "cheat" on an agreement to limit emissions, the others can reciprocate. This suggests that cooperation should be easy.

The flaw in this perspective is that it considers only the interests of individual countries. It ignores these countries' collective interests.

Imagine that all the world's countries come together and negotiate an agreement that maximizes their collective interests. Later, one country announces that it will withdraw. This withdrawal would harm the other states, and they would like to punish this country (or, better yet, threaten to punish it, hoping to deter its withdrawal). In the context of a treaty, they would

⁹ Unless, that is, substantial amounts of carbon are removed from the atmosphere.

naturally *cooperate* to punish the deviant country. To deter a deviation, their punishment must be big enough that the deviant would be better off remaining in the agreement than withdrawing and facing the punishment. But the punishment must also be credible. Given that this country has withdrawn, the remaining $N - 1$ countries must be better off when they impose the punishment than when they do not impose it (or when they impose a weaker punishment). Because so many countries remain in the agreement, it will only pay these countries to cut their abatement a little. A larger punishment wouldn't be credible. A small punishment, however, would be too little to deter a defection. Continuing in this way, it is easy to see that an agreement to limit emissions is only self-enforcing if the number of countries participating is very small. For then, should one country withdraw, the remaining countries would have an incentive to drop their abatement significantly. However, once participation shrinks to such a low level, the treaty achieves very little.

It may be possible for countries to sustain a high level of participation, but this would only be true if the gains to cooperation were small. It may also be possible to sustain a high level of participation if the ambition of the treaty were set very low. What isn't possible is for countries to sustain a high degree of cooperation when the gains from cooperation are very large.¹⁰

I have so far focused on participation. What about compliance? A flaw in the approaches to enforcement taken previously is that they either ignore participation (as in Chayes and Chayes 1995) or fail to distinguish between participation and compliance (as in Downs, Rocke, and Barsoom 1996). Under the rules of international law, countries are free to choose whether or not to participate in a treaty. However, the countries that choose to participate are legally obligated to comply with it (*pacta sunt servanda*, meaning "agreements must be kept"). The easiest way to avoid needing to comply is therefore not to participate in the first place – or to withdraw after becoming a party. From the perspective of game theory, the problem is coming up with a credible punishment that is large enough to deter non-participation. Once this is done, deterring non-compliance is easy. Remember, larger deviations can only be deterred by larger punishments, and larger punishments are less credible. What's the biggest harm a party could ever do? Behaving as it would were it not a party to the agreement (any bigger harm would not be credible). So, if the parties can deter non-participation, they can easily deter a smaller deviation of non-compliance. From both perspec-

¹⁰ All of these points are developed in detail in Barrett (2003).

tives, then, deterring non-participation is the binding constraint on enforcement (Barrett 2003).

This is theory. Is the reasoning compelling? I know of no example from international cooperation that challenges this perspective. The World Trade Organization might appear to be an exception, but trade isn't a global public good. Trade is a bilateral activity, and strategies of reciprocity are very effective in sustaining cooperation amongst pairs of players. The Montreal Protocol on protecting the ozone layer might appear to be another exception, but as I shall explain later, this treaty works very differently.

Enforcement of the Kyoto Protocol

The Kyoto Protocol looks at climate change as a prisoners' dilemma, demands that certain countries cooperate, and then does nothing about enforcement.

How do we know this? The United States participated in the Kyoto negotiations. President Clinton signed the treaty. However, the United States never ratified Kyoto. One reason for this is that there were no consequences to the United States for not ratifying the agreement. Non-participation by the United States was not deterred.

Canada ratified Kyoto, but failed to adopt the domestic legislation needed to implement its obligations. As a consequence, Canada's emissions exceeded the limit set by Kyoto limit. Once in this situation, Canada had three options. It could buy permits or offsets to stay in compliance; it could stay in the agreement and be in non-compliance; or it could withdraw from the agreement. In contrast to the first option, withdrawal would be costless. In contrast to the second option, withdrawal would not violate international law. Not surprisingly, Canada decided to withdraw. The Kyoto Protocol could not deter Canada from withdrawing.

Compliance with the Kyoto Protocol by other parties is uneven (Haita 2012). However, there are ways to get around compliance. For example, Japan is maneuvering to achieve compliance partly by purchasing "assigned amount units" from Ukraine, when Ukraine's emissions are well below its "assigned amounts". In other words, in buying these units from Ukraine, Japan can comply without emissions being reduced anywhere. This may seem crazy but the treaty was written to allow this trading in "hot air".

Finally, countries like China and India are not subject to limits on their emissions. They participate in Kyoto. They comply with it. But Kyoto does not require that these countries do anything.

Overall, did Kyoto contribute to meeting the objectives of the Framework Convention? Did it reduce global emissions? Econometric analysis

of the Kyoto Protocol by Rahel Aichele and Gabriel Felbermayr (2012: 351) shows that Kyoto did reduce the emissions of participating countries. However, its effect on *global* carbon emissions “has been statistically indistinguishable from zero”.

The most important indicator of whether the objectives of the Framework Convention are being met is whether the growth in atmospheric concentrations is slowing. It isn't. If anything, the rate of increase has gone up.¹¹ We are no closer now to addressing this great problem than we were more than twenty years ago when the Framework Convention was adopted.

Pivot: From Kyoto to Paris

The Copenhagen talks were supposed to provide a successor agreement to the Kyoto Protocol. They failed.

A new agreement is now being negotiated under the “Durban Platform”. It is supposed to be ready for adoption by 2015, when the parties to the Framework Convention meet in Paris. It is supposed to be implemented by 2020.

Since Kyoto's emission limits ended in 2012, this leaves a gap of eight years. To fill the gap, Kyoto was given an extension in the form of the Doha Amendment (which has yet to enter into force). However, it is a further sign of Kyoto's failings that Japan, New Zealand, and Russia declared their intention not to participate this time around.¹²

The new agreement being negotiated now won't repeat all of Kyoto's mistakes, but there is no indication yet that it will improve much on what countries would have done in the absence of cooperation. Kyoto referred to its emission limits as “commitments”. However, countries were never truly committed to meeting these limits; they couldn't be committed to meeting these limits so long as Kyoto lacked the means to compel parties to do more than they were willing to do unilaterally. It is a sign of where the current round of negotiations are going that in Durban countries agreed to negotiate a new “protocol, legal instrument or agreed outcome with legal force”, and that in the recent Warsaw talks they agreed to negotiate “contributions” rather than “commitments”.

The world clearly needs a new model for cooperation on climate change.

¹¹ The data can be found at <http://www.esrl.noaa.gov/gmd/ccgg/trends/>

¹² The European Union will participate, because this agreement only requires that Europe meet the target it declared it would meet unilaterally. The new government in Australia has introduced legislation to repeal the previous government's climate legislation, a sign that Australia may not ratify the Doha Amendment.

Why the Montreal Protocol succeeded

Kyoto lacks a strategic design. The emissions targets and timetables were chosen in the expectation that they would be met. No consideration was given to whether the treaty created *incentives* for them to be met.

The Montreal Protocol, negotiated to protect the stratospheric ozone layer, was designed very differently. Remarkably, while the Montreal Protocol was not intended to reduce greenhouse gases, it has been much more successful at doing this than the Kyoto Protocol. It turns out that ozone in the stratosphere is a greenhouse gas (protecting the ozone layer will thus add to climate change), as are the chemicals that deplete stratospheric ozone (reducing these emissions will thus help mitigate climate change) and many of their substitutes (use of these will thus add to climate change). Calculations by Velders *et al.* (2007) show that, by phasing out the ozone-depleting substances that double as greenhouse gases, the Montreal Protocol has done four times as much to limit atmospheric concentrations as the Kyoto Protocol aimed to do.

Why did Montreal succeed where Kyoto failed? A key reason for its success is the threat to restrict trade – in particular, a ban on trade in controlled substances between parties and non-parties (Barrett 2003). The most important motive for the trade restriction was to enforce participation in the agreement (Benedick 1998: 91). If participation could be enforced, then trade leakage would be eliminated; moreover, compliance could also be enforced (Barrett 2003). Crucially, the trade restrictions in the Montreal Protocol are a strategic device. Their purpose was not to be used; their purpose was to change behavior.

How do the trade restrictions work? Imagine that very few countries are parties to an agreement to limit emissions, and your country is contemplating whether or not to join. If you join, you will have to reduce your emissions. Your country will pay the cost, and the benefits will be diffused; the incentives to free ride will not be blunted. If, in addition, you are now also prohibited from trading with non-parties – the vast majority of countries – than you will be doubly harmed. By joining, you not only forfeit the benefits of free riding; you also lose the gains from trade.

Now imagine that almost every other country is a party to the same agreement. If you join, you still lose the benefits of free riding. But now you are able to trade with the vast majority of countries. If the gains from trade exceed the loss from free riding, your country will be better off joining. Put differently, if every country is a party to such an agreement, none will wish to withdraw. The agreement will sustain full participation by means of a self-enforcing mechanism – the trade restriction. Most remark-

ably, in equilibrium, trade will never be restricted, just as the Domsday Device would never be detonated. It is the credible threat to restrict trade (detonate the device) that disciplines behavior.

Notice that a key feature of this strategy is that “enough” countries participate in the agreement. If too few participate, none will want to participate. If enough participate, everyone will want to participate. Somewhere in between there exists a “tipping point” for participation. Once this tipping point has been identified, the treaty only needs to coordinate participation – something treaties can do very easily. As I said before, treaties need to ensure that countries are steered towards the desired outcome. In the Montreal Protocol, this was achieved by the minimum participation clause (Barrett 2003).

The trade restrictions are an acceptable alternative to the Domsday Machine. Like the Domsday Machine, trade restrictions transform the prisoners’ dilemma into a coordination game.

Coordination in climate treaties

The Montreal Protocol could be amended to achieve more for the climate. Hydrofluorocarbons (HFCs) do not deplete the ozone layer, and so are not currently regulated by the Montreal Protocol. However, HFCs are a very potent greenhouse gas – one of the six gases controlled by the Kyoto Protocol. Kyoto has done very little to limit HFCs. In May 2011, the United States, Canada, and Mexico proposed amending the Montreal Protocol to control HFCs. If adopted, such an amendment would represent a significant departure from the approach taken so far to address climate change. It would mean addressing one piece of the problem, rather than all of it in a comprehensive way. And it would likely involve using trade restrictions for purposes of enforcement. I want to underline that the application of trade restrictions is purely strategic. Other proposals for trade restrictions in climate policy are very different; their purpose is to be *used*, not to alter behavior strategically (Barrett 2011).

There are other opportunities for transforming the climate change game from a prisoners’ dilemma into a coordination game, especially the application of technology standards (Barrett 2003, 2006).

Let me give one example. Another greenhouse gas known as perfluorocarbons or PFCs is emitted in the process of manufacturing aluminum. Apparently, these emissions can be eliminated if the anodes being used now are replaced with inert anodes. According to the United States Environmental Protection Agency’s webpage, “This technology is being pursued aggressively through a joint R&D program that has been established between the aluminum industry and the U.S. Department of Energy in its

Industrial Technology Program”.¹³ The new anode is expected to be available in 10–15 years.

Here, then, is a suggestion. A new agreement should be negotiated requiring that producers adopt the new technology, and that all parties agree to import aluminum only from countries that participate in the agreement. This approach creates a “tipping” phenomenon. Provided enough countries join the agreement, all will want to join it. Why? To be outside the agreement when most countries are inside means not being able to trade in aluminum with most of the world.

This proposal for aluminum would be different from Montreal. The trade restriction would be based on a process standard, not a product standard. However, I believe it would still be effective. I also believe it would be compatible with the WTO, partly because of the exemptions allowed under Article XX, but also because it would be adopted by a multilateral agreement.

A final point. Another reason Montreal works is that it includes side payments to address related equity issues. Side payments could also be included in an agreement establishing a aluminum production standard. As in Montreal, any side payments should be based on the “incremental costs” of adopting the standard. Transfers should be small, and the countries giving the money should know what they are getting for their money.

Again, this is just one example of how the negotiations could be made more effective.¹⁴ My aim here is not to develop a comprehensive approach to future climate negotiations but to suggest a new direction. If the negotiators understood their job as needing to achieve coordination, and to think strategically, they would achieve more – and the climate negotiations wouldn’t prove so disappointing.

References

- Aichele, Rahel and Gabriel Felbermayr (2012). “Kyoto and the Carbon Footprint of Nations”, *Journal of Environmental Economics and Management* 63: 336–354.
- Barrett, Scott (2003), *Environment and Statecraft: The Strategy of Environmental Treaty-Making*, Oxford: Oxford University Press.
- Barrett, S. (2006). “Climate Treaties and ‘Breakthrough’ Technologies”. *American Economic Review (Papers and Proceedings)* 96(2): 22–25.
- Barrett, Scott (2011). “Rethinking Climate Change Governance and Its Relationship to the World Trading System”, *The World Economy* 34(11): 1863–1882.
- Barrett, Scott (2013). “Climate Treaties and

¹³ <http://www.epa.gov/aluminum-pfc/resources.html>

¹⁴ For other examples of sectoral approaches to reducing emissions, see Barrett (2011).

- Approaching Catastrophes”, *Journal of Environmental Economics and Management*, 66(2): 235-250.
- Barrett, Scott and Astrid Dannenberg (2012). “Climate Negotiations Under Scientific Uncertainty”, *Proceedings of the National Academy of Sciences*, 109(43): 17372-17376.
- Barrett, Scott and Astrid Dannenberg (2014a), “Sensitivity of Collective Action to Uncertainty about Climate Tipping Points”, *Nature Climate Change* 4: 36-39.
- Barrett, Scott and Astrid Dannenberg (2014b), “Negotiating to Avoid ‘Gradual’ versus ‘Dangerous’ Climate Change: An Experimental Test of Two Prisoners’ Dilemmas”, in Todd L. Cherry, Jon Hovi, and Dave McEvoy (eds.), *Toward a New Climate Agreement: Conflict, Resolution, and Governance*, London: Routledge.
- Benedick, R.E. (1998). *Ozone Diplomacy: New Directions in Safeguarding the Planet*, Enlarged Edition, Cambridge, MA: Harvard University Press.
- Broecker, W.S. (1997). “Thermohaline Circulation, the Achilles Heel of Our Climate System: Will Man-Made CO₂ Upset the Current Balance?” *Science* 278:1582-1588.
- Chayes, A. and A.H. Chayes (1995), *The New Sovereignty*. Cambridge, MA: Harvard University Press.
- Downs, G.W, D.M. Rocke, and P.N. Barsoon (1996), “Is the Good News About Compliance Good News About Cooperation?” *International Organization* 50: 379-406.
- Environmental Protection Agency (2006). *Global Mitigation of Non-CO₂ Greenhouse Gases*, Washington, DC: EPA.
- Haita, Corina (2012). “The State of Compliance in the Kyoto Protocol”, International Center for Climate Governance; http://www.iccgov.org/FilePageStatische/Files/Publications/Reflections/12_Reflection_December_2012.pdf
- Kahn, Herman (1961), “The Arms Race and Some of Its Hazards”, in Donald G. Brennan (ed.), *Arms Control, Disarmament, and National Security*, New York: George Braziller, pp. 89-121.
- Mercer, J.H. (1978). “West Antarctic Ice Sheet and CO₂ Greenhouse Effect: A Threat of Disaster”, *Nature* 271: 321-325.
- Nordhaus, William (2011). “Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model”. Cowles Foundation Discussion Paper No. 1826, Yale University.
- Rockström, J., W. Steffen, K. Noone, Å. Persson, S. Chapin III, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J.A. Foley (2009). “A Safe Operating Safe for Humanity”, *Nature* 461: 472-475.
- Roe, G.H. and M.B. Baker (2007). “Why is Climate Sensitivity So Unpredictable?” *Science* 318: 629-632.
- Rogelj, J., J. Nabel, C. Chen, W. Hare, K. Markmann, M. Meinshausen, M. Schaeffer, K. Macey, and N. Höhne (2010). “Copenhagen Accord Pledges are Paltry”, *Nature* 464: 1126-1128.
- Schelling, T.C. (1960). *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.
- Velders, G.J.M., S.O. Anderson, J.S. Daniel, D.W. Fahey, and M. McFarland (2007), “The Importance of the Montreal Protocol in Protecting Climate”, *Proceedings of the National Academy of Sciences* 104 (12): 4814-4819.

TOWARDS AN INCLUSIVE “GREEN ECONOMY”: RETHINKING ETHICS AND ECONOMY IN THE AGE OF THE ANTHROPOCENE

■ ACHIM STEINER

Sometimes, to look afresh at the problems of today, we need to take a wider view. Not just decades, or centuries. Not even millennia.

Geologists divide the Earth’s existence into periods called epochs. These can be tens of millions of years long. Each is marked by a radically different climate, and most culminate in some kind of mass extinction. The Holocene, for example, started some twelve thousand years ago, when the glaciers started to retreat from the temperate lands we know today, and mammoths and sabre-toothed tigers disappeared from our planet.

Some scientists suggest that we have entered into an entirely new epoch. Nobel Prize laureate Paul Crutzen was the one to give this period its name: the Anthropocene. And this name may soon be formalised, as the Stratigraphy Commission of the Geological Society of London will decide in 2016 if the Anthropocene will indeed become a formal unit of geological epoch divisions. Dating back to the Industrial Revolution, this is the period in which the human race became the single most influential factor in our planet’s future. The mass extinction has already started: it is estimated that species of flora and fauna are presently going extinct at 1000 times the rate we could otherwise expect.

To put that into perspective, that places the human race in the same category as the asteroid which wiped out the dinosaurs, and 75% of all Earth’s species, 66 million years ago.

We are not the inheritors of the Earth’s natural resources, but rather, the custodians. We have a duty of care to the poor, the weak and disenfranchised; to our children and to their children, to protect and nurture creation.

This responsibility presses upon us as individuals, as communities and as nations. The treasures of creation are the very base that allows human society to develop and grow. If we exhaust these resources, there can be no sustainable social and economic growth. To foster these resources and thrive, we need to evolve our development ethic and vision. Alongside that, our very survival as a species could depend upon the adoption of a new paradigm for transforming the ever dominant economic rationale of our times which has guaranteed a great deal of wealth but has also begun

to impoverish our societies and is rapidly compromising the wellbeing of future generations.

A New Development Ethic and Vision

As individuals and communities we need to respond to a different set of realities and responsibilities in the Anthropocene. 250 years of consumption have magnified, not reduced, inequality. We need to correct the irrationality of valuing economic growth and material wealth over happiness, security and wellbeing.

Yet in decoupling the definition of development from Gross Domestic Product (GDP), we must ensure we provide a set of positive solutions, rather than a mere critique of the *status quo*.

Moving the world's 1.2 billion poorest to a life of dignity for all will require recognition that environmental conservation is not an impediment to development, but in fact the key to a future of economic prosperity, human wellbeing, and food and energy security for all.

In the lead up to Rio+20 UNEP worked with partners, including the UN University, to introduce the Inclusive Wealth Indicator (IWI) as an alternative to GDP as a measure of sustainable development.

The IWI is among a range of potential replacements which world leaders can consider as a way of bringing greater precision to assessing wealth generation in order to realize sustainable development and eradicate poverty.

The wellbeing of humanity and the functioning of the economy and society ultimately depend upon the responsible management of the planet's finite natural resources.

Living within the Earth's safe operating space – its planetary boundaries – safeguards humanity from crossing ecological or social thresholds that could undermine or even reverse development gains.

To achieve sustainable development without crossing ecological thresholds, countries will need to transition to a low-carbon economy, adopt sustainable consumption and production patterns, become more resource efficient and decouple economic growth from the over-exploitation of natural resources.

A New Paradigm for Economic Progress and Prosperity

This is the goal of a Green Economy: an inclusive system which creates jobs and prosperity for all by safeguarding the Earth's life support systems.

Sustainable consumption and production can yield economic, social and health benefits, including greater access to markets, social innovation, job creation and empowerment.

Sustainable consumption is not necessarily about consuming less. It is about consuming better – in an intelligent and environmentally sustainable way.

The dominant consumption pattern of affluent societies is a major stress on natural resources. According to a report by the International Resource Panel, total resource use grew eight-fold between 1990 and 2000, from 6 billion to 49 billion tonnes.

By 2050, humanity could devour an estimated 140 billion tonnes of minerals, ores, fossil fuels and biomass per year – three times its current appetite – unless economic growth is “decoupled” from natural resources consumption.

More emphasis is required on resource efficiency in government policies, public and private sector management practices, technology choices, and investments, so as to deliver more output per unit of input, as well as less associated environmental damage.

The success of a new paradigm for economic growth will ultimately be seen in four principle areas: Food, Water, Energy, Natural Capital and Human Capital.

Food

The world is struggling to feed its 7 billion citizens. Figures from The Food and Agriculture Organization of the United Nations (FAO) indicate that 842 million people went hungry between 2011 and 2013, most of them in the developing world. By 2050, we must find a way to feed an additional 2.6 billion people. This means that agricultural production must increase by 70 per cent, according to World Bank figures

The goal of food security for all cannot be achieved by expanding croplands in pursuit of increased food production, which would bring its own problems. Agriculture already accounts for more than two thirds of the world’s freshwater use and is a contributor to deforestation.

Reducing the 1.3 billion tonnes of food lost or wasted each year, equivalent to one third of all food produced and enough to feed the world’s hungry, is one of many sensible ways of tackling the problem – particularly when one considers that 1.4 billion hectares of cropland, as well as water and other agricultural inputs, are needed to produce this discarded food.

Pope Francis in June last year said this waste was ‘like stealing from the table of the poor and hungry’.

UNEP and the FAO last year launched *Think.Eat.Save. Reduce Your Foodprint* – a campaign encouraging consumers and business to rethink their practices.

Meanwhile, two billion hectares of agricultural land is currently degraded. Rehabilitating this land, which lies largely in areas where local food

insecurity is highest, could increase food production by 79 per cent. This has the potential to feed an extra 2.25 billion people.

Intelligent solutions are required to establish a sustainable future. A combination of restoring degraded lands, preventing further degradation, and reducing waste will have a more positive impact than attempting to boost production through expansion.

Water

Feeding the projected 2050 population will require approximately 50 per cent more water than is currently used in agriculture globally. Yet more than 2 billion people live in countries with absolute water scarcity.

Research suggests that with current practices, the world will face a 40 per cent global shortfall between forecast demand and available water supplies by 2030.

Governments are taking steps to improve the management of water resources. In a survey of 130 countries carried out by UNEP and partners, it was reported that over 80 per cent of countries have reformed their water laws in the past twenty years as a response to growing pressures on water resources from expanding populations, urbanization and climate change.

In many cases, such water reforms produce significant impacts on development, including improvements to drinking water access, human health and water efficiency in agriculture.

But global progress has been slower where irrigation, rainwater harvesting and investment in freshwater ecosystem services are concerned.

Energy

Clean, efficient and reliable energy options are indispensable for a sustainable future for all with multiple benefits for development, human health, environment and climate change.

At the moment, over 1.2 billion people – most in rural areas – don't have access to electricity. 2.8 billion rely on wood or other biomass to cook and heat their homes, causing millions of deaths each year as a result of indoor air pollution.

Although 1.7 billion people gained access to electricity between 1990 and 2010, this is only slightly ahead of population growth of 1.6 billion over the same period.

Energy from renewable resources – bioenergy, geothermal, hydro, ocean, solar, wind – is local, clean, inexhaustible and free. In 2013, almost half of total new electricity generating capacity came from renewable sources, but by 2030, the share of renewable energy in the global energy mix will need to grow to 36 per cent, up from 18 per cent in 2010.

Energy efficiency improves energy security, reduces greenhouse gas emissions and increases productivity. Between 1990 and 2010, improvements in energy efficiency have cut over 25 per cent from cumulative global energy demand. But energy efficiency rates need to double by 2035, otherwise energy-related CO₂ emissions will increase by around 20 per cent, according to World Bank estimates.

A global transition to efficient lighting could significantly reduce CO₂ emissions. Lighting accounts for approximately 15 per cent of global power consumption and 5 per cent of worldwide greenhouse gas (GHG) emissions.

Through the *en.lighten* project, a key contribution to the Secretary General's Sustainable *Energy for All* initiative, UNEP assists countries to make the switch to efficient lighting technologies.

A country such as India, for example, could cut its lighting electricity consumption by over 35 per cent, which is equivalent to closing 11 large coal-fired power plants or taking over 10 million cars off the road. Annual savings would be over USD 2 billion.

Globally, this transformation would yield annual cost savings of over USD 140 billion and can achieve annual CO₂ reductions of 580 million tonnes.

Natural Capital

Natural capital not being valued is a large part of the reason land and water systems are being degraded. The Economics of Ecosystems and Biodiversity, or TEEB, aims to change this. The initiative, supported by UNEP, is encouraging governments to accurately account for the present and future benefits of their countries' natural resources.

The share of the poor in global GDP is marginal and is reduced with the erosion of natural capital. The share of the bottom 40 per cent of the population in global wealth remains less than 5 per cent.

These people mainly live on small farms, coastal areas and around forests, and depend on natural capital for their livelihoods, nutrition and health.

Some 2.6 billion people worldwide draw their livelihoods either partially or fully from agriculture, 1.6 billion from forests, 250 million from fisheries, and 200 million from pastoralism. It has been estimated that ecosystem services and other non-marketed goods make up 50 to 90 per cent of the total livelihoods of poor rural households.

Degradation of natural resources creates a poverty trap, which leads to a reinforcing loop of further degradation and worsening poverty. Any reduction in natural capital stocks negatively affects the wellbeing of the poor disproportionately and leads to growing inequalities. On the other hand, investing in natural capital protects livelihoods and creates green jobs.

For example, a stimulus package for sustainable forest management could create an additional 10 to 16 million jobs globally at an estimated cost of USD 36 billion. It is estimated that non-timber forest products can generate some 4 million person-years of employment annually, along with USD 14 billion in international trade and income for subsistent households. Which leads us to our next point.

Human Capital

A shift towards sustainable production can contribute to green, inclusive and decent employment. For example, sustainable agricultural systems tend to be more labour intensive, as this input replaces often-toxic or polluting chemical inputs.

Innovative economic and environmental policy reforms, fiscal measures and green investments can prevent the loss of employment opportunities in both urban and rural areas, expand and diversify the local job market, and contribute to the transfer of the technology and skills that are necessary for long-term poverty eradication and sustainability.

The Partnership for Action on Green Economy, or PAGE, is an inter-agency initiative founded by the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the United Nations Industrial Development Organization (UNIDO) and the United Nations Institute for Training and Research (UNITAR).

By taking a country by country approach, PAGE will catalyze up to 30 national economies between now and 2020, and thus contribute to the global transition to a sustainable future for all.

Today, countries such as Burkina Faso, Peru, Mauritius, Mongolia, and Senegal are set to boost their economies through a shift of investment and policies towards a new generation of assets that include clean technologies and resource efficient infrastructure, green skilled labour, well-functioning ecosystems, and good governance. Such a transformation will pay significant dividends in social, environmental and economic terms.

A package of green investments – coupled with policy reforms that are aimed at making growth socially inclusive – offers economically viable options to reduce poverty and hunger, and addresses challenges of climate change and degradation of natural resources, while simultaneously providing new and sustainable pathways to economic development and prosperity.

Towards a Green Economy

In a Green Economy, growth in income and employment is driven by public and private investment that reduces carbon emissions and pollution,

enhances energy and resource efficiency, and prevents the loss of biodiversity and ecosystem services.

These investments need to be catalyzed and supported by targeted public expenditure, policy reforms and regulation changes.

At Rio+20, world leaders adopted the Ten-Year Framework of Programmes on Sustainable Consumption and Production Patterns (10YFP). This global framework for cooperation and capacity building is designed to accelerate the shift towards sustainable patterns and to promote social and economic development within the carrying capacity of ecosystems.

The text adopted was explicit that the 10YFP should build on existing initiatives and policies, must contribute to all three pillars of sustainable development, and that developed countries should provide leadership in promoting the shift to SCP patterns.

The first 10YFP programme, on Sustainable Public Procurement, just got underway. Governments spend trillions of dollars each year on procuring goods and services, and redirecting this money into green goods and services can drive the transition to a more resource-efficient world.

Climate Change: the threat of the Anthropocene

While much of the world's private capital is locked up in carbon-intensive investment across the developed world, developing country investment in a low-carbon future is on the rise. Clean energy investments reached USD 244 billion in 2012, while outlays in developing countries reached USD 112 billion, according to estimates by REN 21 (Renewable Energy Policy Network for the 21st Century).

World Economic Forum estimates suggest that investment in infrastructure of an estimated USD 6 trillion annually is needed over the next 16 years to deliver a low-carbon economy. Of this, nearly USD 1 trillion is over and above the business-as-usual trajectory.

This investment is worth it, however, to head off the worst impacts of climate change, which fall most heavily on those who are least able to respond, and often on those who have contributed very little to its causes.

Delayed action on climate change means a higher rate of climate change in the near term and likely more near-term climate impacts, as well as the continued use of carbon-intensive and energy-intensive infrastructure, according to the Emissions Gap report launched by UNEP and over 44 research institutes from 17 countries ahead of the Warsaw COP, last year.

UNEP research shows that even if nations meet their current climate pledges, greenhouse gas emissions in 2020 are likely to reach up to 12 gi-

gatonnes of CO₂ equivalent above the level that would provide a likely chance of remaining on the least-cost pathway.

The stepping stone of the 2020 global target can still be achieved by strengthening current pledges and further action, including scaling up international cooperation initiatives in areas such as energy efficiency, fossil fuel subsidy reform, renewable energy and reforestation schemes.

Redefining the Anthropocene

Pope Benedict XVI said: “The ecological crisis offers a historic opportunity to develop a common plan of action aimed at orienting the model of global development toward greater respect for creation and for an integral human development inspired by the values proper to charity in truth”.

Caritas can be understood as a duty of love for God; for creation; and for one’s neighbour. In this interconnected world, our neighbour could be on a different continent. Or indeed, yet to be born. Our duty of care is no longer bounded by traditional spatial or temporal limits.

Almost all faiths and societies share similar notions of responsibility. Embracing this duty will provide a bridge to common understanding between groups which have, at times, found it easier to focus upon their differences.

We don’t have the luxury of millennia to think about it: we need to zoom right back in to the here and now, and start making changes to the way we live on, use and understand our planet. But let us take some hope from our definition of the Anthropocene. If we live in a human-made age, we may have the power to re-make it, too.

THE TWO WORLDS APPROACH FOR MITIGATING AIR POLLUTION AND CLIMATE CHANGE

■ VEERABHADRAN RAMANATHAN¹

*For that which is common to the greatest number
has the least care bestowed upon it*
Aristotle

Synopsis

There is still time to mitigate unmanageable climate changes, particularly, if we drastically reduce carbon dioxide emissions from fossil fuels and simultaneously reduce emissions of the so-called short-lived climate pollutants. Carbon dioxide, the major greenhouse gas released to the air by fossil fuel combustion is responsible for as much as half to two thirds of the anthropogenic effects on climate change. There is an unexplored synergy between this new hybrid climate mitigation approach and the objectives of sustainable development: *Poverty reduction and meeting the needs of a 'larger but stabilizing population' while sustaining the life support systems of the planet (1)*. It is this synergy I explore and illustrate in this paper.

We must, first, recognize that there are two separate but co-dependent worlds: The bottom 3 billion, (B3B), who live in a world with minimal access to fossil fuels while the top 4 billion live in T4B, a world with seemingly inexhaustible supply of affordable fossil fuels. Using emission of climate warming pollutant carbon dioxide as a metric for energy access, the entire B3B world contributes only 6% of fossil CO₂ emissions while about 2.5 billion in T4B contributed as much as 85%. Global efforts such as decarbonization of the economy and reduction of the carbon intensity of energy consumption are essential to slowing down climate change but these policies apply to the life styles of a select 1.1 billion in T4B.

It is my thesis that, to avoid unmanageable climate changes, we must place equal emphasis on three fronts: limiting per capita CO₂ emissions to

* Gratefully acknowledge the Pontifical Academies for the privilege of planning and organizing the workshop with Sir Partha Dasgupta, Bishop-Chancellor Marcelo Sánchez Sorondo and Archbishop Roland Minnerath.

about 10 tons/PP/Year which will affect about 1.1 billion in T4B; reduce drastically emission of short lived climate pollutants by both T4B and B3B; and enable sustainable and clean energy access for the three billion (B3B) living at the base of the energy pyramid. The synergistic part of this two-worlds approach is that it will drastically reduce air pollution which claims about 7 million lives and in addition destroys tens of millions of tons of crops every year; cut by half the deforestation due to firewood harvesting; and most importantly remove one of the major impediments (lack of energy access) for poverty reduction. Currently about a third of food produced for human consumption is wasted. Reduction of food waste by half is another low hanging fruit for such an action will reduce carbon dioxide emissions by about 1.5 billion tons every year.

The approach outlined here requires a combination of top-down approaches of global policies as well as bottom up approaches of interventions in the field at the sub-national and national levels. Examples of actual interventions at the rural level and national level are given to illustrate the two-worlds approach.

Nexus between Energy Access, Human Development and Environment

Access to modern forms of fossil fuel energy is a fundamental necessity for human development and wellbeing (2). The striking feature of the energy access issue is the incomprehensible gap between two groups of population in the world. The gap is so wide that it can best be comprehended and analyzed better if we assume the two groups are living in two different worlds.

About 3 billion (thousand times million or 10^9) people, living mostly in rural areas, depend on solid biomass or solid coal for basic energy needs such as cooking and home heating. Cleaner fossil fuels (gas and electricity) for cooking or heating are either not available reliably (every day) or if available, they are not affordable since the 3 billion live under \$2.5 (PPP) a day (Fig. 1).

Most (90%) of the B3B live in rural areas and rely mostly on subsistence farming and the rest (10%) are in urban or the margins of rural to urban areas. About 1.3 billion of this 3 billion lack access to electricity even for lighting. We will be adding at least two more billion people this century and without a concerted global effort, most of the additional two billion will likely inhabit B3B or the lower income groups in T4B.

The costs of relying on solid biomass and solid coal for basic energy needs to the well being of humanity and that of nature are enormous, both locally and regionally. Exposure to the toxic particles and gases inside the smoke filled kitchens are responsible for about 4 million premature deaths, mainly among women and children, annually. The smoke escapes outdoors

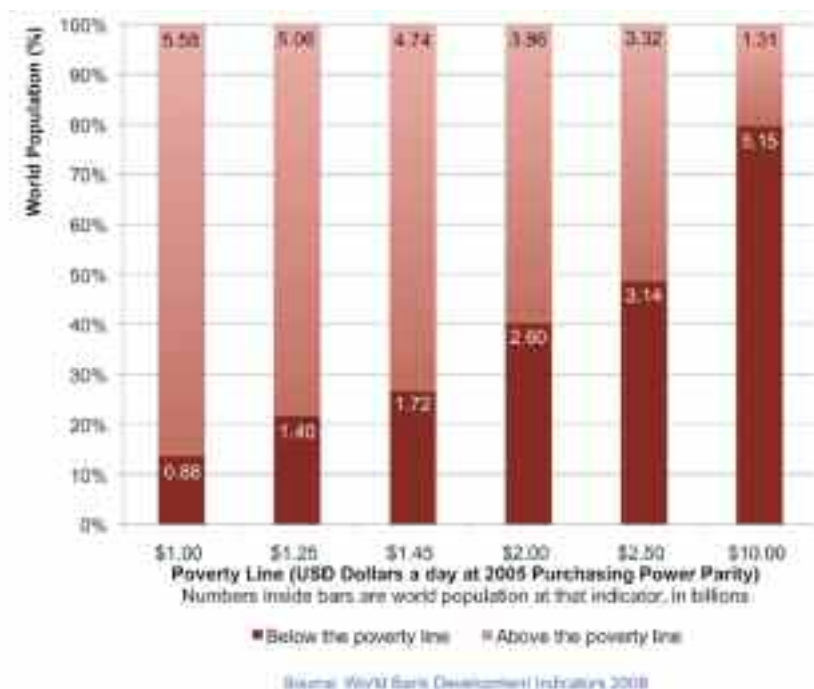


Figure 1. Percent of people in the world at different poverty levels, 2005.

and in a matter of days, becomes widespread brown clouds over thousands of kilometers (3) and causes a million more deaths (4, 5).

The black carbon (also known as soot) from the smoke settles on glaciers and contributes to melting. This problem is particularly severe over the Himalaya/Tibetan region, which provides the headwaters for the major Asian river systems. The particles in the smoke intercept sunlight, which affects regional climate and disrupts monsoon rain fall patterns. The changes in climate and the gases in the brown clouds damage crops and reduce agriculture yield (6, 7). A detailed review of the brown clouds problem can be found in Ramanathan and Carmichael (8) and UNEP-WMO (9). Consumption of solid biomass fuels also leads to deforestation of about a billion tons of firewood, every year.

The bottom three billion people are a world apart from the rest of the 4 billion population, even if they are living side by side in the same rural area or in the same city. The 4 billion in T4B have almost unlimited access

to modern forms of fossil fuel energy. Even among this 4 billion, there are huge disparities in energy access. One reliable metric of access is the amount of CO₂ emitted to the atmosphere by fossil energy consumption. In 2003, roughly 1 billion emitted as much as 50% of the total fossil CO₂; the next 1.5 billion emitted about 35% and the last 1.5 billion in T4B emitted only 10% (10). About 0.9 billion of this 1.5 billion are in urban slums (11). The 3 billion in B3B emit just 5%. The climate change resulting from emissions of CO₂ is one of the biggest threats to sustainability facing society (12). In addition, the added CO₂ increases the acidity of the surface waters of the oceans with major implications for the marine ecosystems and food chain.

It is convenient to sub-divide the T4B, some what arbitrarily, into low income (1.5 billion), middle income (1.4 billion) and high income (1.1 billion high emitters). The CO₂ emission from these three groups correspond reasonably well to their income as follows (inferred from Chakravarty *et al.*, 10): 2.6 giga tons for T4B_low income; 8.9 giga tons for T4B_middle income; and 13 giga tons for the T4B_high income. The per capita emissions are respectively: 1.5 ton/PP, 6.4 tons/PP, and 12 tons/PP. The emission and per capita emission for the 3 billion in B3B are respectively 1.5 giga tons and 0.5 tons/PP. If business as usual continues, the per capita emission is projected to nearly double for the T4B by 2030. The challenge for climate mitigation actions is to maintain the emission by the high and middle income at current levels while allowing much more energy access for B3B and the 1 billion slum dwellers in T4B.

Climate Change: Causes and Effects

Power generation, agriculture, industry, transportation and other sectors of the economy have increased the concentration of carbon dioxide and other greenhouse gases to the atmosphere. Until 1975, scientists assumed that CO₂ was the main anthropogenic or manmade greenhouse gas (13). This picture changed drastically when it was discovered that Chlorofluorocarbons, on a per molecule basis, could be up to ten thousand times stronger than the CO₂ greenhouse effect (14). Chlorofluorocarbons (a banned substance now), belonging to the chemical family of halocarbons, were used as refrigerants and propellants in deodorizers and drug delivery pumps. The other potent greenhouse gases that were added to the list include methane, nitrous oxide, ozone and others. These gases trap the heat (infrared energy) radiated by the earth and the atmosphere and lead to warming. In addition, certain sources such as diesel used in transportation and biomass for cooking and heating emit black carbon (soot) particles, which trap incoming sunlight and lead to additional warming. Carbon

dioxide contributes about 55% of the heat trapping and 45% from the other climate warming pollutants. The sectors, which emit these pollutants, also emit other particles that reflect sunlight (back to space) and offset (or mask the warming) some of the warming effect of the heat trapping pollutants. There is quite a bit of uncertainty in this masking effect with estimates ranging from 30% to 60%.

We have already added enough greenhouse gases to warm the planet by more than 2°C (Figure 2 below from Reference 15) during this century.

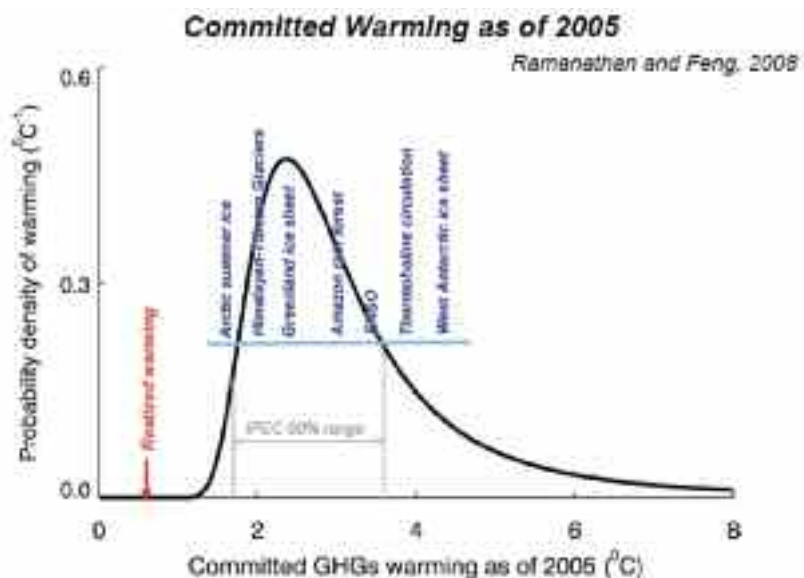


Figure 2. The probability distribution of warming that would ultimately (this century) result from the greenhouse gases that are already in the atmosphere. The various components of the climate system that could tip over are shown as a function of the warming.

Furthermore, the emission of certain climate warming gases, particularly that of CO₂, is continuing unabated. If the trend continues, we can witness unprecedented warming of 2°C by 2050 and 3°C to 4°C by end of this century (Figure 2; also see Reference 12). The worse consequences of such a large warming are yet to be unraveled but the impacts will likely include severe events such as intense droughts, cyclones, heat waves, rapid melting of sea ice and glaciers that provide head waters for major rivers and rising levels threatening the existence of islands, deltas and low-lying coastal areas.

Climate Change Mitigation: Near Term and Long Term

There are two separate but linked problems that have to be dealt with. First, in the near-term (by mid century), the warming (from pre-industrial times) in the absence of any mitigation actions can exceed 2°C. The second problem is that by end of century, the warming can exceed 4°C. The Copenhagen accord recognized 2°C warming as a potential threshold for dangerous interference with the climate system. The lifetime of a CO₂ molecule in the atmosphere is very long. About 45% of the CO₂ emitted today can remain in the atmosphere for a century and about 20% remain longer than few centuries. The warming due to CO₂ that we experience today is a result of accumulated emissions over the last 200+ years. As a result of the long life-time, emission reductions today will take several decades to mitigate the warming and will not reduce much the probability of the warming exceeding 2°C in the near term, i.e., by 2050. However, without mitigation of CO₂ emissions beginning now, we have no hope of keeping the longer-term (end of century) warming below 2°C.

Fortunately, the other climate warming pollutants can come to our rescue for mitigating near term warming. My studies (8, 15, 16) suggest that 1/3 of the warming is caused by four other pollutants: 1) methane, which leaks out of waste dumps, natural gas, fires, paddy fields and cattle; 2) black carbon, which is a particle and is the dark stuff that comes out of diesel trucks, biomass cook stoves, brick kilns and open fires; 3) ozone produced in the lower atmosphere by air pollutant gases such as carbon monoxide, methane, nitrogen oxides; 4) Hydrofluorocarbons (HFCs) used as refrigerants. Black Carbon is the second largest warming agent (8); next to CO₂ and methane is the second largest greenhouse gas warmer next to CO₂. Collectively these 4 warming pollutants are referred to as Short Lived Climate Pollutants (SLCPs), because their lifetime in the atmosphere is short compared with the century or longer lifetime of CO₂. The air pollution from sources that emit the SLCPs also causes deaths in millions, destruction of crops in millions of tons, melts snow packs and glaciers worldwide. The good news is there are technologies to cut their emissions rapidly so we can slow down the warming caused by the other 1/3 of the warming agents within our life times.

We basically have two knobs: one knob is for dialing down the carbon dioxide emissions and that is largely a Top 4 Billion problem. The other knob is the SLCP knob to dial down emissions of the short-lived pollutants. The SLCPs are anywhere between 25 to 4000 times more potent (per ton of emission) than carbon dioxide and they don't live long. The life times of these pollutants are short and vary from a week (black carbon) to a decade

(methane) or two (HFCs). As a result, actions taken today to reduce them drastically, will lead to reduction in the warming trends within few decades and thus address the near-term problem. UNEP has formed the Climate and Clean Air Coalition with over 30 member nations to target mitigation of SLCPs (<http://www.unep.org/ccac/>).

Technologies exist to drastically cut the emissions of these SLCPs. For example, California reduced emissions of black carbon from diesel combustion by 50% since the 1980s using combinations of improved fuels and soot filters (Ramanathan *et al.*, 2013). The state also cut its emissions of ozone precursor gases by about 80%.

Reducing SLCPs in parallel with carbon dioxide reductions can keep global warming below 2°C through this century and reduce end of century (2100) sea level rise by as much as 30% and thus significantly increase the probability of limiting sea level rise below one meter until 2100 (16,17). The required reductions (also see IPCC (12)) are in the range of: about 30% reductions in CO₂ by 2030 to 50% by 2050 and to zero emissions by

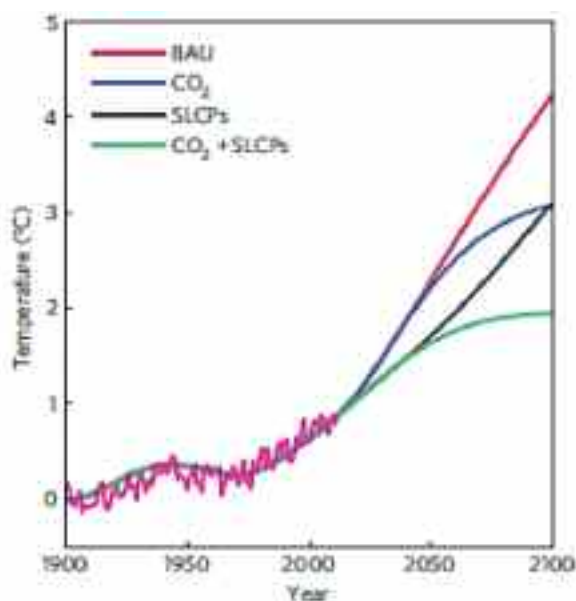


Figure 3. Simulated temperature change for various scenarios. The observed temperatures are shown by the magenta graph. The BAU line shows simulated temperature for the business-as-usual assumption. The CO₂-line includes mitigation of just the CO₂ emissions; the SLCPs-line includes just mitigation of short lived climate pollutants and the green line allows for mitigation of CO₂ as well as SLCPs. Reproduced from Ramanathan and Xu (16).

2070. For the SLCPs the required reductions range from 40% for methane, 80% for black carbon and elimination of HFCs emissions by 2030. These reductions, while drastic, are practical and achievable. For example, replacement compounds are already available for HFCs. With respect to black carbon, California has reduced its black carbon emissions by 90% from 1960s to 2000. The reductions in SLCPs would cut the projected warming trends from now to 2050 by nearly half (9,17). Mitigation of SLCPs also help save over 3.5 million lives lost to air pollution every year and save as much as hundred million tons of crop damages and significantly slowing down retreat of Himalayan glaciers.

The Two-World Approach for Mitigation

While all of human population will be impacted by climate change, the lack of access to energy will make B3B especially vulnerable to extreme events with devastating consequences. This is problematic since the B3B world had the least role in the build-up of the heat-trapping greenhouse gases in the atmosphere. We have to find an equitable way to apportion the responsibility for mitigating the harmful emissions.

We will first discuss the mitigation issue from the T4B perspective. There is rancorous exchange between developing and developed nations about who is responsible for global warming. The developing nations point out that about 70% of the CO₂ and other greenhouse gases in the atmosphere was dumped by about 30% of the global population in developed nations. The developed nations respond, in turn, that as the developing nations industrialize using fossil fuels, their emissions in the coming decades will far exceed levels that can trigger dangerous climate changes and mass extinction of species. To justify their case, the developed nations point out how China is now the top emitting nation of CO₂, even more than that of US'. The two worlds approach moves the debate away from such national conflicts.

Increases in consumption and population are two of the major issues with respect to increase in fossil fuel use. Other confounding issues are the rapid urbanization and the increase in the "middle class" work force (19, 20). Fossil fuel combustion released about 25 Giga (billion) tons of CO₂ in 2000 and it is now (Year 2010) 32 giga tons (12). The 7 giga tons increase was contributed by: Population increase (3 giga tons); economic growth (6.5 giga tons); while decarbonization and reduction in carbon intensity offset 2.5 giga tons of the 9.5 giga tons increase. The other major demographic trend is urbanization (Figure 4).

While the rural population stabilizes around 3.3 billion, the urban population increases from the current 3.7 billion to excess of 5 billion by 2050.

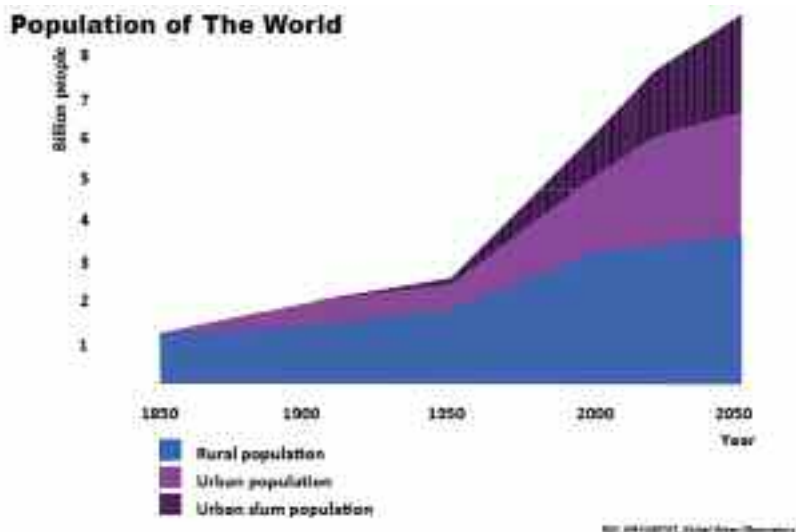


Figure 4. Trends in rural and urban population. Reproduced from UN_Habitat- Global Urban Observatory.

However, most of the increase is due to increase in slum dwellers, who are projected to double from 1 now to about 2 billion in 2050 (UN habitat; also see 19).

If fossil fuel continues to increase at the rate witnessed during the 2000 to 2010 decade, CO₂ emission from fossil fuels can grow to 43 Giga tons by 2030, when the population is projected to reach about 8.1 billion (10). To keep the warming below 2°C, we need to maintain the 2030 emission at or below 30 giga tons, i.e., below the 2010 emission of 32 giga tons. The per-capita emission of CO₂ by the B3B is about 0.5 tons/year, while within the upper 1.1 billion of T4B the per capita emission ranges 10 tons/year to as high as 50 tons/yr. (10). It has been estimated that capping the per capita emission at about 11 tons/year will reduce the projected emission from T4B by 13 giga tons/year, achieving the target emission of 30 giga tons/year. Such a cap will affect only the upper 1.1 billion in T4B (10, 18). As discussed elsewhere (2, 12), the 1.1 billion in T4B can achieve this by decarbonization of the economy and reduction in carbon intensity of energy consumption. The specific steps include: Switching to renewables; carbon capture and storage; improvements in energy use efficiency; drastic reduction in wastage of energy in buildings and clean transportation systems; among many others (2, 12).

On the opposite extreme, we hope that the B3B can catch up with the average living standards of, at least the lower income within the T4B. The compass is pointing in the right direction for this to happen during this century. For example “middle class” wage earners (earning more than \$4/day PPP) increased from 332 million workers in 1991 to 1100 million in 2011 and projected to increase to 1700 million by 2017 (20). But if B3B achieves this by relying on fossil fuels with per-capita CO₂ emission of about 4 tons/year, the emissions of the B3B will increase from the current 1.5 billion tons to 12 billion tons per year. For T4B to still meet the goal of limiting global CO₂ emission to 30 giga tons/yr. by 2030, T4B has to reduce its emission by another 12 giga tons: a reduction of 60% in 15 years! Clearly, it is to T4B’s own advantage to enable B3B climb on the cleaner renewable ladder instead of the fossil ladder. Global population is projected to reach about 9 billion during this century, which further exacerbates the challenges faced by T4B in reducing CO₂ emissions.

The basic energy needs for the B3B are: cooking, lighting, heating and pumping water for home use and for irrigation. Such energy and water access is crucial to lift the 3 billion out of energy poverty as well as monetary poverty. It is for this reason that the United Nations initiated the Sustainable Energy Access for All Program (<http://www.se4all.org>). Technologies are available off-the-shelf to provide access to clean, renewable energy without increasing their CO₂ emissions. The cost for providing this access can be as high as \$90 billion per year (2) but it pales compared with the \$1100 billion cost (2) for decarbonizing T4B sufficiently to mitigate 13 billion tons/year of CO₂ emission by 2030 (2). More importantly, steps for providing energy access to B3B can be initiated by bottom-up sub-national and bi-national efforts with philanthropists and entrepreneurs playing a major role (21). The main motivation is that such steps can also substantially contribute to climate mitigation. Three examples are given below.

1) Advanced Cook Stoves and Solar Lighting for B3B. The woody biomass used for cooking leads to deforestation of about 1 billion tons of woody biomass which is equivalent to 1.5 billion tons of CO₂ emissions; and another 2 billion tons of CO₂-equivalent through emissions of the short lived climate pollutants: black carbon, methane, and ozone. The smoke from the cooking kills over 4 million annually. It is the second- to third-largest source of outdoor air pollution in south Asia; as mentioned earlier, the pollutants destroy millions of tons of crops; exacerbates the melting of Himalayan/Tibetan glaciers; weakens the monsoon. Deforestation combined with monsoon disruption depletes water availability; and worse, women have to walk about 1 to 5 hours per day



to collect firewood. Recognizing the importance of enabling clean cooking to rural areas of the world, the United Nations has formed an alliance called: Global Alliance for Clean Cook Stoves (<http://www.cleancookstoves.org>). I will report below a bottom-up multi institutional approach to the cook stove problem that was incubated under UNEP.

Project Surya (see www.projectsurya.org) started in 2007, demonstrated that improved forced-draft biomass cooking stoves could drastically reduce emissions of black carbon, CO₂, and other pollutants (Kar *et al.*, 2012). But there are several problems related to the adoption of the new technology. One of the major ones is the cost. At about \$75, it is about a month of wages for the head of the household. The second is that the mud stove provides lighting (the exposed fire) and the new advanced cook stoves cut the lighting since the combustion happens in enclosed chamber. So, we have to provide additional lighting for those using the improved cook stoves. Project Surya provides battery-operated lamps at cost of about \$25. The battery for the solar lamp and for the fan in the forced draft stoves is charged by photovoltaic (Solar). Replacement of kerosene lamps with solar-charged lamps saves another billion tons of CO₂ equivalent emissions. The package cost about \$110, further worsening the affordability issue.

Social scientists have learnt by experience that we are not going to solve this problem by giving away things to the poor, because it is not sustainable. We have to develop good business models, so that women earn their way to energy access and sustain it. Project Surya has initiated a major pilot project, Climate Credit Pilot Phase (see C2P2 in www.projectsurya.org), to explore if

rewarding women directly with funds from voluntary carbon markets for using improved stoves and solar lighting will significantly enhance women's ability to sustain adoption of these energy efficient technologies. The secondary goal of the project is to establish a stable carbon market-based revenue source by developing a methodology that awards climate credits for reductions in carbon dioxide and in non-carbon dioxide climate pollutants (including black carbon). By accounting for reductions in non-CO₂ climate pollutants, along with reductions in CO₂, each household can triple the financial returns generated from a carbon market, thereby creating sufficient revenue to sustainably scale up this model. At \$8 market value for the carbon credit in the voluntary carbon market, the participating woman can earn about \$40 per year of usage, thus recovering the cost of the advanced stove and solar lamp in 2.5 years. One unique part of C2P2 is the use of cell phones to collect data on cook stove usage and on compliance by women participating in the program. The Energy Resource Institute of India, The University of California at San Diego (UCSD) and Nexleaf Analytics of Los Angeles has launched the project with 5000 stoves. A climate mitigation fund has been created by UCSD with funds from a private donor to demonstrate the viability of the method (C2P2_MC-QUOWN5000 in www.projectsurya.org).

The T4B can enable the adoption of clean cooking/lighting technologies by participating in the voluntary carbon market funds. If it is adopted by all of B3B (3 billion population with about 600 million homes) and each member of the 1.1 billion in T4B contribute to the climate credit for one cook stove (\$30) or one solar lamp (\$10) per year, the funds will generate about \$22 billion to sustain the use of the clean cooking and lighting technologies by the 600 million homes.

2) Off-grid and Micro-grids for solar power for water access. Micro-grids or off-grid of solar power is required for farming and other small-scale industrial needs, i.e., instead of using highly polluting diesel pumps to extract water for irrigation, solar water pumps should be deployed, which are now available in the market in even remote rural locations in India. The reason I added the farming is that most villagers (at least in India) can afford to have only one crop per year due to energy and water limitations. The one crop per year, since the villagers only few acres each, is barely enough to meet their own food demand. They need the second and third cropping for extra income: education, buying other goods, and health care. Their water comes from rainwater or irrigation. In many parts the river water is either diverted to the burgeoning cities or dries out due to unsustainable draw down upstream. Solar micro-grids are a much better option since the

main grid is off limits or, if it is available, they are unreliable with just few hours of power supply. The micro-grids are becoming very popular in rural areas of S. Asia and Africa and have to be scaled-up. Distributed solar photovoltaic and solar micro-grids can provide electricity for lighting and small-scale industry, replacing highly polluting (and expensive) kerosene lamps and diesel generators. Diesel is one of the major sources of black carbon, the second largest contributor to global warming.

3) The Transportation Sector. This is a case where sub-national participation can go a long way toward mitigation of air pollution and climate change and help promote human wellbeing. The transportation sector consumes about 28% (91 Exa joules) of the global energy demand and contributes to 23% of fossil fuel CO₂ emissions. It is also slated for the fastest growth in the coming decades with respect to energy consumption and CO₂ emissions. In addition, in industrialized nations it is a major source of black carbon and NO_x in cities, which leads to ozone production (SLCPs). Even in developing nations like India, the transportation sector (diesel vehicles) contributes more than 40% to black carbon emission in cities such as Bangalore. California which had some of the most polluted cities in the world (e.g. Los Angeles) in the 1960s, employed cleaner diesel fuels, engine technologies and diesel particulate filters to cut down its black carbon and ozone precursor emissions by 90% from 1960s to now. A program has been started, called India-California Air Pollution Mitigation Program (<http://ramanathan.ucsd.edu/about/icamp.php>), which brought scientists, technologists and policy makers from California and several states in India to exchange knowledge and expertise to develop an action agenda to reduce emissions of air pollutants, including short-lived climate pollutants in India. Similar national and sub-national partnerships are being formed under the Climate and Clean Air Coalition of UNEP to reduce short-lived climate pollutants (<http://www.unep.org/ccac/>).

Synergy with Sustainable Development Goals

Basically the world we live in has about 3 billion in rural areas and 4 billion in urban areas with 1 billion of urban dwellers in slums, mostly migrated from rural areas for a better life. In the two-world approach, we included the slum dwellers under the Top 4 Billion world because they have access to energy. Whether or not they can afford it are a socio-economic issue and not an energy access issue.

Goals of sustainable development include meeting the needs of the population (in both worlds), eliminating hunger and poverty and preserving

the life support systems. In this concluding section I explore the synergy between the two-world approach for mitigation of air pollution/climate change and sustainable development.

Local and regional climate changes unleashed by a 2°C to 4°C warming are likely the biggest threat to sustainability of the present or future generations. Basically, we have to hold carbon dioxide emission at current levels until 2030 and reduce it to near zero by 2070. For the 2030 period, the required reduction is about 13 billion tons/year of carbon dioxide emission compared with business-as-usual scenarios. With current growth rates, carbon dioxide emission is projected to increase by about 50% by 2050. Even under such fast growth rate scenarios, the B3B still have very poor access to fossil fuel energy. To meet sustainable development goals, however, my analyses suggests the following mitigation actions:

- Limit maximum per capita emission to about 10 tons/PP/year until 2030 and reduce it to near zero by 2070. This action will mainly affect the 1.1 billion high-income groups in T4B (10). The per capita emission by the rest of 6.9 billion population is less than this upper limit.
- Reduce both CO₂ and the four short-lived climate pollutants (methane; black carbon; ozone and HFCs). The SLCPs, by themselves, can reduce the rate of warming in the coming decades by about half; save 4 million lives; avoid hundred million tons of crop damages; and slow down the melting of Himalaya glaciers.
- Enable clean energy for cooking and lighting to B3B. We show how by using voluntary carbon markets funded by T4B at a cost of about \$22 per person per year, just among the high-income 1.1 billion emitters, advanced cook stoves and solar lighting can be accessed by every one in B3B. If the new technologies are adopted by every one in B3B, it will reduce carbon dioxide emissions from deforestation by about 1 billion tons every year; will reduce black carbon emissions sufficiently that the climate mitigation potential is equivalent to eliminating another 2 billion tons of carbon dioxide emissions. With respect to sustainability goals, this will save 4 million lives every year; slow the rate of warming and melting of Himalayan-Tibetan glaciers; increase monsoon rainfall. More importantly, it will save each woman using the new technologies about 1 to 5 hours of lost time in collecting firewood and dung.
- Enable micro-grid and off-grid solar power for access to water (potable water and irrigation water) of B3B. This would make rural life much

more sustainable and mitigate carbon dioxide and black carbon emissions from diesel generators.

- Initiate sub-national and nation-to-nation collaborative projects to share the knowledge and actions to reduce air pollution and GHGs emissions from out-dated technologies in the transportation and industrial sectors in developing nations. Examples of such initiatives are given in the text.
- Drastically reduce the food waste. About 1/3 of the global food production is wasted (FAO Report, 2014). Roughly 3.3 billion tons of CO₂ emissions were emitted to produce this wasted food. If we can cut this waste by half, we can reduce CO₂ emissions by 1.6 billion tons, which is the total emission by the entire B3B and can account for 12% of the 13 giga tons/year emissions we need to reduce by 2030.

References

1. National Research Council, 1999. *Our Common Journey*, National Academy of Sciences Report.
2. IIASA, 2012. *Toward a Sustainable Future*. Global Energy Assessment.
3. Ramanathan, V. et al. *Science*, 2001, 294, 2119-2124.
4. *Atmospheric Brown Clouds: Regional Assessment Report with Focus on Asia*, published by the United Nations Environment Program, Nairobi, Kenya, pp. 1-360. <http://www.rrcap.ait.asia/abc/>
5. *WHO Report* (2014). March 24 news release.
6. Auffhammer, M., V. Ramanathan, and J.R. Vincent (2006). Integrated model shows that atmospheric brown clouds and greenhouse gases have reduced rice harvests in India, *PNAS*, 10.1073/pnas.0609584104.
7. Burney, J and V. Ramanathan, 2012: AGU Fall meeting Abstracts XV.
8. Ramanathan, V. and G. Carmichael (2008). *Nature Geoscience*, 1, 221-227.
9. Shindell, D., Ramanathan, V., Raes, F., Cifuentes, L., and Oanh, K.N.T. (2011b). *Integrated Assessment of Black Carbon and Tropospheric Ozone*. Nairobi, Kenya: UN Environment Programme and World Meteorological Organization. Retrieved from http://www.unep.org/dewa/Portals/67/pdf/Black_Carbon.pdf
10. Chakravarty et al., 2009. *Proc Natl Acad. Sci.*, 106:11884-11888.
11. United Nations (2013). *Global Sustainable Development Report*. <http://sustainabledevelopment.un.org/globals-report/>
12. IPCC-AR5, 2014: Reports of WGI, WGII and WGIII.
13. Report of the *Study of Man's Impact on Climate* (SMIC), 1972. Published by the Royal Swedish Academy of Sciences and MIT.
14. Ramanathan, V., 1975. *Science*, 190, 50-52.
15. Ramanathan, V. and Y. Feng, 2008. *Proc. Natl. Acad. Sci.*, 105, 14245-14250.
16. Ramanathan, V. and Y. Xu, 2010: *Proc. Nat. Acad. Sci.*, 107 (18) 8055-8062
17. Hu, A et al., 2013. *Nature Climate Change* 3(5), 1-5.
18. Grubler, A. and S. Pachauri, 2009. *Proc. Natl. Academy Sci.*, 106(43), E123.

19. Ramanathan, T. 2006: *Urban Poverty Reduction Strategies: Past, Present and Future*. Book published by National Institute of Urban Affairs, New Delhi.
20. ILO, 2013. *Employment and Economic Class in the Developing World*, ILO research paper No. 6.
21. Seddon J. and V. Ramanathan, 2013: Bottom-Up Solutions to Mitigate Climate Change, *Stanford Social Innovation Review*, Summer, 48-53.

MAINSTREAMING THE VALUES OF NATURE FOR PEOPLE INTO DECISION-MAKING

■ GRETCHEN C. DAILY

*There are three pathways to wisdom.
The first is through contemplation, and that is the noblest.
The second is through imitation, and that is the easiest.
The third is through experience, and that is the bitterest.*
(Confucius)

Summary

Promising efforts to harmonize people and Nature are being launched worldwide, in ways that reflect this ancient Confucian proverb. They are designed to help individuals and institutions see the values of Nature; to replicate models of success for integrating Nature's values into decision-making; and, thereby, to avoid devastating consequences of their loss.

Lights of innovation shine in many regions of the world. In terms of pace and scale of policy innovation, China and Latin America stand out especially. Key challenges remain, however, in fundamental understanding of the vital connections between people and Nature, and the institutions and governance systems through which these intimate, yet often hidden, connections can be made visible priorities for investment. Rapid advances are urgently needed to move from the initial awakening underway today to a deep and lasting societal transformation.

Introduction

The idea that ecosystems are vital assets, utterly essential to human well-being, has emerged over the past decade in many arenas that formerly seemed far from matters of ecology and conservation. Globally, "natural capital" now appears in society's thinking about agriculture, water, energy, health, fisheries, forestry, mining, cities, and the infrastructure supporting these and other vast sectors – and it is increasingly evident in the ways communities, corporations, governments and other institutions frame decisions (e.g., Ouyang, 2007; MEP and CAS 2008; Li *et al.* 2005; Rapidel *et al.* 2011; Goldstein *et al.* 2012; Levy *et al.* 2012; Kieseker *et al.* 2010). In particular, there is growing demand for rigorous approaches that integrate the values of natural capital into major development decisions, in order to reverse the degradation of Earth's life-support systems and enhance human well-being.

Now marks a key moment for the communities working on this grand challenge: to reflect on what has been learned in this creative, yet highly dispersed, phase of innovation. Our planet remains besieged by massive degradation and growing threats of catastrophic change. How can we help channel and magnify the energy of this movement into large-scale, durable, improved outcomes for Nature and people?

A wide range of strategies is needed. After a bit of background, I will focus my brief remarks on meeting and cultivating further demand from decision-makers now. This requires rapid advances on four science and policy frontiers: (i) *fundamental understanding* of ecosystem services, human well-being, and their inter-linkages, in biophysical, economic, social, institutional, and governance domains; (ii) *practical, science-based tools*, tailored initially for use in highest-leverage decision contexts; (iii) *pilot demonstrations* that implement new understanding and tools in such key decisions contexts, in diverse sites and sectors globally; and (iv) *engaging leaders* and building capacity to achieve transformative and lasting change. I will offer two real-world examples of how these advances are unfolding, in China and Latin America.

Background

Living Natural Capital

The world's ecosystems – Earth's lands, waters, and the myriad types of organisms embedded within them – are vital to human well-being. If properly managed, they yield a stream of “ecosystem services” that sustain and fulfill human life. These include the *production of goods*, such as seafood, crops, timber, and many industrial products, a familiar part of the economy. Second, the services also include less visible *life-support processes*, such as water purification, pest control, crop pollination, flood control, and climate stabilization. Third, they include *life-fulfilling conditions*, such as the beauty and uniqueness in Nature that spawn deep cultural attachments to place, and that improve aspects of cognitive function and mental well-being. Fourth, ecosystem services include the *preservation of options and resilience*, such as those embodied in biological diversity, from genetic to ecosystem levels.

Framing ecosystems as natural capital assets is a way of incorporating human impacts and dependence on Nature into mainstream decision-making. This framing shows starkly that – relative to other forms of capital (physical, financial, human, and social forms) – living natural capital is poorly understood, scarcely monitored, and in many important cases undergoing rapid degradation and depletion (Daily *et al.* 2000; Balmford *et al.* 2002; NRC 2005; Dasgupta 2010). Often its importance is widely appreciated only upon loss, such as in the wake of Hurricane Katrina or the Asian Tsunami.

Including the value of ecosystem services in the decisions of governments, corporations, traditional cultures, and individuals is designed to broaden our understanding of the roles Nature plays in our lives and the reasons – including the moral imperative – for conserving it (e.g., Leopold 1949, Norton 1987, Ehrenfeld 1988, Rolston 2000, Daily and Ellison 2002).

The Opportunity Today

Mainstreaming ecosystem services into everyday decisions requires a systematic method for characterizing their value – and the change in value resulting from alternative choices. Unlike the tools we apply to measure the value of traditional economic goods and services, which are already well established and integrated into decisions, we have no existing accounting tools to measure the value of ecosystem services (MA 2005; NRC 2005; Mäler *et al.* 2008).

What makes it possible to change this today? Four big advances of the last decade offer promise that mainstreaming ecosystem service values into decisions is within reach. First, the Millennium Ecosystem Assessment represented a visionary step in global science – it was the first comprehensive assessment of the status and trends of the world's major ecosystem services. The key finding of this assessment was that two-thirds of the world's ecosystem services were declining, a finding that captured the attention of world leaders (MA 2005).

Second, the science of ecosystem functions and processes has made huge advances, so that we can now model (albeit with uncertainty) the impacts of management decisions and activities across landscapes and seascapes on a wide variety of ecosystem processes. Ecological science has also become adept at spatially explicit modeling, essential for mapping ecosystem services and their distribution to people (e.g., Chan *et al.* 2006, Rokityanskiy *et al.* 2007, Bennett *et al.* 2009, Nelson *et al.* 2009, Harrison *et al.* 2010, Goldstein *et al.* 2012, Guerry *et al.* 2012).

Third, economic valuation methods have been applied to the spatial provision of ecosystem services to estimate the monetary value of benefits and the distribution of those benefits to different segments of society (NRC 2005, Naidoo and Ricketts, 2006). In addition, qualitative and quantitative methods from other fields are now being applied to gain better understanding of the psychological, social, and cultural importance of ecosystem services, and of shared values that people hold together (e.g., MA 2005, US EPA 2009, Bratman *et al.* 2012, Daniel *et al.* 2012, Kenter *et al.* 2014).

Lastly, experiments in payments for ecosystem services, in ecosystem-based management, and in regional planning give us the empirical data to evaluate

approaches to valuing ecosystem services and incorporating values into decision-making (Barbier *et al.* 2008, Pagiola and Platais 2007, Zheng *et al.* 2013). There is a growing recognition that bundling together of ecosystem services and explicit attention to tradeoffs will both better inform decisions, and help diverse stakeholders to appreciate the perspectives of others (e.g., Bennett *et al.* 2009, Boody *et al.* 2005, Egoh *et al.* 2008, Goldstein *et al.* 2012).

Meeting the Challenge

A Strategy

Our urgent challenge today is to build on this foundation and move from ideas to action on a broad scale (Carpenter *et al.* 2006, Carpenter *et al.* 2009, Daily *et al.* 2009). Doing so requires understanding the production of services from landscapes and seascapes, together with their biodiversity and human activities; quantifying service flows, from producers to beneficiaries, across space, social class, economic sector, and time; understanding the decision-making processes of individuals, communities, governments and corporations; integrating research with institutional design and policy implementation; and crafting policy interventions with flexibility for learning and improvement. Each of these alone is a complex and difficult task; together they form a daunting but critically important agenda for collaboration.

The Natural Capital Project is an international partnership, founded in 2006 to help meet this challenge (www.naturalcapitalproject.org). The vision of the Natural Capital Project (NatCap) is a world in which people, governments, and corporations recognize the values of Nature in supporting human well-being, and routinely incorporate them into decision-making. NatCap is focused on making three major advances that together will help transform how businesses, governments, and individuals interact with nature:

(1) Co-developing interdisciplinary knowledge, packaged into practical tools and approaches, for incorporating natural capital values into planning and policy. This work is accelerating in institutions globally, and involves greatly increasing the interaction between researchers and real-world generators and users of knowledge.

In support of such work, NatCap has developed InVEST, a family of tools for Integrated Valuation of Ecosystem Services and Tradeoffs. InVEST helps decision makers visualize the impacts of potential policies – identifying tradeoffs and compatibilities between environmental, economic, and social benefits – by modeling and mapping the delivery, distribution and economic value of ecosystem services under alternative scenarios (Tallis *et al.* 2011). These models were co-devel-

oped with hundreds of researchers, practitioners, and managers. INVEST is free and designed for data available anywhere, globally.

(2) Implementing new knowledge, tools, and approaches in major resource decisions, in replicable and scalable models of success. Working with many partners around the world, NatCap is integrating the diverse values of natural capital into major resource policies and decisions.

These demonstrations range from: informing the infrastructure development strategies of major development banks and private investors, in transportation and other key sectors; to working with indigenous communities in strategic planning of land and ocean resource uses to balance conflicting values; to working with corporations to quantify the risks and opportunities of alternative resource development options. The approach has informed decisions relating to spatial planning, payment for ecosystem services, climate adaptation planning, impact assessments for permitting and mitigation, corporate risk mitigation, marine and coastal development, and habitat restoration (Ruckelshaus *et al.* 2013).

(3) Engaging leaders and practitioners in key institutions to magnify the impact of these successes, build capacity, and forge and accelerate lasting, transformative change. The focus is on developing tools for mainstreaming natural capital systemically, across high-leverage decision contexts, where there is strength and commitment among necessary leading partners to demonstrate real change. So far, these areas include: infrastructure investment; disaster risk reduction; national development planning; water security for cities; and agricultural supply chains.

Real-World Demonstrations

A great number and diversity of efforts to implement the ecosystem services framework have emerged worldwide over the past decade. Individually, most of these efforts are small and idiosyncratic. But collectively, they represent a powerful shift in the focus of conservation organizations and governments (primarily) toward a more inclusive, integrated and effective set of strategies. Taken together, these efforts span the globe and target a full suite of ecosystem services, including carbon sequestration, water supply, flood control, biodiversity conservation, and enhancement of scenic beauty (and associated recreation / tourism values).

Many local or regional efforts focus on a single service that stands out as sufficiently important, from economic and political perspectives, to protect

it. Under the institutional umbrella created for the focal service it is possible that other services may be at least partially protected. Beginning in the late 1990s, larger-scale investment in natural capital for water flow regulation in China – and for a broad suite of ecosystem services in Costa Rica – set pioneering examples that are now being adapted elsewhere and scaled up.

Next, I briefly describe two contrasting models, at different scales and in different kinds of social-ecological systems. In each case, there is an acute or looming crisis, innovative leadership, and an experiment underway in pursuit of dual goals: securing natural capital and human well-being.

Water for Cities in Latin America and Beyond

In the mid-1990s, New York City made one of the first and most famous investments in ecosystem service provision in recent history. The city invested about USD 1.5 billion in a variety of watershed protection activities to improve drinking water quality for 10 million users rather than spending the estimated USD 6–8 billion needed (excluding annual operating and maintenance costs) for building a new filtration plant. This seminal example is widely cited as evidence of the business case for investing in natural capital (Daily and Ellison 2002).

Now the New York City investment is one of many such experiments underway. With rapidly growing urban populations, expanding natural resource extraction in upstream watersheds, and climate change, water security for cities is a growing concern for governments, corporations, and other stakeholders globally. The source watersheds serving cities are now the target of a range of creative policy and finance mechanisms that link beneficiaries to suppliers through a payment system.

Water funds are a finance mechanism through which downstream water consumers and other parties (e.g., conservation and human development organizations, public entities) pay for upstream changes in land cover and use in order to achieve certain objectives. In biophysical terms, the objectives typically include maintenance or enhancement of: water quality; regular water flows (for dry-season supply and flood control); groundwater recharge; terrestrial and aquatic biodiversity; and well-being in upstream human communities. Other services are also anticipated, such as carbon storage and sequestration, crop pollination, and pest control (Goldman-Benner *et al.* 2012). Water fund objectives may also include sustainable improvements in human livelihoods and well-being.

There is now a major effort underway, supported by The Nature Conservancy, the World Bank, the Inter-American Development Bank, and FEMSA (a major bottling company) to replicate and standardize these funds

in terms of design, implementation, and monitoring, across more than 40 major cities throughout Latin America. Analysis is focused on predicting the relative feasibility and payoff of potential land-use / cover changes, such as conservation and restoration in headwaters, on steep slopes, and in riparian areas; and shifting to more sustainable pastoral and cropping practices. InVEST has been tailored for use in this decision context, to predict where and which potential activities would yield the greatest societal return-on-investment (the decision-support system is called Resource Investment Optimization System, RIOS).

Fondo Agua por la Vida y la Sostenibilidad, one of the recently established water funds, demonstrates the diversity of water users that are becoming engaged in these funds and the kinds of watershed management changes these funds motivate. Formally established in the Cauca Valley, Colombia in 2009, this water fund is supported by the region's sugar cane grower's association (PROCAÑA), the sugar producers' association (ASOCANA), 16 local watershed and river management groups, The Nature Conservancy and a Colombian peace and justice non-government organization. Many of these entities began working together as far back as 20 years ago, and the water fund is seen as building upon and strengthening these vital relationships.

Each member of the water fund voluntarily pays a self-determined amount into the fund that is then jointly managed by the members to improve landscape and river condition over 3,900 square kilometers. The aim is to strengthen the financing in the future. For now, members in this fund have committed to contributing USD 10 million over five years to be invested in five kinds of management changes: protection of native vegetation, restoration of denuded lands, enrichment of degraded forests, fencing of rangelands and implementation of best practices combining trees, pasture and livestock. The fund also invests in farmer training (agroforestry systems, cattle management), environmental education in schools, strengthening local community organizations, and setting up "food security modules" – essentially home gardens, with a diversity of crops, chickens, and other production. The investments target the dual goals of improving upstream livelihoods as well as downstream water security.

Investments will be targeted across landscapes to yield the highest return, using RIOS, subject to stakeholder preferences for security and equity. A great deal of stakeholder input feeds into the analysis of options. The fund is starting a monitoring program designed to ensure that these investments lead to measurable improvements in water quality for approximately 1 million water users downstream, as well as significant improvements in terrestrial and freshwater biodiversity.

Since the official establishment of the first water fund in Quito, Ecuador, in 2006, the model has spread rapidly (Figure 1). The Nature conservancy is exploring establishing the first funds in Africa. The effort is focused on developing standards – in the biophysical modeling (through RIOS), financing, governance, and monitoring – that can be sensibly applied in contrasting conditions, but that guide the process and incorporate lessons as they are learned.



Figure 1. Water funds featured by stage of development (as of January 2014). Filled circles indicate that the water fund has been created, with a legal agreement among parties. Open circles designate water funds that are in the process of creation; four more (not depicted) are underway in Latin America since January 2014. Figure courtesy of the Latin American Water Funds Partnership Dashboard (Nov 2013) and The Nature Conservancy, Internal Survey of Water Funds (Dec 2013).

Water funds are an inspiring example of rapid advances in all areas of the three-part strategy laid out above. Today they are still at an early and vulnerable stage. With care, one could envision the emergence of flexible yet durable institutions that help guide growth of cities and management of the natural capital they depend on, more broadly.

China's Land-Use and Human Development Planning

The ecosystem service investments being made in China today are breathtaking in their goals, scale, duration and innovation. Following massive droughts and flooding in 1997-98, China implemented several national forestry and conservation initiatives, into which investments exceeded 700 billion yuan (about USD 100 billion) over 2000-2010 (Zhang *et al.* 2000; Liu *et al.* 2008). The larger and older of these initiatives, the Sloping Land Conversion Program (SLCP), involves 120 million farmers directly and is being rigorously evaluated to improve its design and efficacy.

These initiatives all have dual goals: to secure critical natural capital through targeted investments across landscapes and to alleviate poverty through targeted wealth transfers from coastal provinces to inland regions where many ecosystem services originate. The investments are focused on forests and grasslands, to help secure people from flooding, improve drinking and irrigation water supply, maintain efficient hydropower production, protect biodiversity, stabilize climate, reduce sand storms and soil loss, and foster more sustainable farming and other aspects of human well-being (Daily *et al.* 2013). In addition, the government aims to change the economic structure in rural areas to increase local household income while simultaneously making local households' patterns of land utilization and agricultural production more sustainable (Liu *et al.* 2008; Li *et al.* 2011).

Evaluation of the SLCP shows significant achievement of the biophysical goals, with remarkably rapid land conversion in the desired directions. For example, by the end of 2006, the SLCP had converted ca. 9 million ha of cropland into forest / grassland and had afforested ca. 12 million ha of barren land. Village level field measurements have shown not only that the payments for ecosystem services have altered land use patterns, but in turn soil erosion has been decreased in some areas by as much as 68% (Cao *et al.* 2009).

Overall social impacts of the programs are mixed, and depend on the details of the financial incentives and property rights (Cao *et al.* 2009, Liu *et al.* 2008). In some places, payment levels and types are leading to improvements in economic measures of well-being, whereas in others payments were not sufficient to compensate for loss of income from shifting livelihoods (Liu *et al.* 2008). In addition, in some places where participation in the SLCP has

significant positive impacts upon household income, it has not yet transferred labor towards non-farming activities as the government wished (Li *et al.* 2011). Payments are now being adjusted to improve success in achieving goals of poverty alleviation and growth of new economic sectors in rural areas.

China also stands out in strengthening the scientific foundation supporting these public policies. This is illustrated in the development of a first National Ecosystem Assessment, spanning a wide range of ecosystems, services, and spatial scales, over the past decade (2000–2010). The first step is to classify land cover for the whole of China, for 2000, 2005, and 2010, based on Landsat TM data at 30m x 30m resolution. The next stages of work involve characterizing the composition and structure of ecosystems and their changes over the assessment decade. The final stage will involve characterizing levels and types of ecosystem services, and changes therein across China and the assessment decade. This important effort will showcase state-of-the-art technical approaches relevant to other nations undertaking such assessments, and provide critical analysis to decision-makers (Perrings *et al.* 2011).

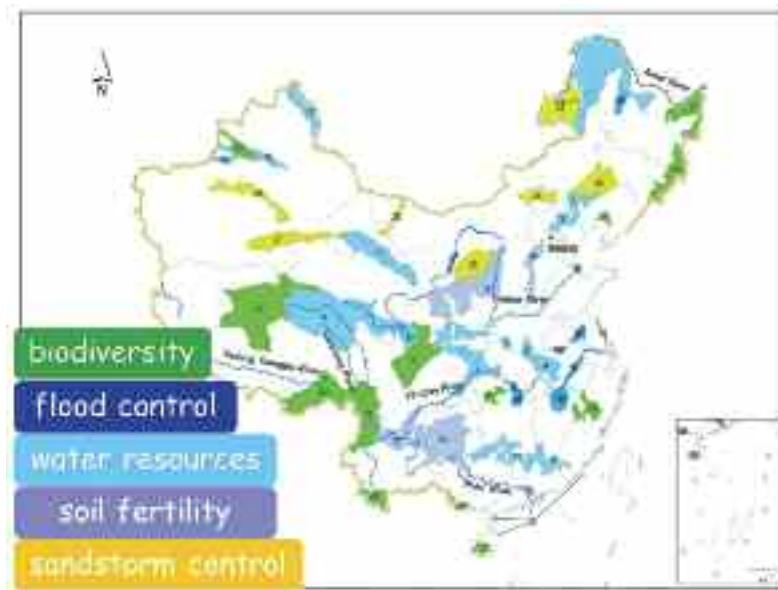


Figure 2. China's new system of Ecosystem Function Conservation Areas (EFCAs). As delineated by the Ministry of Environmental Protection and the Chinese Academy of Sciences, EFCAs span 28% of China's land area and 25% of its counties. EFCAs have dual goals of securing biodiversity and ecosystem services and alleviating poverty. Figure courtesy of Z. Ouyang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences.

Perhaps most ambitiously, China is establishing a new network of “ecosystem function conservation areas” (EFCAs) (MEP and CAS 2008) (Figure 2). The network now spans 28% of the country and are expected to grow over time; their exact delineation and implementation is now being defined using InVEST together with a broad set of biophysical and social science tools and approaches.

EFCAs are a way of zoning land, so as to focus conservation and restoration in places with highest return-on-investment for public benefit, to halt and reverse degradation of vital ecosystems and their services. The zoning is also meant to focus high-impact human activities in places where they will do least damage. The design and implementation of EFCAs involves assessments from local to national scales. At the national scale, the priority services are conservation of soil and water resources, flood protection, biodiversity, and sand storm protection (Ouyang, 2007; Ehrlich *et al.* 2012).

EFCAs are also a way of focusing poverty alleviation efforts in places where the stakes are highest, both for local residents and for beneficiaries of ecosystem services living farther away. Implementing EFCAs involves compensation mechanisms, whereby regional beneficiaries – of, for example, water purification and sand storm control in Beijing – invest in the transformation to more sustainable livelihoods and durable improvements in well-being among the landholders producing the services (e.g., Zheng *et al.* 2013).

While these initiatives represent a massive scientific and policy undertaking, they are very young and there is still little understanding of the local costs of implementation, or their effects on poor and vulnerable populations. The EFCA model represents a new paradigm for integrating conservation and human development, but for this policy innovation to have wide applicability and success, it will be important to assess and improve local livelihoods (e.g., Li *et al.* 2011; Li *et al.* 2012; Liang *et al.* 2012). This need points to the science and policy frontiers before us.

Pushing the frontier further, in March 2014, the central government approved development of a new metric – Gross Ecosystem Product – to be implemented highly visibly, alongside Gross Domestic Product, at all levels of government.

The current and potential future impacts of ecosystem service investments in China are enormous, both within the country and globally, perhaps most importantly in lessons on making the investments needed in natural capital and human well-being everywhere. This is seen as a vital matter of national security, and national leaders now speak of “China’s dream” as becoming “the ecological civilization of the 21st Century”.

Conclusion

Mainstreaming natural capital into decisions is a long-term proposition, requiring co-evolving advances in knowledge, social institutions, and culture. Certainly no single effort will be sufficient to achieve this. But each can contribute to the theory of change (Bradach *et al.* 2009) laid out here, with its three key elements: co-development of new tools and approaches; real-world demonstrations; and engaging leaders.

First, governments, businesses, and individuals must find it easy to inculcate ecosystem services and natural capital into their decisions, and the methods for doing so must be transparent, credible, and predictable. In many cases, sectors of society are open to the concepts of ecosystem services and natural capital, but simply do not know how to use them in a tangible way.

Second, there need to be examples of projects or enterprises that – as a result of properly valuing ecosystem services and natural capital – end up with improved decisions, institutions, and human well-being. These examples both test our knowledge against real-world problems, but also produce compelling stories of how an ecosystem services approach made a difference.

Lastly, these examples of success must have visibility and charisma, to draw political and thought leaders to them and thereby trigger much broader awareness. This is where the lessons of a set of examples can be mainstreamed into the myriad decisions – by businesses, governments, farmers, and banks – that are made every year and that impact our natural and social world. This is where the impact of scattered projects can be magnified into worldwide change.

None of these steps is complicated, and this theory of change does not require a brilliant and novel strategy. In fact, all three ingredients appear within striking distance. The environmental and human development movement has a much bigger and more diverse and powerful community behind it now than ever before. Co-development of knowledge with knowledge users is beginning to provide tools and methods that will reduce the transaction costs. There are enough policy experiments underway that compelling examples of natural capital stewardship enhancing human well-being are already forthcoming – the first step in an iterative process between basic science and application to real-world problems. Science by itself cannot change the world, but science plus the vision and action of leaders can.

Acknowledgements

I am deeply grateful to the many collaborators and partners whose insight, trust, and commitment make this work possible. I thank the workshop organizers, Professor V. Ramanathan, Professor P. Dasgupta, and Archbishop Roland Minnerath, and the Pontifical Academy of Social Sciences and the Pontifical Academy of Sciences.

References

- Balmford, A, A Bruner, P Cooper, R Costanza, S Farber, RE Green, M Jenkins, P Jefferiss, V Jessamy, J Madden, K Munro, N Myers, S Naeem, J Paavola, M Rayment, S Rosendo, J Roughgarden, K Trumper, and RK Turner. 2002. Economic reasons for conserving wild nature. *Science* 297: 950–953.
- Barbier, E, E Koch, B Silliman, SD Hacker, E Wolanski, J Primavera, EF Granek, S Polasky, S Aswani, LA Cramer, DM Stoms, CJ Kennedy, D Bael, CV Kappel, GME Perillo, and DJ Reed. 2008. Coastal ecosystem-based management with non-linear ecological functions and values. *Science* 319, 321–323.
- Bennett, E., Peterson, G. and Gordon, L. 2009. Understanding relationships among multiple ecosystem services. *Ecology Letter*. 12, 1394–1404.
- Bratman, GN, JP Hamilton, and GC Daily. 2012. The impacts of nature experience on human cognitive function and mental health. In Richard Ostfeld and William Schlesinger, Eds. *The Year in Ecology and Conservation Biology. Annals of the New York Acad. Sci.* 1249: 118–136.
- Boody, G, B Vondracek, DA Andow, M Krinke, J Westra, J Zimmerman, and P Welle. 2005. Multifunctional agriculture in the United States. *BioScience* 55, 27–38.
- Bradach, J., Tierney, T. and Stone, N. 2008. Delivering on the promise of nonprofits. *Harvard Business Review*. Dec, 88–97.
- Cao, S, B Zhong, H Yue, H Zeng and J Zeng. 2009. Development and testing of a sustainable environmental restoration policy on eradicating the poverty trap in China's Changting County. *Proceedings of the National Academy of Sciences, USA* 106, 10712–10716.
- Carpenter, S., DeFries, R., Dietz T. *et al.* 2006. Millennium Ecosystem Assessment: Research Needs. *Science*. 314, 257–258.
- Carpenter, S., Mooney, H., Agard, J. *et al.* 2009. Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences, USA* 106, 1305–1312.
- Chan, K.M.A., M.R. Shaw, D.R. Cameron, E.C. Underwood, and G.C. Daily. 2006. Conservation planning for ecosystem services. *PLoS Biology* 4, e379.
- Daily, GC, T Söderqvist, S Aniyar, K Arrow, P Dasgupta, P Ehrlich, C Folke, A-M Jansson, B-O Jansson, N Kautsky, S Levin, J Lubchenco, K-G Mäler, D Simpson, D Starrett, D Tilman, and B Walker. 2000. The value of nature and the nature of value. *Science* 289: 395–396.
- Daily GC and Ellison K. 2002. *The New Economy of Nature: The Quest to Make Conservation Profitable*. Washington, D.C.: Island Press.
- Daily, G.C., Polasky, S., Goldstein, J., P. Kareiva, H.A. Mooney, L. Pejchar*, T.H. Ricketts, J. Salzman, R. Shallenberger 2009. Ecosystem services in decision-making: time to deliver. *Frontiers in Ecology and the Environment* 7, 21–28.
- Daily, GC, Z Ouyang, H Zheng, S Li, Y Wang, M Feldman, P Kareiva, S Polasky, M Ruckelshaus. 2013. Securing natural capital and human well-being: innovation and impact in China. *Acta Ecologica Sinica* 33: 669–676.
- Daniel, T.C., A. Muhar, A. Arnberger, O. Aznar, J.W. Boyd, K. Chan, R. Costanza, T. Elmqvist, C.G. Flint, and P.H. Gobster. 2012. Contributions of cultural services to the ecosystem services agenda. *Proceedings of the National Academy of Sciences* 109: 8812–8819.
- Dasgupta, P. 2001. *Human Well-Being and the Natural Environment*, Oxford University Press, Oxford.
- Dasgupta, P. (2010). Nature's role in sustaining economic development. *Philosophical Transactions of the Royal Society B*. 365, 5–11.
- Egoh, B., Reyers, B., Rouget, M. *et al.* (2008). Mapping ecosystem services for

- planning and management. *Agriculture Ecosystems and Environment* 127, 135-140.
- Ehrenfeld, D. (1988). Why put a value on biodiversity? In *Biodiversity*, E.O. Wilson (ed.). National Academy Press.
- Ehrlich, PR, P Kareiva, and GC Daily. 2012. Securing natural capital and expanding equity to rescale civilization. *Nature* 486: 68-73.
- Goldman-Benner, RL, S Benitez, T Boucher, A Calvache, GC Daily, P Kareiva, T Kroeger, A Ramos. 2012. Water funds and PES: Practice learns from theory and theory can learn from practice. *Oryx* 46(1): 55-63.
- Goldstein, JH, G Caldaron, TK Duarte, D Ennaanay, N Hannahs, G Mendoza, S Polasky, S Wolny, and GC Daily. 2012. Integrating ecosystem service tradeoffs into land-use decisions. *Proc. National Academy of Sciences USA* 109: 7565-7570.
- Guerry, A.D., M.H. Ruckelshaus, K.K. Arkema, J.R. Bernhardt, G. Guannel, C.K. Kim, M. Marsik, M. Papenfus, J.E. Toft, G. Verutes, S. Wood, M. Beck, F. Chan, K. Chan, G. Gelfenbaum, B. Gold, B. Halpern, W. Labiosa, S. Lester, P. Levin, M. McField, M. Pinsky, M. Plummer, S. Polasky, P. Ruggiero, D. Sutherland, H. Tallis, A. Day, J. Spencer. 2012. Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning. *International Journal of Biodiversity Science, Ecosystem Services & Management* 8: 107-121.
- Harrison, J., Bouwman, A., Mayorga, E., and Seitzinger, S. 2010. Magnitudes and sources of dissolved inorganic phosphorus inputs to surface fresh waters and the coastal zone: A new global model. *Global Biogeochemical Cycles* 24, 271-279.
- Kenter, J.O., Reed, M.S., Irvine, K.N., O'Brien, E., Brady, E., Bryce, R., Christie, M., Church, A., Cooper, 39 N., Davies, A., Hockley, N., Fazey, I., Jobstvogt, N., Molloy, C., Orchard-Webb, J., Ravenscroft, N., 40 Ryan, M., Watson, V. 2014. *Shared, plural and cultural values: A guide for decision-makers*. UK 41 National Ecosystem Assessment follow-on phase. Cambridge, UNEP-WCMC.
- Kiesecker, J.M., H. Copeland, A. Pocewicz, and B. McKenney. 2010. Development by design: blending landscape-level planning with the mitigation hierarchy. *Frontiers in Ecology and the Environment* 8: 261-266.
- Leopold, A. 1949. *A Sand County Almanac*, Oxford University Press.
- Levy, K, GC Daily, and S Myers. 2012. Human health as an ecosystem service: A conceptual framework. pp. 231-251 in JC Ingram, C Rumbaitis Del Rio, A DeClerck, Eds., *Integrating Ecology and Poverty Reduction: Ecological Dimensions*. Springer, New York, NY.
- Li, F, Wang, R., Paulussen, J., and Liu, X. 2005. Comprehensive concept planning of urban greening based on ecological principles: a case study in Beijing, China. *Landscape and Urban Planning* 72: 325-336.
- Li, J., M. Feldman, S. Li, and G.C. Daily. 2011. Rural household income and inequality under payment for ecosystem services: The Sloping Land Conversion Program in Western China. *Proceedings of the National Academy of Sciences USA* 108: 7721-7726.
- Li, C, S Li, MW Feldman, GC Daily, and J Li. 2012. Does out-migration reshape rural households livelihood capitals in the source communities? Recent evidence from Western China. *Asian and Pacific Migration Journal* 21: 1-30.
- Liang, Y, S Li, MW Feldman, and GC Daily. 2012. Does household composition matter? The impact of the Grain for Green Program on rural livelihoods in China. *Ecological Economics* 75: 152-160.
- Liu, J., S. Li, Z. Ouyang, C. Tam, and X. Chen. 2008. Ecological and socioeconomic effects of China's policies for ecosystem services. *Proceedings of the National Academy of Sciences USA* 105, 9489-9494.

- MA (Millennium Ecosystem Assessment). 2005. *Ecosystems and Human Well-being: The Assessment Series* (Four Volumes and Summary). Washington, D.C.: Island Press.
- Mäler K.-G., Aniyar, S., and Jansson, A. 2008. Accounting for ecosystem services as a way to understand the requirements for sustainable development. *Proceedings of the National Academy of Sciences USA* 105, 9501-9506.
- MEP (Ministry of Environmental Protection of China), CAS (Chinese Academy of Sciences). 2008. *National Ecosystem Service Zoning in China*.
- NRC (National Research Council). 2005. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. Washington, D.C.: National Academies Press.
- Naidoo, R. and Ricketts, T.H. 2006. Mapping the economic costs and benefits of conservation. *PLoS Biology* 4, e360.
- Nelson, E., G. Mendoza, J. Regetz, et al. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7, 4-11.
- Norton, B. 1987. *Why Preserve Natural Variety?* Princeton University Press, Princeton, NJ.
- Ouyang ZY. *Ecological Construction and Sustainable Development*. Beijing: Science Press, 2007.
- Pagiola, S. and G. Platais. 2007. *Payments for Environmental Services: From Theory to Practice*. Washington, DC: World Bank.
- Perrings, C., A. Duraiappah, A. Larigauderie, and H.A. Mooney. 2011. The biodiversity and ecosystem services science-policy interface. *Science* 331: 1139-1140.
- Rapidel, B., DeClerck, F., Le Coq, J.-F., and Beer, J., Eds. 2011. *Ecosystem services from Agriculture and Agroforestry: Measurement and Payment*, Earthscan, London.
- Rokityanskiy D., Benítez, P., Kraxner, F. et al. 2007. Geographically explicit global modeling of land-use change, carbon sequestration, and biomass supply. *Technological Forecasting and Social Change*. 74, 1057-1082.
- Rolston, H. III. 2000. The land ethic at the turn of the millennium. *Biodiversity and Conservation* 9, 1045-1058.
- Ruckelshaus, M, E McKenzie*, H Tallis*, A Guerry*, GC Daily, P Kareiva, S Polasky, T Ricketts, N Bhagabati, S Wood*, and J Bernhardt. 2013. Notes from the field: Lessons learned from using ecosystem services to inform real-world decisions. *Ecological Economics*. <http://dx.doi.org/10.1016/j.ecolecon.2013.07.009>
- Tallis, H.T., Ricketts, T., Guerry, A.D., Wood, S.A., Sharp, R., Nelson, E., Ennaanay, D., Wolny, S., Olwero, N., Vigerstol, K., Pennington, D., Mendoza, G., Aukema, J., Foster, J., Forrest, J., Cameron, D., Arkema, K., Lonsdorf, E., Kennedy, C., Verutes, G., Kim, C.K., Guannel, G., Papenfus, M., Toft, J., Marsik, M., and Bernhardt, J. 2011. *INVEST 2.4.4 User's Guide*. The Natural Capital Project, Stanford.
- US EPA (United States Environmental Protection Agency) Science Advisory Board. 2009. *Valuing the Protection of Ecological Systems and Services*. EPA-SAB-09-012. US EPA.
- Wunder, S., Engel, S., and Pagiola, S. 2008. Taking stock: a comparative analysis of payments for environmental service programs in developed and developing countries. *Ecological Economics* 65, 834-852.
- Zhang, P., Shao, G., Zhao, G., et al. 2000. China's forest policy for the 21st Century. *Science* 288, 2135-2136.
- Zheng, H, BE Robinson, Y Liang*, S Polasky, D-C Ma, F-C Wang, M Ruckelshaus, Z Ouyang, and GC Daily. 2013. The benefits, costs, and livelihood implications of a regional PES (Payment for Ecosystem Service) program. *Proc. National Academy of Sciences USA* (doi/10.1073/pnas.1312324110).

ENERGY FOR SUSTAINABLE AND EQUITABLE DEVELOPMENT

■ DANIEL M. KAMMEN^{*1,2,3}, PETER ALSTONE^{1,2}, DIMITRY GERSHENSON^{1,2}

Abstract

With 1.4 billion people lacking electricity to light their homes and provide other basic services, or to conduct business, all of humanity (and particularly the poor) are in need of a decarbonized energy system that can close the energy access gap and protect the global climate system. With particular focus on addressing the energy needs of the underserved, we present an analytical framework informed by historical trends and contemporary technological, social, and institutional conditions that clarifies the heterogeneous continuum of centralized on-grid electricity, autonomous mini- or community grids, and distributed, individual energy services. We find that the current day is a unique moment of innovation in decentralized energy networks based on super-efficient end-use technology and low-cost photovoltaics, supported by rapidly spreading information technology, particularly mobile phones. Collectively these disruptive technology systems could rapidly increase energy access, contributing to meeting the Millennium Development Goals for quality of life, while simultaneously driving action towards low-carbon, Earth-sustaining, energy systems.

Introduction: Global Energy Challenges

Two critically important challenges face the global community in the 21st Century: the persistence of widespread energy poverty and intensifying human-driven climate disruption [1, 2]. These crises are inexorably linked through the technology systems that underlie them. Although electricity networks have connected billions of people with relatively low cost and high value energy, providing services that unlock economic and social free-

*Correspondence to: kammen@berkeley.edu; 310 Barrows Hall, University of California, Berkeley, CA 94720-3050; T: +1-510-642-1640; <http://kammen.berkeley.edu>

¹ Energy and Resources Group, University of California, Berkeley, USA.

² Renewable and Appropriate Energy Laboratory, University of California, Berkeley, USA.

³ Goldman School of Public Policy, University of California, Berkeley, USA.

doms [3], pollution from the energy sector is the primary driver of locally and globally disruptive climate change [1]. Furthermore, despite significant growth in the extent of centrally planned electricity networks, billions worldwide still lack even the most basic or reliable services [2]. Meeting the needs of the developing world with modern energy and other infrastructure is both a critical task for improving the quality of life and enhancing human development opportunities [4, 5]. However the notion of universal electrification is a key point of contention for negotiations on climate change mitigation [6, 7]. This tension between energy services and increasing emissions exists because of the dominant paradigm for electrification in the industrializing world, i.e. through centrally planned and currently carbon-intensive power systems [8]. Despite its undisputed value, without significant changes to these trends, a billion people are projected to remain without access in 2030, with the majority in Sub Saharan Africa and significant numbers in developing Asia [9]. Eighty percent of those projected to remain in deprivation live in rural areas, where the lack of modern infrastructure and services directly result in low resilience to the potentially catastrophic impacts of climate change, such as drought, losses in agricultural productivity, and extreme events [1, 2].

To clarify the potential of technological, political, and market mechanisms to sustainably addressing household-level and global energy needs, we present a historical and conceptual framework to evaluate the opportunities to manage energy and information resources over vastly different scales of network services. Focusing on electricity access for the poor and unempowered we begin by (1) exploring the links between access to electricity and human development; (2) considering the historical trajectory of electricity technology systems and (3) describing an emerging continuum of electricity technology options available today.

Our synthesis of the available data moves towards an integrated theory for understanding the dynamics of on- and off-grid energy systems in the Anthropocene [10-12] based on emerging understandings of network dynamics [13]. The implications for power system development on- and off-grid can contribute to achieving universal access using strategies that improve *both* human development and climate impacts from the energy sector through the effective support of networks for energy access, including novel approaches that leverage ubiquitous information technology connectivity. With better frameworks for understanding the complex systems that are the foundation for energy access both private and public sector agents can better target their efforts.

Energy and Human Development

Thus far, progress towards eradicating energy poverty has been insufficient in scale and pace. Unserved populations still primarily rely on low-efficiency open flames for lighting [14] that is often inadequate [14], incurring substantial economic costs [15] and increased health [16] and safety risks [17]. Greenhouse gas emissions from fuel-based lighting are significant [14], particularly in light of recent findings on black carbon from wick lamps [18]. The off-grid poor devote also devote large amounts of time and financial resources to charge mobile phones [19, 20], which are used by 72% of people in low-to-middle income countries, a twenty-fold increase since 2000 [21]. Mobile phones have become a critical basic needs technology that provides valuable services that link people with family, allow for participation in the market place through mobile banking and mobile money transfers, and facilitate a greater access to information [22].

Access to electricity is linked with improvements in human development including productivity, health and safety, gender equality, and education [2, 16, 17, 19, 23, 24]. Much of the research broadly describing quality of life and electrification, stems from the pioneering insights of Goldemberg, Johansson, Reddy and Williams [25] who demonstrated a clear correlation between human development and electricity consumption per capita (kWh/capita, which suggested a relationship with steep gains for the first 2,000–4,000 kWh/capita-year and greatly diminishing marginal returns to human development for consumption beyond that basic-needs level) [26]. The kWh/capita metric thus became a de facto indicator for progress on energy access, and has been explored in depth, especially by those attempting to determine the direction of causality between consumption and development [26–30].

Figure 1 shows consumption-based relationships in the spirit previous work along with a set of relationships based on the fraction of people with electricity access (as defined in national censuses and household surveys – typically a non-specific, legal connection to the grid). Unlike consumption-based relationships that exhibit a power law decline in returns to human development as they increase, access is first-order linear predictor of HDI along with an important set of selected MDG over its full range. This is consistent with an aggregate view of household-level diminishing returns on energy consumption, where the first applications of energy that are prioritized are also the most valuable for improving peoples' lives, followed by less valuable applications.

While electricity access is highly correlated with several development indicators, it is not the only factor at play. The underlying relationship be-

tween development and electricity consumption cannot be extricated simply from macro data. There are numerous complex socioeconomic factors that can contribute to a high consumption per capita, including industrial activity, geography, and political relationships [27, 28, 30]. Although it is difficult to determine causality [29, 31-33], there is sufficient case study data

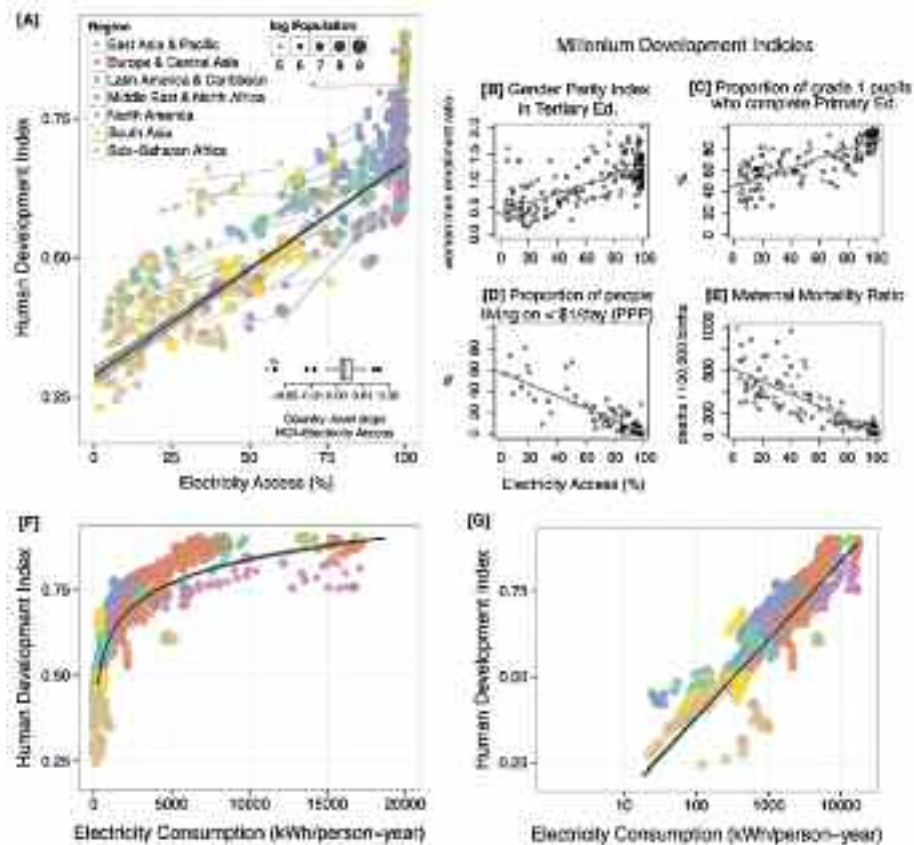


Figure 1. The relationship between access to electricity and human development ((A) HDI, (B)-[E] Selected Millennium Development Indices, 2000-2010) and between electricity consumption and HDI similar to the relationship originally suggested by Goldemberg, Johansson, Reddy and Williams [25] ((F) on a continuous abscissa, [G] with a logarithmic abscissa). All the data are on a country level. In (A) country level regressions along with a full regression are shown for the relationship with HDI, and the distributions in slopes on a country level indicates the global relationship holds within countries over time (typically). The R^2 values for the full-sample linear regression are [A] 0.65, [B] 0.52, [C] 0.66, [D] 0.72, [E] 0.69, and [F]/[G] 0.81 (same relationship on different axis scales).

[19, 23, 34] to provide a strong argument that electricity access is a necessary, but not sufficient, condition for improving human development.

The response thus far to the multi-dimensional problems of global climate and poverty has been driven primarily by multilateral institutions (e.g., the United Nations Framework Convention on Climate Change and the United Nations Development Programme) and articulated in large consensus reports like the IPCC Assessments of Climate Science [1] and Human Development Reports [35]. In assessing progress and planning future action, there is a critical role for global metrics, for both climate and poverty. While climate pollutants lend themselves to direct measurement (albeit with continuing improvement in the understanding of atmospheric chemistry, forcing, and sources), poverty, like other social issues, is less straightforward to measure. The current commonly used broad indices are the Human Development Index (HDI) and the Millennium Development Goal indicators from the United Nations [35] but there are other measures in parallel and in development that support a richer picture of development. The Human Development Index (HDI) was developed by the UNDP to provide a multi-objective metric to track progress of poverty alleviation through a synthesis of health, education, and living standards. The HDI was expanded upon with the introduction of the Millennium Development Goals, which include eight targets and 20 indicators. The MDGs present a multidimensional view of improving human development, from measures of literacy to gender equality and infant health [35]. A direct measure of electricity access – in terms of the fraction of households with modern energy – is currently missing from official development tracking but has been proposed for a 2015 update to the Millennium Development Goals (MDG) [20] and there is a proposed *Global Tracking Framework* for energy access in a pilot testing process that could support explicit access goals [2].

Networks of Power and Technology

The expansion of energy access is fundamentally a process of networks forming and extending in the context of technological innovation with support from complementary systems of capital, institutions, and information. Innovation along any of those dimensions can lead to growth, but only to the extent of support from the remaining complementary networks (as Hughes described in his seminal historical synthesis of early power grids, *Networks of Power* [36], this can be understood using the concept of the “reverse salient” as a bottleneck for development). In the case of electric utilities, the genesis of utility networks was in 1882 with the Pearl Street Station in New York City. These were greatly enabled by technology innovation

across supply and demand technologies (including dynamo generators, AC transmission and distribution, and efficient lighting and motors that occurred in the late 1800s and early 1900s), and catalyzed by the critical development of a new business model for selling electricity on a commercial basis. Thus, utilities created a disruptive technology system that leveraged networks of multinational enterprise, transportation (particularly sea freight and railroads) and capital to grow and (mostly) displace an incumbent global structure of fuel-based lighting and non-electric mechanical power [37].

Branching out from the early-adopting coastal hubs of New York, Paris, and London, multinational private enterprise opportunistically followed existing links of trade and capital to quickly electrify the world's cities and factories, using mainly standalone power stations and minigrids. Hausman *et al.*'s work on mapping the evolving business and institutional networks of power systems shows they developed quickly to serve the needs of disconnected urban and industrial users with concentrated demand and ability to pay for electric service that combined to create both smaller and higher return investments in transmission and distribution infrastructure per customer. As electric power networks grew and interconnected with one another across the globe, both following and driving industrial development, the value and reach of emerging regional and national grids demanded additional attention from national governments. By the 1930s–40s, the energy sector began to shift towards a collection of public and private approaches with primarily state ownership and/or control of national and regional power systems [37]. By 1930, electricity had transformed the lives of many city dwellers but rural populations remained in the dark [36].

Rural Electrification

The Tennessee Valley Authority (TVA) is a classic and instructive example of early efforts public institutions took to drive development of electricity networks in areas of deprivation that were neglected by the private sector. Part of the broader “New Deal” program of United States government infrastructure projects and financial reform in the 1930s, it featured many elements that are present in current-day debates around rural electrification. The TVA was sold partially as a jobs and economic development program (which has been shown to hold true to its promise on a regional basis in *ex post* econometric analysis) and also on the basis of providing populist “Electricity for All” (see SOM) while taming the capricious Tennessee River to make it navigable and less disruptive with a series of large hydroelectric dams [41]. In the context of linked networks, it was the river that provided a critical natural support structure for the project, aggregating

fuel supply (water with elevation change) and population density along its reach. Although today the Tennessee River Valley is seamlessly interconnected with the rest of the Eastern Interconnection transmission grid and has experienced a significant regional increase in jobs and ongoing manufacturing capacity [41], during the development of the TVA, the project encountered opposition and criticism from many perspectives [42]. The emerging but powerful energy sector whose pricing was undercut by the subsidized tariffs of the TVA denounced the project as wasteful and anti-capitalist [43]. Further objections arose from existing racial and socioeconomic disparities in the region that were magnified in the allocation of jobs and services in the Valley [44]. Furthermore, several rural, poor communities were displaced from their homes in areas that were flooded for hydroelectric storage reservoirs as the project transformed the valley [45].

Similar rural electrification dynamics continually play out as power grids expand in the developing world, with combinations of private and public initiative, issues of equity in development, and the inevitable localized negative impacts from expanding transmission networks and power stations, such as loss of land to eminent domain, environmental degradation, and other issues. While power reached the cities and industry of the developing world in the early 1900s around the same time as it reached cities in the industrialized world [46], rural (and poor urban area) electrification has significantly lagged industrialized countries. The current electrification rate in developing countries, as classified by the International Energy Agency, is 76.5%, as compared to OECD nations with an electrification rate of 99.9% [47].

A key challenge in rural electrification efforts is the cost of building the distribution system to go the “last mile”. A recent study focused on Kenya found that the marginal capital cost of connecting customers in places with high density and existing power infrastructure is relatively low, \$1000 USD, but the cost is \$4000 USD or more in less dense rural areas where people have an even lower ability to pay for the service (or buy appliances that result in higher demand) [48]. In the context of typical annual household expenditures (approximately \$1000 in Kenya, which is roughly a median case in Sub-Saharan Africa) and the fact that typical household spending on energy is 5–10% of the annual budget, it is clear that it is often financially undesirable for system operators to expand electricity services to the rural poor, who may not consume energy at a rate that allows steep connection costs to be recouped.

In many areas, even prior to addressing distribution issues, power generation and transmission needs to be close enough to enable a connection. Transmission networks reach out to meet load centers, connect with gen-

eration that is in a geographically fixed area (e.g., a renewable resource area), and to interconnect with adjacent power grids. There are many such projects currently under way in the developing world, including the often-polemic, multinationally funded generation and transmission expansion in the East African corridor, which includes large projects such as Gibe III and IV hydroelectric projects in Ethiopia, the Eastern Electricity Highway Project connecting Kenya and Ethiopia, the Lake Turkana Wind Farm in Kenya, geothermal resource expansion in Burundi, DRC, and Rwanda, and other related initiatives [49]. These large-scale activities, while incredibly important for national growth, are not without their drawbacks, reflecting the previously learned lessons of the TVA. The expansion of hydroelectric generation in Ethiopia, for example, has been a point of contention for academics, non-profit advocacy groups, and even regional governments. Much of the discussion today focuses on many of the same issues as with the TVA, including displacement of populations [50], disproportionate impacts on the poor and marginalized people [51], and political tension [52].

The development of transmission infrastructure to create regional interconnected networks, such as the East African Power Pool (EAPP), illustrates other common drivers for transmission network expansion today: the desire for a greater stability, expanded service provision, reduced locational marginal costs, and opportunities for trade and international collaboration. In many cases, this expansion is not only driven by, but also acts as a driver of the previously mentioned extensive energy resource development projects. Regional interconnection is not without its faults however, and the technical difficulties of interconnecting large-scale power systems can be complex, especially when member states operated under independent grid codes in the past. Furthermore, because institutional and administrative features can vary from country to country, the technical and operational attributes of initially independent national systems can be quite disparate. This adds to the challenge of successful interconnection when it is done through HVAC transmission infrastructure, where synchronicity of systems is key to ensure reliable service. In such systems, disturbances in one area can rapidly degrade service provision across the whole network [54, 55].

Energy Poverty Today

In spite of rapid expansion driven initially by the private sector and later by public institutions, our analysis of the archival record in Figure 2 show that since the initiation of centralized electricity, there have consistently been between 1–2 billion people without access (i.e., still primarily relying on fuel-based lighting technology and fuel networks) as grid expansion has

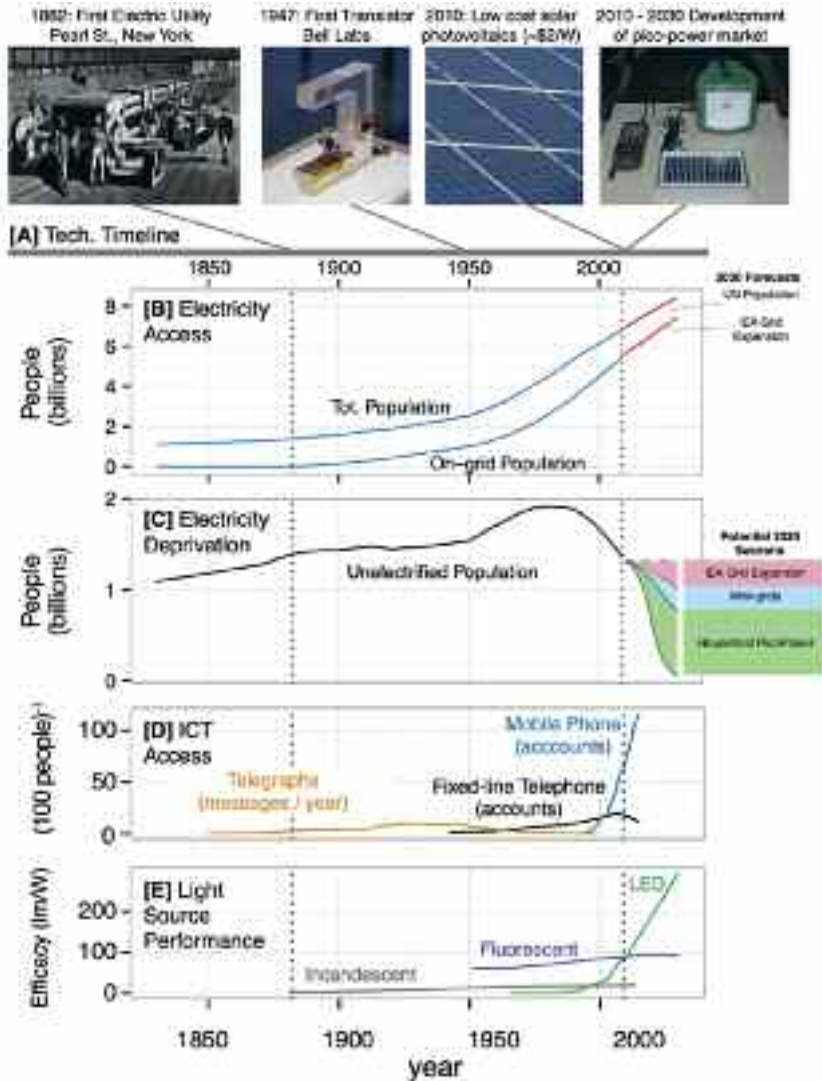


Figure 2. Two centuries of historical trends and a potential future scenario from 1830 to 2030 for electricity access in the context of technology and supporting network events and trends. [A] The technology timeline shows watershed moments of innovation and market paradigm shifts. Panels [B] and [C] show the population with access to electricity over the time period, with [C] including a potential future scenario for decentralized electricity development. Panel [D] shows a range of market penetration for ICT, going as far back as telegrams, a primary enabling technology in the spread of electric grids. Mobile phones, also shown, are the contemporary alternative to decentralized systems. The lower plot [E] shows the trend in electric light source efficacy for a range of technology including LED solid-state lighting. A full description of the data sources and analysis for this figure are in the Supplementary Material.

roughly paced global population growth since 1900. About 1.4 billion people in 2013 [2] are completely off-grid, and many ostensibly connected people in the developing world experience significant outages accumulating to 20–200+ days a year [56]. The pervasive “energy isolation” people experience, in the context of grid-based electricity, stems from being remote in multiple dimensions:

- Geographically remote: Long transmission distances, diffuse population densities, and difficult terrain quality restrict grid extension to many rural areas due to high marginal cost of connection compared to expected usage [23].
- Economically remote: The rural and urban poor do not consume large quantities of electricity due to budgetary restrictions and often struggle to pay connection fees to nearby grid infrastructure or procure household wiring and appliances [57]. Many households and businesses in “electrified” areas lack access, even directly beneath power lines. Principle-agent market failure may contribute to this phenomenon for renters.
- Politically remote: Centralized grid extension often requires a degree of political power that is a barrier for disadvantaged rural and urban populations with opposition, marginalized, or diffuse societal and political affiliations who are not supported by strong institutions [58] [23]. People without property rights may lack the stability to justify investments in fixed infrastructure, or permission from central authority to do so.

Off-grid Energy Access Technology Continuum

A contemporary continuum of off- and micro-grid electricity systems does not require the same supporting networks as centralized power generation and can overcome energy isolation barriers. The process of network expansion for decentralized power is fundamentally different from electricity grids. Where electricity grids require installation of capital-intensive fixed infrastructure – plants and relatively large loads connected by transmission and distribution followed by infill and rural extension – the decentralized power network is more diffuse. There are still important hubs like factories in Southeast Asia where a majority of components and integrated systems are produced, but these are connected to end users by global supply chains and knowledge networks instead of fixed physical infrastructure.

Dynamo generators and arc lighting catalyzed the market for electric utilities and it is a range of semiconductors (stemming from the discovery of the transistor noted in Figure 2) that enable decentralized power systems. High-performance, low-cost photovoltaic generation, paired with advanced

batteries and controllers, provide scalable systems across much larger power ranges than central generation, from megawatts down to fractions of a watt. The rapid and continuing improvements in end-use efficiency for LED lighting [59] (e.g., see Figure 2), DC televisions [60], refrigeration [61], fans [62], and ICT [63] (a “superefficiency trend”) that enable decentralized power and appliance systems to compete with legacy equipment on a cost for energy service basis.

With these technological cornerstones, aid organizations, governments, academia, and the private sector are developing and supporting a wide range approaches to serve the needs of the poor, including pico-lighting [14], solar home systems, and community-scale micro- and mini-grids [2, 4]. In many cases, preconfigured systems are sold in market-based structures, rather than involving the establishment of geographically tied institutions [64]. Figure 3 shows the range of costs for decentralized power across several orders of magnitude in scale and shows a caricature of the typical temporal cost structure for each. We observe a power-law inverse relationship between the unit cost and scale of electricity supply technology from pico-power to gigawatt grids.

The off-grid poor reveal a high value is derived from the first increment of energy service – equivalent to 0.2-1 Wh/day for mobile phone charging or the first 100 lumen-hours of light – as indicated by the incumbent technology consumption-cost regimes noted in Figure 2A. Given the cost and service level that fuel-based lighting and fee-based mobile phone charging provide as a baseline, simply shifting expenditure to a range of modern energy technology solutions could provide much better service, or in the case of PLS, similar service can be provided at significant cost savings over the lifetime of the product (typically 3-5 years) [65]. In fact, many of the off-grid poor have already switched to LED lighting, but often to low-quality products that consume relatively expensive dry-cell batteries (with effective electricity prices of \$100’s per kWh). Although such technologies represent a step forward in the quality and convenience of lighting, they maintain a high cost to the consumer and result in significant electronic and battery waste streams in countries that are poorly equipped to manage them [66, 67]. This waste stream can contribute to significant environmental degradation, human health impacts, and other social concerns [67-70].

The transformative nature of superefficient lighting is also highlighted in Panel C and is indicative of similar trends across other appliance types. It shows how a hypothetical person who consistently invests \$100 per year for lighting shifts from an energy “investment” of over 2000 Wh per day (as liquid kerosene fuel) for 100 lm-hr of lighting service to 20,000 lm-hr with a grid connection and incandescent bulb or 100,000 lm-hr with high-efficacy LED

lighting. LED lighting enables off-grid pico-power systems to offer the rural poor roughly the same cost performance for lighting service as grid power with incandescent lighting, in spite of higher effective unit costs for electricity, and with an order of magnitude lower energy requirements [65].

Meeting peoples' basic lighting and communication needs is an important first step on the "modern electricity ladder". This can be easily accomplished without necessarily increasing overall energy consumption if

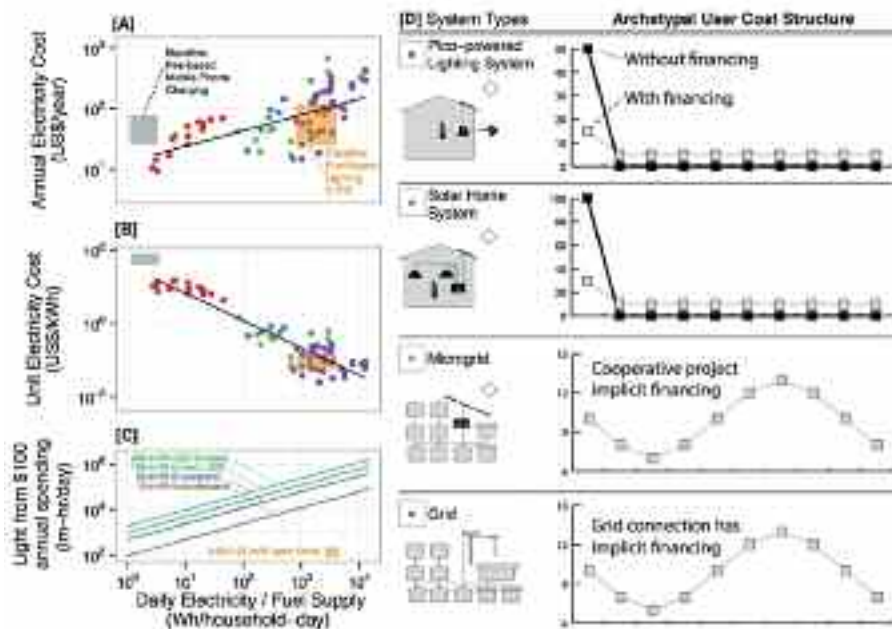


Figure 3. The total annual [A] and unit cost [B] of electricity over a range of daily supply levels and technology types. The incumbent energy access options (fuel-based lighting and fee-based mobile phone charging) are included for reference, with fuel-based lighting expressed in terms of the lower heating value of a range for typical fuel consumption [15] and prices paid for fuel [71] with $\pm 50\%$ bounds around the price to account for spatial and temporal variation. Panel [C] shows the implications of superefficient lighting for getting energy service for a given level of spending over the technology continuum, with the unit cost of electric lighting at a given electricity consumption level (a proxy for the scale of the system) based on the regression in panel [B]. For reference a range of service provided by fuel based lighting is also shown as an orange rectangle, with bounds defined by uncertainty in the price of fuel (from USD 0.75 to 1.25) and the efficacy of the flame (0.03 to 0.05 lm/W). In [D], for each electricity technology type, we show a pictogram of the system arrangement and an archetypal cost structure for end users. The cost structures illustrate how the availability of financing. The data sources for the cost and performance of technology are described in the Supplementary Material.

Technology	Generation Capacity (Watts)	Services Available	Energy Isolation Barriers
Incumbent technology bundle: Fuel Based Lighting, Dry cell batteries, Fee-based mobile phone charging	N/A	Lighting, Radio communication reception, Two-way mobile communication	Economic: Very Low barrier. Day to day payments for increments of energy Geographic: Low barrier. Requires distribution to remote areas through normal supply chains with some markup. Political: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Pico Power Systems	0.1 – 10	Lighting, Radio communication reception, Two-way mobile communication (Note: basically the same as incumbent bundle)	Economic: Low barrier. Market-based dissemination. Retail cost USD 10-100 Geographic: Low barrier. Requires distribution to remote areas. Political: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Solar Home Systems	10 – 10 ³	Same as above plus television, fans, additional lighting and communication, limited motive and heat power.	Economic: Medium barrier. Market-based dissemination. Retail cost USD 75-1,000 Geographic: Low barrier. Requires distribution to remote areas. Political: Low barrier. Gov't and institutions can support market or hinder depending on policies.
Microgrid	10 ³ – 10 ⁶	Same as above with opportunity for community-based service with higher power requirements e.g. water pumping or grain milling	Economic: Medium-high barrier. Requires financing or investment aggregation for large capital outlay but offers relatively low marginal cost electricity to users. Geographic: Medium barrier. Requires critical density of population Political: Medium barrier. Requires community support and local political decisions.
Regional Grid	10 ⁶ – 10 ⁹	Depending on the quality of connection, same as above up to a full range of electric power appliances, commercial and industrial applications.	Economic: Medium to high barrier. Often high initial connection costs, but low cost power after connection. (Cost of power lines) Geographic: High barrier. Requires nearby transmission and distribution infrastructure. Political: High barrier. Depends on ministerial and departmental decisions about extension.

Table 1. Basic characteristics of electricity access technology options with descriptions of the typical range of generation capacity, fuel mix, services available, and the degree to which economic, geographic, and political isolation is a barrier to adoption. The descriptions are a synthesis from the authors' experience and research.

efficient end-uses are combined with low-carbon generation [65] while still leading to substantial benefits in household health, education, and poverty reduction [19, 72]. Beyond basic needs there is a wide range of service provided depending on the power level, reliability, scarcity, and power quality along with demand-side efficiency and appliance access. There will be significant rebound effects due to decreased unit costs for better quality energy services when moving up the “electricity ladder” as people fulfill unmet needs by re-optimizing in the context of new technology options [73], but given the inefficiency of fuel-based lighting, a rebound equivalent to roughly 500 times the baseline service level is required before the environmental gains from switching to modern energy systems are negated [65].

Institutional Support for Off-grid Power

Filling the gaps left by grid expansion, decentralized rural electrification with off-grid power has been a consistent feature of development efforts with varied levels of commitment and success on the part of local private sector, government, and multinational development agency involvement. While home-scale solar electric systems have been possible and were described as early as 1959 [74] the cost was prohibitively expensive until at least the 1970s when the “first wave” of solar development efforts focused on rural areas of Sub-Saharan Africa and Asia. During that time it was public institutions that were leading rural electrification efforts through the grid and much of the effort towards off-grid solar was also directed by governments and development institutions. These early programs developed an important knowledge base for rural off-grid energy development and also lead to some cautionary tales.

One example of national rural energy access efforts is the National Electrification Program (NEP) in South Africa, which formed as part of the Reconstruction and Development Program after the first democratic elections in 1994 [75]. The program was successful in many regards; access to electricity increased from less than 35% to over 75% in less than a decade [76]. However, many have critiqued the implementation and efficiency of the off-grid program components, i.e. primarily the fee-for-service solar electrification program, pointing to significant wasted resources and structural inadequacies of the institutions that were developed to manage the system [76, 77]. Although the goals of the program was incredibly ambitious, and the government attempted to employ the private sector in a large degree, only 50,000 solar home systems have been installed so far, and an unknown quantity (assumed to be quite substantial) are no longer operational. The primary causes are believed to have been a lack of political will and vision, disruption of capital subsidies by the central government, non-payment of fees and poor tariff collection by concessionaries, and the perception by the users that systems are temporary or inferior due to the marketing of the program [23, 77].

In South and Southeast Asia, off-grid electrification efforts have also been mixed, although a number of successful initiatives have shed light on effective best practices. In all cases, government involvement through the setting of an enabling policy framework has been key (such as VAT exemptions, micro-credit systems, subsidies, and income tax exemptions), and in the majority, a large level of initial subsidies was required for growth and expansion [23, 78]. However, both Bangladesh and Sri Lanka have demonstrated success through market-based approaches, using public-private partnerships, dedicated gov-

ernment agencies, improved access to capital and grant mechanisms, and product standardization practices [23]. Grameen Shakti, which has been one of the primary private-sector actors in the off-grid space in Bangladesh, has benefited over 3.5 million people with their efforts, and have achieved success in tariff payback and service/maintenance for their systems, in part, by using micro-credit finance, locally manufactured system components, and the development of Grameen Technology Centers [78, 79].

The System Dynamics of Energy Access

Understanding the dynamics of energy markets and peoples' interactions with the underlying technology systems is a critical goal for effectively addressing climate issues and energy deprivation. As modern on- and off-grid energy systems evolve in the context of their supporting institutions and information technology networks there is a need for transdisciplinary "theories" of energy access that can catalyze an acceleration of clean energy development that mitigates climate change and alleviates energy poverty.

One promising approach to a theory of energy access that combines technology and social systems is through a conceptual framework of linked and interdependent networks, as is caricatured in Figure 4. The figure shows how people are connected with primary sources of energy – natural forces like the sun and wind along with fossil fuel – through complex and material and energy transportation networks. The interface with users (e.g. solar LED lanterns, metered grid electricity connections and mobile phones) are often the iconic element but are closely linked and dependent on global physical infrastructure. In turn, those critical networks of physical infrastructure, and their operation, are supported by important information networks of policy, social interaction, economic exchange, and knowledge.

Network theory has been applied in isolation to many of the components of the energy-information nexus we detail here, and in a very preliminary way to the interconnected systems that we identify as supporting energy access including the development and growth of national power grids [80], electricity grid failure rates in North America [81], assessments of risks to, and vulnerability of, critical infrastructure [80, 82], the growth and emergence of the World Wide Web [83], the formation of policy stakeholder interaction networks [84], the network structures of water policy [85], the spread and scaling of hardline [86] and wireless telecommunications networks [87], financial decline and global economic networks [88] and the management of complex supply chains [89, 90]. Much more work is needed in this area, and in how best to integrate behavioral and consumer preferences in building functioning and profitable 'networks of service' for

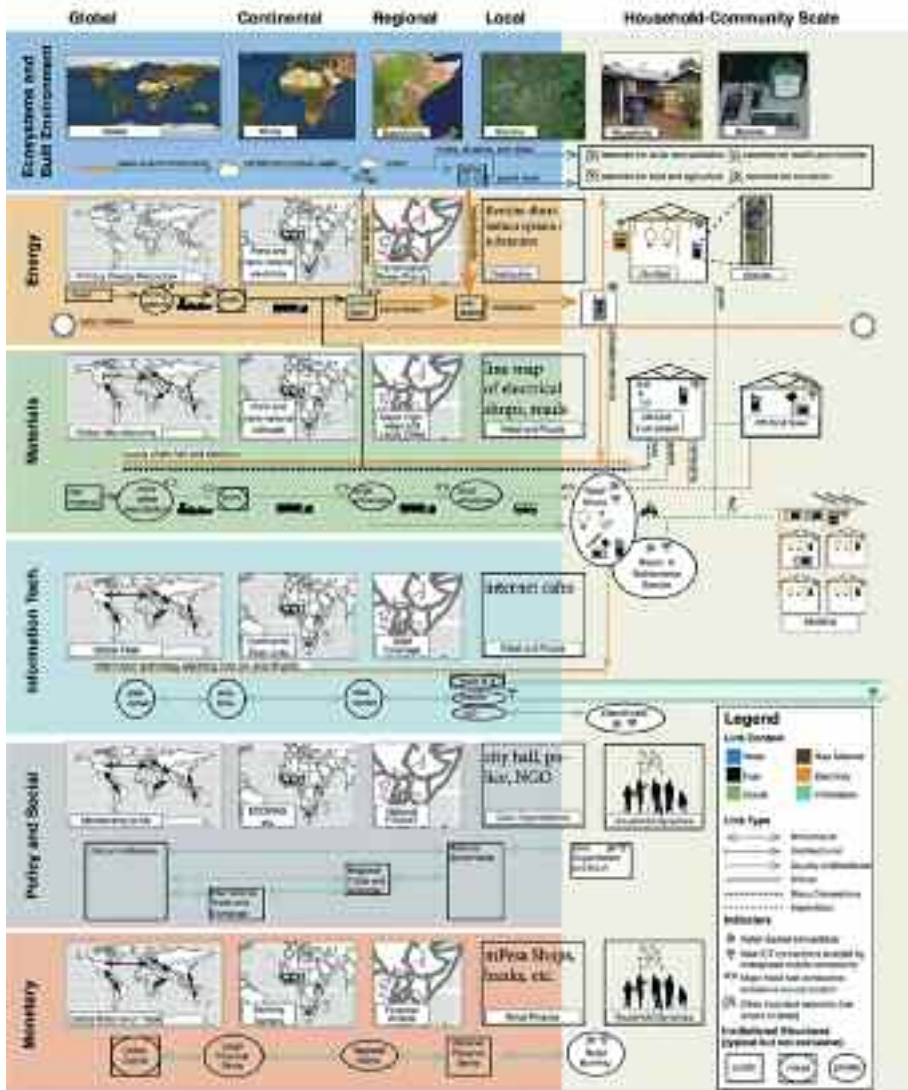


Figure 4. Multiscale, linked physical and information networks for energy access. This caricature zooms from global scale to a focus on households outside Kericho, Kenya but is meant to be representative of the dynamics for many other off-grid locations. [Note to editor: This is an evolving version of this figure. The maps shown here have dummy data but will be replaced with maps that have the best available data from current-day to map networks at these scales. We are aware of sources for these data and have access].

new energy customers. To date, no comprehensive analysis exists of the interconnections between these complex networks in the context of energy access on a global scale.

Linking diverse networks of physical materials, energy, and information with varied and uncertain structure is a scientific and engineering challenge that could lead to meaningful insights on how to more effectively manage complex technology networks in the Anthropocene [13, 91]. The concept of entropy – fundamentally a measure of order and uncertainty – may prove to be useful for linking networks since many of the underlying flows and processes can be reformulated in entropic terms. Thermodynamic and statistical entropy are well understood and documented for energy and material systems. Information and energy are physically coupled concepts and typically it is through the concept of entropy that they are related, using Landauer’s principle that predicts the minimum energy associated with information is related to $kT \ln 2$, which has been verified for simple systems of molecules [92]. Similarly, the flow of money can be reformulated as information with a particular amount of uncertainty associated with it. In the ‘thermo-economist’ perspective statistical mechanics is used to formulate the flow of money and its distribution in the economy [93].

In each of the systems that comprise the network for energy access there is a tendency towards maximum entropy, but the goals of individuals and firms is often countervailing. People would prefer to minimize entropy locally (i.e., have more control over resources in the future and more certainty about future outcomes) by aggregating low-entropy resources – money, reliable energy network connections, durable technology systems, and stable social relationships. This fundamental tension in the context of agents embedded in networks of geography, technology, and information could be the core of a useful bottom-up theory for behavior in energy access networks.

The quest for certainty as a fundamental driver for behavior is an old idea [94] that takes on new meaning in the context of energy access networks. By framing behavior in terms of embedded agents applying Bayesian decision making – combining past experience with new information in the context of their expectations about the future and position in the broader network – all to minimize entropy (gain certainty), it is possible to explain a number of emergent phenomena that have been shown in other work to be important drivers in global networks. Agents who minimize entropy will have different tolerances for risk and future benefits depending on the stability of their position, which leads to future discounting and the concept of demand curves in the rational choice economic model. What seem to be unreasonably high future discount rates have been observed for a range of energy efficiency de-

cisions and are often described as contributing elements to an energy efficiency gap [95], but could emerge from short-term constraints on cashflow (i.e., low entropy resources) and a quite reasonable preference to maintain low entropy through keeping cash rather than trading for future energy services. We also would expect diminishing returns from energy and information as people prioritize high-value (entropy minimizing) services like basic lighting (to reduce uncertainty about ones surroundings) and information technology (reducing uncertainty about the world in general), followed by less-important service. These diminishing returns are manifested in the relationship between human development and energy consumption observed by Goldemberg, where steep initial gains are seen during energy consumption growth, but few gains after.

Our observations of the structure and dynamics for energy access networks, characterized in Figure 4, reveal several patterns for understanding how decentralized systems can play an important role in meeting energy access and climate goals and help overcome the barriers people face to reliable access to electricity through the grid.

Resilience – in this context the probability and certainty of energy service “uptime” – is an important part of the value of power networks. The structure of electricity transmission and distribution systems typically includes some inherent resilience to random failures of particular components because they are “scale-free” networks that have a structure with hubs of local importance and strength (Chassin, 2005), (Callaway, 2000). However, in much of the developing world, the power grid (transmission and distribution electricity links in the diagram) is quite unstable with long periods of brownouts (low voltage) or blackout [96–99]. On the other hand, a well-functioning off-grid power system may provide more reliable power, albeit at lower power levels. Conceptually, off-grid solar power is connected to a universal and stable hub for power transmission: solar radiation. While solar power is subject to diurnal and seasonal patterns in availability and the vagaries of weather it is not subject to the kind of random failure that afflicts complex electricity networks. Energy storage systems (batteries) are used to improve the reliability of solar power and it is also possible to add local resilience to grid connections with decentralized storage. A common but overlooked source of resilience is the batteries in a mobile phones and other devices that make them portable and also allow for decoupling from unreliable power availability, up to a point. The resilience of decentralized power systems may also be an important contributor to community resilience in the face of natural and unnatural disasters like large storms and civil conflict that can disrupt large-scale networks.

Decoupling end-user service from fixed geographic positions is another feature of some decentralized power networks, particularly pico-power devices, which are more flexible in their arrangement and relocation than grid-based power connections. For people who live in places that are only accessible on foot, it is not tenable to expect extension of an energy network that requires the movement of goods over roads. Additionally, many people – particularly the very poor – live in itinerant or temporary housing often with uncertain or nonexistent ownership. It simply may not make sense for some people who are off-grid to invest heavily in fixed or difficult-to-move infrastructure. Where fuel-based lighting was the only viable option for those particular network conditions before, there are now clean energy options that meet the same constraints but with better service.

Eliminating fuel-based lighting in favor of the grid or off-grid power serves an important public health need by shifting emissions associated with energy use and appliance manufacturing from inside the household where particulate matter and other pollutants are concentrated where people live (Lam, 2012) to factories and power plants that typically have better emissions profiles and dispersal. The quantity of emissions is also reduced; pico-power systems have very favorable life-cycle energy performance compared to fuel-based lighting (Alstone, 2013).

Catalyzing Off-Grid Power

While off-grid power systems have several inherent advantages – network resilience, flexibility, and tangible environmental and health benefits among others – there are important barriers to overcome as well. Decentralized energy systems are increasingly distributed through market-based systems, with much of the investment risk often borne by diffuse end-users who, compared to the developers of central power grids, currently lack the ability and incentives to engage directly with the global market. While they already pay as much or more for lower quantity of energy service (see Figure 3a), support is vital to mitigate risks throughout the supply chain with financing, product quality assurance, maintenance and support networks, and robust networks for exchange of knowledge and expertise [24]. Creating resilient and lasting networks for off-grid energy may not require building new power lines but relies instead on building strength and connections in the range of supporting networks highlighted in Figure 4, from supply chains to financing.

The private sector drives much of the development in the off-grid power market, as was the case for early grid-based power systems. Because there is no dedicated infrastructure required for off-grid power supply

chains there is no natural spatial monopoly (as there is with on-grid power), allowing a range of private sector initiatives to coexist and compete for potential customers. Currently there is a wide range of business models and technology designs being tested and deployed, without clear indications that one particular technology and institutional structure is dominant (DGBA, 2012). The compelling technical and economic attributes of super-efficient end-uses and inexpensive solar charging drive the market, but institutional support is required to correct market failures around missing information and connections.

In response, global institutions that are often oriented towards supporting centralized physical infrastructure projects are refocusing to also provide targeted support for decentralized initiatives that can fill in the glaring gaps in service for the energy isolated poor, as can be seen in the efforts and projects of the Sustainable Energy For All Initiative of the UN [100], the recent revision to the World Bank's Energy Strategy [101], and President Obama's Power Africa initiative [102]. The transnational and multi-dimensional nature of off-grid energy access networks requires these new institutional responses to have different structures and activities from large-scale development efforts (e.g., financing or planning large power generation and transmission projects).

The Lighting Global project is an example of new institutional efforts to support and transform markets for off-grid power. Funded through the World Bank and IFC, along with the regional Lighting Africa and Lighting Asia programs, it supports markets for pico power energy systems with a range of information and educational interventions and through creating and strengthening links in the supply chain and supporting networks of finance. A key effort of the program is building a Global quality assurance framework that integrates standardized third-party testing, a set of minimum quality standards for buyer protection, and standardized ways of communicating positive test results to the broader market. By reducing uncertainty about product quality and performance the test program enables national governments, buyers, and potential financiers in the market to regulate, choose, and support products with better knowledge about the likely quality. The program creates new links in supply chains with business-to-business matchmaking between parties that have passed a basic ethical and financial screening, and helps actors in the supply chain access financing.

Information Technology and Clean Energy Deployment

The rapid emergence of global (decentralized) wireless communication networks and widespread access in the developing world [21] is a new and

important support system for decentralized energy. Not only are mobile phones an important and highly valued source of electricity demand (as the radio was for early electric grids), but they also provide a new platform for finance and connectivity to support markets for pico-lighting and solar home systems. Targeted and well-designed “killer applications” of information technology hold the promise to accelerate the market for off-grid power and increase energy access for the global poor. The rapid expansion of decentralized mobile communication compared to fixed line phones (see Figure 2) is indicative of the potential for decentralized small-scale power systems to rapidly expand compared to fixed power systems.

Pay-as-you-go (PAYG) household and minigrid systems that use combinations of mobile banking, financing, and user outreach can make decentralized power accessible to people who are cash poor but are acclimatized to gathering small sums of money for ongoing energy costs [103], by making the payment stream for off-grid power more similar to the typical expenditures for traditional fossil or biomass fuels being replaced (and to ongoing costs for grid power). Financing clean energy fits peoples’ ability and willingness to pay in the context of uncertainty and deprivation [105]. PAYG systems typically rely on mobile phones as a platform for making payments (or verifying the transfer of money) and some include a cut-off switch in the system hardware that prevents use when fees or loan payments have not been completed [106]. This ICT add-on to off-grid power hardware transforms decentralized energy systems into “energy as a service”, rather than a durable goods purchase.

ICT is also critical feature for supporting the supply chains and maintenance networks that connect consumers with producers. Supply chain management and intra-chain information sharing and payments are important features of energy access networks much as they are for many other products [108–110]. By enabling information to flow much more quickly and reliably it is possible to set up vertically integrated supply chains that can be monitored and controlled, a key feature of many successful early efforts at pico-power deployment (DGBA, 2012).

Remote monitoring and analytics of off-grid power systems can be enabled when there are systems for collecting and transmitting system health and performance through ICT channels. Effective monitoring and maintenance is a common barrier across all decentralized modern energy systems, whether solar home systems, lighting, or improved stoves, especially in regions where technical capacity levels are low, and in the early period of diffusion when the density of systems is limited. There are numerous successful cases of the use of GSM enabled sensors, mobile issue reporting

platforms, and remote management systems that reduce costs, improve technician response times, enhance overall service quality, reduce system outages and increase project success rates [104, 107].

As ICT is integrated throughout the energy system on- and off-grid there will be new opportunities and challenges around data management and control. With access to large-scale decentralized energy data across a range of network scales it may be possible for regulatory institutions to better protect and support consumers and for academics and scholars to test theories of socio-technical network dynamics (Barabási, 2009). “Big Data” is a potential microscope for investigating the society in which it is embedded but only to the extent it is available and rigorously analyzed. The status quo, however, is for data to be protected and mined by the private sector system integrators, who may extract different value from the data (e.g., by encouraging repeat customers or improving their competitive position with product design improvements). Both uses of the data are important but are in tension because strategic private-sector use creates more value for system integrators when data are scarce and not globally shared. There may be reduced incentive to include data collection components in off-grid energy systems without the incentives related to extracting value from the data before it is made public. Ownership of distributed energy usage data generated by systems that are owned by dispersed global citizens is a critical unresolved legal issue, and is fraught with important privacy, equity, and access concerns.

Achieving Universal Access

While achieving universal access has proved to be challenging, recent technological advances, along with years of lessons learned, have the world poised to eliminate energy poverty related to electricity access within our lifetime, and provide everyone with enough electricity to extinguish the open flames of fuel-based lighting. The decentralized power network is rapidly forming with support from underlying energy technology, enterprises and institutions, ICTs, and other complementary systems. It enables the off-grid poor to redirect their current spending on inefficient sources of energy to modern electric power systems that meet their basic needs and more with lower barriers related to isolation and a significantly reduced environmental impact than was possible a generation ago [25].

In the IEA’s “new policies” scenario, 1.8 billion people will be newly connected to centralized electricity by 2030, an impressive pace but one that is still projected to leave nearly 1 billion without a centralized connection [2]. Supporting adoption of decentralized power can bridge the gap, and in some cases replace the need for grid expansions that may take an-

other generation or more to be completed. A number of agencies and organizations have calculated the potential costs of such an effort, with estimates ranging from 15–45 billion USD per year [2]. The investment would be less than 0.5% of the current annual GDP of the United States, or 0.1% of the global annual GDP [112] and is on par with current spending on fuel-based lighting and ad-hoc electricity use by people without access.

Such an effort will require more than just targeted aid funding and appropriate technology. Institutional frameworks will have to be developed at local, national, and regional levels to support energy access growth. National level policy measures like feed-in-tariffs, net metering, subsidies, and rural electrification funds will have to be coupled with international trade agreements, collaborations with mobile telecommunications companies around mobile banking infrastructure, and other public private partnerships. Governments will need to look towards novel sources of data to better inform evidence-based policy, especially with the advent of Big Data analytics. Donor countries will need to support large-scale private sector participation in emerging markets through political risk insurance, conditional grants, debt financing, and other financial mechanisms.

Support for private sector approaches to energy access off-grid today is in line with the trajectory that led to rapid expansion of grid-based power networks in the past: a beginning with dispersed private approaches until a critical mass is reached and it becomes the task of the public sector to regulate and maintain the system. What is needed next is an expansion of the types of off-grid and mini-grid service providers, and a coordinated effort to gather real-time data from these new and often experimental efforts to build a practical, likely for-profit, network of energy service companies.

There are a range of key ‘next step’ research and field data-collection questions that this framework and emerging theory highlight. Each is an area where an expanded set of theoretical models would help greatly, and where practical, field-driven, data on both how energy service providers and consumers interact is vital, but largely absent today.

These include efforts to understand how: 1) technology development can be shaped and directed to further ease mobile payment, remote monitoring and maintenance, theft-protection, integration into grid systems, dynamic micro-grids that can expand and grow with user demand growth; 2) what micro-grid technologies would best facilitate user interaction, real-time data collection, improved energy efficiency, and remote management and system operation; 3) new approaches to studies can be built to assess how new electricity users move between tiers of service consumption and how their socioeconomic conditions change as a result of electrification,

an area likely to fill squarely into the realm of ‘big-data’ analytics. Finally, there is an over-arching need for research into the financing of energy access, including the information gaps that exist for private investors, the current preferences and behavior of actors that could potentially provide capital for customers who – at least initially – consume very small amounts of energy (first users), but over time could become one of the largest and most dynamic sectors of change in the global energy economy.

Taken together this paper and the new research areas outlined above moves *towards a theory of energy access* that can inform strategies to shape and catalyze the trend towards decentralized power as it evolves in the coming decades. As new networks for energy access form and evolve, an awareness of the critical role of nested network structure and institutional dynamics can inform better interventions to provide power to the global poor while slowing degradation and harm of the ecological networks that underpin a growing population in the Anthropocene.

Acknowledgments

We thank the Karsten Family Foundation for their endowment support of the Renewable and Appropriate Energy Laboratory, and the Class of 1935 of the University of California, Berkeley; this work was also supported by NSF Award SMA-1338539 and a grant from Humanity United (all to D.M.K.). P.A. is supported by a US EPA STAR fellowship award.

P.A. is a consultant to the Lighting Global program (described in the article) and is a core member of the Lighting Global Quality Assurance team, but this work was not supported under that contract and was not subject to review by Lighting Global or its funding partners.

We thank Doug Arent, Dan Arvizu, Morgan Bazilian, Anand Gopal, and Arne Jacobson and Amol Phadke for fruitful discussions about the implications of superefficient appliances in an off-grid context. Thanks to the Energy and Resources Group Ph.D. seminar participants and to anonymous reviewers and the editorial staff at *Science* for helpful comments.

The original data will be made available at <http://rael.berkeley.edu> and the analysis methods with source descriptions for the data are included in the Supplementary Materials.

References

- 1 M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, C.E. Hanson, *Climate Change 2007: Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Fourth Assessment Report of the IPCC Intergovernmental Panel on Climate Change* (Cambridge University Press, Cambridge, UK, 2007), vol. 4.
- 2 SEFA, “Global Tracking Framework” (United Nations Sustainable Energy For All, 2013).
- 3 A. Sen, *Development as freedom* (Oxford University Press, 1999).
- 4 C.E. Casillas, D.M. Kammen, The energy-poverty-climate nexus. *Renewable energy* 300, 200 (2010).
- 5 IPCC, *Special Report on Renewable Energy Sources and Climate Change Mitigation*. R. P.-M. Working Group III of the Intergovernmental Panel on Climate Change [O. Edenhofer, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. von Stechow], Ed. (Cambridge University Press, United Kingdom and New York, NY, USA, 2011).
- 6 M. Bazilian, B.F. Hobbs, W. Blyth, I. MacGill, M. Howells, Interactions between energy security and climate change: A focus on developing countries. *Energy Policy* 39, 3750–3756 (2011).
- 7 F. Rong, Understanding developing country stances on post-2012 climate change negotiations: Comparative analysis of Brazil, China, India, Mexico, and South Africa. *Energy Policy* 38, 4582–4591 (2010).
- 8 B. Girod, D.P. Van Vuuren, E.G. Hertwich, Global climate targets and future consumption level: an evaluation of the required GHG intensity. *Environmental Research Letters* 8, 014016 (2013).
- 9 IEA, “World Energy Outlook 2012” (Organization for Economic Cooperation and Development/International Energy Agency, 2012).
- 10 W. Steffen, P.J. Crutzen, J.R. McNeill, The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature. *AMBIO: A Journal of the Human Environment* 36, 614–621 (2007); published online Epub2007/12/01 (10.1579/0044-7447(2007)36[614:TAAHNO]2.0.CO;2).
- 11 M.R. Raupach, J.G. Canadell, Carbon and the Anthropocene. *Current Opinion in Environmental Sustainability* 2, 210–218 (2010).
- 12 E. Ehlers, T. Krafft, C. Moss, *Earth system science in the anthropocene* (Springer, 2006).
- 13 S.H. Strogatz, Exploring complex networks. *Nature* 410, 268–276 (2001).
- 14 E. Mills, The specter of fuel-based lighting. *Science* 308, 1263–1264 (2005).
- 15 R. Bacon, S. Bhattacharya, M. Kojima, Expenditure of low-income households on energy. *Extractive Industries for Development Series* 16, (2010).
- 16 N.L. Lam, K.R. Smith, A. Gauthier, M.N. Bates, Kerosene: a review of household uses and their hazards in low- and middle-income countries. *Journal of Toxicology and Environmental Health, Part B* 15, 396–432 (2012).
- 17 E. Mills, “Health Impacts of Fuel Based Lighting” (Lawrence Berkeley National Laboratory Lumina Project, 2012).
- 18 N.L. Lam, Y. Chen, C. Weyant, C. Venkataraman, P. Sadavarte, M.A. Johnson, K.R. Smith, B.T. Brem, J. Arineitwe, J.E. Ellis, Household light makes global heat: high black carbon emissions from kerosene wick lamps. *Environmental science & technology* 46, 13531–13538 (2012).
- 19 R.A. Cabraal, D.F. Barnes, S.G. Agarwal, Productive uses of energy for rural development. *Annu. Rev. Environ. Resour.* 30, 117–144 (2005).

- 20 V. Modi, S. McDade, D. Lallement, J. Saghir, Energy services for the Millennium Development Goals. *Energy services for the Millennium Development Goals* (2005).
- 21 WB, "Maximizing Mobile: Information and Communication Technologies for Development" (World Bank, Washington, DC, 2012).
- 22 J. Burrell, J. Matovu, "Livelihoods and the mobile phone in rural Uganda" (The Grameen Foundation, Washington, DC, 2008).
- 23 S. Bhattacharyya, *Rural Electrification Through Decentralised Off-grid Systems in Developing Countries* (Springer, 2013).
- 24 B.K. Sovacool, Deploying off-grid technology to eradicate energy poverty. *Science* 338, 47-48 (2012).
- 25 J. Goldemberg, T.B. Johansson, A.K. Reddy, R.H. Williams, Basic needs and much more with one kilowatt per capita. *Ambio*, 190-200 (1985).
- 26 A.D. Pasternak, Global energy futures and human development: a framework for analysis. *US Department of Energy Report UCRL-ID-140773, Lawrence Livermore National Laboratory, Livermore, CA*, (2000).
- 27 S. Ghosh, Electricity consumption and economic growth in India. *Energy Policy* 30, 125-129 (2002).
- 28 C.B. Jumbe, Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. *Energy Economics* 26, 61-68 (2004).
- 29 Y. Wolde-Rufael, Energy consumption and economic growth: The experience of African countries revisited. *Energy Economics* 31, 217-224 (2009); published online Epub3// (<http://dx.doi.org/10.1016/j.eneco.2008.11.005>).
- 30 Y. Wolde-Rufael, Electricity consumption and economic growth: a time series experience for 17 African countries. *Energy Policy* 34, 1106-1114 (2006).
- 31 P. Mozumder, A. Marathe, Causality relationship between electricity consumption and GDP in Bangladesh. *Energy Policy* 35, 395-402 (2007); published online Epub1// (<http://dx.doi.org/10.1016/j.enpol.2005.11.033>).
- 32 S.-T. Chen, H.-I. Kuo, C.-C. Chen, The relationship between GDP and electricity consumption in 10 Asian countries. *Energy Policy* 35, 2611-2621 (2007); published online Epub4// (<http://dx.doi.org/10.1016/j.enpol.2006.10.001>).
- 33 E. Cecelski, "Energy, Development, and Gender: Global Correlations or Causality", *Collaborative Research Group on Gender and Energy* (ENERGIA, 2005).
- 34 W.K. Biswas, P. Bryce, M. Diesendorf, Model for empowering rural poor through renewable energy technologies in Bangladesh. *Environmental Science & Policy* 4, 333-344 (2001).
- 35 UN, "The Millennium Development Goals Report 2013" (United Nations Department of Economic and Social Affairs, 2013).
- 36 T.P. Hughes, *Networks of power: electrification in Western society, 1880-1930* (JHU Press, 1993).
- 37 W.J. Hausman, P. Hertner, M. Wilkins, *Global electrification: multinational enterprise and international finance in the history of light and power, 1878-2007* (Cambridge University Press, Cambridge, UK, 2011).
- 38 M. De Nooij, C. Koopmans, C. Bijvoet, The value of supply security: The costs of power interruptions: Economic input for damage reduction and investment in networks. *Energy Economics* 29, 277-295 (2007).
- 39 A.P. Sanghvi, Economic costs of electricity supply interruptions: US and foreign experience. *Energy Economics* 4, 180-198 (1982).

- 40 K.H. LaCommare, J.H. Eto, Understanding the cost of power interruptions to US electricity consumers (2004).
- 41 P. Kline, E. Moretti, Local economic development, agglomeration economies and the big push: 100 years of evidence from the tennessee valley authority. *Mimeograph UC Berkeley* (2011).
- 42 S. Chase, in *The Nation* (1936).
- 43 *Statement of John D. Battle, Executive Secretary of the National Coal Association* (1935).
- 44 C. Clayton, The TVA and the Race Problem. *Opportunity, Journal of Negro Life* 12, 111 (1934).
- 45 *Relocation: Unequal Treatment of People and Businesses Displaced by Governments* (1965).
- 46 D.G. Victor, T.C. Heller, *The political economy of power sector reform: the experiences of five major developing countries* (Cambridge University Press, 2007).
- 47 “World Energy Outlook 2013” (Organization for Economic Co-operation and Development & International Energy Agency, Paris, France, 2013).
- 48 L. Parshall, D. Pillai, S. Mohan, A. Sanoh, V. Modi, National electricity planning in settings with low pre-existing grid coverage: development of a spatial model and case study of Kenya. *Energy Policy* 37, 2395-2410 (2009).
- 49 T.C. Wanger, The Lithium future-resources, recycling, and the environment. *Conservation Letters* 4, 202-206 (2011) 10.1111/j.1755-263X.2011.00166.x.
- 50 T. Hathaway, What cost Ethiopia’s dam boom. *International Rivers Network: California* 26, (2008).
- 51 H. Kloos, W. Legesse, S. McFeeters, D. Turton, Problems for Pastoralists in the Lowlands. *Water Resources Management in Ethiopia: Implications for the Nile Basin (Amherst: Cambria)*, 253-283 (2010).
- 52 J. Abbink, Dam controversies: contested governance and developmental discourse on the Ethiopian Omo River dam. *Social Anthropology* 20, 125-144 (2012).
- 53 “EAPP and EAC Regional Power Systems Master Plan and Grid Code Study” (SNC Lavalin International, Parsons Brinckerhoff, 2011).
- 54 “Multi Dimensional issues in electric Power System Interconnections” (United Nations Department of Economic and Social Affairs, New York, NY, 2006).
- 55 E. Auriol, S. Biancini, “Powering up developing countries through integration?”, *Industrial Organization* (CESifo, 2012).
- 56 O. Rosnes, M. Shkaratan, H. Vennemo, *Africa’s Power Infrastructure: Investment, Integration, Efficiency* (World Bank Publications, 2011).
- 57 J. Goldemberg, E.L.L. Rovere, S.T. Coelho, Expanding access to electricity in Brazil. *Energy for sustainable development* 8, 86-94 (2004).
- 58 G. Foley, J. Logarta, Power and politics in the Philippines. *The Challenge of Rural Electrification: Strategies for Developing Countries*, 45-73 (2007).
- 59 I.L. Azevedo, M.G. Morgan, F. Morgan, The transition to solid-state lighting. *Proceedings of the IEEE* 97, 481-510 (2009).
- 60 W.Y. Park, A. Phadke, N. Shah, V. Letschert, “TV energy consumption trends and energy-efficiency improvement options” (Ernest Orlando Lawrence Berkeley National Laboratory, Berkeley, CA (US), 2011).
- 61 A. Gopal, G. Leventis, S. Can, A. Phadke, in *ECEEE Summer Study* (2013).
- 62 N. Shah, N. Sathaye, A. Phadke, V. Letschert, Costs and Benefits of Energy Efficiency Improvement in Ceiling Fans. *Proceedings of ECEEE 2013 Sum-*

- mer Study (2013).
- 63 J.G. Koomey, S. Berard, M. Sanchez, H. Wong, Implications of historical trends in the electrical efficiency of computing. *Annals of the History of Computing, IEEE* 33, 46-54 (2011).
- 64 R. Podmore, R. Larsen, H. Louie, B. Waldron, in *Power and Energy Society General Meeting, 2011 IEEE*. (IEEE, 2011), pp. 1-8.
- 65 P. Alstone, P. Lai, E. Mills, A. Jacobson, High Life-cycle Efficacy Explains Fast Energy Payback for Improved Off-Grid Lighting Systems. *Journal of Industrial Ecology* (accepted, in press), (2013).
- 66 M. Harper, P. Alstone, A. Jacobson, "A Growing and Evolving Market for Off Grid Lighting" (IFC Lighting Africa, <http://lightingafrica.org/resources/market-research/-market-intelligence.html>, 2013).
- 67 P.J.H. van Beukering, M.N. Bouman, Empirical Evidence on Recycling and Trade of Paper and Lead in Developed and Developing Countries. *World Development* 29, 1717-1737 (2001) ([http://dx.doi.org/10.1016/S0305-750X\(01\)00065-1](http://dx.doi.org/10.1016/S0305-750X(01)00065-1)).
- 68 I. Nnorom, O. Osibanjo, Overview of electronic waste (e-waste) management practices and legislations, and their poor applications in the developing countries. *Resources, Conservation and Recycling* 52, 843-858 (2008).
- 69 F. Shah, T.G. Kazi, H.I. Afridi, Exposures of lead to adolescent workers in battery recycling workshops and surrounding communities. *Journal of Exposure Science and Environmental Epidemiology* 22, 649-653 (2012).
- 70 P. Haeffliger, M. Mathieu-Nolf, S. Locicero, C. Ndiaye, M. Coly, A. Diouf, A.L. Faye, A. Sow, J. Tempowski, J. Pronczuk, A.P. Filipe Junior, R. Bertollini, M. Neira, Mass lead intoxication from informal used lead-acid battery recycling in Dakar, Senegal. *Environmental health perspectives* 117, 1535-1540 (2009) 10.1289/ehp.0900696.
- 71 M.L. Clark, J.L. Peel, J.B. Burch, T.L. Nelson, M.M. Robinson, S. Conway, A.M. Bachand, S.J. Reynolds, Impact of improved cookstoves on indoor air pollution and adverse health effects among Honduran women. *International journal of environmental health research* 19, 357-368 (2009).
- 72 M. Ezzati, D.M. Kammen, Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. *The Lancet* 358, 619-624 (2001).
- 73 S. Borenstein, "A Microeconomic Framework for Evaluating Energy Efficiency Rebound And Some Implications" (National Bureau of Economic Research, 2013); Acker, R. and Kammen, D.M. (1996) "The quiet (Energy) revolution: the diffusion of photovoltaic power systems in Kenya", *Energy Policy*, 24, 81-111.
- 74 L.J. Giacoletto, Electrical System for Home Conversion and Storage of Solar Energy. *Science* 130, 915-916 (1959) 10.2307/1758023.
- 75 M.G. Pereira, J.A. Sena, M.A.V. Freitas, N.F.d. Silva, Evaluation of the impact of access to electricity: A comparative analysis of South Africa, China, India and Brazil. *Renewable and Sustainable Energy Reviews* 15, 1427-1441 (2011).
- 76 D. Reinmuller, D. Seifried, B. Praetorius, O. Langniss, "Sustainable Energy and Policy Concepts" (International Solar Energy Society (ISES) & DIW German Institute for Economic Research & DLR German Aerospace Center, Berlin, Germany, 2002).
- 77 X. Lemaire, Off-grid electrification with solar home systems: The experience of a fee-for-service concession in South Africa. *Energy for Sustainable Development* 15, 277-283 (2011).
- 78 M. Alam Hossain Mondal, L.M. Kamp,

- N.I. Pachova, Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh – An innovation system analysis. *Energy Policy* 38, 4626–4634 (2010).
- 79 M. Asif, D. Barua, Salient features of the Grameen Shakti renewable energy program. *Renewable and Sustainable Energy Reviews* 15, 5063–5067 (2011); published online Epub12// (<http://dx.doi.org/10.1016/j.rser.2011.07.050>).
- 80 M. Amin, National infrastructures as complex interactive networks. *Automation, Control, and Complexity: An Integrated Approach*, 263–286 (2000).
- 81 D. P. Chassin, C. Posse, Evaluating North American electric grid reliability using the Barabási-Albert network model. *Physica A: Statistical Mechanics and its Applications* 355, 667–677 (2005); published online Epub9/15/ (<http://dx.doi.org/10.1016/j.physa.2005.02.051>).
- 82 I. Eusgeld, W. Kröger, G. Sansavini, M. Schläpfer, E. Zio, The role of network theory and object-oriented modeling within a framework for the vulnerability analysis of critical infrastructures. *Reliability Engineering & System Safety* 94, 954–963 (2009).
- 83 A.-L. Barabási, R. Albert, Emergence of scaling in random networks. *Science* 286, 509–512 (1999).
- 84 U. Brandes, P. Kenis, J. Raab, V. Schneider, D. Wagner, Explorations into the visualization of policy networks. *Journal of Theoretical Politics* 11, 75–106 (1999).
- 85 S. Luzi, M.A. Hamouda, F. Sigrist, E. Tauchnitz, Water policy networks in Egypt and Ethiopia. *The Journal of Environment & Development* 17, 238–268 (2008).
- 86 A. Balakrishnan, T. Magnanti, A. Shulman, R. Wong, Models for planning capacity expansion in local access telecommunication networks. *Annals of Operations Research* 33, 237–284 (1991).
- 87 L.-L. Xie, P.R. Kumar, A network information theory for wireless communication: Scaling laws and optimal operation. *Information Theory, IEEE Transactions on Information Theory* 50, 748–767 (2004).
- 88 F. Schweitzer, G. Fagiolo, D. Sornette, F.Vega-Redondo, A. Vespignani, D.R. White, Economic networks: The new challenges. *Science* 325, 422 (2009).
- 89 I.J. Chen, A. Paulraj, Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management* 22, 119–150 (2004); published online Epub4// (<http://dx.doi.org/10.1016/j.jom.2003.12.007>).
- 90 A. Nagurney, J. Dong, D. Zhang, A supply chain network equilibrium model. *Transportation Research Part E: Logistics and Transportation Review* 38, 281–303 (2002); published online Epub9// ([http://dx.doi.org/10.1016/S1366-5545\(01\)00020-5](http://dx.doi.org/10.1016/S1366-5545(01)00020-5)).
- 91 D.J. Watts, S.H. Strogatz, Collective dynamics of ‘small-world’ networks. *Nature* 393, 440–442 (1998).
- 92 A. Berut, A. Arakelyan, A. Petrosyan, S. Ciliberto, R. Dillenschneider, E. Lutz, Experimental verification of Landauer’s principle linking information and thermodynamics. *Nature* 483, 187–189 (2012); published online Epub03/08/print
- 93 A. Dragulescu, V.M. Yakovenko, Statistical mechanics of money. *The European Physical Journal B-Condensed Matter and Complex Systems* 17, 723–729 (2000).
- 94 J. Dewey, *The Quest for Certainty: A Study of the Relation of Knowledge and Action: Gifford Lectures 1929*. (George Allen & Unwin Limited, 1930).
- 95 A.B. Jaffe, R.N. Stavins, The energy paradox and the diffusion of conservation technology. *Resource and Energy*

- Economics* 16, 91–122 (1994); published online Epub5// ([http://dx.doi.org/10.1016/0928-7655\(94\)90001-9](http://dx.doi.org/10.1016/0928-7655(94)90001-9)).
- 96 A. Eberhard, O. Rosnes, M. Shkaratan, H. Vennemo, “Africa’s Power Infrastructure” (The International Bank for Reconstruction and Development/The World Bank, Washington, DC, 2011).
- 97 A. Sebitosi, R. Okou, Re-thinking the power transmission model for sub-Saharan Africa. *Energy Policy* 38, 1448–1454 (2010).
- 98 A. Eberhard, V. Foster, C. Briceño-Garmendia, F. Ouedraogo, D. Camos, M. Shkaratan, “Underpowered: The State of the Power Sector in Sub-Saharan Africa” (The International Bank for Reconstruction and Development/The World Bank, 2008).
- 99 N. Wamukonya, Power sector reform in developing countries: mismatched agendas. *Energy Policy* 31, 1273–1289 (2003).
- 100 IFC, “Lighting Africa Progress Report” (International Finance Corporation, 2011).
- 101 “Toward a Sustainable Energy Future for All: Directions for the World Bank Group’s Energy Sector” (World Bank Group, Washington, DC, 2013).
- 102 *Fact Sheet: Power Africa* (2013).
- 103 D. Soto, E. Adkins, M. Basinger, R. Menon, S. Rodriguez-Sanchez, N. Owczarek, I. Willig, V. Modi, in *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development* (ACM, 2012), pp. 130–138.
- 104 J. Rosa, P.A. Madduri, D. Soto, in *Global Humanitarian Technology Conference (GHTC), 2012 IEEE* (IEEE, 2012), pp. 23–26.
- 105 P. Alstone, C. Niethammer, B. Mendonça, A. Eftimie, Expanding Women’s Role in Africa’s Modern Off-Grid Lighting Market. *Lighting Africa Project, International Finance Corporation (IFC), Washington, DC* (2011).
- 106 M. Nique, F. Arab, “Sustainable Energy and Water Access Through M2M Connectivity” (GSM Association, London, UK, 2013).
- 107 ...
- 108 J. Aker, I. Mbiti, Mobile phones and economic development in Africa. *Center for Global Development Working Paper* (2010).
- 109 V. Ilavarasan, M.R. Levy, “ICTs and urban microenterprises: Identifying and maximizing opportunities for economic development” (2010).
- 110 J. Donner, C.A. Tellez, Mobile banking and economic development: Linking adoption, impact, and use. *Asian Journal of Communication* 18, 318–332 (2008).
- 111 N. Schelling, M.J. Hasson, S.L. Huang, A. Nevarez, W.-C. Lu, M. Tierney, L. Subramanian, H. Schützeichel, in *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development* (ACM, 2010), pp. 42.
- 112 WB, “World Development Indicators – GDP (Current USD)” (World Bank, 2013).
- 113 UN, “World Population Prospects The 2012 Revision: Key Findings and Advance Tables” (United Nations, New York, NY, 2013).
- 114 DGBA, “Lighting Africa Market Trends Report 2012” (Dalberg Global Development Advisors, <http://www.lightingafrica.org/resources/market-research/market-trends-.html>, 2012).
- 115 T. Nonnenmacher, *History of the US Telegraph Industry*. E. b. R. Whaples, Ed. (Economic History Association, <http://eh.net/encyclopedia/history-of-the-u-s-telegraph-industry/>, 2001).
- 116 J.Y. Tsao, Solid-state lighting: lamps, chips, and materials for tomorrow. *Circuits and Devices Magazine, IEEE* 20,

- 28-37 (2004).
- 117 J. Byrne, B. Shen, W. Wallace, The economics of sustainable energy for rural development: a study of renewable energy in rural China. *Energy Policy* 26, 45-54 (1998).
 - 118 C. Briceño-Garmendia, M. Shkaratan, Power tariffs: caught between cost recovery and affordability. *World Bank Policy Research Working Paper Series, Vol.*, (2011).
 - 119 S. Chakrabarti, S. Chakrabarti, Rural electrification programme with solar energy in remote region – a case study in an island. *Energy Policy* 30, 33-42 (2002).
 - 120 A. Chaurey, T. Kandpal, A techno-economic comparison of rural electrification based on solar home systems and PV microgrids. *Energy Policy* 38, 3118-3129 (2010).
 - 121 S. Pokhrel, S. Singal, S. Singh, Comprehensive Study of a Community Managed Microgrid. *International Journal of Emerging Technology and Advanced Engineering* Volume 3, 514-520 (2013).
 - 122 ARE, “Hybrid Mini-Grids For Rural Electrification: Lessons Learned” (Alliance for Rural Electrification & USAID, 2013).
 - 123 C.-W. Shyu, End-users’ experiences with electricity supply from stand-alone mini-grid solar PV power stations in rural areas of western China. *Energy for sustainable development* (2013).
 - 124 N. Phuangpornpitak, S. Kumar, User acceptance of diesel/PV hybrid system in an island community. *Renewable energy* 36, 125-131 (2011).
 - 125 M.J. Bambawale, A.L. D’Agostino, B.K. Sovacool, Realizing rural electrification in Southeast Asia: lessons from Laos. *Energy for sustainable development* 15, 41-48 (2011).
 - 126 C. Ketlogetswe, T. Mothudi, Solar home systems in Botswana – Opportunities and constraints. *Renewable and Sustainable Energy Reviews* 13, 1675-1678 (2009).
 - 127 H. Zerriffi, in *Rural Electrification* (Springer, 2011), pp. 89-109.
 - 128 G.W. Hong, N. Abe, Sustainability assessment of renewable energy projects for off-grid rural electrification: The Pangan – an Island case in the Philippines. *Renewable and Sustainable Energy Reviews* 16, 54-64 (2012).
 - 129 L. Ferrer-Martí, A. Garwood, J. Chirotque, B. Ramirez, O. Marcelo, M. Garfi, E. Velo, Evaluating and comparing three community small-scale wind electrification projects. *Renewable and Sustainable Energy Reviews* 16, 5379-5390 (2012).
 - 130 R.C. Poudel, Quantitative decision parameters of rural electrification planning: A review based on a pilot project in rural Nepal. *Renewable and Sustainable Energy Reviews* 25, 291-300 (2013).
 - 131 V. Kishore, D. Jagu, E.N. Gopal, in *Rural Electrification Through Decentralised Off-grid Systems in Developing Countries*. (Springer, 2013), pp. 39-72.
 - 132 R. Akikur, R. Saidur, H. Ping, K. Ullah, Comparative study of stand-alone and hybrid solar energy systems suitable for off-grid rural electrification: A review. *Renewable and Sustainable Energy Reviews* 27, 738-752 (2013).

GLOBAL KNOWLEDGE ACTION NETWORK

■ CHARLES F. KENNEL

Abstract

When adaptation joins greenhouse gas mitigation as a major climate management responsibility, it becomes essential to grapple with the great diversity of regional climate change impacts, to understand the highly specific needs of local communities, and to deliver trustworthy knowledge to a huge variety of decision makers. This leaves us with an important question. How can the relatively small science, policy, and technology community develop the capacity to serve the needs of millions of decision makers in thousands of communities with different cultural, economic, and environmental characteristics? Already, the world climate science community is stretched thin in providing the assessments of the Intergovernmental Panel on Climate Change every seven years. Part of the answer to this capacity problem is a planned deployment of modern knowledge management services and technologies to support the assessment process. Add to this a requirement for global, regional, and local coordination and we see that smart cyber-infrastructure that informs and integrates global, regional and local decision-making is needed.

In part 1, we argue that assessment is the critical first step in the management of climate change impacts in an adaptive framework. While adaptation governance requires correlated policies and actions at the global, regional, and local levels, the primary locus of effective adaptation action will be at the level of communities. In any distributed assessment-governance network, success depends upon flexible communication of situational awareness and outcomes of decisions amongst many decision makers and stakeholders. Thus, the precursor to governance is the development of a knowledge action network for adaptation and disaster management. There are few approaches to adaptation that appeal to the interests of both developed and developing countries. However, there is a potential mutuality of interest in a global knowledge action network for disaster management and adaptation. The considerable infrastructure built in the 20th century for the management of research knowledge could and should become the basis of an extended system that supports polycentric decision making for adaptation.

In part 2, we look at how we do assessments from the point of view of local leaders who use them to formulate their adaptation decisions. We describe some of the requirements that assessments for adaptation must satisfy.

We examine how the science, technology, and policy community manages assessments to serve not only the traditional goal of preparing knowledge in the academic literature for non-expert use, but also of prompting timely and coordinated action by the huge variety of decision makers who must use the knowledge. The challenges posed by the way things have been done thus far point to the need to embed the four functions of assessment – certification, assembly and synthesis, translation, and delivery – in a knowledge-rich cyber-infrastructure that supports their decision-making. A key enabling step, one that requires the participation of the world scholarly community to accomplish, is to develop standards that can indicate when research results are ready for practical use. The ultimate goal is to turn assessment from a document that appears periodically to an always-on knowledge management service that experts, decision makers, and stakeholders can access at times and places of their choosing.

Part 1: Assessment-Governance Architecture

Introduction

Roger Revelle made the famous observation that humanity is performing a great one-time geophysical experiment. At the time, he may have meant that people were causing changes in the climate that they could study in their lifetimes when natural processes would have taken hundreds of generations to accomplish. Today, this famous saying of his takes on a darker hue. We know now as he did not that there is more CO₂ in the atmosphere today, almost 50% more than in the preindustrial era, than anytime in the last 800,000 years and it is rising faster than ever before in earth history. We are taking the climate places it has never been. Human civilization is going along for the ride.

We are entering a world new to human experience. Paleoclimatology tells the story. The argument by now is familiar. There is more CO₂ in the atmosphere today than there has been for the last 800,000 years. There were four ice ages during this period; in the warm interglacial intervals separating them, atmospheric CO₂ concentrations peaked at a characteristic limit of 270 parts per million (ppm). We do not know why there was this limit, but there was. We were at that limit before industrialization began 150 years ago, and have blown right through it. The CO₂ concentration has reached 400 ppm and is rising faster than ever before in earth history. We are taking the climate places it has never been. Human civilization is going along for the ride.

Climate forecasts tell a similar story. In recent years there have been numerous assessments of the impacts of future climate change. The idea is to dissect the predictions of climate models to construct a picture of a future

world that could result from what we are doing. One of the most compelling was commissioned by the World Bank¹ and put together by the Potsdam Institute for Climate Research. The Institute scientists described the climate conditions that would prevail if the world warmed to four degrees Centigrade (4C) above preindustrial, a level many observers fear we will reach by the end of this century if we continue with “business as usual”. To convey a flavor of how unfamiliar that world would be, it suffices to note that there will be regions where the *average* summer temperature will exceed the highest temperatures achieved during 20th century. In other words, every day will seem like a heat wave to people like us.

Until very recently many advocates of action on climate change mitigation – the effort to reduce emissions of climate altering gases like CO₂ – disparaged talk of adaptation. There seemed to be a code of silence among climate scientists. It was about morality and morale. If you admitted that people could adapt to climate change, you would absolve gross emitters of their ethical responsibility to mitigate; you would transmit a paralyzing fear that the climate problem is getting away from us. Well, it probably is. It is no less urgent to reduce carbon dioxide emissions, but it is becoming equally urgent to adapt to the climate change we clearly cannot avoid (Pielke, *et al.*, 2007).² Policymakers are beginning to adjust their priorities.

Mitigation and adaptation have different requirements and different policymakers. CO₂ mitigation policy focuses on measures of global reach – things like deployment of green energy technologies and other methods of reducing fossil fuel use, along with macroeconomic, regulatory, and innovation policies. On the other hand key adaptation decisions are about local resilience. They focus on disaster management and known environmental issues that are expected to grow in importance. Adaptation speaks to the practical people who manage local and regional issues on behalf of their communities.

Not only do mitigation and adaptation have different audiences, they have audiences of different size. The IPCC assessments were designed to support a small number of large decisions made by a comparative handful of central decision makers. By contrast, adaptation assessments will be needed for millions of decision makers for hundreds of regions and industrial sectors and thousands of communities.

¹ *Turn Down the Heat – why a 4 C warmer world must be avoided*, World Bank, 2012.

² Pielke, Jr., R., G. Prins, and S. Rayner, *Climate Change 2007: Lifting the taboo on Adaptation*, *Nature*, 445, 597-598, 08 February, 2007.

The past will not be a guide to the future for those decision makers. As we think about how to support them, the most important thing is to remember that their intuitions and past experience will be decreasingly reliable. Of course, forecasts of the future climate will also be imperfect. But they will still have to figure out how to adapt to climate change when they are not entirely sure they know where they are and where they are going.

Assess, Decide, and Act

Adaptive management is what you do when you know you have a problem you can't put off but you don't know how it will unfold. You take stock, figure out what makes sense to do in the short run, do it, and start again. In short, you assess, decide, and act. You *assess, decide, and act* over and over again. You hope successive iterations bring you closer to a more satisfactory solution.³

There is no magic bullet. For climate, we will have to assess, decide, and act for the thousand years or more that the oceans will store the extra heat humans have put into the oceans. Enduring institutions devoted to the management of the climate and its impacts will surely be needed. A governance architecture needs to be thought through, and the *Assess, Decide, and Act* cycle of adaptive management provides a useful conceptual framework for doing so.

A simple analogy can help us understand the task facing us. An international consortium of 14 nations, led by NASA, has put a small planet in orbit around the earth – the International Space Station. This little planet is life-bearing, and there are managers in a control room at the Johnson Space Flight Center in Houston who assess the changing conditions on-board, decide what to do, and adjust the Station's life support systems accordingly. They too assess, decide, and act. The world will have to manage the entire planet the same way, only instead of a single control room in one city, a global network will be required.

³ Working adaptively has several clear advantages, and one major weakness. It does what can be done given contemporary political and economic realities, it leads to incremental progress, you can learn from your mistakes and readjust in the next assessment cycle. This eases stress on the decision maker. At the same time, adaptive management could not cope with a tipping point – a sudden reconfiguration of the climate system. However, you need not be blind to the approach of one. You can look for precursors to an approaching tipping point. The cyclic nature of adaptive management ensures ongoing vigilance, so at least you have some warning and can put into motion the back up plans your assessments have prompted you to prepare.

Think Globally, Assess Regionally, Act Locally

These six words structure an approach to making assessments for adaptation purposes. Clearly, the talents of the international science, technology, and policy community will be as critical to adaptation as they have been to mitigation, but they will have to be deployed differently. The international community's role will be to support regional experts and decision makers as they assess the impacts of climate change in their regions. Their assessments will set the stage for the actions that the local communities within their regions will be called upon to take.

If we keep in mind the two phrases, *Assess, Decide, and Act*, and *Think Globally, Assess Regionally, Act Locally*, it will be easier to follow the discussion of the relationship between assessment and governance that follows.

Assessment and governance

Assessment prepares research knowledge for practical use. In the past, the coalescence of research into practical knowledge was unforced and relied largely on the passage of time for controversies to settle out. Not until the climate clock started ticking was there a need to accelerate this coalescence. The Intergovernmental Panel on Climate Change made its first comprehensive assessment of Climate Change in 1990. Now the climate clock is ticking even faster. Past experience is becoming as uncertain as tomorrow's forecasts.

We said it once; we will say it again; the past is no longer a reliable guide to the future. This stark fact, new to our cultural appreciation of the climate in all its manifestations, implies that assessment and governance are joined at the hip. Like it or not, decision makers will have to trust assessments as much or more than their own intuitions. Like it or not, they will have to pay close attention to what recent research is saying (Tschakert and Dietrich, 2010).⁴

Assessment frames decisions and governance⁵ makes them. By designing an assessment regime, we constrain a governance regime and *vice versa*. In an

⁴ Tschakert, P., and K. A. Dietrich. 2010. Anticipatory learning for climate change adaptation and resilience, *Ecology and Society* 15(2): 11.

⁵ My friends in the social sciences will consider my use of the governance word a naïve over-simplification, and they'll be right. The word governance evokes a wealth of associations in their minds; of treaties, intergovernmental agreements, and other international instruments; of states, alliances, regional associations, bureaucracies, non-governmental organizations, and stakeholders; of regulations, taxes, and incentives. Here we use the term governance broadly, assuming that there is an entity tasked with making climate decisions or at least guiding the evolution of outcomes. The terms "decision" and "decision maker" are equally abstracted from complex reality.

ideal world, assessment would identify a suite of issues and an existing governance mechanism would be prepared to deal with them. We do not live in an ideal world. Assessment considers the issues an existing governing authority has the mandate to decide. This leaves the burden of cleaning up the remaining issues identified by assessment to others, if they can be found. Moreover, the climate is changing so the arrangements we make in one decade may not be helpful in the next. What is needed is a flexible relationship between assessment and governance that can deal with the challenges of adaptive management.

Impatience with the present way of doing things has been growing. David Victor's book, *Climate Change Gridlock*, makes it clear that if we try to govern too broadly, we govern not at all. In the past five years two rather large ideas about how to govern the climate system have emerged. Connected together, they become even more powerful.

Let's start at the global scale. Lael-Aria (2011) recently proposed that specialized forms of international climate governance – in effect, “coalitions of the willing” – are proving more effective than the top-down approach prescribed by the UN Framework Convention on Climate Change.⁶ In the same year, Keohane and Victor (2011)⁷ also argued that sub-global international political mechanisms, to which they gave the names, “regime complexes” or “clubs”, have made progress on more limited climate issues that do not require global unanimity and lengthy negotiations.

What is needed is a global club that encourages action on adaptation.

At the regional and local levels, those who govern environmental decisions today will be among those who make adaptation decisions tomorrow. The complex systems they govern are embedded in other complex systems, and their decisions have ramifications over large multi-disciplinary and geographic domains with fuzzy boundaries. Ostrom (2010)⁸ proposes the name “polycentric” for this kind of decision-making.

What is needed is a way to enable the “poly” in polycentric.

Below is a schematic governance architecture that might satisfy the two needs we just identified above. An approach may be found where *Assess, Decide, Act* intersects with *Think Globally, Assess Regionally, Act Locally*:

⁶ Lael-Aria, Alternative Architecture for Climate Change, *European Journal of Legal Studies*, 4, no. 1, 2011.

⁷ Keohane, R.O. and D.G. Victor, The Regime Complex for Climate Change, *Perspectives on Politics*, v. 9, no. 1, March 2011.

⁸ Ostrom, E., Beyond Markets and States: Polycentric Governance of Complex Economic Systems, *American Economic Review* 100 (June 2010): <http://www.aeaweb.org/articles.php?doi=10.1257/aer.100.3.1>

Think Globally

A loosely organized club of nations generates scientific knowledge and makes much of it freely available. Funds from UNFCCC mechanisms or other clubs of nations and non-governmental organizations provide resources to encourage regional assessments and local participation.

Assess Regionally

Regional or local governing bodies commission multi-level groups to identify issues, assemble pertinent knowledge, and deliver a synthesis in useful forms. Experts interpret international knowledge, regional leaders specialize it, and local decision makers help prepare it for polycentric decision-making.

Act Locally

Communities make the key adaptation decisions. They participate in polycentric decision making by communicating their actions, reactions, and special issues to all three levels.

Knowledge, Governance, Action

	Assess	Decide	Act
Think Globally	Science & Policy IPCC, UNEP, IOC ICSU-Future Earth	Top Down UNFCCC Informal Clubs of Nations World Bank, other NGOs	Global Services Knowledge Sharing Financial support Capacity building Standard setting
Assess Regionally	Specific Impacts Natural systems Human systems Hazards Exposure to risk	Polycentric Consortia Compacts Alliances Information exchange	National Policies Goals, Incentives, Regulations, Technical Services
Act Locally	Strategic choices Vulnerability Capability Feasibility	Bottom Up Trusted local leaders Stakeholders Managers	Adaptation Resilience Disaster preparations Remediation

Kennel, C.F., Climate Change: Think Globally, Assess Regionally, Act Locally, *Issues in Science and Technology*, 25, 46-52, <http://trid.trb.org/results.aspx?q=&serial=%22Issues in Science and Technology%22&issue=%22%22>, Publisher: National Academies, ISSN: 0748-5492, Order URL: <http://worldcat.org/issn/07485492>

Success depends upon free and easy communication throughout any distributed assessment/governance network. In the present situation, knowledge needs to be related to action “horizontally” among experts and decision makers at each level, and “vertically”, both up and down, through the global, regional, and local levels.

The precursor to governance in such a scheme is the development of a global knowledge action network for adaptation and disaster management. The schematic drawing below helps to convey the basic architectural principles of such a network, whose purpose is to enable flexible communication among and within the global, regional, and local levels of thought and action.

Global Knowledge Action Network

The Precursor To Governance



Success depends upon flexible communication throughout any distributed assessment/governance network. Knowledge needs to be related to action “horizontally” among experts and decision makers at each level, and “vertically”, both up and down, through the global, regional, and local levels.

Since such a network would be populated at first by knowledge generated in the first-world, proposals to create one could founder on the polarized attitudes generated by adaptation’s primary ethical dilemma – the “north-south” problem.⁹ There are assertions of blame and responsibility but few

⁹ In short, the nations that did the least to cause the climate problem and have the least capacity to adapt are going to suffer the most. It can be no surprise that developing

approaches to the north-south problem that appeal to the interests of both developed and developing countries. However, there is a potential mutuality of interest in a global knowledge action network for disaster management and adaptation. Developed nations will continue to support their knowledge management systems because they will have adaptation problems of their own. Disaster management is already an arena of collaboration between the developed and developing worlds that could be extended to adaptation. A knowledge action network that reaches them would enable communities in developing countries to initiate their own assessments, design their own adaptation strategies, and most, critically, take action on their own without having to wait for ponderous bureaucracies to make up their minds. Communities get a chance to become centers of innovation for adaptation.

Both developed and developing nations would have to invest in enabling the present system, which was created to support research, to enable polycentric decision-making at the community level. Though there will be an asymmetry in scale and nature of investment, both developed and developing countries could well see benefit in investing. It won't solve everything but it could help.

The question is where to start. The future is built on foundations constructed in the past. In Appendix 1A, we summarize some key features of the knowledge management infrastructure created for earth system science (and climate) in the second half of the 20th century. Many of the building blocks of a global knowledge network that can document the impacts of the changing climate were put in place – satellite and ground observations, models, and data archives. There now exist high capacity communications that can handle the exchange of large amounts of data, removing one impediment to cooperative behavior amongst large research institutions. There is even an intergovernmental organization, the Group on Earth Observations (GEO), charged with synthesizing data important to nine societal benefit areas, the kind of data that regional assessments of climate change impacts need. GEO is underfunded and has little influence on the large national systems that collect the data, but is there. If it disappeared, we would have to reinvent it.

countries have demanded compensation for the damages they expect to incur. After all, why should they pay for adaptation when the developed nations caused the problem? This is a valid ethical claim, but developed nations have not responded to it with alacrity. They might ask, for example, how one should calculate how much to pay when no one can say with certainty how much it costs to adapt to problems that have not yet occurred. With one side sticking to the mantra, compensation before adaptation, and the other slow-rolling compensation, there has been inaction on adaptation.

The critical next step is to change today's knowledge management system into tomorrow's knowledge action system, or, in other words, to connect today's research systems to polycentric decision makers around the world. Elsewhere, we have suggested¹⁰ that purposed smaller scale social networks comprising international science, technology, and policy experts, regional thought and action leaders, and local decision makers can effectively link local action to the global knowledge. These would be staffed by secretariats of professional knowledge translators who facilitate the exchange of understanding and motivation among the participants. These knowledge action social networks would be incubated internationally and empowered regionally and locally. The cyber-infrastructure for supporting the knowledge management needs of local decision makers is available.¹¹ Recent developments in "middleware" are enabling such user-providers to find, access, exchange, and use data, software, and computing capacity that reside in remote systems ("the cloud"). Since non-scientific users no longer have to manage their own cyber-infrastructure, cloud services promise to make climate change knowledge management adequate to the challenge of polycentric decision support.

What's missing is the realization that it could be done and agreement that it should be done. We have no illusion that it will be easy; it took decades to bring capabilities to their present state, and it would take decades more to complete the job. That does not mean it is not urgent to get started. At the 2011 UNFCCC meeting in Durban, the nations agreed to provide a US \$100B fund for adaptation by 2020. We have suggested elsewhere (Kennel, *et al.*, 2012)¹² that a fraction be used to develop a 21st Century assessment infrastructure. Moreover, non-Governmental organizations that already support the use of knowledge in managing human and economic development should now also support the management of that knowledge. Shouldn't we all plan for a social and information network of global scale that provides decision-ready knowledge to those who hold the responsibility to act, wherever they are, and at times of their choosing? Should we not start by assembling the social infrastructure – policies, governance, institutions, financing – needed to knit climate knowledge and adaptation action together?

¹⁰ Kennel, C.F., and S. Daultrey, Knowledge Action Networks, Connecting regional climate change assessments to local action, University of California, e-scholarship, 2010, <http://escholarship.org/uc/item/8gd6j0k5>

¹¹ *NSF Report on Revolutionizing Science and Engineering through Cyber-Infrastructure* (Atkins Report) www.communitytechnology.org/nsf_ci_report/

¹² Kennel, C.F., V. Ramanathan, and D. Victor, Coping with Climate Change in the next half-century, to be published, *Proceedings of the American Philosophical Society*, 2012.

Appendix 1A

As the space age unfolded, the earth science community turned to articulating a common vision of what observing systems should do and how they should do it. From the beginning, it was understood that both space and *in situ* observations should be connected together. Satellite observations have been internationally coordinated since 1984 by the Committee on Earth Observing Satellites (CEOS), which today comprises the earth observation program leaders of national space agencies, together with affiliates and associates. Currently, there are 52 member and affiliate agencies. A 1995 white paper of the US Office of Science and Technology Policy urged CEOS to lead the creation of an Integrated Global Observing Strategy (IGOS).¹³ The strategy proposed linking CEOS to the international organizations developing *in situ* observing strategies, the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the Global Terrestrial Observing System (GTOS). These discussions proceeded surprisingly rapidly.

The 2002 World Summit on Sustainable Development and the 2003 G-8 Summit called for a “system of systems” connecting national earth observing systems. A ministerial conference in Washington in 2003 was followed by technical discussions that culminated an intergovernmental agreement in 2005 to create the Global Earth Observation System of Systems (GEOSS) and a Group on Earth Observations (GEO) to govern it.¹⁴

GEO measures success not by advancing science but by assembling the information produced by science that is pertinent to nine societal benefit areas: disasters, health, energy, climate, water, weather, ecosystems, biodiversity, and agriculture/desertification. GEOSS has taken on a critical task that is invisible to all but experts: forging articulation standards that enable assembly of a common pool of data from many sources about *all* types of earth observations: space and *in situ*; global and regional; physical, chemical, and biological; atmosphere, land, and oceans. To that end, GEOSS sponsors a “common infrastructure” that promotes data interoperability. In other words, GEOSS is preparing one of the most critical steps along the way to a federation of knowledge management services.

¹³ C.F. Kennel, P. Morel, and G.J. Williams, Keeping Watch on the Earth: an Integrated Global Observing Strategy, in *Consequences: the Nature and Implications of Environmental Change*, v.3, no. 2, pps. 21-32.

¹⁴ As of 2012, 88 governments and the European Commission are GEO members, and 64 other organizations are affiliated with it. The GEO secretariat is at WMO headquarters in Geneva.

Climate science and policy rely upon putting present observations and future forecasts in the context of the past. Thus the preservation and archiving of climate information is essential. The 20th century saw the creation of data repositories for much of the multidisciplinary data required for adaptation. The World Data Center (WDC) system was created to archive and distribute data collected during the International Geophysical Year (1957) and has since expanded to 52 Centers in 12 countries. Its holdings include solar, geophysical, environmental, and human dimensions data. Examples of repositories in the US include NOAA's National Climatic Data and National Ocean Data Centers, the USGS Earth Resources Observation Systems Center, NASA's Distributed Active Archive Centers, and Columbia University's Center for International Earth Science Information Network, which focuses on the human dimensions of global change.

Climate change presents a challenge encountered in no other area of knowledge management: knowledge artifacts must be preserved and used for a thousand years. The world's climate archives will need a common strategy that anticipates technological, institutional, and social evolution. Their most immediate task is to agree on what should be preserved, what should be widely available, and incentives for deposit. This will require a policy framework that includes archiving standards, security, accessibility, meta-languages. Agreements that allocate institutional roles and responsibilities need to be negotiated.

Examples of the high-volume communications technologies needed for federation already exist. NASA pioneered the use of the Internet to connect large numbers of researchers with data and management tools in the late 1980s. NASA's Earth Observing System Data and Information System¹⁵ assembles, processes, archives, and distributes huge volumes of earth science data collected from space. More recently, open non-centrally managed networks have also developed the capacity to deal with huge data volumes. The US National Lambda Rail system,¹⁶ for example, is a university-based

¹⁵ Kobler, B.; Berbert, J.; Caulk, P.; Hariharan, P.C.; "Architecture and design of storage and data management for the NASA Earth observing system Data and Information System (EOSDIS)", *Mass Storage Systems, 1995. Storage – At the Forefront of Information Infrastructures, Proceedings of the Fourteenth IEEE Symposium on*, vol., no., pp. 65-76, 11-14 Sep 1995 doi: 10.1109/MASS.1995.528217 <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=528217&isnumber=11538>

¹⁶ D. Kim, J-B, Kim and J-H Park, *Virtual Federated Network Operations on Future Internet*, Proceedings of the 6th International Conference on Future Internet Technologies ACM, New York, NY, USA, 2011; NLR (National Lambda Rail), <http://www.nlr.net>

high-speed network that connects major research centers in the US via dedicated fiber-optic lines. The US national system connects to subsidiary regional networks, and to Europe, Asia, and Australia.

Part 2: Rethinking the assessment process

Summary of part 1

We are entering a world new to human experience. We cannot go back. Our choices are, in the words of Rosina Bierbaum and Peter Raven, to “avoid the unmanageable and manage the unavoidable”, or, in the terms of the trade, mitigate the causes of climate change and adapt to what we cannot mitigate. Scientists and policymakers alike have to think out how to use their resources to address both priorities simultaneously. The challenges are not the same. Mitigation and adaptation have different requirements and different policymakers. Not only do mitigation and adaptation have different audiences, they have audiences of different size. The IPCC assessments were designed to support a small number of large mitigation decisions made by a comparative handful of central decision makers. Adaptation cannot be managed top-down like mitigation. No central actor – no leader, no committee, no government agency, no global forum – can conceive of all the specific actions needed, much less how they interrelate. The assessments needed for adaptation have to grapple with a great diversity of regional climate change impacts, to attend to the highly specific needs of local communities, and to deliver trustworthy knowledge to a huge variety of decision makers. The enlargement of scope raises an important question that we asked in our first paper. Does the relatively small science, policy, and technology community have the capacity to serve the needs of millions of decision makers in thousands of communities with different cultural, economic, and environmental characteristics?

The past will not be a guide to the future for those decision makers. As we think about how to support them, the most important thing is to remember that their intuitions and past experience will be decreasingly reliable. Of course, forecasts of the future climate will also be imperfect. But they will still have to figure out how to adapt to climate change when they are not entirely sure they know where they are and where they are going. There is really only one practical approach: adaptive management. It is what you do when you know you have a problem you can't put off but you don't know how it will unfold. You take stock, figure out what makes sense to do in the short run, do it, and start again. In short, you assess, decide, and act, over and over again. You hope successive iterations put you on a safer course. The whole process starts with assessment.

What Assessments Do

While there are many variations, assessment usually comprises four basic tasks. The first is a new form of *knowledge certification* that distinguishes between peer-reviewed research and decision-ready knowledge. In peer review, disciplinary experts judge whether a new result merits wider examination by the research community. Decision-readiness is a judgment whether expert knowledge merits use by non-experts. The second assessment task is *knowledge assembly and synthesis* in which knowledge from different sources is gathered and integrated according to the needs of the decision maker. The third task is *knowledge translation*. Complex concepts are condensed into forms non-experts understand, decision options are formulated, and are expressed in politically, economically, and culturally aware terms. The fourth task is *knowledge delivery*. It is important to deliver the results of assessments to decision makers when they need them and where they need them.

Next we set forth arguments that we will need to embed the four functions of assessment – certification, assembly and synthesis, translation, and delivery – in a knowledge-rich cyber-infrastructure that supports decision-making social networks. We examine each of these functions in more detail, reserving certification to the end for reasons that will become clear.

Knowledge Assembly and Synthesis

It is sometime convenient to picture global climate change as triggering a chain of impacts, a global to regional to local cascade. In this way of looking at things, climate scientists forge the first link in the assessment chain. They document how the climate has changed and is changing. They devise scenarios that project into the future the human drivers of climate change, and average the forecasts of several dozen global climate models (Washington, 2006; Washington and Parkinson, 2005). IPCC's synthesis of the worldwide effort in global climate modeling provides the foundation of what happens subsequently in the chain of regional assessments that follows.

The next step is to understand how global climate change affects regional natural systems. First, you need to extract from the global models how the prevailing weather and ocean circulation patterns might change in your region. Then you ask how these changes affect the natural systems there. At this point, other disciplines – meteorology, oceanography, ecology, hydrology, forestry, environmental science, others – come into play. The adaptation analysis starts here, and natural system impact assessments are well under way in many regions around the world. Synthesizing the interactions among the different natural systems is difficult (Warren, 2011), but

it is from the synthesis that the next link in the chain is forged – identification of the impacts on regional technical systems. Here decision makers need answers to questions like the following. How will heat waves affect forest fire frequency, electrical power consumption, or public health? How will changes in mountain snow cover and rainfall patterns affect agricultural and urban water availability? How will changes in seasonality affect the timings of agricultural planting and harvest, or water release from dams?

Humans are at the bottom of the knowledge cascade. Regional natural system change and regional technical system change combine to bear on human welfare at the community level (Kennel, 2009).

The table below is intended to convey an impression of the complexity of the adaptation knowledge cascade. In some very approximate sense, you need to know how climate change affects the layers above before you can assess the changes in what of interest is in your particular layer. But what is given to you is inexact and can only be described in probabilistic terms. You are faced with extracting conclusions from a concatenation of statistical systems. In principle, you might try a hierarchical Bayesian computation but this is very laborious, and to my knowledge, no one has done so for climate. You fall back on applying human judgment to juxtapositions of data, model results, algorithms, and intuitive guidelines. Still, you need access

Adaptation Knowledge Cascade

Weather and Ocean Patterns

Large atmospheric systems-equator to pole heat transport, polar vortex, atmospheric rivers,...

Ocean circulation-El Nino/La Nina, Pacific Decadal Oscillation, Gulf Stream...

Regional characteristics- temperature, wind, rainfall, relative sea level...

Extreme events-heat waves, cold snaps, storms, droughts, floods,...

Regional Geophysical Systems

Cryosphere-Sea ice, Greenland, Antarctic, mountain glaciers and snows, permafrost...

Mountains and Watersheds-river networks, aquifers, deltas, sediment transport...

Deserts-dust transport,...

Regional Ecosystems

Biodiversity: species distributions and abundances...

Biomes- chaparral, grassland, savannah, forest, tundra, marshlands, coastal zones...

Habitats-invasive species, fragmentation,...

Regional Technical Systems

Managed Ecosystems-Agriculture, forestry, fisheries...

Managed Water and Air Supplies-Irrigation, pollution,...

Managed Extreme Events-Disaster response and civil infrastructure...

Managed Human Services-Electricity production and transmission,...

Humans

Health-Malaria, cholera, respiratory diseases, ...

Security-Food, water, and energy, environmental conflict, migration

Economics-Industries, trade, investment

Welfare-Socio-Economic Development

to knowledge sources from many disciplines, and you need to assure your decision makers that you have found the best available. Moreover, if you wait for knowledge to trickle down the chain from the global level you risk waiting too long. Fortunately, knowledge does not only propagate downward. At any time, hundreds of strands of knowledge are propagating up, down, and across a complex network of sources and users. Your job is to locate the strands your community needs and weave them into a fabric of useful knowledge.

Knowledge Translation

In the world of climate assessment, people usually think that the word translation means making technical concepts understandable to non-experts, or explaining uncertainty in layperson's terms. It does, but there is a much deeper function of translation, one even more essential to adaptation than to mitigation, one that requires intimate communication among knowledge generators and action leaders.

People do not live on the globe; they live in communities. Community leaders focus on local trends, and the distant international community competes for their attention with local advocates of social, economic, political, legal, and cultural issues. Climate change operates in the background, and poverty, public health, food availability, land conversion, safety, flood control, fire protection, water distribution, water and air pollution, and congestion all make more immediate demands. Local leaders will pay attention only if their assessments address how climate change affects the specific things they care about.

Communities have their own ways of making decisions. Communities know best what they can and cannot do. Each has to decide what to preserve and what to let go. As they think out what they will do, they will arrive at socially and politically realistic strategies that may differ from those of international policymakers.

Community leaders may be in different political systems, but there is not one that does not appreciate public support. Woe to the assessment that does not take into account local political sensibilities or fails to communicate in culturally aware terms.

Translation goes beyond expressing ideas in accessible ways. It extends to supplementing knowledge assembly and synthesis with social networking in order to promote timely action. Communities are more likely to act promptly when their assessments transmit the motivation to act along with knowledge. The precursor to motivation is trust; do keep in mind that the degree of trust needed to acknowledge the truth of scientific facts is far

smaller than that needed to risk resources and reputation on action. Trust is more easily achieved when there is face-to-face interaction, so when knowledge and action leaders join together in “knowledge-action” social networks, the prospect for timely action is improved. Indeed, a survey of some 20 assessments showed that the direct participation of decision makers does promote action.

Knowledge Delivery

The ultimate assessment task is to deliver translated knowledge to decision makers where they need it and when they need it. This is easier said than done.

There is a looming timeliness problem. According to IPCC AR5 and other expert estimates, the pace of global climate change is expected to double in the coming decades. The Arctic climate is already changing at twice the global rate, so our present Arctic experience suggests what might be in store for the rest of the world in about 20 years.

The structure of the Arctic climate changed between two assessments seven years apart. Between the 2004 Arctic Climate Impact Assessment (ACIA) and its sequel, the 2011 Snow, Water, Ice, and Permafrost Assessment (SWIPA), there was a marked acceleration in the rate of polar warming, and most significantly, a change in the pattern of warming. The retreat of sea ice in the past decade had replaced a white ice surface by darker ocean, leading to increased absorption of sunlight and overwhelming the local warming that had been in progress in 2004. Bottom line: ACIA got out of date in just seven years.

The unexpectedly rapid pace of polar climate change also confounded the fourth IPCC Assessment in 2007; the scientists on its cryosphere panel could not agree on the rates at which the Greenland and Antarctic Ice sheets were melting. Their disagreement would not have had consequences beyond the world of science but for the fact that the ice melt rates are part of the estimation of the rate of sea level rise, in which all kinds of practical people are interested. IPCC, however, prides itself in releasing its pronouncements only when the scientists reach consensus. It chose to release a partial estimate of sea level rise, using only the part due to the much better founded rate that can be calculated from the measured ocean warming. IPCC was careful to list all the uncertainties in the ice melt rates, but practical people are not really very interested in the anxious handwringing of scientists. So a substantial under-estimate got out there. The scientific community, however, was horrified, and a veritable explosion of research followed, so that by the time the IPCC’s fifth assessment was released in late

2013 one could see what had happened in 2007. The ice melt rates had been undergoing a tremendous transformation. IPCC AR5 estimated that the ice melt rate from Antarctica, while uncertain, probably increased by about a factor 5 between the two decades, 1992–2001 and 2002–2011; the Greenland ice melt rates increased by a factor 6 comparing the same two decades. The melt rate had been changing faster than the scientists could document the changes.

If indeed the pace of climate change does pick up around the globe, there may come a time when the global climate assessments also get misleadingly out of date between releases. By that time, communities will likely be dealing with serious adaptation issues of their own. At that time, will they be willing to wait for knowledge to cascade down to them from the next global assessment? Won't their problems be so acute that they will demand immediate delivery of whatever is available?

In addition to the timeliness challenge, there is a coordination challenge. No community is an island unto itself. No community can escape being part of a polycentric governance network in which it is obligated to coordinate its decisions with those of its neighbors. Each has a responsibility to account for the climate benefit or risk it is passing on to others. Each needs to communicate its special needs, vulnerabilities, strategies, and costs to the larger governance network in which it resides. Not until many communities have done so, and the results added up around the world, will global policymakers be able to estimate a truly realistic cost-benefit ratio that balances the costs of adaptation and mitigation. The knowledge flow can never be one way.

To sum up the past three sections, assessments made for adaptation must cope with an extraordinary complexity of knowledge assembly and synthesis, highly specialized requirements of a vast number of decision makers, an increasingly exacting requirement for timely delivery, and a need to coordinate decisions. By now our position should be clear. The challenges of complexity, capacity, timeliness, and coordination can all be alleviated by the purposeful deployment of information, communication, and social technologies. By blending technologies, policies, and institutions, we could turn assessment from a periodically appearing document into an always-on knowledge management service that communities, industries and agriculture, and individuals everywhere can access at any time.

What is keeping us back?

Knowledge Certification

Decision makers are used to acting on less than perfect knowledge, but they do need to know how much trust to place in the knowledge they use.

How do they find knowledge they can trust? How can they judge unfamiliar information sources? Sometimes they cannot wait until a formal assessment is published; what risk do they take if they use research whose practicality has not been evaluated?

Knowledge Certification is the Intergovernmental Panel on Climate Change's most important value added product. In its knowledge assembly function, IPCC's expert sub-panels, through exhaustive small group discussion, judge whether a recent synthesis of research results is ready to be considered reliable knowledge. The sub-panels express their consensus judgments in terms like "virtually certain" to which they intuitively assign an illustrative probability percentage (*e.g.*, 90–100% certain). In this way, IPCC experts estimate the reliability of the knowledge in the academic literature before they pass it on to the policy-maker.

IPCC characterizes research knowledge, and does not assess the uses to which that knowledge is put. IPCC does not and cannot address the reliability of the secondary and tertiary assessments that may be needed to address the highly specific needs of communities, agriculture, and industry. As time passes, and the knowledge is put to work in various adaptation contexts, decision makers with similar issues will want to know how that knowledge has been used. And waiting seven years for the next global level assessment may take too long; as we have already argued, decision makers in need may not wait for knowledge to trickle down. They will want the most up-to-date knowledge, and they will turn to the worldwide web to find it. Non-experts who try it today run into a familiar problem: they do not have a trusted guide to help them hunt for the reliable knowledge in the information jungle.

Embodying in institutional and technical practice the distinctions among peer-review, research impact, record of use, and what we will call decision-readiness could be a key enabling step. In peer review, a few experts evaluate whether a new research paper merits examination by the rest of their disciplinary community. The traditional peer-review process is managed by scholarly journals, whose editorial boards select the reviewers. The subsequent citation history measures impact *in the eyes of experts in the originating or closely related disciplines*. Peer review and research impact are precursors to evaluating knowledge reliability, where the question is to what extent the overall picture emerging from a synthesis of research results is generally accepted by the expert community.

By and large, research impact has been measured by the degree of assent or dissent in the citation history. Knowledge reliability, or general acceptance, has been intuitively evaluated by face-to-face social networking amongst ex-

perts, as with IPCC. This will continue to be the most important process, but we can also ask whether internet-based methods can relieve some of the burden. To what extent can reliability as well as impact be evaluated using a combination of data mining and social networking? For example, one could ask whether citations generated in a basic research discipline have propagated to an applied discipline. One could provide social maps of the knowledge users that track the propagation of knowledge from source to users. Addressing such questions is a task not only for the climate science community but also for the broader scholarly community. Together, they could convene leaders of journals, scholarly societies, libraries, commercial services, and potential users to formulate standards that find a workable balance between information theoretic indicators and human judgment.

There is one further characterization of knowledge that will become more prominent once adaptation proceeds – by decision-readiness. The idea that climate research could be described in terms of decision-readiness levels has been inspired by a successful practice adopted years ago by NASA in which technology in development is characterized by its record of use as it progresses to ultimate inclusion in flight hardware. In the climate case, a judgment of decision-readiness involves both the research and decision making communities. Regional and local decision makers around the world will be facing broadly similar adaptation issues. There will be many of them. They will want to know the practical issues considered by their compatriots in putting the knowledge to use, and they would like to know the record of its use. A characterization of decision-readiness will help them make their own decisions.

Annotated search

We hope we have made our position clear. The more the basic functions of assessment – knowledge certification, knowledge assembly and synthesis, knowledge translation, and knowledge delivery – are carried out by web-enabled services, the more the goal of combined bottom-down and bottom-up adaptation management becomes achievable, the more the goal of globally connected governance of polycentric decision making at local and regional levels becomes attainable, the more communities far from centers of knowledge generation are empowered to take their own adaptation initiatives.

In the fullness of time, there could evolve a search engine that could first supplement and ultimately even replace the burdensome documentary form in which assessments appear today. An annotated search engine would operate in two ways. First, like a globally distributed library of libraries that stores and catalogs the information products needed by researchers and de-

cision makers and facilitates access to vast quantities of knowledge and data. Second, like a multi-disciplinary journal with a huge table of contents that appears every day, every entry annotated by a globally distributed network of expert reviewers and users. The annotation would provide measures of research quality, extent of impact, breadth of expert acceptance, and experience with use. (Sir Bob Watson has argued that reviews be posted in wiki form). The search engine would likely be governed by an IPCC-like organization, but be professionally managed. Its managers and editors would among other things solicit synthetic summaries as soon as an area of new research seems mature, decide which materials qualify for archiving, provide finding and data mining tools, and promulgate quality, impact, and reliability indices. For decision-readiness it would manage reviews that include the user as well as the peer communities. All this is a tall order, but not beyond the kinds of things that are done in the financial world.

A Way Forward

Adaptation requires an international framework of policies, institutions, technical agreements, and finance. In the terms of our two white papers, we can see at least four components of the framework: incentives to incubate knowledge action social networks at the regional and community levels; political understandings that enable knowledge sharing; incentives for existing institutions to integrate research knowledge management with decision support; and steps to stimulate the evolution of a global federation of knowledge management services that support polycentric decision-making.

A club of research knowledge management institutions could get the process started. The diplomatic community could then establish a timeline for the creation of a global decision support federation. This would extend the initiative the diplomatic community took in creating the Group on Earth Observations, GEO. As GEO recognizes, the precursor to connecting knowledge management systems together is agreement on standards; the right standards, especially for decision-readiness, could set the stage for today's research system to be turned into tomorrow's knowledge action system. Standards could be a good place to start.

Acknowledgements

It is a pleasure to thank Naomi Oreskes, Veerabhadran Ramanathan, and David Victor for a stimulating collaboration over the years, and Martin Rees for being patient with me as these ideas developed. In addition, I should like to thank the students in SIO 209 at the Scripps Institution of Oceanography and the audience of the lectures on adaptation sponsored by the Cen-

tre for Science and Policy at the University of Cambridge for their questions and interest.

Appendix 2A. Natural System Impacts

Some aspect of climate change will have an impact on every region, nation, community, and industry (IPCC Working Group II, 2007; Stern, 2007; Padwardhan, *et al.*, 2009). Here we take an impressionistic tour of the many different types of changes in regional natural systems that communities are beginning to worry about.

If you live in the Arctic, you wonder how long the permafrost will support the structures you have built on it or how caribou migration might change (Arctic Climate Impact Assessment, 2004). If you live along the Indus or Ganges rivers, one of your concerns will be how the melting Himalayan snows (Immerzeel, *et al.*, 2010) and changing monsoon (Aufhammer, *et al.*, 2012) will affect the irrigated agriculture, biodiversity, and populations along the river (Xu, *et al.*, 2009). If you live in a number of places in Asia, you worry about how air pollution and climate change interact to affect public health, agriculture and mountain snows (UNEP, 2008). If you live in coastal Peru, all your fresh water comes from Andes snowmelt, which you know is vulnerable to warming (Vergara, 2007). In Bangladesh, you worry whether villages will cope with floods, storm surges, and the cholera outbreaks that accompany them (Shahid, 2010). If you live in Venice (Carbonin, *et al.*, 2010), London (Nicholls, *et al.*, 2011), Tokyo (Yasuhara, *et al.*, 2011), Bangkok (Dutta, 2011), New York (Lin, *et al.*, 2012), or Amsterdam (Katsman, *et al.*, 2011) you wonder how much it will cost to protect from storm surges the valuable infrastructure you have built over the centuries (Adly, *et al.*, 2011). If you live on a small island, you wonder how long you will be able to do so (Kelman and West, 2011). If you live in Egypt (Serageldin, private communication 2011) or in California's Central Valley (Cloern, *et al.*, 2011), you worry that salt-water intrusions might harm the fabulously rich agricultures of the deltas of the Nile and Sacramento rivers. If you live in the American West (Painter, *et al.*, 2010; Cook, *et al.*, 2009), Australia (Lindenmaier, *et al.*, 2010), or North China (Qian, *et al.*, 2002), you worry about drought, desertification, wildfires, and dust storms. In Western Canada, you worry about the warming-induced infestation of pine bark beetles (Cudmore, *et al.*, 2010) that subjects its boreal forest to fires that put nearly as much CO₂ into the atmosphere as Canada's natural forest growth is sequestering (Running, private communication; Socks and Ward, 2010). In Africa, you worry about how agriculture (Dinar, 2012) and livestock (Thornton, *et al.*, 2009) will fare. And there are a few things that everybody worries

about: food security (Commission on sustainable agriculture and food security, 2011), human health (Bowen, *et al.*, 2012), how nature's wild places will survive (Morzillo and Alig, 2011).

In short, adaptation is an issue for everyone, but not the same issue. People are not interested in everything that can happen, only what could happen to them.

Appendix 2B. NASA Technology Readiness Levels

The following description is taken from a NASA website. There are nine technology readiness levels. TRL 1 is the lowest and TRL 9 is the highest. When a technology is at TRL 1, scientific research is beginning and those results are being translated into future research and development. TRL 2 occurs once the basic principles have been studied and practical applications can be applied to those initial findings. TRL 2 technology is very speculative, as there is little to no experimental proof of concept for the technology.

When active research and design begin, a technology is elevated to TRL 3. Generally both analytical and laboratory studies are required at this level to see if a technology is viable and ready to proceed further through the development process. Often during TRL 3, a proof-of-concept model is constructed. Once the proof-of-concept technology is ready, the technology advances to TRL 4. During TRL 4, multiple component pieces are tested with one another. TRL 5 is a continuation of TRL 4, however, a technology that is at 5 is identified as a breadboard technology and must undergo more rigorous testing than technology that is only at TRL 4. Simulations should be run in environments that are as close to realistic as possible. Once the testing of TRL 5 is complete, a technology may advance to TRL 6. A TRL 6 technology has a fully functional prototype or representational model.

TRL 7 technology requires that the working model or prototype be demonstrated in a space environment. TRL 8 technology has been tested and "flight qualified" and it's ready for implementation into an already existing technology or technology system. Once a technology has been "flight proven" during a successful mission, it can be called TRL 9.

SUSTAINABLE TRANSFORMATION OF HUMAN SOCIETY IN ASIA

■ YUAN TSEH LEE

Abstract

The train of human development is going in the wrong direction, and is headed for a terrible crash. From here on, Asia and other emerging regions will be the main drivers. So we must work closely with them to steer in a more sustainable direction, by fundamentally transforming the way we think about, and do, development.

Introduction

The human-nature relationship is out of balance. The stream of scientific warnings this past year – the World Bank’s *Turn Down the Heat* report, the Intergovernmental Panel on Climate Change (IPCC) reports and more – have made clear the severity of this reality. We have seen that human impacts are changing our earth system in ways so dangerous, it could destroy human welfare on this planet.

The implication is grave: *The train of human development is going in the wrong direction, and is speeding towards a horrific crash... If we wish to avoid a tragic end, we must radically change the train’s course in this coming decade.*

And we can only steer away from disaster if we transform the way societies develop. Exciting efforts on this are now sprouting up all over the world, but still our collective effort is, we must admit, far from what the challenge requires. I fear that humanity is losing this fight.

Asia is now driving the train

Our task is complicated by another reality. It is the fact that the train of human development has other drivers now – the emerging economies of Asia, Latin America, Africa and elsewhere, and especially the 2.5 billion people in China and India. In terms of the future growth of human activities and impact, simply put, Asia and the developing world are now driving this train.

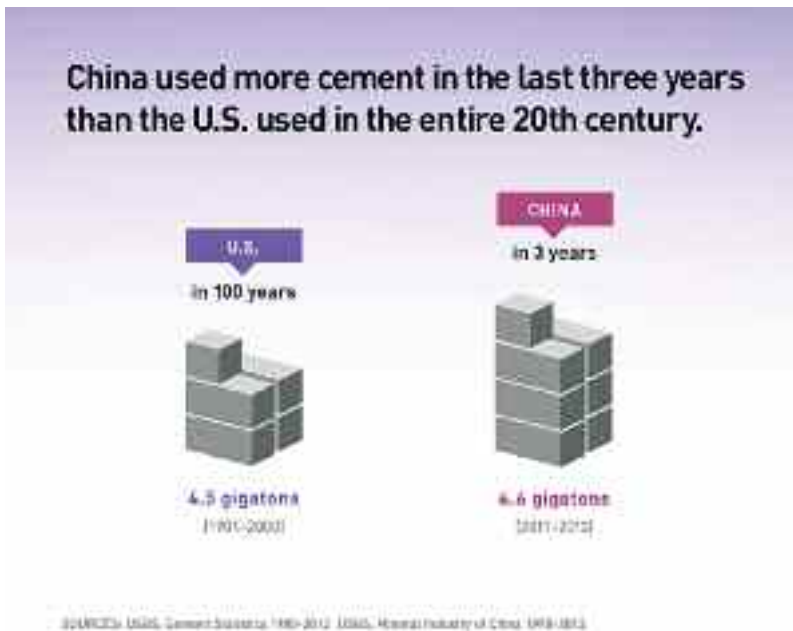
This article will discuss what this means and then offer some thoughts on what we can do about it. But first, I would like to share with you some incredible numbers.

The US Energy Information Administration projects that in the next 30 years, global energy consumption will rise by 56%. Of that growth, half

will come in China and India alone, and 90% will be in non-OECD countries. By 2040, China's energy consumption is projected to double to about twice of the US demand.

On food, some experts project that we will need to increase today's food production by 80% by 2050, in part because the rising middle class in emerging economies is eating more and more meat. The Meat Atlas project that, over the next 8 years, 80% of the growth in world meat consumption will come in the booming economies of Asia and other developing regions, with China and India again accounting for the fattest slice.

In mid-June, Bill Gates tweeted this shocking statistic: in the past three years alone, China used more cement than the United States did in the entire 20th century.



The scale and speed at which the emerging world is developing and consuming resources boggles the imagination. A recent report from the UN Environment Programme thus concluded: “Because of the Asia Pacific region’s growing dominance in total world resources demand, the demand curve for the world as a whole has come to increasingly reflect that for the region”. The message is unambiguous. The train of development, growth and impact is now being driven by Asia, with China and India at the wheel. And they are charging full speed ahead.

Pursuing prosperity on a limited earth

The whole world would celebrate this without hesitation, were we living on a planet of infinite space and resources. But we obviously do not. Decades of scientific research show that the earth system we live in has only limited resources to supply our needs, and limited capacity to absorb our impact. And we have already gone over those limits. Since 1900, the global population has increased four times, while global resource consumption went up eight times. And the impacts are proving devastating: heating the world, killing species, ruining ecosystems, intensifying disasters, worsening human health... the other pieces in this volume document these impacts expertly.

However, this has not stopped Asia or the rest of the emerging world. They are hungry for development, hungry for more resources, and hungry for a better life. They believe, with good reason, that the rich countries have gotten their share, and are responsible for most of the environmental impacts. It is time for the developing regions to get theirs.

A couple of years ago, at an international meeting in Berlin, I had an exchange that I still remember like it happened yesterday. When I said that the world was over-developed, and that we must turn back, an African colleague, a well-respected leader on sustainability, immediately responded: "Professor Lee, you cannot say that. The people in Africa are miserable. We have to develop. And if that means we destroy the world, well... then we can all die together!"

I am guessing that like me, you would rather not die together. But you can probably understand where my colleague is coming from. The people of Africa, Asia, Latin America and elsewhere want a decent life. And let us be honest: they deserve a decent life, and they will try to get a decent life, one way or another. The question therefore changes from "whether" to "how". How will they develop? How will they give their people a decent life?

We may not know the precise answer to that question, but we do know this: If Asia gets wealthy the old way, by chasing GDP growth at any cost and consuming and emitting massively, like some Western countries have done, then it is game over. Asia represents over 60% of the world's population and the biggest share of future resource consumption and impact. So which way Asia goes could very well decide our future.

It is therefore in the interest of us all to work with Asia and the rest of the developing world on choosing a better course, to steer the train of human development in a new, sustainable direction. And this will effectively amount to the biggest and most complete transformation ever in the way humanity develops on this planet.

The Sustainability Transformation

Since other chapters in this volume address transformations in technology and innovation with more expertise, I will focus instead on a different kind of transformation, one that starts with the way we think about development.

As you know, the Brundtland Commission defined sustainable development as “development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs”. This definition did set the tone for decades of efforts. But it does not answer two rather fundamental questions: what do we mean by development? And what do we mean by “need”? These two questions are more critical than you think.

In Asia, the dominant view of development is that GDP and consumption will keep on growing. It is the dream that one day, everyone will have a big and beautiful house, personal cars, new consumer goods, foreign vacations, and so on. But is that really what “development” means? Is this really what present and future generations “need”?

A sleeping human can survive on 100 watts, continuously supplied. An average American uses 100 times that, 10,000 watts. A Swiss initiative believes 2,000 watts is the sustainable level. Which is the right level? Asia seems to be aiming for 10,000 watts.

I am not arguing for one right definition of development or one right level of need. There are already many versions of development even just within Asia. Some focus on growing the GDP, and growing shopping malls and condos connected by freeways for personal cars. Others, like Bhutan, focus on growing something else, such as happiness. The problem is with NOT defining development at all, because then anything goes. Countries can freely pursue the versions with sky-high consumption and waste, because it is perceived as being just as valid as any other version. Yet we know this would be disastrous for all of humanity. In sustainability terms, not all versions of development are equal, and we should not pretend that they are.

Sadly, the trends are not good. The UNEP report mentioned earlier observes that in the Asia-Pacific, resource consumption per unit of GDP is not falling. It is rising. If our appetite for resources grows indefinitely, then no amount of technological innovation is going to save us. That is why we urgently need a sustainability transformation, starting with the very way we define “development” and “human needs”. We must be willing to speak the truth, that in matters of development, “anything goes” is not acceptable.

The responsibility of the developed countries

This also has important implications for the developed countries and what they should do. Because the path Asia chooses is so critical, we cannot

leave it up to chance. Instead, the developed countries should actively work with Asia to choose the right direction.

This means 3 things:

- First, the rich countries should admit that the path they took to get rich is not to be followed without careful examination. And they should actively transform their own development, so that they have more credibility by “walking the talk”.
- Second, they should stop encouraging Asia and the developing world to keep spending, consuming and growing, like they have done repeatedly in the media and in international meetings. It is like knowing perfectly well that this train is heading for a crash, but still telling the driver to go faster.
- Third, they should actively work with Asia to find new directions, to identify, test and implement new ways of development that improve welfare but consume *less* resources and lead to *less* environmental impacts. There are already tons of inspiring examples out there, so we know it can be done.

This is a pivotal moment, because Asia is literally choking on the smog of unsustainable development. Air pollution is dominating global headlines and even crossing the Pacific Ocean. People now understand how stupid it is to chase growth while our environment and living conditions are being damaged and degraded.

But the transformation requires full-hearted commitment. We cannot do a few sustainability initiatives here and there, while continuing to promote unsustainable consumption and unsustainable growth with our economic and trade policies.

Future Earth

Before wrapping up, I would like to tell you about a big mobilization of the global science community to drive this transformation. The International Council of Science (ICSU), of which I am President, has launched a 10-year research program together with the International Social Science Council (ISSC), the Belmont Forum of government research funders, UNESCO, UNEP, UNU, and the WMO.

We call this program Future Earth. We think it can make a big difference. And we want to invite you to work with us. Future Earth organizes global sustainability research that produces knowledge and solutions to help societies confront environmental change: To increase resilience and reduce vulnerabilities, and to identify pathways for transition to a sustainable future.

There are three things that make Future Earth different from any previous research program:

- First, governments, businesses and other stakeholders sit at the table with scientists from the very beginning, to ensure that the research is relevant.
- Second, Future Earth brings together researchers of all fields and disciplines, in a way that is more integrated than ever before.
- Third, Future Earth is about producing concrete solutions to the big challenges, like how we can make cities and communities less vulnerable and more resilient.

At this moment, Future Earth is establishing a globally distributed Secretariat with regional centers, and its networks are growing across the world.

Conclusion

So this is where we are. The train of human development and impact is now being driven by Asia and the emerging economies, and they are charging full speed ahead. Where they take us will likely decide the fate of both humanity and nature. We can encourage them to keep accelerating in the wrong direction, as we have often done, or we can help them steer in a new direction, by fundamentally transforming the way we think about and do development.

This is a transformation we must fully commit to with our hearts, words and actions. Every minute we wait, the train gains more speed and momentum towards a terrible crash.

▶ VIII. SOCIAL INFRASTRUCTURE

THE PRICE OF INEQUALITY: HOW TODAY'S DIVIDED SOCIETY ENDANGERS OUR FUTURE

■ JOSEPH E. STIGLITZ¹

Growing inequality within most countries around the world is one of the critical issues facing the world today. People everywhere sense that it is morally wrong. We sense that it cannot be justified. We sense that it is dividing our societies and undermining our democracies. And we are right in sensing this harm.

These effects of inequality should be more than enough to steel the resolve to do something to reduce growing inequality. But even if one didn't care about these effects, there are further reasons to fight inequality. It is self-defeating: it undermines our economies.

In this short paper, I want to do two things: First, I will describe the nature of this growing inequality, its multiple dimensions, and say a few words about its origins, explaining why it has such adverse effects, and arguing that this inequality is not inevitable: it is a result of policies and politics. There are policies that would simultaneously reduce inequality, heal some of the divides in our societies, and strengthen our economies. Then, I turn to the main focus of this conference – the environment – and explore its relationship to inequality.

This paper takes a global perspective with a special focus on the United States, simply because America has achieved the distinction of becoming the country with the highest level of income inequality among the advanced countries. As others have followed America's lead, they too have suffered increasing inequality.

I. The multiple dimensions of inequality in America, and its lessons for the world

There is no single number that can depict all aspects of society's inequality, but matters have become worse in every dimension. *Income* inequality is one of the most obvious indicators: In the United States, more than a fifth of all income goes to the top 1%.² This is a level of income concen-

¹ University Professor, Columbia University.

² See Emmanuel Saez, "Striking it Richer: The Evolution of Top Incomes in the United States" (Updated with 2012 preliminary estimates), September 3, 2013. Accessed on June 11, 2014 from <http://eml.berkeley.edu/~saez/saez-UStopincomes-2012.pdf>

tration that, until the 2000s, the United States had not experienced since before the Great Depression. It is twice the proportion of 30 years ago, and it is getting worse. Since the so-called recovery began after the Great Recession of 2008–2009 – in other words, since the U.S. economy returned to growth – 95% of the gains in income have gone to the top 1%.³ Even within the top 1%, there is inequality, with ultra-high income earners in the top 0.1% taking home some 11.3% of total income in 2012, which is some three to four times the number thirty years ago.⁴

Wealth in America is far more concentrated than income. The wealthiest 1% of Americans hold 35% of the wealth, and even more when housing wealth is not counted.⁵ This too is on the upswing. For the quarter century before the Great Recession, the rich were getting wealthier at a more rapid pace than everyone else. When the crisis hit, it depleted some of the richest Americans' wealth because stock prices declined, but many Americans also had their wealth almost entirely wiped out as their homes lost value. After the crisis, the wealthiest 1% of households had 225 times the wealth of the typical American in 2009, almost double the ratio 30 or 50 years ago.⁶ (Just one example of the extremes of wealth in America is the Walton family: the six heirs to the Wal-Mart empire command wealth of \$90 billion, which is equivalent to the wealth of the entire bottom 42% of U.S. society.⁷ The numbers may not be as surprising as they seem, simply because those at the bottom have so little wealth).

Inequality in America plays out along ethnic lines in ways that should be disturbing for a country that had begun to see itself as having won out against racism. Between 2005 and 2009, a huge number of Americans saw their wealth drastically decrease. The net worth of the typical white American household was down substantially, to \$113,149 in 2009, a 16% loss of wealth from 2005. That's bad, but the situation is much worse for other groups. The typical African American household has lost 53% of its wealth

³ Ibid.

⁴ See Alvaredo, Facundo, Anthony B. Atkinson, Thomas Piketty and Emmanuel Saez, "The World Top Incomes Database", <http://topincomes.g-mond.parisschoolofeconomics.eu> Accessed on 06/12/2014.

⁵ See Wolff, Edward N. "The Asset Price Meltdown and the Wealth of the Middle Class", *NBER Working Paper No. 18559*, November 2012.

⁶ See Allegretto, Sylvia A., "The State of Working America's Wealth", 2011, *EPI Briefing Paper #292*.

⁷ See for example Josh Harkinson, 2012, "6 Walmart Heirs Hold More Wealth Than 42% of Americans Combined", *Mother Jones*, July 18, available at <http://www.mother-jones.com/mojo/2012/07/walmart-heirs-waltons-wealth-income-inequality>

– putting its assets at a mere 5% of the median white American's. The typical Hispanic household has lost 66% of its wealth.⁸ In the years of “recovery”, as stock market values rebounded (in part as a result of the Fed's lopsided efforts to resuscitate the economy through increasing the balance sheet of the rich), the rich have regained much of the wealth that they had lost; but this is not the case for the rest of the country.⁹

At the same time that income has become ever more concentrated at the top in the United States, more people are in poverty at the bottom. Some 22% of American children live below the federal poverty level. The inflation-adjusted median income of an American male worker with only a high school degree has fallen by 47% from 1969 to 2009.¹⁰

Equally disturbing, there has been a hollowing out of the middle class – long the core strength of the societies of countries with advanced economies – which has seen its income stagnate. Median household income in the United States, adjusted for inflation, is lower today than it was in 1989, a quarter century ago. For large segments of the American population, matters are even worse. A full-time male worker today makes less than 40 years ago.

This recession has made the plight of those in the bottom and middle far worse. For most, there is no recovery. Still, the data just presented should make clear that the problems of inequality pre-date the crisis.

An economy in which most citizens see no progress, year after year, is an economy that is failing to perform in the way it should. Indeed, there is a vicious circle: the high inequality in the United States and other wealthy

⁸ See Paul Taylor, Rakesh Kochhar, Richard Fry, Gabriel Velasco, and Seth Motel, 2011, “Wealth Gaps Rise to Record Highs Between Whites, Blacks and Hispanics”, Pew Research Center report, available at http://www.pewsocialtrends.org/files/2011/07/SDT-Wealth-Report_7-26-11_FINAL.pdf

⁹ That this is the case can be clearly seen by examining what has happened to different kinds of wealth since the end of the crisis. Stocks, which are disproportionately owned by the wealthy, have done very well. Stock market values in the United States increased \$13 trillion from January 2009 to December 2013, according to data from the Center for Research in Security Prices. Meanwhile, home values, which account for much of middle class wealth, have not enjoyed a strong recovery: one fifth of American homes were still underwater as of Spring 2014 – their owners owe more on their mortgages than the market says their houses are worth. For a concise discussion of this, see “What Housing Recovery?” by Peter Dreier, *The New York Times*, May 8, 2014, available at http://www.nytimes.com/2014/05/09/opinion/what-housing-recovery.html?ref=opinion&_r=0.

¹⁰ US Census Bureau, Census Table P-5. Census historical table P-5 available at <http://www.census.gov/hhes/www/income/data/historical/people/> Accessed on June 12, 2014.

countries is one of the major contributing factors to their weak economies and low growth, a theme to which I will return later in this paper.

As disturbing as the data on the growing inequality in income are, those that describe the other dimensions of America's inequality are even worse. There are, for instance, marked inequalities in health, reflected in differences, for instance, in life expectancy. The poor are exposed more, too, to environmental hazards. What is particularly disturbing is the large numbers of Americans who do not have access to the basic necessities of life. Until the American Affordable Care Act, more than a sixth of Americans had no health insurance. Even though about one in seven Americans now depend on the government for basic food, a comparable number still go to bed hungry every year, not because they are on a diet, but because they or their families cannot afford adequate nutrition.

Perhaps the most invidious aspect of inequality is that affecting opportunity. Equality of opportunity – the “American dream” – has always been a cherished American ideal. But data now show that this is a myth: America has become the advanced country not only with the highest level of inequality, but one of those with the least equality of opportunity. The life prospects of a young American are more dependent on the income and education of his parents than in other developed countries. We have betrayed a fundamental value. And the result is that we are wasting a most valuable resource, our human resources: millions of those at the bottom are not able to live up to their potential.

A number of studies have noted the link between inequality of outcomes and inequality of opportunity. When there are large inequalities of income, those at the top can buy privileges for their children that are not available to others, and they often come to believe that it is their right and obligation to do so. And, of course, without equality of opportunity, those born in the bottom of the distribution are likely to end up there: inequalities of outcomes perpetuate themselves. For the United States, this should be deeply troubling: given the low level of equality of opportunity and the high level of inequality of income and wealth, it is possible that the future will be even worse, with still further increases in inequality of outcome and still further decreases in equality of opportunity.

America has been “winning” the race to be the most unequal country (at least among developed countries). But unfortunately, much of what I have just described for America has been going on elsewhere. The more countries follow the American model, the more the results seem to be consistent with what has occurred in the United States. The United Kingdom has now achieved the second highest level of inequality among the coun-

tries of Western Europe and North America, a marked change from its position before the Thatcher era. Germany, which had been among the best performers within the Organisation for Economic Co-operation and Development (OECD), now ranks in the middle. Most disturbing are the patterns that have emerged in the economies of transition, which at the beginning of their movements to a market economy had low levels of inequality in income and wealth (at least according to available measurements). Today, China's inequality of income, as measured by its Gini coefficient, is roughly comparable to the inequality of the United States and of Russia.¹¹ Across the OECD, since 1985 the Gini has increased in 17 of 22 countries for which data is available – often dramatically.¹²

Today, I want to make several observations concerning the growing inequality that I have just described.

1. The first observation is that this inequality is largely a result of policies. The laws of economics are universal: the fact that in some countries there is so much less inequality and so much more equality of opportunity, the fact that in some countries inequality is not increasing – it is actually decreasing – is not because they have different laws of economics. France and Norway are examples of OECD countries that have managed by and large to resist the trend of increasing inequality; Brazil and several other Latin American countries have actually managed to reduce the level of inequality, albeit from a very high level. The Scandinavian countries have a much higher level of equality of opportunity, regardless of how that is assessed. The European countries with public health care systems succeed much better in achieving equality of health outcomes.

Every aspect of our economic, legal, and social frameworks helps shape inequality: from the education system and how it is financed, to the health system, to tax laws, to our governing of bankruptcy, corporate

¹¹ Some caution should be exercised in comparing different countries' Gini coefficients: in addition to the well-known flaws in the measure, different databases have used slightly different methodologies or income data to arrive at their respective figures, and thus figures are different depending on the data source. Nevertheless, many different studies confirm these broad trends.

¹² See Organisation of Economic Co-operation and Development, 2011, *Divided We Stand*, OECD Publishing, available at <http://www.oecd.org/social/soc/dividedwestand-whyinequalitykeepsrising.htm>

governance, the functioning of our financial system, to our anti-trust laws. In virtually every domain, the United States, for instance, has made decisions that help enrich the top at the expense of the rest.

2. The second observation entails looking at the current levels of inequality in a historical context. While I have emphasized the growth of inequality in the last third of a century, Thomas Piketty in his recent book notes that the preceding four decades should perhaps be viewed as an historical anomaly: we are returning to the high levels of inequality that prevailed in the 19th century and in the 20th in the years before the Great Depression. Piketty concludes that inequality is likely to get worse.¹³ I will comment on this forecast later. But his analysis has some profound implications: it means that Kuznets's optimism that increasing inequality in the initial process of development gives way to a decrease (an idea referred to as the Kuznets curve),¹⁴ may well be wrong. Countries should not accept increasing inequality today, in the blind faith that it will eventually be reversed.
3. The third observation is that much of the inequality at the top cannot be justified as "just deserts" for the large contributions that these individuals

¹³ Thomas Piketty, 2014, *Capital in the Twenty-First Century*, Cambridge, Massachusetts: The Belknap Press of Harvard University Press. He notes, that there are policies – namely global capital taxation – that might prevent the ever increasing level of wealth inequality. As I note below (and have discussed more fully in Joseph E. Stiglitz, 2012, *The Price of Inequality: How Today's Divided Society Endangers Our Future*, New York: W.W. Norton) there are many policy reforms that will reduce inequality, and many of these reforms would actually improve economic performance.

Many years earlier, I had analyzed the long run evolution of wealth inequality in the economy, showing that there was, in fact, some presumption that the economy would converge towards an equilibrium wealth distribution (rather than that there would be ever more increasing inequality of wealth). Changes in the structure of the economy would, of course, shift the equilibrium wealth distribution. I identified some of the key parameters, changes in which could lead to an increase in wealth inequality. See J.E. Stiglitz, 1969, "Distribution of Income and Wealth Among Individuals", *Econometrica*, 37(3): 382-397. (Presented at the December 1966 meetings of the Econometric Society, San Francisco).

For an update and elaboration on these issues, see J.E. Stiglitz, "Distribution of Income and Wealth Among Individuals: Theoretical Perspectives", paper presented to World Bank/International Economic Association Roundtable, Dead Sea, Jordan, June 11, 2014.

¹⁴ Simon Kuznets, 1955, "Economic Growth and Income Inequality", *American Economic Review* 45(1): 1-28.

have made. If we look at those at the top, they are not those who have made the major innovations that have transformed our economies and societies; they are not the discoverers of DNA, the laser, the transistor; not the brilliant individuals who made the discoveries without which we would not have had the modern computer. Disproportionately, they are those who have excelled in rent seeking, in wealth appropriation, in figuring out how to get a larger share of the nation's pie, rather than enhancing the size of that pie. (Such rent seeking activity typically actually results in the size of the economic pie shrinking from what it otherwise would be). Among the most notable of these are, of course, those in the financial sector, some of whom made their wealth by market manipulation, by engaging in abusive credit card practices, predatory lending, moving money from the bottom and middle of the income pyramid to the top. So too, a monopolist makes his money by contracting output from what it otherwise would be, not by expanding it.

The inaptness of the "just deserts" argument was shown by the Great Recession, a recession which in no small measure was caused by the financial sector, which itself is responsible for so much of the inequality today. Even as they were bringing their firms and the global economy to the brink of ruin, the managers of these firms walked off with multimillion dollar bonuses.

The notion that large fractions of today's inequality are associated with rent seeking is supported by a look at the composition of the wealthiest and top income earners. But there is additional evidence. Three striking aspects of the evolution of the American economy (and the economies of other wealthy countries) in the last 35 years are (a) the increase in the wealth-to-income ratio; (b) the stagnation of median wages; and (c) the failure of the return to capital to decline. Standard neoclassical theories, in which "wealth" is equated with "capital", would suggest that the increase in capital should be associated with a decline in the return to capital and an increase in wages. The failure of wages to increase has been attributed by some (especially in the 1990s) to skill-biased technological change, which increased the premium put by the market on skills. Hence, those with skills saw their wages rise, and those without skills saw them fall. But recent years have seen a decline in the wages paid even to skilled workers. Something else must be going on. While in production functions with multiple inputs (say multiple kinds of labor), an increase in capital does not necessarily increase the wages of each type of labor (capital and unskilled labor can be substitutes rather than complements), if the production function exhibits constant returns

to scale (a standard assumption in neoclassical theory), then the average wage must increase.¹⁵ This does not seem to be happening.

There are two alternative explanations. The first is that rents are increasing (the fraction of income that is appropriated by monopolists and by other forms of exploitation). These rents are captured by (large) owners of capital, and since they are, at least in part, marketable, the present discounted value of these rents themselves become part of “wealth”. But an increase in this form of wealth does not lead to an increase in the productivity of the economy – or to an increase in the average wage of workers; to the contrary, it reduces the amounts received.

The second is that there may be other assets – like land – that can increase in value. These assets may not be very directly related to the production of goods and services,¹⁶ and indeed, with more wealth invested in these assets, there may be less invested in real productive capital. (A disproportionate part of America’s savings in the years before the crisis went into the purchase of housing, which did not increase the productivity of the “real” sectors of the economy).

Monetary policies that lead to low interest rates can increase the present value of these fixed assets – an increase in the value of wealth that is unaccompanied by any increase in the flow of goods and services. By the same token, a bubble can lead to an increase in wealth – for an extended period of time – again with possibly adverse effects on the stock of “real” capital. Indeed, it is easy for capitalist economies to generate such bubbles (a fact that should be obvious from the historical record,¹⁷ but which has been confirmed in theoretical models).¹⁸ There has been a “correction” in the housing bubble (and in the underlying price of land); but we should not be confident that there has been a *full* correction. We still may be on a “bubble” trajectory.

¹⁵ Assume a constant returns to scale production function with two types of labor, L_1 and L_2 . Then $F_{L_1}L_1 + F_{L_2}L_2 + F_KK = F$, so $F_{L_1K}L_1 + F_{L_2K}L_2 + F_{KK}K = 0$, from which it follows immediately that the average wage must increase when capital is increased.

¹⁶ Though they may be reflected in GDP, and may be related in particular to the value of housing services.

¹⁷ See Carmen Reinhart and Kenneth Rogoff, 2009, *This Time Is Different: Eight Centuries of Financial Folly*, Princeton, NJ: Princeton University Press.

¹⁸ See, for instance, Karl Shell and Joseph E. Stiglitz, 1967, “Allocation of Investment in a Dynamic Economy,” *Quarterly Journal of Economics*, 81: 592–609, and Frank Hahn, 1966, “Equilibrium Dynamics with Heterogeneous Capital Goods,” *Quarterly Journal of Economics* 80: 633–46.

Still another piece of evidence supporting the importance of rent-seeking is that showing that increases in taxes at the very top do not result in decreases in growth rates. If these incomes were a result of their *efforts*, we might have expected those at the top to respond by working less hard, with adverse effects on GDP.¹⁹

Piketty's recent research has emphasized a different aspect of the "just deserts" argument: the increasing fraction of inequality arising from inheritance.

4. The idea that one shouldn't worry about inequality – because everyone will benefit as money trickles down – has been thoroughly discredited. In some ways, it would be nice if it were true, because it would mean that the average American would be doing very well today, since the country has been thrown so much money at the top. But the statistics show that trickle-down is a fallacy: while the top has been doing very well, the rest has been stagnating.

In the absence of a change in the degree of inequality, if mean income (GDP) increases, everyone can benefit. But I emphasized above that there has been a large increase in inequality, and this gives rise to an increasing disparity between the mean and the median, between what is happening on average, and what is happening to the typical individual. Those at the very top, in the 1% or the .1%, can see their income increase; while incomes for the bottom 99% (or the bottom 99.9%) can actually decrease. That is what has been happening. An economic system that only delivers for the very top is a failed economic system. If the failures were of a short duration, that would be one thing. But they have been persistent – and there is no evidence of a turnaround.

5. Some go further: it is not just that everyone will benefit from trickle-down, but inequality is actually necessary for growth. One of the popular misconceptions is that those at the top are the job creators; and giving more money to them will thus create more jobs – and indeed this is the only way by which jobs can be created. This view, I believe, is fundamentally wrong: America and other countries are full of creative entrepreneurial people throughout the income distribution. What creates jobs is *demand*: when there is demand, firms (especially if the financial system could be made work in the way it should, providing credit to small and medium-sized enterprises) will create the jobs to satisfy that demand. But

¹⁹Thomas Piketty, Emmanuel Saez, and Stefanie Stantcheva, 2011, "Optimal Taxation of Top Labor Incomes: A Tale of Three Elasticities", *American Economic Journal* 6(1): 230-271.

in the United States, for example, the distorted tax system provides incentives for those at the top to destroy jobs by moving them abroad.

6. In contrast to those who believe that inequality is necessary for good economic performance, recent research has shown that inequality – when it gets to the level that characterizes the US and some other countries and when it is generated in the manner that it is created in the US and some other countries – is bad for growth, stability, and economic efficiency. This was the central thrust of my book *The Price of Inequality*, where I argued that inequality was not just a moral issue, but an economic one – we were paying a high price for our inequality. This view has now become mainstream, and the IMF has produced research supporting it, and endorsed it. Thus, the IMF finds that countries with greater inequality tend to be marked by lower growth and greater instability.²⁰

Economists used to think of there being a trade-off: we could achieve more equality, but only at the expense of giving up on overall economic performance. Now we realize that, especially given the extremes of inequality achieved in the United States and the manner in which inequality is generated, greater equality and improved economic performance are *complements*. By the same token, one of the reasons for the poor economic performance in many countries in recent years is the high and growing level of inequality.

This is especially true if we focus on appropriate measures of growth. If we use the wrong metrics, we will strive for the wrong things. Economic growth *as measured by GDP* is not enough – there is a growing global consensus that GDP does not provide a good measure of overall economic performance. What matters is whether growth is sustainable, and whether *most* citizens see their living standards rising year after year. This is the central message of the International Commission on the Measurement of Economic Performance and Social Progress, which I chaired.²¹

Economists and policymakers need to focus not on what is happening

²⁰ Andrew Berg and Jonathan Ostry, 2011, “Inequality and unsustainable Growth: Two Sides of the Same Coin?” IMF Staff Discussion Note No. 11/08, April, International Monetary Fund. See also IMF, “Fiscal Policy and Income Inequality”, Policy Paper, January 23, 2014, available at <http://www.imf.org/external/np/pp/eng/2014/012314.pdf>

²¹ The Committee’s report was released in 2009, and published as Joseph Stiglitz, Amartya Sen, and Jean-Paul Fitoussi, 2010, *Mismeasuring Our Lives*, New York: The New Press. The Organisation for Economic Co-operation and Development (OECD) has since continued work in this vein with its Better Life Initiative (<http://www.oecd.org/statistics/betterlifeinitiativemeasuringwell-beingandprogress.htm>) and its High Level Expert Group on the measurement of economic and social progress, convened in 2013.

on average, or to those at the top, but how the economy is performing for the typical citizen, reflected for instance in median income. We value opportunity *directly*, not just for the benefits which it might bring to conventionally measured GDP. And as inequality increases, so does insecurity. Everyone, even those higher up the rungs in the ladder, worry about slipping down: they know the consequences. Once this is taken into account, the surge in inequality looks every worse.

7. One of the reasons that inequality is bad for economic performance is that this growing inequality is weakening demand. The reason that inequality leads to weak demand is easy to understand: those at the bottom spend a larger fraction of their income (they need to, just to get by) than those at the top.

The problem of weak demand is compounded by the flawed responses to this weak demand by monetary authorities, by lowering interest rates, which can easily give rise to a bubble, the bursting of which leads in turn to recessions. This indeed describes what has happened in recent years. (This is not the only possible response: fiscal authorities could lower taxes on say the middle class, or increase government investments in infrastructure, technology and education. But the Bush administration took exactly the opposite strategy – lowering taxes on the rich. These responses are perhaps not a surprise: as I emphasize below, economic inequality translates into political inequality, and those at the top have a tendency to seek their own advantage).

8. There are still other reasons that inequality is bad for the economy and growth. One of the reasons is that today, inequality is associated with rent seeking, and rent seeking distorts the economy. Another is the observation made earlier that inequality of outcomes is associated with inequality of opportunity, and that means that those unfortunate enough to be born at the bottom of the income distribution are at great risk of not living up to their potential. We thus pay a price not only in terms of a weak economy today, but lower growth in the future. With nearly one in four American children growing up in poverty,²² many of whom face a lack of access to adequate nutrition and education, the country's long-term prospects are being put into jeopardy.

²² See <http://www.childstats.gov/americaschildren/eco1a.asp> (accessed March 30, 2014).

A third is related to the corrosive effect of inequality on morale, especially when it cannot be well-justified (and as I have noted, the inequality evidenced in the United States and elsewhere cannot be justified). There is a widespread understanding of the adverse effects of corruption on morale, societal solidarity, and the functioning of the economy. But increasingly, inequality in the US is viewed as *unfair*, arising out of a corrupt political and economic system.

Still two further reasons are related to the political economy of inequality: societies with greater inequality are less likely to make investments in the *common* good, in say public transportation, infrastructure, technology, and education. The rich don't need these public facilities, and they worry that a strong government which could increase the efficiency of the economy might at the same time use its powers to redistribute. Moreover, with so many at the top making their money from financial market shenanigans and rent-seeking, we wind up with tax and other economic policies that encourage these kinds of activities rather than more productive activities. When we tax speculators at less than half the rate that we tax workers, and when we give speculative derivatives priority in bankruptcy over workers, and when we have tax laws that encourage job creation abroad rather than at home, we wind up with a weaker and more unstable economy.

9. The ninth observation is that the weaknesses in the economy (partly caused by the high levels of inequality) have important budgetary implications. Deficits have become a central focus of policymakers in many countries. But worries about the deficit are exacerbating the real inequalities in our society; it is those at the bottom and middle that suffer the most from government cutbacks in expenditures.

The budget deficits of recent years are a result of the weak economy, not the other way around. If we had more robust growth, the budgetary situation would be far improved. That's why investments in decreasing inequality and increasing equality of opportunity make sense not only for the economy, but for the budget. When we invest in our children, the asset side of our country's balance sheet goes up, even more than the liability side: any business would see that its net worth is increased. In the long run, even looking narrowly at the liability side of the balance sheet, it will be improved, as these young people earn higher incomes and contribute more to the tax base. But if we look at these issues the wrong way, the budgetary weaknesses will lead to cutbacks in public investments – including those that help ameliorate inequality – and we

reinforce the vicious circle, with lower investment in the public sector (including education) leading to a weaker economy and more inequality, and leading in turn to still lower investments and growth.

10. Countries also pay a high price for this inequality in terms of their democracy and the nature of their societies. A divided society is different – it doesn't function as well. Democracy is undermined, as economic inequality inevitably translates into political inequality. I describe in my book how the outcomes of America's politics are increasingly better described as the result of a system not of *one person, one vote* but of *one dollar, one vote*.²³ And just as we described earlier how the rules of the economic game affect the outcomes, so too in the realm of politics: with the rich having more and more influence, they write the rules of the political game to give them more power and influence, which means economic inequality gets even more translated into political inequality, and the political inequality gets translated into ever more economic inequality, in a vicious circle. The same process is occurring in other countries where the wealth and income have become stubbornly concentrated.
11. There are further adverse effects of this economic/political inequality as we view societal well-being from the broader perspective that I argued for earlier. Special interests have incentives and scope to shape our society – in their interests. Even when most citizens care about the environment, they see actions to protect the environment as costing them profits, and they use their economic and political power resist such actions. This has proved to be a major impediment to dealing with the challenges of global warming. But as I comment on more extensively in the second part of this paper, the costs of failing to deal with climate change and other environmental hazards are borne disproportionately by the poor.
12. With extreme inequality, the nature of society changes in fundamental ways. Those at the top come to believe that they are entitled to what they have. And this can lead to behaviors which themselves undermine the cohesiveness of society. Those excluded from prosperity begin to expect the worst from their governments and leaders. Trust is eroded, along with civic engagement and a sense of common purpose.

²³ Joseph E. Stiglitz, 2012, *The Price of Inequality: How Today's Divided Society Endangers Our Future*, *Op cit*.

13. For those who believe we would have a better world were more countries to become committed to market economies with democracy, there are further adverse effects: Will other countries want to emulate an economic system in which most individuals' incomes are simply stagnating? A political system which seems to be captured by the wealthy?
14. In this paper, I have emphasized the economic, social, and political costs of the growing inequality and diminishing equality of opportunity that has afflicted so many countries. But in viewing inequality this way, I do not want to diminish the *moral* argument. The moral argument should reinforce the commitment to reduce inequality. We should, I believe, have been willing to reduce inequality – especially reduce the high levels of poverty that seem endemic even in rich countries – even if there were a price for doing so, even if overall economic performance, as measured by GDP, were weakened as a result. But the fact is, as I have stressed, that we could actually get better economic performance with less inequality.

A way out from inequality

The fact that inequality is created by policies – it is not the ineluctable result of economic forces – means there is a glimmer of hope. Policy created the problem, and it can help get us out of it. There are policies that could reduce the extremes of inequality and increase opportunity – enabling our countries to live up to the values to which they aspire. There is no magic bullet, but there are a host of policies that would make a difference. In the last chapter of my book, *The Price of Inequality*, I outline 21 such policies, affecting both the distribution of income before taxes and transfers and after.

There is a strong need macroeconomic policies that maintain economic stability and full employment. Nothing is worse for those at the bottom and the middle than a higher level of unemployment. Today, workers are suffering thrice over: from high unemployment, weak wages, and cutbacks in public services, as government revenues are less than they would be were our economies functioning well. (Central bank policies focusing on inflation have almost surely been one of the factors contributing to the growing inequality).

Policymakers must make it a priority to move more people out of poverty, strengthen the middle class, and curb the excesses at the top. Most of the policies are familiar: more support for education, including pre-school; increasing the minimum wage; strengthening the earned-income tax credit; giving more voice to workers in the workplace, including

through unions; more effective enforcement of anti-discrimination laws; better corporate governance, to curb the abuses of CEO pay; better financial sector regulations, to curb not just market manipulation and excessive speculative activity, but also predatory lending and abusive credit card practices; better anti-trust laws, and better enforcement of the laws we have; and a fairer tax system – one that does not reward speculators or those that take advantage of off-shore tax havens with tax rates lower than honest Americans who work for a living.

If we are to avoid the creation of a new plutocracy in our countries, we have to retain a good system of inheritance and estate taxation, and ensure that it is effectively enforced. We need to make sure that everyone who has the potential to go to college can do so, no matter what the income of his parents – and to do so without undertaking crushing loans.

Again, the United States provides numerous examples of the path to avoid. It stands out among advanced countries not only in its level of inequality, but also in its treatment of student loans in bankruptcy proceedings. A rich person borrowing to buy a yacht can get a fresh start, and have his loans forgiven; not so for a poor student striving to get ahead. A contingent loan program of the kind employed by Australia shows that there are alternatives – ways which provide access to all who can benefit from a college education without imposing the risks of hardship that the United States does.

In the United States, the special provisions for capital gains and dividends not only distort the economy, but, with the vast majority of the benefits going to the very top, increase inequality – at the same time that they impose enormous budgetary costs: \$2 trillion dollars over the next ten years, according to the Congressional Budget Office.²⁴ While the elimination of the special provisions for capital gains and dividends is the most obvious reform in the tax code that would improve inequality and raise substantial amounts of revenues, there are many others that I have discussed elsewhere.²⁵ In the past, when the United States reached these extremes of inequality, at

²⁴ See Congressional Budget Office, 2013, *The Distribution of Major Tax Expenditures in the Individual Income Tax System*, May, p. 31, available at http://cbo.gov/sites/default/files/cbofiles/attachments/TaxExpenditures_One-Column.pdf (accessed March 28, 2014). This figure includes the effects of the “step-up of basis at death” provision, which reduces the taxes that heirs pay on capital gains. Not including this provision, the ten-year budgetary cost of preferential treatment for capital gains and dividends is \$1.34 trillion.

²⁵ See Joseph E. Stiglitz, “Reforming Taxation to Promote Growth and Equity”, Roosevelt Institute working paper available at <http://www.rooseveltinstitute.org/reforming-taxation-promote-growth-and-equity>

the end of the 19th century, in the gilded age, or in the Roaring 20s, it pulled back from the brink. It enacted policies and programs that provided hope that the American dream could return to being a reality.

Other countries have done likewise: Brazil, torn by even greater inequality than the United States, has shown how concerted policies focusing on education and children can bring down inequality within the span of less than two decades.

We are now at one of these pivotal points in history. We must hope that the citizens of the world will make the right decisions.

II. Inequality and the environment

There is a two-way relationship between inequality and the environment, and the complex relationships between inequality and the environment play out both at the local (national) and global levels.

The poor are often more dependent on the natural environment than the rich, and thus environmental degradation, including climate change, has particularly adverse effects on them. Many in developing countries are dependent on common resources, such as local forests and ground water. Their very survival may be at stake when there is degradation of these resources. In both developing and developed countries, the poor are more likely to live in areas where they are exposed to higher levels of pollution and toxicity.

Indeed, not only does environmental degradation *affect* the poor, it creates poverty. Farmers who might otherwise have eked out a living above the poverty threshold can no longer do so. Those who live surrounded by pollution and toxicity are likely to be less healthy. They will perform more poorly at school, and their lifetime productivity will be lower.

While it is gradually being recognized that a rich country with a temperate climate, like the United States, will be very seriously hurt by climate change, it is the poor in poor countries especially in the tropics that are likely to suffer the most. They disproportionately work in agriculture, which will be hurt both by global warming and climate variability. It is likely that there will be more serious consequences for health. They are more likely to be buffeted by extreme events like typhoons and floods, likely to suffer greater *relative* losses of wealth, and less likely to be able to protect themselves either physically or materially. They have less access to insurance to compensate them for the loss of property, and have less savings with which they can self-insure and recover. They live in countries with poor disaster management and social protection systems. Many (such as millions in Bangladesh) live in low-lying areas that will be inundated with the rise of sea levels.

But poverty can also contribute to environmental degradation. Because they are too poor to afford an efficient cookstove, too poor to buy kerosene, they turn to surrounding forests, leading to increasing deforestation.

At a global level, the poor imitate the materialistic life styles of the rich. This is true both within countries and across countries. Those in the emerging markets aspire to have life styles as similar as possible to those of the advanced countries, and especially the United States. But if even one such large country, such as China, were to follow America's lifestyle, there is a very high risk that our planet will not survive.

Some have argued that any attack on climate change (reducing greenhouse gas emissions) though in the long run might benefit the poor, in the short run would have adverse effects. There is, they suggest, a trade-off between social justice today and sustainability, between equity *within* a generation and across generations. What I have said so far (as well as discussions elsewhere during this conference) has suggested that that is not necessarily the case; the two can be complementary. Providing efficient cookstoves to the poor and connecting them to the electric grid would improve their health, their standard of living, and simultaneously reduce greenhouse gases (including emissions other than of carbon dioxide).²⁶ More broadly, poverty in many developing countries today leads to increased deforestation, with adverse effects on carbon sequestration.

Similarly, in developed countries today, an attack against climate change would yield benefits today as well as for the future. Forcing firms and households to pay for the social costs associated with carbon emissions would lead to a retrofitting of the economy – with large investments that would create jobs, restoring the economy towards full employment. The installation, for instance, of solar panels would give rise to large employment of construction workers, who currently face high levels of unemployment in many countries. Reducing unemployment would not only be of direct benefit to those suffering from lack of income (especially important in the US,

²⁶ See Veerabhadran Ramanathan, 2014, The two worlds we inhabit: The Top 4 billion and the The Top 4 Billion (T4B) and the Bottom 3 Billion (B3B), *Pontifical Academy of Social Sciences*; also see Comments by Joseph E. Stiglitz on Climate Change, Cook Stoves, and Coughs and Colds in *Environment and Development Economics*

Essays in Honour of Sir Partha Dasgupta, Ed. Scott Barrett, Karl-Goran Maler, and Eric S. Maskin. Oxford University Press, 2014. I note there that the provision of cookstoves may also promote gender equity, since the burden of gathering wood is borne in most traditional societies by women, and women are more exposed to the health hazards arising from traditional cooking methods.

with its poor system of social protection), but would reduce the downward pressure on wages arising from unemployment. The restoration of growth to the economy would provide government with additional revenues, so that some of the cutbacks of public service that have been so costly to the poor would be reduced.

But the *potential* conflict between the two raises important issues of social justice and global fairness, which could play out in important ways in the attempt to reach a global agreement on climate change. Whenever there are important externalities – and climate change entails an externality of first order importance – it is possible to achieve a Pareto improvement. There are a set of “deals”, payments from some parties to others, accompanied by a reduction in greenhouse gas emissions, such that everyone is better off than in the current, business as usual, scenario. Unfortunately, however, since it is the poor countries that are likely to be hurt most and the rich countries that do the most polluting, the compensations required would entail the poor countries bribing the rich countries not to pollute. That is politically unacceptable for most developing countries, and understandably so. It seems patently unjust.

One way of thinking about what is “fair” is to think of the atmosphere as having a certain capacity for carbon – beyond a critical level, an unacceptable level of climate change will result. In a sense, the international community has agreed to this perspective: in Copenhagen, they resolved not to allow atmospheric concentrations that would result in an increase in climate of more than 2 degrees Celsius. We can translate that into how much carbon can be added to the atmosphere. Then the question becomes how the rights to add that limited amount of carbon to the atmosphere should be divided. A natural principle suggests itself: allocating rights in proportion to population (as of the time that the problem was globally recognized, i.e. 1992). One might argue that principles of social justice would entail giving more rights to those who are poor, i.e. that these rights should be allocated progressively. (Giving rights is really equivalent to giving money). In this perspective, allocating (total) emission rights on a per capita basis is socially unjust.²⁷

In effect, however, the US and some other developed countries are arguing for a regressive allocation –giving rights in part on the basis of past emission levels (allocation systems which require different countries to re-

²⁷ Note that many in the developing world would even view the criterion suggested above, with an allocation of the carbon capacity of the atmosphere according to per capita population in 1992 as unjust, for it gives a “free ride” to the advanced countries for all their carbon emissions prior to 1992.

duce emission levels from 1992 levels by the same percentage allow those who were polluting more the right to continue to pollute more).

The allocation of “carbon space” perspective has one important implication going forward: since the United States (and some other advanced countries) failed to curb their emissions after 1992, they have already used up most of the carbon space allocated to them. Fairness, then, requires them to move quickly to zero emissions.

There is a wealth of evidence (including from laboratory experiments) on the importance people attach to fairness.²⁸ They would rather accept an allocation that leaves them worse off, than one that they view as excessively unfair. The implications for reaching a global agreement on climate change are daunting: while there is a Pareto improving agreement (one which makes all countries better off than they would be in the business-as-usual scenario), such agreements would appear to be patently unfair to most of those in the developing world. Some would, as we suggested, entail the poor countries transferring money to the rich countries – contravening principles widely accepted in virtually all countries, that polluters should pay, i.e. should bear not only the cost of reducing their pollution, but also the costs they impose on others. Others would give the rich countries a disproportionate share of the world’s carbon space, allocating to the rich a disproportionate share of a scarce resource. It will be difficult to get poor countries to accept such measures. At the same time, so far, leaders in the advanced countries have done little to convince their citizens that there is a moral case (as opposed to self-interested case) for reaching a fair agreement with developing countries. (Undoubtedly, this is in part a result of the influence of the special corporate interests in the politics of many Western democracies, and especially the United States). We have created institutional structures which are seemingly designed to constrain use of the moral calculus in making important social decisions, by having decision structures in which *amoral* institutions (corporations) play pivotal roles. Individuals working for such institutions are instructed to care primarily (or only) about the well-being of, say, their shareholders; to do otherwise would be a dereliction of their duties to others, an action which might even be labeled as immoral. In so doing, they seem released from the broader moral obligation of thinking more broadly about the consequences of their actions, and in

²⁸ See for example See Werner Güth, Rolf Schmittberger, and Bernd Schwarze, “An Experimental Analysis of Ultimatum Bargaining”, *Journal of Economic Behavior and Organization* 3 (December 1982): 367-88.

particular, the consequences for their actions on the poor. And under such institutional arrangements, arriving at a global agreement will be difficult.

There is an alternative approach which reframes what needs to be done, and outlines a common set of principles which would receive wide assent, such as the “polluter pays principle”, the principle that those who pollute should pay for the cost of reducing their pollution and the damage that is done by their pollution; the “right to development”, the principle that says that any new obligation put on developing country should not impede their basic right to develop; if there are substantial costs imposed on less developing countries, those costs should be borne by the developed countries.

Rather than focusing on how to allocate a scarce resource (the carbon carrying capacity of the atmosphere), we should focus on what needs to be done to achieve a common purpose – the common purpose of reducing carbon emissions. This includes eliminating old coal burning generators, not installing new ones (without carbon storage), requiring all cars to be emissions efficient, etc. It should go so far as agreeing on the imposition of a carbon price, with the revenues generated retained within the country. There may be differential net costs/benefits from the imposition of such a tax, but the differences are likely to be small. The deadweight (inefficiency) loss associated with the imposition of any tax is called its “Harberger triangle” and is typically a very small number, usually of the order of magnitude of 3 to 10% of the revenues raised. Moving from taxing labor or savings to taxing carbon will thus result in a net distortionary cost which is the difference between these two small numbers; and the difference between the dead weight losses among countries is the difference in these differences across countries. Most countries are likely to gain – though special interests within their countries are likely to lose. Nonetheless, it would be appropriate for rich countries to help facilitate the transition of the poor countries, using perhaps some of the net gain in welfare which arises from shifting to the more efficient taxation of pollution.²⁹

It has been more than a quarter century since the risks of climate change have been recognized. Climate change is a quintessential global public good – a problem that can only be address through collective action at the global level. If the world consisted of identical individuals, the problem would be

²⁹ Some of the ideas in this section are elaborated in Stiglitz, 2006, *Making Globalization Work*, New York: W.W. Norton, and in Stiglitz, 2013, “Sharing the Burden of Saving the Planet: Global Social Justice for Sustainable Development”, in Mary Kaldor and Joseph E. Stiglitz, eds., *The Quest for Security: Protection without Protectionism and the Challenge of Global Governance*, New York: Columbia University Press, pp. 161-190.

easy to solve: that individual would realize the destructive effect of his behavior and the carbon emissions leading to climate change would be curbed. But there are very large distributive consequences: some gain from the current arrangements. It is by and large the rich that gain, and the poor that suffer. Climate change may become an increasingly important force contributing to global inequality.

And yet, the high level of global inequality today – with powerful corporate interests blocking actions which would be in the common interest of global society – means that reaching a global agreement for reducing carbon emissions is proving extraordinarily difficult, even though the broader societal benefits are becoming increasingly clear. We have suggested some alternative approaches that might at least move us in the right direction faster than we have been moving recently.

HUMANITY'S RESPONSIBILITY TOWARD CREATION – AN ETHICAL AND ANTHROPOLOGICAL CHALLENGE

■ ARCHBISHOP ROLAND MINNERATH

What is at stake?

1. We should inquire how the different cultures of humanity relate to nature. Cultures shape human minds and give us an insight into humanity's readiness or not to accept changing its attitude in dealing with its natural environment. The purpose of our joint session is precisely to allow natural and social scientists to interact on the question of the interchanges between Humanity and Nature. So many conferences and symposiums have been dedicated to that issue, yet mainly with a descriptive and analytical approach. The perspective obviously affects not only social planners; it already has a profound impact on the daily living conditions of millions of people who have no proper access to water, food, shelter, healthy air and a future for their children.

Issues include concern for demographic growth, the economic unbalance between advanced industrial countries and less developed countries, the destruction of environmental capital resources. Resources are becoming exhausted, climate is changing; pollution devastates large cities; oceans are dying; population is increasing; nations close themselves in search of identity; globalisation progresses promising benefits yet arousing fears. International conventions try to rally governments to take preventive measures. Yet only one development model prevails.

The western development model relies on the assumption of an unlimited capacity of nature. It has exported worldwide its modes of exploitation and devastation of whatever the earth can produce. But other cultures also have little consideration for the precariousness of nature's resources.

As long as nature appeared as a huge inexhaustible reservoir, it could be exploited without fear. Now we have enough evidence that we cannot continue with the same scheme. Nature's resources are limited, some are renewable, and some are coming to an end.

2. Among scholars there are large areas of consensus with respect to decisions which have to be taken on a global scale. But these decisions are necessarily political. They involve all cultures and political systems, peoples

who are more or less informed about the real situation, more or less keen to abandon their dream to have a quick share in the richness of the North.

Three ecologic schools try to win adherents throughout the world, with the help of the media and the standardisation of human minds.

- The first one is shared by the political ecological movements for the moment. Environmental ecology still considers that humanity cannot live except in harmony with nature, even if nature plays the leading role in dictating its terms to humanity.
- The next is utilitarian ecology which denies any distinction between human life and animal life. All are sensate beings and want to avoid or at least lessen suffering. Well-being is seen as the absence of suffering whether physical or moral. Euthanasia is accepted as a means to promote well-being. Animals have as many rights as human to exist.
- The third class is deep ecology which maintains that nature has rights and humans have duties. The biosphere is the all-encompassing reality which prevails over all its components. In the biosphere the only danger is man as a predator both for other species and for nature. Nature is a subject. In order to let life develop freely, some in the vanguard even suggest that humanity should not exceed half a billion people.

Faced with the growing damage imposed by human action upon Nature, this new holistic ideology has set its objective: restore the autonomy of Nature by eliminating human impact on it.

This ideology has made room for a new kind of religion. The earth should be considered as a living entity – called Gaia. Gaia breathes and thinks through the humanity it has begotten. Through the Internet a common way of thinking is emerging that will impose itself, and Gaia will prevail over its adversaries. At the Earth Summit of Rio, as early as 1992, this new religion found proselytisers with the clear objective to supplant a Christianity that they accused of all sorts of evils.

A correct concept of nature

Something must change in our relationship with nature. After the analysis of the crisis, the time for action arrives. And action is ethical. It calls for responsibility, objectives, and convictions.

If we do not deliver a message of hope in some precise directions, our work will be useless. The new ideologies claim that the Jewish-Christian paradigm of Genesis (“go and subdue all creation”) is responsible for the devastation of the earth. Nothing is more false than such an assertion. Our Academy has dedicated one of its first sessions to Work. I had the opportu-

nity in that session to develop the meaning of work in the Bible and in the understanding of millions of people on earth.

The specific task of this Joint Meeting is to work out the relationship between Humanity and Nature. In this endeavour, the Social Doctrine of the Church (SDC) has a particular contribution to offer. The SDC offers a challenge both to the irresponsible devastation of Nature and to mistreating Humanity as a definite enemy of Nature. The SDC considers Humanity as the centre and the aim of the whole creation. Nature has been entrusted to Humanity like a garden to be cultivated with care, not for the use or misuse of a few, but in order to share its fruits with all for a decent life on earth.

Yet Humanity and Nature are not on the same level. Humanity is the subject. Nature is the object to take care of. It is the responsibility of Humanity to keep Nature “sustainable”. Devastation of Nature and exploitation of its resources have been performed by Humanity. Humanity has to be aware of the disastrous result of years of uncontrolled devastation of Nature. Now the time has come to change the paradigm.

Most contributions from PAS belong to the first step to be performed: becoming aware of the present situation and working out perspectives for the coming years. But this first step has to be completed by another one: which lever can we reasonably resort to in order to provoke a new orientation in the way Humanity deals with Nature.

Human behavior resorts to mental paradigms. The relationship of humanity with nature will never result from communication campaigns, scholarly evidence, and political options. It asks for deeper mental representations and implicit evidence. Some of these deeply based representations may have little objective connection with the huge problems at stake. Some may help in understanding the challenge. In the Jewish-Christian tradition, there is one fundamental belief which governs the others. The world of nature is the creation of God who is not nature. The distinction between Creator and creation is basic.

All that exists proceeds from God’s will, the physical, animal and human world. So in dealing with the relationship between humans and nature there appears a third element in play which changes the deal. If God is God, all humans and all creatures proceed from him. Creation or nature is what God entrusted to human beings. And human beings consider themselves as related to the same origin. From this derives a common feeling of fundamental equality between all these human beings, and a common responsibility towards this creation entrusted to them.

Where there is no reference to any transcendental Being, or to any common ultimate horizon of meaning, I doubt we could find among humans

the deep and unquestionable feeling that something has to be undertaken in common in order to save the future of our environment.

The awareness that God is a common Father of all humans and that nature must not be spoiled for the benefit of few, but should rather provide resources for all is grounded in deep religious paradigms that you will never be able to replace with reasoning, statistics and international conferences.

On all these issues, the Catholic Church has made specific contributions. Its main concern is to work out what is common to all persons and communities in order to obtain a collective change in our way of dealing with energy sources, in our methods of production and habits of consumption. The common foundation is always the dignity of the human person. Hence convincing people to move to more responsibility in dealing with natural goods appeals to the very conception we have of humanity itself.

The issue is anthropological

So the anthropological question is at the core of our PAS/PASS 2014 Joint Session. In his enlightened teaching, Pope Benedict often spoke of “human ecology”. This expression cannot be understood as a concession to holistic ideologies. It has to be put in its right anthropological context. Human persons are not objects but subjects of their interaction with nature. The idea is twofold: humans are a product of evolution, they are part of nature, but at the same time, they are the only species that has transformed nature in order to survive and to improve its living conditions. They are the only species able to reflect on what they are doing. Humans relate to nature as groups with specific cultures or representations of their place in nature. Looking at the history of civilization, what characterized the switch from pre-history to history is precisely the conquest of more rational dominion over nature, the organization into cities, and later communication through writing.

The first known civilizations developed huge representations of the place of man in the cosmos, between fear of its tremendous might and ability to capture its potentialities. Political power was thought as having to regulate human activity in agriculture and governance in accordance with the cosmic cycles. Humans indeed had the intuition that nature was a tremendous divine entity.

All schools of Greek philosophy considered the cosmos as eternal and thus divine. The powers of nature were object of worship and submission.

Something radically changed with the Bible. The world was no longer an eternal entity; it was the work of a creator God. The whole creation had a purpose which appears at the end of the Genesis chapter on the creation of man and woman. God entrusted all of creation to them: “be fruitful, multiply

fill the earthy and subdue it. Be master of the fish in the sea, the birds of heaven and all the living creatures that move on earth” (Gn 1, 28-29). So creation is not a blind or alien eternal reality which subdues humans endowed with intelligence and feeling. There is an inner connection between humans and nature. Thus emerges the sense of responsibility for humanity. Through his partners, namely, men and women, God continues his creative work. Humanity is associated with an endless process. God perpetually creates and protects his creation, not alone but with human collaboration.

The enlightenment movement in the 18th century was alien to the idea of an ongoing creative work of God. Most of the leading philosophers of that time shared the idea of a Creator who is mentioned as such in the American *Declaration of Independence*, or elsewhere under the abstract concept of “Supreme Being”. They rejected in fact the biblical teaching of a loving Creator who continues to take care of his creature. But they still had the idea of an ultimate Being who initiated all that exists and left it in the hands of humanity. So the Jewish-Christian tradition of the Creator and the western philosophy of the initiator of all that exists developed side by side for some time, without creating major clashes.

In both contexts, humans are thought of as being responsible for what occurs to nature. The gap between secular thinking and religion-based thinking appeared in the step that came afterwards.

In the secularized context, humanity considers itself as bound by no other law than the one it decides upon. In the traditional Jewish-Christian context, it is considered that there is an inherent order in the world which reflects the Reason of creation itself. Human intelligence is participation in the absolute intelligence which created the world. In this second case, there is a natural law understood as the right order of things as disclosed to human reason. The apprehension of this order is subject to progress and modification, in a deepening process of closer knowledge of the right order.

Natural law does not relate to the order of the physical world, but to the order of man in society, which is precisely the realm that modern thinking has preferred to leave to the arbitration of individual and social will.

Nature is challenged by culture, just as reality is challenged by its representation. In a time when nanotechnologies are able to replace brain cells and repair our neurons, what would nature be if not a raw material offered to our skills and power? Nature appears no longer as resistant data. Nearly nothing still resists to our will. Human will is now the last horizon of our future. It serves as a substitute for objective reasoning.

As long as we were under the regime of reason, we could expect to progress to an ever-growing objective knowledge of what exists, of the in-

herent order of things. Under the dominion of human will, everything is possible, the worst being more likely to have the advantage over the best. The shift from reason to will is not new. We only experience its consequences. It started with modern thinking when “*voluntas non veritas facit legem*”, as Hobbes nicely said.

The Social Doctrine of the Church

Sustainability of nature unavoidably has the advantage over humanity as its competitor. Yet the question could be approached differently if we start with the only thinking subject, namely humanity. Humanity is responsible for all the damage inflicted to nature. Humanity cannot survive without nature. Nature cannot survive without a mental conversion of humanity. So the right way is to start with the responsibility of man toward nature today and tomorrow.

This approach belongs to the sphere of human ethics.

This is why the social doctrine of the Church warns about the consequences of a world in which reason would be disguised as mere dominion of will, obviously the will of the more powerful.

If there is no inherent order in human behavior and human relationships, there is no right order for humanity to deal with nature and its resources. Otherwise everything is possible, as we can see.

As it has often been reminded in this room, the social doctrine of the Church relies on the assumption that man in nature is the creation of God and that the right relationship between human communities and their natural environment is in a way inscribed in the depth of our being.

The principles which govern our humanity in relation to nature are not arbitrary products of our will, but perceptions of our reason, as illuminated by divine revelation. These principles are the dignity of each single human person, the need for all human communities to work for the common good and the principle of the common destination of all the goods of the earth. This latter principle plays a particular role with respect to sustainability. Indeed, considering the human person under the concept of nature has little in common with the general consensus that seems to be shared in international debates today.

The world and its richness belong to all the human family. This is the ethical foundation of the whole issue of humanity towards nature. It has to be understood in the perspective of what we have said of the world entrusted to man in order to be developed for the advantage of all.

Once western thinking left God aside, nature was no longer a creature, but took the place of the Ultimate Being. It is not an exaggeration to see the

present ideological trends concerning Mother Earth as a return to the antique holistic philosophies, with the evident consequence that humanity becomes a mute part of a whole instead of being in charge of its stewardship.

Our concern is that we will never find a way out of the deterioration of nature as long as humans are not individually and collectively convinced that they bear responsibility for it. The social doctrine of the Church has always considered that ethical behavior is dictated by freedom. It would certainly be utopian to expect that a change in the way humanity deals with its natural environment could be obtained without the inner conviction of the all people involved.

NATURE AND THE LAW: THE GLOBAL COMMONS AND THE COMMON CONCERN OF HUMANKIND

■ EDITH BROWN WEISS

Many believe that we are entering a new geological epoch: the Anthropocene. Humans have now become a force of nature affecting our planet Earth on a geological scale and at a much faster rate than traditional geological speed. We have the power to affect the robustness and resilience of the planet. We have impacts on all spatial scales, from local to global.

There are many examples of our dramatic impact, ranging from decreased sediments in rivers, to accelerating rate of species extinction, to pollution of land, freshwater, oceans, and atmosphere, to the recently discerned speeding up of the carbon, nitrogen, and now the hydrological cycles. The 5th Report of the IPCC's Working Group II warns that our activities are already having profound effects on every continent and on our oceans, which pose many threats, especially to global food and fresh water.¹

The result is that our planet has now become in effect a global commons. Traditionally a commons constitutes an area to which one cannot prevent access to it. The atmosphere, oceans, the ocean-atmospheric system with its monsoon system and thermohaline circulation patterns, and the ozone layer are examples of global commons. Our climate is also a global commons, for no one can prevent access to the climate system or prevent interactions from human activities in disparate parts of the planet from affecting the climate. Even the ice of the Arctic Ocean and the glaciers of the Himalayas and Antarctica are put at risk by anthropogenic carbon dioxide emissions.

The global climate, and hence the resilience and the integrity of our planet, cannot be compartmentalized. While States have claimed and exercised national sovereignty over certain specific areas, which may be analogous to the privatization of a commons, they do not have the power alone to prevent threats to the planet or to ensure its survival. In this sense, they

¹ Intergovernmental Panel on Climate Change, Summary for Policymakers, Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014) http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf

inherently share the global commons of our planet. Their actions and those of many others also affect people's access to resources, such as fresh water, and to benefits derived from their use.

To view the Earth as a global commons that we all share does not require that we regard it as common property that we own. Many policies, such as for energy, agricultural, and water resources, are decided upon and put into effect at the local, national, or regional level. And yet, together they affect access to and the quality of resources and the Earth's resilience and integrity. Biological diversity and fresh water, although local or regional in character and subject to national jurisdiction, are in a broader sense a common concern of the global community. The international legal doctrine of the common concern of humankind, which was set forth for climate change and biodiversity in 1992, should be extended to the global commons, so that we explicitly recognize our responsibilities for conserving the commons. This point is developed later in this manuscript.

International law offers a useful perspective in which to view issues concerning the global commons. Law is an expression of agreed values and provides a normative basis for action. It can frame issues and give order to how we should think about them and what we should do about them. It creates expectations regarding behavior and offers predictability. It influences decision-making and processes for decision-making, and can facilitate cooperation and lead to the creation of new institutional arrangements to accomplish agreed obligations or goals. For the global commons, international law speaks to the development and implementation of principles and legal instruments to protect the natural and human sustainability of our planet, both locally and globally.

One must view the global commons through two distinct lenses: the intergenerational lens, which is long-term ranging from the next generation to decades or even centuries hence; and the kaleidoscopic lens, which is a bottom-up approach focused on the actions of those who affect the commons and are affected by it.

I. The Intergenerational Framework

All generations – past, present, and future – are linked in the global commons of the Earth. We are part of the Earth and both profoundly affect the Earth and are affected by it. Since we are the most sentient of living beings on the Earth, one could argue that the Earth constitutes common property for us, but this could imply that we could do with the Earth whatever we wanted to do. Rather we are intrinsically part of the system and, in this sense, we are owners of the global commons.

The thesis is that we hold our planet in common with past, present, and future generations. If we view our planet as a trust, we are at the same time trustees of the planet for future generations and beneficiaries with the right to access and benefit from the trust.

This perspective has deep roots in many different cultural, religious, and legal traditions. In the Judeo-Christian tradition, God gave the Earth to his people as an everlasting possession to be passed on from generation to generation. In the Islamic religious tradition, man has inherited all the resources of life and nature and has certain religious obligations to God in using them. Each generation makes the best use of the Earth without upsetting the interests of future generations. No generation owns the Earth permanently. The nontheistic traditions in Asia and South Asia also respect nature and our responsibilities to future generations as stewards of the Earth. They stress living in harmony with nature.

Both the common law and civil law legal traditions also reflect the perspective of a trust to be used and cared for by each generation. In the common law tradition, John Locke, for example, posits that whether by natural reason or by God's gift to Adam and his posterity, humankind holds the planet in common. We have an obligation not to take more of the fruits of nature than we can use, so that they remain for others to use. We ought not to waste the fruits of nature. In the civil law tradition, Germany recognizes social obligations that are inherent in the ownership of private property. Karl Marx proposed that all communities were only in possession, or users, of the Earth, with obligations to conserve it for future generations.

African customary law is striking in that it generally recognizes that we are only tenants on Earth, and thus have obligations to both past and future generations to care for the Earth. The Chief is like a trustee who holds the Earth in common for the use of the community. Customary laws and practices of many traditional peoples all over the world also view nature as held in common by the community and thus impose obligations on its use so that it will be available to future generations.

These examples show that the concept that we hold the Earth in common with past, present, and future generations – that we act as trustees or stewards of the Earth – has deep cross-cultural roots. It can provide the basis for recognition of a common ownership of the Earth that both gives entitlements of access and use and imposes restrictions on that access and use.

Principle of Intergenerational Equity

The principle of intergenerational equity holds that all generations are partners in caring for and using the Earth. The present generation must pass

the Earth and our natural and cultural resources on to future generations in at least as good condition as it received them so they can meet their own needs. This obligation applies both to diversity and quality. It leads to robustness and resilience of the human environment.

The principle is a foundation for sustainable development and is found in diverse juridical writings and legal instruments.² As we have seen, it is broadly acceptable across diverse cultures and religious traditions. In international law, the principle builds upon the use of equity, initially formulated by Aristotle and elaborated by Grotius, as addressing cases not covered by universal law. In the 20th century, equity has been invoked more broadly as a basis for allocating and sharing resources and for distributing burdens.

The principle of intergenerational equity has three intergenerational elements: comparable options, comparable quality, and comparable or nondiscriminatory access. These elements are consistent with the following criteria: a) to encourage equality among generations; b) not to require the present generation to predict the values and preferences of future generations, but rather to give future generations flexibility to achieve their own goals; c) to be reasonably clear in application to foreseeable situations; and d) to be generally shared by different cultural traditions and generally acceptable to different economic and political systems.

The first element, “comparable options”, calls for conserving the diversity of the natural resource base so that future generations have a robust and flexible inheritance with which to achieve their own well-being. This means, for example, conserving biological diversity, respecting recharge rates in using fresh water from renewable ground water aquifers, conserving germplasm and local understanding of the plant environment, conserving productivity of soils, and constraining the use of fossil aquifers according to certain criteria. Conserving options is especially relevant for adapting to climate change.

The second element, “comparable quality”, calls for ensuring that the quality of the environment left to future generations is *on balance* in no worse condition than received. At any given time, we may both degrade and protect or improve the environment. Hence, the reference is to “on balance”. Some actions generate long-term, even irreversible serious harm. For example, pollution of ground water is difficult and costly to reverse. Flushing persistent toxic chemicals from lakes through natural processes

² See, e.g., Edith Brown Weiss, *In Fairness to Future Generations: International Law, Common Patrimony, and Intergenerational Equity* (Dobbs Ferry, N.Y.: United Nations University, Transnational Publishers, 1989); “Intergenerational Equity”, *Max Planck Encyclopedia of Public International Law*, Vol. V (Oxford: Oxford University Press, 2012 and online).

may take a century, as it does, for example, in Lake Superior in the United States. Disposal of nuclear wastes can lead to long-term contamination. Desertification of soils renders them unproductive. We should avoid these actions. But other actions, such as those that result in the cutting of forests or the taking of ground water in excess of recharge rates can be offset by replanting or conservation of forests elsewhere or by the carrying out and implementation of water research into more efficient transport and use of fresh water.

The third element, “comparable or nondiscriminatory access” gives members of the present generation a reasonable, non-discriminatory right of access to the environment and natural resources to use for their own benefit and provides for equitable non-discriminatory access to future generations. This suggests, for example, that the real price of resources to future generations, at least to immediate ones, be comparable to the present value. In the context of climate change, the element of access suggests that measures to adapt to climate change try to provide comparable or nondiscriminatory access to resources and environmental benefits for future generations.

The principle of intergenerational equity imposes obligations on the present generation to future generations. The 1997 UNESCO Declaration on Responsibilities to Future Generations focuses on such obligations.³ Obligations do not necessarily entail corresponding rights. In the context of future generations, one can argue that future generations have rights and the present generation has obligations to respect those rights. Rights of future generations are not individual rights. Rather they are generational rights, which can be usefully conceived only at a group level. They are in the nature group or collectively held rights in relation to other generations – past, present, and future. They exist regardless of the number and identity of the people who exist in each generation.

Rights of future generations are rights to diversity and quality comparable to those enjoyed by previous generations. Both of these can be evaluated by objective criteria and indices. Enforcement of these rights would appropriately be done by a guardian or representative of future generations as a group, not of future individuals, who are necessarily indeterminate. Implementation of the rights of future generations could, for example, mean giving a voice to the interests of future generations in the decisions we take today, such as those decisions related to climate change.

³ UNESCO, Declaration on the Responsibilities of the Present Generations Towards Future Generations, Nov. 12, 1997, http://portal.unesco.org/en/ev.php-URL_ID=13178&URL_DO=DO_TOPIC&URL_SECTION=201.html

Intergenerational equity and intragenerational equity may appear to clash, in the sense that resources should be devoted to resolving the great inequities that exist today rather than addressing the concerns of future generations. Indeed, many people are too poor today to have effective access to the benefits of the resources of our planet. This also, however, affects our ability to conserve the planet for future generations. From the intergenerational perspective, as our concerns extend further in time, we can conserve our resources for our descendants only by conserving the environment in which they will live. This in turn means that we need to assist impoverished people and communities. Their willingness and ability to meet obligations to future generations is conditioned upon having access now to the benefits of their environmental legacy. Thus addressing the severe problems of poverty and inequality, especially within countries, can be seen as a critical part of the intergenerational issue.

One can argue, further, that intergenerational equity encompasses intragenerational equity as an integral element of the principle. Once future generations become part of the present generation, they have obligations toward members of the present generation that reflect their intergenerational obligations. Thus, the intergenerational element of access gives members of the present generation, defined as living persons, reasonable, nondiscriminatory rights of access to resources to use to improve their own economic and social well-being, with the obligation to respect their obligations to future generations. Thus, in the intragenerational context, the realization of the intergenerational principle of conservation of access means that all peoples should have a minimum level of access to the Earth and its resources today for their own benefit.

While this intragenerational component flows from the principle of intergenerational equity, it could also be regarded as an independent component, which is not required by the principle. In international law, the principle of intergenerational equity has been accepted as defining the obligations among generations, and for many, both the rights and the obligations of future generations, but not the issues of equity among those living today.

Implementation of a Principle of Intergenerational Equity

Governments habitually avoid addressing the long-term. Sustainable development and other goals require paying attention to the long term. The principle of intergenerational equity puts the focus on the long-term and requires that the interests of future generations be considered in our decisions today.

Actions implementing a principle of intergenerational equity are increasing. We turn first to some of the specific developments in institutions

and in judicial cases at the international, national, and local levels, and then to the general strategies needed to implement the principle.

At the international level, civil society has led a push to establish a formal position representing the interests of future generations within the United Nations. The August 2013 Report of the UN Secretary-General on *Intergenerational Solidarity and the Needs of Future Generations* references several options, including a United Nations High Commissioner for Future Generations or a Special Envoy for Future Generations. At the national level, Finland has established a permanent parliamentary Committee for the Future; the Hungarian Parliament created an Ombudsman for Future Generations, which is now under the Commissioner for Fundamental Rights; the Israeli Knesset created a Commission for Future Generations, which while dissolved is now under consideration to be recreated, and the German Bundestag established the Parliamentary Advisory Council on Sustainable Development to serve as the advocate of long-term responsibility. The functions vary from issuing reports to intervening in the judicial process, as in the case of Hungary. The first meeting of all the national institutions concerned with future generations was held in Budapest, Hungary, in late April 2014. The principals have agreed to meet annually to exchange information and experiences on a regular basis.

National courts have also used a principle of intergenerational equity in their decisions. These include courts in New South Wales, Australia, the National High Court of Brazil, the High Court of Kenya, the Supreme Court of India, courts in New Zealand, and the Supreme Court of the Philippines, among others. These developments are especially significant because a principle of international law is being invoked domestically or otherwise found in national constitutions or statutes.

To implement a principle of intergenerational equity in a broader context, we need to adopt an intergenerational lens to identify appropriate strategies. These strategies may include, but are not limited to, the following:

1. Representation for the interests of future generations in decision-making and in other appropriate venues
2. Sustainable use of resources, especially including soils
3. Long-term integrated, intergenerational assessments, monitoring, and transparency
4. Scientific and technological research and development on long-term issues that the private sector does not otherwise fund, such as monitoring of ground water pollution and certain resource use
5. Attention to the cost and ease of maintaining projects or programs when deciding whether to undertake them

6. Codification of norms and promotion of shared values
7. Education for conserving diversity, quality, and access for present and future generations

These and other strategies are appropriately pursued at all levels and are consistent with the rapidly emerging bottom-up empowerment described below. We need to engage all actors at all levels in taking actions to conserve our global commons for present and future generations.⁴

II. The Kaleidoscopic World with Bottom-up Empowerment

At the same time that we are being forced in the Anthropocene Epoch to confront our responsibilities for the Earth as a global commons, we are an international community that is becoming more and more a kaleidoscopic world, with increased integration and fragmentation, millions of new actors, rapid communication, and rapid change. Governance, or management, of the many systems, whether directly or indirectly, is becoming ever more challenging and difficult. At the same time, we face powerful threats of top down control, which further complicates governance issues.

In the new kaleidoscopic world, information technology is transforming the participation of individuals, *ad hoc* coalitions, nongovernmental organizations, transnational networks, business groups, religious orders, communities and other groups in governance at the international, national, regional, and local levels. States and international organizations remain critical players, but the international system is less hierarchical and much more chaotic than before. There is an explosion of bottom-up initiatives and empowerment. This has important advantages but also raises important issues.

Integration and fragmentation in the international system are taking place at the same time. States now number more than 195, as opposed to little more than 50 when the United Nations was founded. According to the 2013–2014 Yearbook of International Organizations, there are over 26,000 active intergovernmental and international nongovernmental organizations, and if special international organizations, including religious orders and secular institute, and inactive ones are included, the total number rises to over 66,000.⁵ In addition, numerous networks and other significant groups operate across national borders.

⁴ For a comprehensive report on steps for decision-makers to take to address the future, see *Now for the Long Term*, Report of the Oxford Martin Commission for Future Generations (Oxford: Oxford University, 2013).

⁵ Union of International Associations, *Yearbook of International Organizations 2013–2014* (Leiden: Brill, 2013). The data was collected in 2012.

In the new situation, informal groups, *ad hoc* coalitions and individuals are becoming important participants in helping to conserve or to desecrate our planet. Information technology enables people to create cross-border coalitions, which constantly shift in focus and followers. There are myriads of informal groups, communities, and special interests, and millions of individuals that can affect the governance of the commons. As of June 2014, Tumblr reported 191 million blogs.⁶ In February 2014, the blogging tool WordPress reported 77 million WordPress sites, with 409 million unique monthly users per month.⁷ In November 2011, BlogScope tracked more than 57 million blogs across the different sites, with 1 billion posts. At that time, blogs were already read daily by 346 million people in 81 different languages, with 900,000 unique blog posts on average every 24 hours.⁸ Twitch, a live video streaming site, reported 900,000 unique broadcasters per month at the end of 2013, while YouTube reported that 100 hours of video are uploaded to YouTube every minute.⁹ The microblogging social networks report similarly large numbers. In April 2014, Twitter reported 255 million monthly active users as of March 31, 2014, 198 million of which were mobile monthly active users.¹⁰ In July 2013, Burson–Marsteller released a study that found that more than three-quarters of States had a Twitter account.¹¹ There are many more social networking sites than those referenced here.

Mobile phones are widely used to help organize coalitions and actions, whether locally or across national borders. While many poor people still do not have access to mobile phones, access is rapidly increasing across Africa, Asia and Latin America. Cell phones are the fastest diffusing technology in history. These explosive developments in communications technology mean

⁶ <https://www.tumblr.com> Yahoo, which acquired Tumblr in June 2013, indicated that Tumblr receives 300 million unique monthly visitors, though experts believe the number may be significantly lower, J. Yarrow, “The Truth About Tumblr: Its Numbers Are Significantly Worse Than You Think”, *Business Insider*, May 21, 2013, <http://www.businessinsider.com/tumblrs-active-users-lighter-than-expected-2013-5>

⁷ WordPress, “Stats”, <http://en.wordpress.com/stats/>

⁸ BlogScope, <http://www.blogscope.net/> The site has been discontinued as of April 2012, but the BlogScope technology has been channeled into www.sysomos.com since 2007.

⁹ Twitch, “2013 Retrospective”, <http://www.twitch.tv/year/2013>; YouTube, “Statistics”, <http://www.youtube.com/yt/press/statistics.html>

¹⁰ Twitter, “Twitter Reports First Quarter 2014 Results”, Apr. 29, 2014, <https://investor.twitterinc.com/releasedetail.cfm?releaseid=843245>

¹¹ *Twiplomacy: Heads of state and government on Twitter, July 2013* (2013), http://twiplomacy.com/wp-content/uploads/2013/12/Twiplomacy_countries.pdf

that many groups and especially individuals can participate directly in so-called governance of our global commons and its innumerable local aspects. We may characterize this as “bottom-up empowerment”.

Bottom-up empowerment is taking place across the globe. Examples include the campaign to ban land mines, which led to the conclusion of an international treaty, the significant protests in London against the treatment of Tamil people in Sri Lanka, which led to pressures on the government in Sri Lanka, so-called color and velvet revolutions in the Ukraine and areas of Central and Eastern Europe, and the Arab Spring. Actions in civil society in one part of the world can quickly go viral today.

Bottom-up empowerment also is taking place across different sectors of the world, which involve the world economy. The creation of Bitcoin and other new electronic forms of money and the development of thousands of small businesses that operate through the Internet illustrate this new and growing phenomenon. Kiva and other informal groups that seek funds from thousands of donors on the Internet for specific development projects and the emergence of crowd sourcing as a source of funds for a specific new project illustrate the growing bottom-up empowerment. Bottom-up initiatives are doing things that in the past have been associated with initiatives of governments or of large businesses. Thus, if we want to address issues of sustainability for the global commons effectively, it will be essential to recognize and use the bottom-up initiatives that are possible in this new kaleidoscopic world.

There is a substantial literature on governing a commons, which is relevant to governance in the kaleidoscopic world.¹² People have been organizing among themselves for centuries to use resources, which may give at least some hope that we can organize at multiple levels and places for sustainability.

The Importance of Values

In the new kaleidoscopic world, effective governance requires a set of common values. Such common values are particularly important for voluntary commitments to be effective for the global commons. These com-

¹² See, e.g., Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (New York: Cambridge University Press, 1990) and subsequent work. For legal literature, see Burns H. Weston and David Bollier, *Green Governance: Ecological Survival, Human Rights, and the Law of the Commons* (New York: Cambridge University Press, 2013).

mitments must be based on the normative value of sustainability, and on other equally important values, such as intergenerational fairness and social and economic equality. Traditionally international agreements reflect such values and articulate shared commitments, and States have the responsibility to implement them. In the kaleidoscopic world, the common values and shared commitments must also flourish from the bottom up. Because local communities, informal or transient groups of participants, or individuals will increasingly be able to influence the development and commitment to international agreements and other legal instruments, the sharing of common values becomes essential to effective governance. Otherwise, voluntary commitments to sustainability will be wholly insufficient to achieve even modest sustainability goals, or worse, only a fig leaf for inaction.

Since as part of the revolution in information technology, individuals can communicate globally and are doing so in rapidly increasing numbers, the youngest generation is growing up with an outlook that assumes that people can communicate with others elsewhere. This development may provide a means for fostering shared values about sustainable development and conservation of the integrity of our planet.

Religious institutions have significant influence in fostering the values of sustainability, environmental justice, and fairness to future generations. Sustainability depends upon the ethical principles of the people who decide every day what actions to take. This in turn, at least in part, is likely to reflect principles that have been widely discussed and publicized and have been endorsed by religious and political leaders.

The Doctrine of the Common Concern of Humankind

New legal principles and doctrines are emerging that are critical to protecting our global commons. The principle of intergenerational equity represents one such development. The second is the concept and evolving doctrine of the “common concern of humankind”.

If, in the new Anthropocene Epoch, we were to designate our planet as a global commons, the legal doctrine of common concern of humankind would serve as the legal basis for developing new commitments to sustainability. These could take place in all sectors and at all geographical levels.

The legal concept of the common concern of humankind first emerged as a distinct concept in the parallel negotiations for the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity, which were prepared for the 1992 Rio Conference on Environment and Development. The Preface to the UNFCCC “acknowledges” that “changes in the Earth’s climate and its adverse

effects are a common concern of humankind". The Preface to the Convention on Biological Diversity "affirms" the conservation of biological diversity as "a common concern of humankind".

The terminology is intended to distinguish the concept from the by then familiar legal concept of the "common heritage of mankind", which had been developed and primarily used to refer to the deep seabed resources and to outer space.¹³ Traditionally the doctrine of "common heritage of mankind" has been associated with notions of property in the sense that everyone or every State may have a property interest in anything that is so designated. One may argue that such property could be regarded as "*res communis*" or owned in common. This need not follow, for the 1972 World Heritage Convention provides for States to put natural or cultural sites located within their country on a World Heritage List, and this does not mean that the site has become *res communis*.¹⁴ Except for this singular example, States have been exceedingly reluctant to adopt any terminology that could suggest they are relinquishing any property interest in areas under their jurisdiction or control. For centuries they have exercised national sovereignty in such areas. By developing the concept of "common concern of humankind", one can avoid the focus on a property interest and focus instead on the common interest that all have in protecting the resources and environmental systems essential for humankind.

The concept of common concern of humankind has never been articulated in detail in any legal instrument. From 1990–1991, the United Nations Environment Programme (UNEP) hosted a group of legal experts to examine the concept. The report of the final meeting of the group noted that "the concept... was sufficiently flexible to warrant its general acceptance as providing a broad basis for the consideration of environmental issues... and should relate both to environment and to development".¹⁵ Since 1992, there has been only limited attention to the concept until recently. Scholarly writing has proposed that access to and quality of fresh water should be

¹³ For writings, see Prue Taylor and Lucy Stroud, *Common Heritage of Mankind: A Bibliography of Legal Writing* (Valletta, Malta: Fondation de Malte, 2013).

¹⁴ Convention Concerning the Protection of the World Cultural and Natural Heritage, Nov. 16, 1972, 1037 UNTS 151.

¹⁵ United Nations Environment Programme, Beijing Symposium on Developing Countries and International Environmental Law (Beijing, China, August 12–14, 1991); Antônio Augusto Cançado Trindade, *International Law for Humankind: Towards a New Jus Gentium*, 2nd rev. ed. (Leiden: Hague Academy International Law, Martinus Nijhoff, 2013).

viewed as a common concern of humankind,¹⁶ and there are incipient efforts to explore its application more broadly in other fields.

Voluntary Commitments

In the Anthropocene Epoch and the new kaleidoscopic world, legal instruments are and will be important for codifying values, for specifying obligations and for trying to ensure that commitments are followed, whether by States, other groups, or individuals. They shape the way actors are expected to behave.

The new kaleidoscopic world has significant implications for these legal instruments and processes. We are accustomed to thinking of international law as consisting of binding international legal agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Montreal Protocol on Substances that Deplete the Ozone Layer, or the Convention on Biological Diversity.¹⁷ But non-binding legal instruments, commonly referred to as “soft law”, have become increasingly important in addressing new problems, in taking first steps to address an old problem, or in putting in place an instrument to address a rapidly evolving problem. In the case of the Arctic, for example, countries adopted a non-binding Declaration on the Arctic, which led to the creation of the Arctic Council, under whose auspices a binding agreement was recently negotiated.¹⁸

The new century of “bottom up empowerment” is leading to the emergence of a new legal instrument to address problems of the global commons, namely voluntary commitments. This is not only because there are over 195 States, who must agree to specific obligations, but as importantly because the many groups of nonstate actors and individuals must commit to taking actions. While States remain central for certain functions such as security, these other actors are essential in performing other functions. Their embrace of common goals and commitments is essential to achieving them.

¹⁶ Edith Brown Weiss, *International Law for a Water-Scarce World* (Leiden: Hague Academy International Law, Martinus Nijhoff, 2013).

¹⁷ United Nations Framework Convention on Climate Change, May 9, 1992, 1771 UNTS 107; Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 1522 UNTS 3; Convention on Biological Diversity, June 5, 1992, 1760 UNTS 79.

¹⁸ Declaration on the Establishment of the Arctic Council, Sept. 19, 1996, 35 *International Legal Materials* 1382 (1996). Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, May 15, 2013, <http://www.arctic-council.org/eppr/agreement-on-cooperation-on-marine-oil-pollution-preparedness-and-response-in-the-arctic/> The agreement provides for provisional application pending the receipt of necessary documents from member States to become party.

Voluntary commitments are to be distinguished from international agreements and nonbinding legal instruments. Voluntary commitments are not taken pursuant to a binding or nonbinding international legal instrument, which embody a consensus reached by the negotiating parties. Rather they are undertaken voluntarily, pursuant to shared objectives or goals or to common undertakings.

States themselves are resorting to such voluntary commitments. For example, when States could not agree in Copenhagen in 2009 on specific binding or even non-binding commitments to limit greenhouse gases, 141 States subsequently made voluntary nonbinding commitments to limit greenhouse gases.¹⁹ The Copenhagen Accord on climate change had no legal status, since the Conference never adopted it. In the case of climate change, we could have a new binding international agreement in which individual countries voluntarily make whatever commitments they deem appropriate, if agreement on specific binding commitments to control greenhouse gases cannot be reached.

This new emphasis on voluntary commitments extends especially to private industry, nongovernmental organizations, and others, which are increasingly making voluntary commitments to promote sustainability and other goals. The United Nations Global Compact, for example, has three principles for businesses that directly concern environment: support a precautionary approach to environmental challenges, undertake initiatives to promote greater environmental responsibility, and encourage development and diffusion of environmentally friendly technologies. As of June 2014, the Compact had over 12,000 participants in more than 145 countries.²⁰ An increasing number of international initiatives solicit and publish voluntary commitments by States, private industry and nongovernmental organizations to sustainable development. Most initiatives record and collect these commitments in their own separate registries.

The United Nations hosts at least several such initiatives: The UN Sustainable Development Knowledge Platform established in preparation for the Rio+20 conference in 2012; the Sustainable Energy for All, initiated by the United Nations Secretary General to obtain commitments by gov-

¹⁹ States submissions are available at https://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php See also US Climate Action Network, <http://www.usclimatenetwork.org/policy/copenhagen-accord-commitments>

²⁰ United Nations Global Compact, <http://www.unglobalcompact.org> Figures are compiled from database which can be searched by participants or countries.

ernments, industry and civil society to take actions to ensure global access to sustainable energy by 2030, and the UN Global Compact referenced above.²¹ There are also multiple private sector initiatives, such as the Clinton Global Initiative, the Corporate Eco Forum, which is a membership organization of large companies which publishes commitments to sustainability, and the Natural Resources Defense Council's Cloud of Commitments, which provides an international registry which aggregates commitments from various initiatives.²²

Notably, these registries and sites do not yet gather data on compliance with commitments, and there are generally no reporting requirements. We do not know whether those who make the commitments are successful in reaching their goals. Voluntary commitments are often made because they enhance the reputation of those making them, though according to some research, there is little evidence that sales or share prices reflect these commitments.²³

There are several technical problems with voluntary commitments. They may be enunciated in different formats, which make it hard to compare and to assess the aggregate progress in advancing toward sustainability. Monitoring is difficult, since there may be hundreds, or thousands of commitments in different formats and with different content. It would be helpful to have platforms that compile and aggregate individual commitments and that make them readily accessible online. It would be even better to have a system of reporting on implementation and results and systematic monitoring of what is actually happening on the ground. In the absence of even a reporting requirement, it may be difficult to detect "green-wash" and distinguish it from genuine commitments to sustainability.

In the bottom-up kaleidoscopic world, accountability will be ever more essential and at the same time difficult. Not only governments, but the private sector, nongovernmental organizations, ad hoc coalitions, and individuals need to be accountable for their actions. The traditional ways of holding institutions and people accountable, namely by determining post hoc whether they have met their obligations and imposing sanctions if they have

²¹ United Nations Sustainable Development Knowledge Platform, <http://sustainabledevelopment.un.org>; Sustainable Energy for All, <http://www.se4all.org/>; United Nations Global Compact, <http://www.unglobalcompact.org>

²² Clinton Global Initiative, <http://www.clintonfoundation.org/clinton-global-initiative/commitments/>; Corporate Eco Forum, <http://corporateecoforum.com>; Natural Resources Defense Council, "Cloud of Commitments", <http://cloudofcommitments.org>

²³ See, e.g., David Vogel, "The Private Regulation of Global Corporate Conduct: Achievements and Limitations", *Business & Society*, 49: 68-87 (2010).

not, are not sufficient for making innumerable actors in rapidly changing contexts accountable. At the same time, it is essential not to saddle a bottom-up world with accountability requirements that pose such significant administrative costs or are inappropriate to local conditions so as to discourage innovation and badly needed actions. It will take time to work out an appropriate balance, but it is important to begin to do so.

III. Concluding Comment

Two major developments confront us. The first is that we are entering a new geological Epoch of the Anthropocene, in which we humans are a major force of change. The second is the emerging kaleidoscopic world, with millions if not several billion participants, which features bottom-up initiatives and empowerment. Our Earth has become a global commons. Cumulatively, actions taken across the world affect its resilience and integrity. Increasingly we face problems with serious long-term implications for the well-being of future generations. Changes can be rapid. Bottom-up empowerment can collide with top-down efforts to control it. In this complex, dynamic setting, shared values and widely accepted legal principles will be central to the stability of the international system. The legal principle of intergenerational equity and the doctrine of the common concern of humankind can provide bases upon which to address the sustainability of Earth and to ensure its resilience and integrity for present and future generations. Religious institutions have a very important role to play in fostering such common values, so that they are diffused and accepted among diverse peoples. These institutions affect billions of people. They can become a major force for addressing the sustainability of the Earth as a global commons.

IX. SOCIAL INCLUSION

TOWARDS A SOCIAL BALANCE OF THE CURRENT GLOBALIZATION

■ JUAN J. LLACH

1. Current globalization overview

For the last quarter century our world has been experiencing one of the most intense periods of globalization, loosely defined here as those of above normal migrations, trade and investments across political borders. This paper is a first, very preliminary and synthetic essay on a social balance of this last quarter century. As it frequently happens when dealing with issues like these, black-or-white assessments tend to predominate in public discussions and debates. In contrast, nowadays the world looks to us like a multi-faceted polyhedron. On the positive side, we find that for the first time since the Western empires' expansion in the 15th century the per capita GDP of Africa, Asia and Latin America has begun to converge with that of the developed countries (Table 1). Associated to that process our world has witnessed an astonishing growth of the world's populations, particularly since the early 20th century, an expansion that would have not been possible without a significant improvement in living and, particularly, in health conditions (Table 2).

Table 1. Convergence for the first time in centuries.

Year	Ratio
1	100%
1500	78%
1820	47%
1950	19%
1990	15%
2010	19%
2040	45%*

Source: own estimates based on Maddison Project (web) and R. Fogel (2007).

Table 2.

Year	Billion
1804	1
1927	2
1960	3
1988	5
2012	7
2046	9

Source: UNDP estimates.

As a matter of fact, the human life conditions of billion people have significantly improved along the last quarter century. Extreme poverty has fallen both in absolute and relative (%) terms although with big variations across regions and countries and there have been very diverse geographically progresses in health, nutrition and education.

On the negative side, and in the same process, new forms of social exclusion and destitution either appeared or increased. They include structural unemployment; the NEET phenomenon, i.e., growing amounts of youngsters that are not in employment, education or training; increasing elderly populations whose lives confront serious risks; marginalized immigrants and, what is perhaps the most evident, ever growing numbers of people living in slums, particularly in emerging countries, without access to formal jobs nor to most of the conditions of modern wellbeing. Finally, even when most of the evidence shows that the distribution of wealth and income, considering the whole world, has somewhat improved, it has worsened in most of the countries taken one by one and shows in some of them increases even in the shares of the superrich “1%” or less of the population.

2. Demography and Social Security

A huge population increase has not been the only recent relevant demographic change. Ageing is another and it poses tough challenges. By 2050 ageing-related public spending will amount to 15–25% of GDP in developed countries (Table 3) and it will be very difficult to get resources to care for the elderly, especially in slow-growing economies where public pension schemes and old-age health plans are patently unsustainable (Table 3). Soaring public debts exacerbate the problem, because future generations are being asked both to service our debt and to pay for our retirement (K. Rogoff, 2014).

Table 3. Ageing-related public spending pressures are mounting in % of GDP (assuming unchanged policies).

	Old-age pension outlays		Health and long-term care spending	
	circa 2000	circa 2050	circa 2010	circa 2050
Belgium	9.0	15.0	6.3	10.0
Canada	4.7	6.4	6.3	10.5
France	12.1	14.5	6.9	9.4
Germany	11.8	13.8	3.7	8.8
Italy	14.2	14.0	5.5	7.6
Japan	7.9	8.5	3.8	8.2
Netherlands	5.2	8.3	7.2	12.0
Sweden	9.2	10.8	8.1	11.3
Switzerland	7.2	10.8	3.8	10.3
United Kingdom	5.0	5.0	7.0	11.0
United States	4.4	8.2	2.0	7.0

Source: Visco *et al.* (2005).

3. Nutrition and Health

In spite of clear progresses huge weaknesses and challenges remain ahead (Table 4).

Life expectancy. There have been very significant progresses in East Asia and LATAM, not as much in South Asia and just a little in Sub-Saharan Africa. This last subcontinent must be at the core of future policies.

Under-five mortality. The picture is very similar to life expectancy, with significant progresses in East Asia and LATAM, less in South Asia and much less in Sub-Saharan Africa where it is too high yet.

Undernourishment. In spite of lower percentages, there are still too many undernourished people. In 2012 they were 980 million globally, 220 million of them in low-income countries and 760 million in middle-income ones. This is clearly far from the potential of a world in which food waste is huge and widespread.

Table 4. Health and nutrition indicators.

	Life expectancy at birth (years)		Under-five mortality: Per 1000 people		Undernourishment: % of population	
	1991	2012	1990	2012	1991	2012
World	66	71	30	48	23	14
Low income	53	62	105	82	35	26
Middle income	65	70	37	45	22	12
High income	75	79	11	6	8	8
Low income regions						
East Asia & Pacific	68	74	39	21	24	11
South Asia	59	67	125	60	27	17
LATAM	68	74	25	19	13	8
Sub-Saharan Africa	50	58	177	58	28	22

Source: World Bank.

4. Economic growth

The world is not only witnessing convergence between the GDP per capita of developed and developing countries for the first time but it has also been accelerating since the beginning of the 21st century (Table 5). Africa is converging for the first time in history.

5. Poverty and exclusion

5.1. Extreme poverty

Conventionally measured as people living on less than US\$ 1.25 per day, extreme poverty has been steadily declining since 1990 both in relative (%) and absolute terms (Table 6). It's not by chance that the absolute number of people under the extreme poverty line coincides almost exactly with that of undernourished people.

Table 5. GDP pc growth: 1960-90, 1990-2010, 2005-2012.

	1960-90	1990-2010	2005-2012
World	2.1	2.1	1.1
Developed countries	3.5	1.2	1.0
Western Europe	2.9	1.4	---
Western Offshoots	2.4	1.4	---
Japan	5.3	0.8	---
Emerging countries	2.2	2.6	4.8
Eastern Europe	1.9	2.4	---
Former Soviet Union	1.9	0.6	---
Latin America	1.6	2.0	---
East Asia	3.8	4.4	---
West Asia	2.3	2.0	---
Africa	1.0	1.8	---
China	3.5	7.6	---
India	1.9	4.9	---

Table 6. Extreme poverty: World population living on less than 1.25 US\$ (2005 PPP).

	1990	1999	2010	2015
Persons (million)	1908	1743	1215	970
% of world population	43.1	34.1	20.6	15.5

Source: World Bank.

There has been a positive association between economic growth and poverty reduction as extreme poverty fell roughly 1 percentage point every 3.5% of GDP growth. However, this ratio has been increasing from 3.33% in 1990–99 to 3.73% in 1999–2010, i.e., it has been more expensive to reduce poverty alongside with economic growth, which implies the need to improve its pro-poor effects.

However, as a consequence of the huge under-reporting of income in the household surveys on which poverty measurement is based, alternative estimates of it give very different results. The most recent and ingenious, shown in Figure 1 in the case of India, is based on nighttime pictures taken from satellites. The increase of illumination consumption between 1994 and 2010 is evident and very probably higher than the twofold decrease in India's poverty rate. According to the authors of this new estimate (M. Pinkovskiy and X. Sala-i-Martin, 2014) the largest estimate of world poverty with the new method in 2010 is 12.1%, in sharp contrast with the 20.5% using currently survey means; East and South Asia is experiencing a more rapid poverty reduction and Sub-Saharan Africa is also reducing (not as fast) its poverty by 30%, which is still more rapidly than the current estimate of 20%.

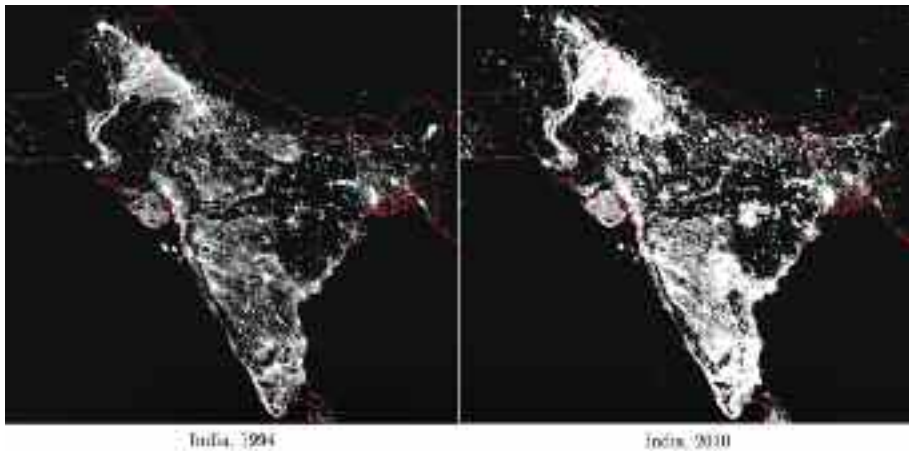


Figure 1. Alternative estimates of poverty. India at nighttime as seen from satellites. Source: M. Pinkovskiy and X. Sala-i-Martin (2014).

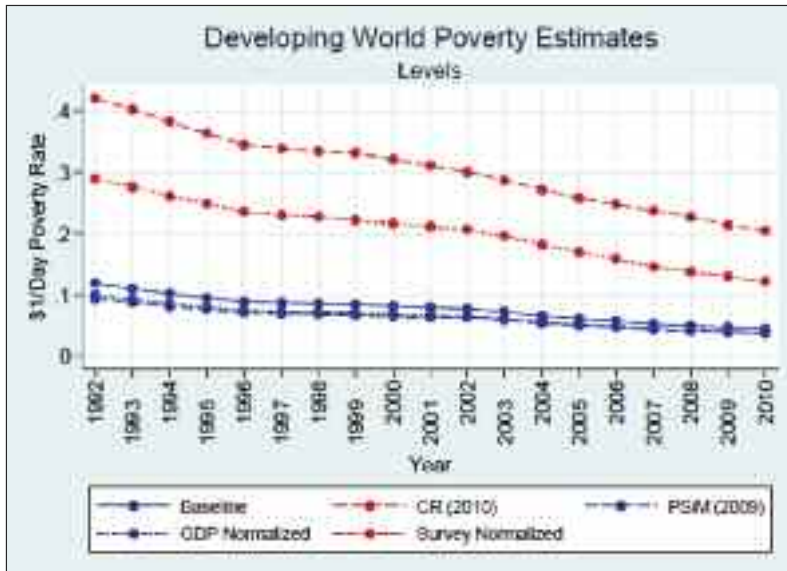


Figure 2. Alternative estimates of poverty. Source: M. Pinkovskiy and X. Sala-i-Martin (2014).

5.2. Exclusion

5.2.1. Informal labour

Beyond doubt, low quality jobs are one of the most important causes of structural, persistent poverty. More dramatically, but with an undoubted dose of realism, J. Breman (2003, quoted by M. Davis, 2006) wrote that “a point of no return is reached when a reserve army waiting to be incorporated into the labor process becomes stigmatized as a permanently redundant mass, an excessive burden that cannot be included now or in the future, in economy and society. This metamorphosis is, in my opinion at least, the real crisis of world capitalism”.

Measuring informal labour by the proportion of people without pension entitlement Figure 3 shows – in this case for a sample of Latin American countries – that informal labour is very negatively associated to income.

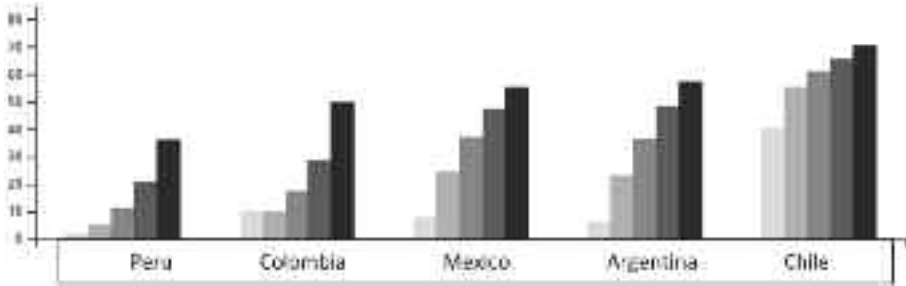


Figure 3. Percentage of economically active population with pension entitlement by income quintiles. References: Each bar represents each country's income quintiles from the lowest (Q1, pale grey) to the highest (Q5, black) to the right. Source: G.E. Perry *et al.* (2007).

G.E. Perry *et al.* (2007) demonstrate that the higher a country's income inequality measured by the Gini coefficient, the higher the percentage of people without pension entitlement and that the lower the GDP per capita the higher the percentage of informal workers without pension entitlement (Figure 4). So we see again that economic growth appears as a necessary condition to successfully combat poverty.

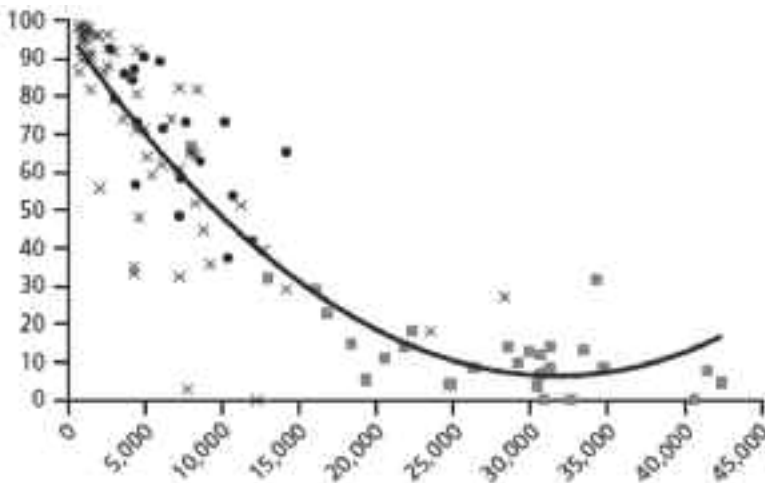


Figure 4. GDP PPP per capita and percentage of workers without social security entitlements. References: Latin America. x Developed. Rest of the world. Source: G.E. Perry *et al.* (2007).

5.2.2. Slums

Nearly 1 billion people are currently living in slums, most of them in emerging or very poor countries. One third of their urban population, and more than 70% in the case of Africa, live in slums (Figure 5). The poorer the country, the higher the proportion of youngsters in slum populations. More than 50% of the urban population in South Asia and 40 per cent in Sub-Saharan Africa lack access to sanitation services.

For the first time in history, more than 50% of the world's people live in cities and 2 billion of new urban residents are expected in the next twenty years. One of the results of these population movements is that the number of slum dwellers is increasing by 7 million every year. Paradoxically, and at the same time, 227 million people in DCs were lifted out of slum conditions between 2000 and 2010, 74% of them in Asia, primarily China and India. It is relevant to point out that slums are often economically vibrant and nearly 85% of new employment opportunities worldwide occur in the informal economy and many of them in the slum context.

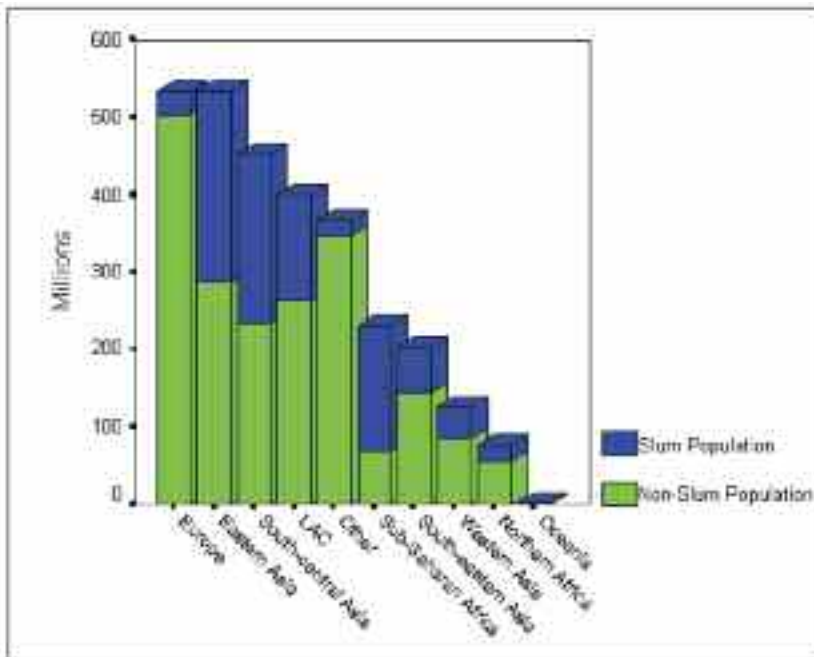


Figure 5. People living in slums (million). Source: N. Foroutan (n/d).

6. Unemployment

As it can be seen in Table 7, both youth and adult unemployment were high in 2012 but the second one was nearly 20% higher than before the Great Recession. Although youth unemployment has remained stable almost since then, it is higher than adults' in relative terms, 13.1% in 2013 or almost three times the rate of adult unemployment. The International Labor Office wonders about the risk of a jobless recovery as the current high levels of unemployment look like a structural phenomenon.

7. Youngsters

The relatively new phenomenon of too many youngsters being neither in employment nor in education or training (NEET) is particularly worrisome, but it is also worth learning that the huge differences in NEET rates among countries, from 4% in Netherlands to 15% in Belgium and 35% in Turkey (Figure 6) show that there are strategies to moderate the problem.

Table 7. Unemployed people, total, by gender and by age.

	2000	2001	2006	2007	2008	2009	2010	2011	2012*			
										CI Lower Bound	Preliminary Estimate	CI Upper Bound
Total	174.9	185.7	177.1	169.0	170.7	196.4	194.6	199.1	199.0	197.9	201.4	
Male	102.0	105.8	101.8	97.2	102.0	117.0	115.0	112.0	112.0	114.8	117.0	
Female	72.9	79.9	75.2	71.8	72.7	81.4	81.7	81.1	81.0	82.7	84.4	
Youth	72.8	77.9	74.1	70.4	71.0	78.2	74.7	73.2	72.2	73.8	75.4	
Adult	102.1	107.9	102.9	98.5	104.7	122.2	120.0	118.9	120.8	123.5	126.0	

Source: ILO, Global Employment Trends 2013.

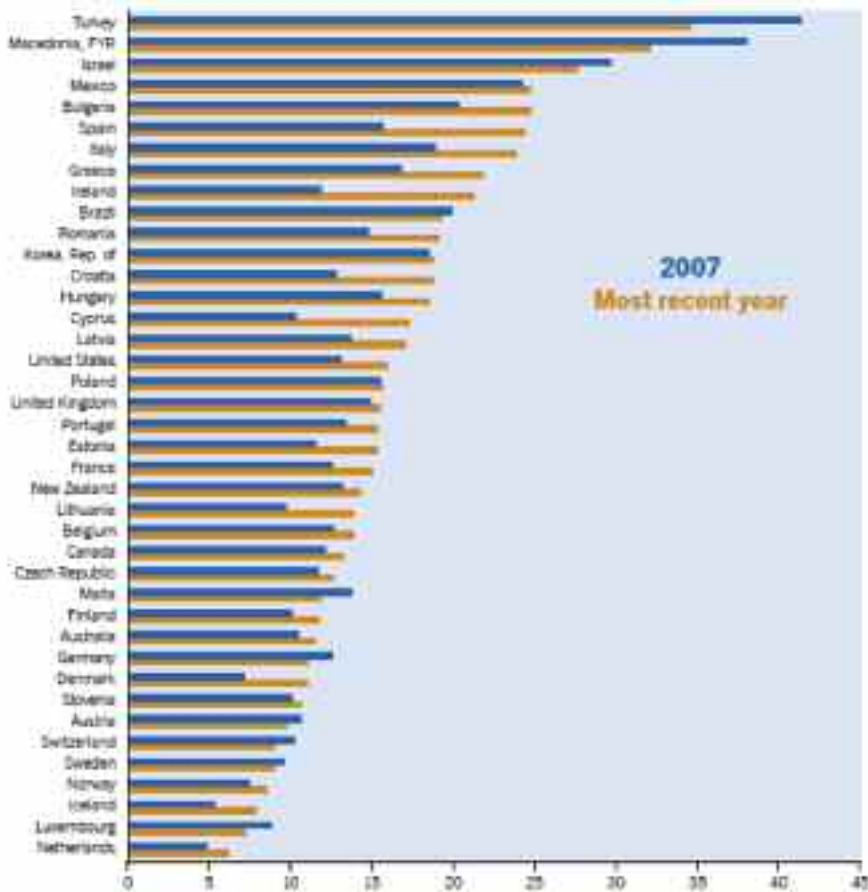


Figure 6. The NEET (not in employment education or training), % of population aged 15-29. Source: ILO (2014).

8. Education

There have been progresses in the access to basic education. Primary level completion rates jumped 10 percentage points worldwide between 1991 and 2011 (Figure 8). Although they are at 94% in middle-income countries, many low-income ones are seriously off track as regards the 2015 goal of universal primary education, particularly in Sub-Saharan Africa, Central Asia and MENA and, to a lesser extent, also in LATAM.

Table 8. Primary education completion rates.

	1991	2011
World	81	91
Low income	46	67
Middle income	83	94
High income	97	100

Source: World Bank.

Differences in access to secondary education remain too high as they reached in 2012 just 43% in low-income countries, 71% in middle-income ones and nearly 100% in developed countries. Noteworthy progresses among middle-income countries like Poland, Colombia, South Africa or China, as well as in low-income countries like Bangladesh or Nigeria, show that there are successful strategies of educational inclusion.

Table 9. Secondary gross enrolment rates.

	Circa 1990	Circa 2010
Denmark	109	120
France	92	110
Poland	87	97
Colombia	52	96
South Africa	63	94
U.S.	91	93
Mexico	54	84
China	37	83
Egypt	61	76
Bangladesh	20	50
Nigeria	24	44

Source: World Bank.

9. Income distribution

Even when most of the evidence shows that the distribution of wealth and income considering the whole world has somewhat improved (M. Pinkovskiy and X. Sala-i-Martin, 2014; F. Alvaredo and L. Gasparini, 2013), mainly as a consequence of the rapid growth of big emerging countries like China and India, it has worsened in most of the countries, showing in some of them increases even in the shares of the superrich “1%” or less of the population (Z. Bauman, 2013; T. Piketty, 2014).

Table 10 shows the evolution of the poorest deciles income shares in a sample of countries since 1990. There are both increases and decreases, most of them marginal except in the case of China that shows a huge fall.

Table 10. Share of consumption or income, lowest 10%.

	Circa 1990	Circa 2010
Bangladesh	4.2	4.0
Egypt	3.9	4.0#
Poland	3.9	3.3
France	2.8**	?
Denmark	2.6^	?
Mexico	1.6	2.0
United States	1.9^^	?
Nigeria	1.4	1.8
China	3.5	1.7
South Africa	1.3*	1.2
Brazil	0.7	0.9

Source: World Bank.

Table 11. Share of consumption or income, highest 10%.

	Circa 1990	Circa 2010
Poland	21.6	26.7
Bangladesh	24.6	27.0
Sweden	25.0	27.0
Tunisia	30.7	26.6
India	26.0*	28.8
China	25.3	30.0
France	33.0	34.0
Mexico	40.3	37.5
Nigeria	33.5	38.2
Brazil	48.4	42.9
United States	40.0	47.0
South Africa	46.7	51.7

Source: World Bank.

Table 11 clearly shows the widespread increase in the share of the top 10%. The encouraging main exceptions are in Latin America – pictured as a region in Figure 7 – where an increase in the middle classes' share and, to a lesser extent, also in the poor took place at the expense of the richest through a combination of rapid growth and an improvement in taxation and social policies.

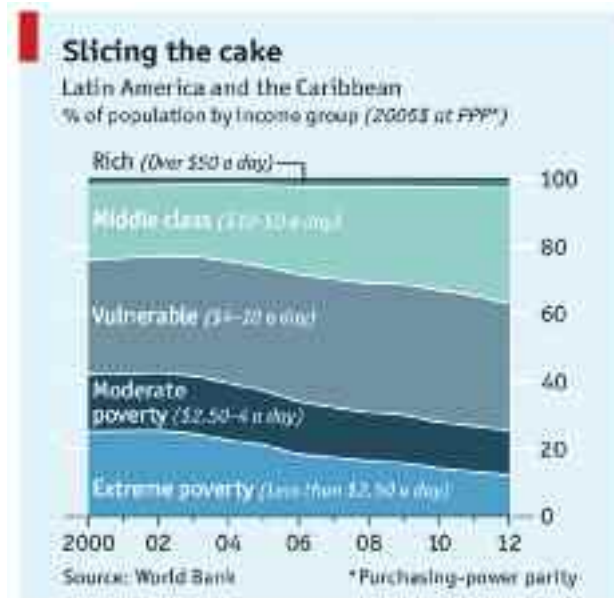
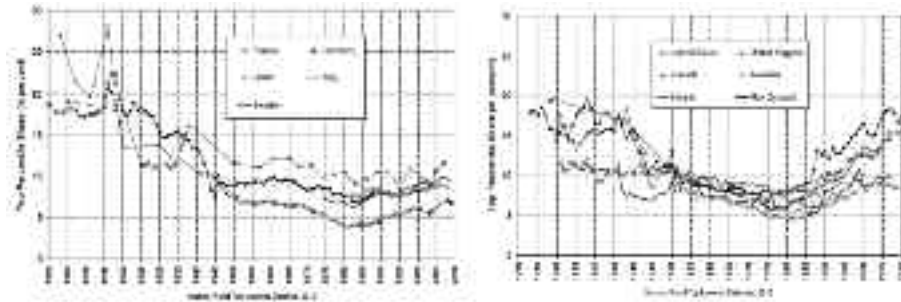


Figure 7. Income distribution in LATAM 2000-2012, a promising improvement. Source: *The Economist*.

Tables 12 and 13 taken together very clearly show that the huge increase in the income share of the top 1% exists in very different ways according to countries. It has been very intense in some of the English-speaking countries, particularly in the US and then in the UK and Canada, but much less so in Australia, New Zealand and Europe where it is now much lower than a century ago.

Tables 11 and 12. Highest 1% shares of income. Europe and English-speaking countries.



Source: Piketty and Saez (2012).

10. Pope Francis’ *Evangelii Gaudium* and the new challenges we face *An economy of exclusion and inequality*

Since the very beginning of his pontificate Pope Francis has very clearly depicted the most relevant social challenges that humanity confronts in spite of the progresses described heretofore in the paper. Before concluding our contribution it is very helpful to recall some of those teaching as they were posed in his apostolic exhortation *Evangelii Gaudium*.¹

53. Just as the commandment “Thou shalt not kill” sets a clear limit in order to safeguard the value of human life, today *we also have to say “thou shalt not” to an economy of exclusion and inequality*. Such an economy kills. How can it be that it is not a news item when an elderly homeless person dies of exposure, but it is news when the stock market loses two points? This is a case of exclusion. Can we continue to stand by when food is thrown away while people are starving? This is a case of inequality. Today everything comes under the laws of competition and the survival of the fittest, where the powerful feed upon the powerless. As a consequence, masses of people find themselves excluded and marginalized: without work, without possibilities, without any means of escape.

204. *We can no longer trust in the unseen forces and the invisible hand of the market. Growth in justice requires more than economic growth, while pre-*

¹ The numbers of the paragraphs are the ones of *Evangelii Gaudium* while the *italics* and subtitles are the author’s.

supposing such growth: it requires decisions, programs, mechanisms and processes specifically geared to a better distribution of income, the creation of sources of employment and an integral promotion of the poor which goes beyond a simple welfare mentality.

Need for global solutions

206. *Indeed, it is becoming increasingly difficult to find local solutions for enormous global problems which overwhelm local politics with difficulties to resolve.* If we really want to achieve a healthy world economy, what is needed at this juncture of history is a more efficient way of interacting which, with due regard for the sovereignty of each nation, ensures the economic well-being of all countries, not just of a few.

New forms of poverty

210. *It is essential to draw near to new forms of poverty and vulnerability, in which we are called to recognize the suffering Christ, even if this appears to bring us no tangible and immediate benefits. I think of the homeless, the addicted, refugees, indigenous peoples, the elderly who are increasingly isolated and abandoned, and many others. Migrants present a particular challenge for me, since I am the pastor of a Church without frontiers, a Church which considers herself mother to all. For this reason, I exhort all countries to a generous openness which, rather than fearing the loss of local identity, will prove capable of creating new forms of cultural synthesis. How beautiful are those cities which overcome paralyzing mistrust, integrate those who are different and make this very integration a new factor of development! How attractive are those cities which, even in their architectural design, are full of spaces which connect, relate and favour the recognition of others!*

211. *I have always been distressed at the lot of those who are victims of various kinds of human trafficking... This infamous network of crime is now well established in our cities, and many people have blood on their hands as a result of their comfortable and silent complicity.*

212. *Doubly poor are those women who endure situations of exclusion, mistreatment and violence, since they are frequently less able to defend their rights. Even so, we constantly witness among them impressive examples of daily heroism in defending and protecting their vulnerable families.*

213. *Among the vulnerable for whom the Church wishes to care with particular love and concern are unborn children, the most defenseless and innocent among us.*

The environment

215. *There are other weak and defenseless beings who are frequently at the mercy of economic interests or indiscriminate exploitation. I am speaking of creation as a whole.* We human beings are not only the beneficiaries but also the stewards of other creatures. Thanks to our bodies, God has joined us so closely to the world around us that we can feel the desertification of the soil almost as a physical ailment, and the extinction of a species as a painful disfigurement. Let us not leave in our wake a swath of destruction and death which will affect our own lives and those of future generations.

Social dialogue as a contribution to peace

240. It is the responsibility of the State to safeguard and promote the common good of society. Based on the principles of subsidiarity and solidarity, and fully committed to political dialogue and consensus building, it plays a fundamental role, one which cannot be delegated, in working for the integral development of all. This role, at present, calls for profound social humility.

11. Preliminary conclusions

1. *Globalization, trade and war.* The intensification of cross-border movements of people, goods, services and capitals called nowadays “globalization” has an important trait in common with democracy and capitalism. The three of them are plenty of defects, flaws and injustices, but none of them has yet an at least acceptable replacement. Without setting aside the exploration of true alternatives, the most practical attitude towards the three of them is thinking of concrete suggestions to improve their performances. In any case it’s also very convenient to keep in mind that it continues to be true that trade and war are most of the time either/or alternatives, and that the 20th century’s death toll because of wars and political crimes was 180 million people up to 1995 (Figure 8).

2. *Ambiguity of terms like “capitalism”, “State intervention” or “market economies”.* They are misleading most of the time, since there are many kinds of each. Let us give just an example. The incidence of taxation and public expenditures in GDP gives a good approximation of the proportion of total resources allocated not according market principles but based on political and social criteria. Among developed countries, in 2013 Korea had a public expenditure to GDP ratio of 22.6% (the lowest), Finland 58.6 (the highest, 2.6 times the lowest) and the US was in the middle with 38.0%. In the case of emerging countries, Hungary has 50.2% (the highest) and the Philippines

18.7% (the lowest) while Argentina and Brazil are around 40%. Not all but most public expenditures imply a redistribution of incomes from high- and middle-high income people to lower-income sectors of society and this implies that “capitalism”, “the market” and “the State” are substantially different in Finland compared to Korea, and in Hungary compared to the Philippines.

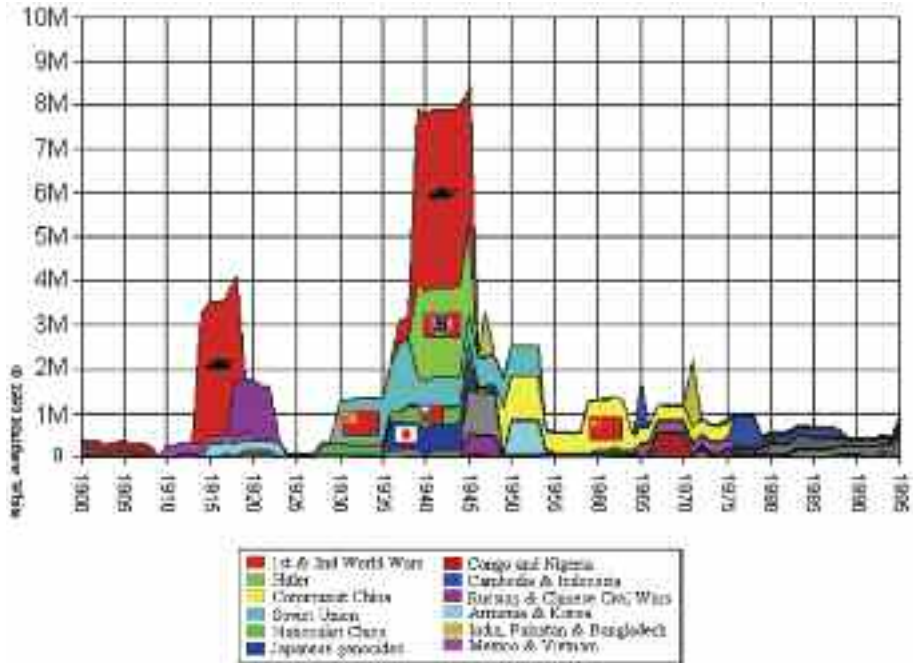


Figure 8. Not a lost paradise: Twentieth century death toll, 1900-1995. Source: <http://users.erols.com/mwhite28/war-1900.htm>

3. *The right to grow.* It does not seem fair to advise emerging or, even worse, the poorest countries to slow down growth in order to preserve an environment whose accumulated damages have been done by DCs in approximately two thirds or in order to practice a new development pro-poor style. Without growth, both present social progress and intergenerational solidarity seem impossible. Precisely for that reason, emerging and poor countries will continue trying to grow *anyway* as fast as possible and they have the right to behave like that. The best approach to this undoubtedly

complicated issue seems to be exploring concrete ways of improving both environmental and social aspects of rapid growth.²

4. *The global, the national, the local.* The “development of productive forces” seems to be in conflict again or at least in tension with “production relationships”, as in Marx, but nowadays it has a different nature because it is between increasingly internationalized productive processes and, on the other hand, governance structures limited to national or regional supra-national borders. It is not clear up to what point it would be convenient for humankind or at all possible to significantly surpass national or regional sovereignties. But the conflict is there and if new forms of world governance do not develop, economic results could be a slowing down of both, EC’s development and the recovery of DC as well as increased and diverse risks including that of a 2008-style world economic crisis.

5. *Ethical change.* There also seem to be even deeper tensions between globalization at a planetary scale and postmodern values like consumerism and individualism. To give an effective answer to them some ethical changes to improve justice, intergenerational solidarity and an active subsidiarity both at the national and international levels could be crucial. It is not clear however what leaderships or institutions will have a voice that is clear and loud enough to induce these new values and behaviours. The Social Doctrine of the Church has consistently insisted on their importance and it could be essential as it is one the best endowed to fulfil more clearly and firmly this role in the near future, as can be seen clearly now in the teachings of Pope Francis.

12. Policies

In spite of its undeniable achievements, current economic growth is under threat because of serious and unresolved challenges. All of them were referred to in the first nine sections of the paper but some of them deserve underlining for their inherent importance and difficulties. They are environment sustainability; the situation of migrants, particularly international ones, and social inclusion and equity in wealth and income distribution, particularly in the case of youngsters affected by structural unemployment and NEET situations, ageing populations confronting the crisis of social security systems and people living in slums at the border of megalopolises, most of them without formal jobs and in very bad health and sanitation conditions. In the final section of the paper a list of complementary or al-

² See next section on Policies.

ternative policies to answer to these challenges is offered. It does not hope to be exhaustive but just to show how many ways we have relatively at hand to go from the current situation to a more just, equitable and sustainable world in the long term.³

12.1. Pro-human and pro-sustainable economic growth policies and actions ***Global***

- Macroeconomic and financial coordination – particularly that which is needed to reduce current account imbalances, to mend unsustainable foreign exchange rates and to enforce prudential regulations of the international financial system. The risk of another Big Crisis is still alive.
- Global carbon taxation and corporate income tax coordination to at least reduce global tax on capital?
- Non-protectionist and decent labour standards.
- Rebalancing consumption, investments and exports in some Asian countries and developing social security systems there to help the rebalance and also to avoid non-decent labour conditions.

Regional (multi-national)

- Trade and investments helping designed to improve the conditions in the weakest members of the agreements.

National

- Macroeconomic balances avoid or at least prevent crises whose main victims are, sooner or later, the poor.
- More progressive fiscal and social policies.
- Maximizing growth rates and profits to get them is the wrong way.

12.2. Intergenerational solidarity and respect for the Creation

Although not analyzed in the paper this issue is mentioned just not to forget how crucial it is in order to get a sustainable pro-poor approach to development.

³The list also has a bias as it includes mainly subjects that are closer to the expertise of the author. For that reason sectorial policies in the fields of health, nutrition, urban development, housing or energy are not included.

12.3. *Pro-inclusive development policies and actions*

Global

- Post-2015 Development Agenda
 - Despite lacking both pathways and enforcement, giving guidelines could help.
- Revamping the goal of 0.7% of developed countries' GDP in aid to the poorest countries (see current aid in Figure 9)
 - Linking it to actions pro-environment through conditional cash transfers.
 - Middle-income emerging countries with GDP per capita > x could contribute too.
 - Total potential amounts to US\$ 440 billion against a current total of 135 US\$ billion.
 - Giving Pledge's⁴ first 40 billionaires have already given 125 billion US\$ and could be integrated in a *global pro-poor ethical alliance*.
- Projects to return or restore the artistic treasuries that were originally of LDCs, considering the possibility of a Trust-Fund whose income could help to finance development goals.

National

- *Social inclusion*
 - Alternative, respectful and decent urbanization.
 - Rural and local development, clusters when possible, adding value in situ to the natural resources with positive effects both on more people living in small towns and medium cities and less people living in megalopolis slums.
 - Empowerment of the poor giving them credit, access to property, entrepreneurial abilities, education and health.
- *Employment*
 - Promoting labour-intensive development and investments as well as entrepreneurship.
 - Rethinking the net impact of new technologies on employment and policies to compensate them.
 - Designing tax and social contributions schemes specifically addressed to formalize informal workers.

⁴The Giving Pledge is a commitment by the world's wealthiest individuals and families to dedicate the majority of their wealth to philanthropy (<http://givingpledge.org/>).

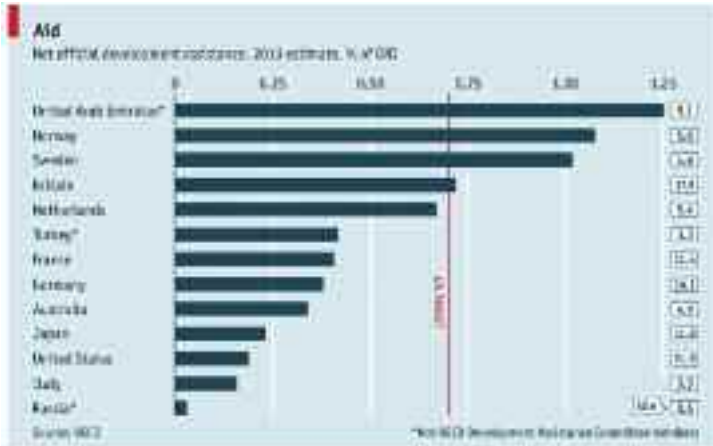


Figure 9. Net official development assistance, 2013, as % of GNI. *The Economist*, 4/12/14.

– *Education*

- Giving effective priority in educational policies to schools attended by low-income students in such a way as to get in their neighbourhood schools as rich as the ones attended by their higher-income peers and with similar teaching and learning quality.
- Renewing the teaching profession through better education and training and aiming to obtain, for this career, a similar income and social prestige as lawyers, doctors or engineers.
- Empowering schools to allow them to be teaching-and-learning communities as autonomous as possible with a clever regulatory framework.

Making TICs an integral part of renewed teaching styles and practices, thus making it possible to profit from the technology-friendly nature of young generations.

– *Ageing populations*

- Without a population-prone change both Europe and Japan will have slow growth, serious fiscal and indebtedness problems and social conflicts on pension systems. More immigration and increasing the age of retirement seem to be the only sort of solutions at hand, but both confront serious social and political resistance.

As pictured in Figure 10, better growth and social policies would allow having less than 400 million or 5% of persons in poverty in 2030.

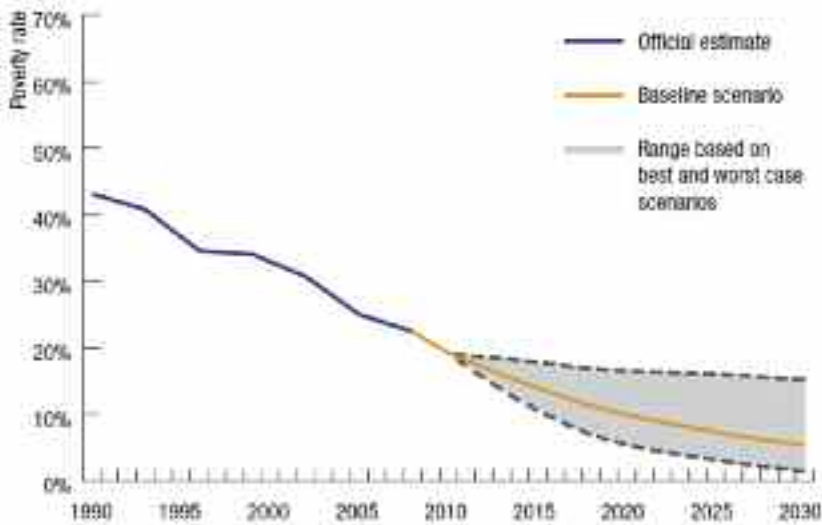


Figure 10. Extreme poverty rate projections under different assumptions. L. Chandy *et al.* (2013).

12.4 *The role of Academies and academicians*

In spite of its importance, the study of public policies is just the youngest sibling of the social sciences and – wrongly from my point of view – is not considered as a science yet. Academic incentives encourage neither the interdisciplinary studies nor the development of this new field because they give paramount importance to publications in refereed journals that not infrequently give excessive importance to methodology as opposed to relevance. Partly as a consequence of those factors discussions on public policies most of the time tend to be mainly ideological and too general and even the development of statistics is poor on issues like poverty, with estimates that differ by up to 100%.

Many people think of these questions as not relevant because politicians have a systematic decision-making. But anyone with experience in government decision-making can testify that many times, or even most of the time, this is not the case. So the real situation is that, in spite of the need for new and innovative policies to overcome the human, social, political and environmental risks and injustices of the current globalization, academies in general do not show enough commitment. Academicians should think more deeply of this challenge and perform more and better interdisciplinary and policy-oriented work even at the risk of sacrificing academic honours.

Bibliography

- Alvaredo, Facundo and Leonardo Gasparini (2013). *Recent trends in inequality and poverty in developing countries*, La Plata: CED-LAS, Documento de Trabajo 151.
- Bauman, Zygmunt (2013). *Does The Richness Of The Few Benefit Us All*, Cambridge: Polity Press.
- Chandy, Laurence, Natasha Ledlie and Veronika Penciakova (2013). *The final countdown: Prospects for ending extreme poverty by 2030*, Washington: Brookings Institution.
- Chetty, R., Nathaniel Hendren, Patrick Kline, Emmanuel Saez and Nicholas Turner (2014). *Is the United States still a land of opportunity? Recent trends in intergenerational mobility*, NBER Working Paper 19844.
- Davies, James B., Susanna Sandström, Anthony Shorrocks and Edward N. Wolff (2008). *The world distribution of household wealth*, UNU-WIDER, Discussion Paper 2008/3.
- Davis, Mark (2006). *Planet of slums*, New York and London: Verso.
- Fogel, Robert (2007). *Capitalism and democracy in 2040: forecasts and speculations*, NBER Working Paper 13184.
- International Labor Office (ILO, 2013). *Global employment trends for youth: A generation at risk*, Geneva: ILO.
- Maddison Project, <http://www.ggd.net/maddison/maddison-project/home.htm>
- Mc Kinsey (2013). *Education to employment: Designing a system that works*.
- OECD (2011). *An overview of growing income inequalities in OECD countries: main findings*, <http://www.oecd.org/els/soc/49499779.pdf>
- Perry, Guillermo E., William F. Maloney, Omar S. Arias, Pablo Fajnzylber, Andrew D. Mason and Jaime Saavedra-Chanduvi (2007). *Informalidad, escape y exclusión*, Washington: The World Bank.
- Piketty, Thomas (2014). *Capital in the twenty-first century*, Harvard: The Belknap Press of Harvard University Press.
- Piketty, Thomas and Emmanuel Saez (2012). *Top incomes and the Great Recession: Recent evolutions and policy implications*, 13th Jacques Polak Annual Research Conference.
- Piketty, Thomas and Emmanuel Saez (2012). *Top incomes and the Great Recession: Recent evolutions and policy implications*, 13th Jacques Polak Annual Research Conference.
- Pinkovskiy, Maxim and Xavier Sala I Martin (2014). *Lights, camera, ... income!: Estimating poverty using national accounts, survey means and lights*, NBER Working Paper 19831.
- Pope Francis, *Evangelii Gaudium* (2013). http://w2.vatican.va/content/francesco/en/apost_exhortations/documents/papa-francesco_esortazione-ap_20131124_evangelii-gaudium.html
- Rogoff, Kenneth (2014). *Malthus, Marx and modern growth*, Project Syndicate, <http://www.project-syndicate.org/commentary/kenneth-rogooff-identifies-several-obstacles-to-keeping-living-standards-on-an-upward-trajectory>
- Solt, Frederick (2013). "The Standardized World Income Inequality Database", <http://hdl.handle.net/1902.1/11992>

SUSTAINABLE EDUCATION: URUGUAY'S PLAN CEIBAL

■ ANTONIO M. BATTRO AND CECILIA DE LA PAZ¹

Introduction

This meeting on “sustainable humanity and sustainable nature” is a valuable opportunity to introduce and discuss the notion of “sustainable education”. We are willing to understand and improve the interactions between “human capital and natural capital”. Education is part of the human capital of our societies but the notion of “sustainable education” is still under construction and needs special consideration. In particular it is impossible to imagine a sustainable school system that remains independent of the rapidly expanding digital environment of today. Our society has created a new “virtual ecosystem” which is covering the planet and is modifying the life of millions. The good news is that education can play, and is playing in many cases, an increasing and constructive role in this global process towards equity and solidarity in the human family. We are convinced that a sustainable education must be based on evidences and not on ideologies. A sustainable education must be supported by *political, economical, social, technological and pedagogical* sustainable programs.

Towards a sustainable education

We are facing the formidable requirements of education in a growing population that will reach some 9000 millions in 2050. At a recent meeting of the Pontifical Academy of Sciences on *Bread and Brain. Education and Poverty* (November, 2013) we shared our concern

on the learning environments of the 72 million children in remote regions of the world today with no schools, and the additional 170 million with schools with so few resources, that little learning occurs. Approximately 800 million human beings, concentrated especially in low-income countries, cannot read. For these children and adults the emerging uses of new technological tools are promising.

The proposal to give a primary education to all is one of the Millennium Goals and we can say that in the first decade of this century we have sub-

¹ Ceibal: Cluster Leader. Global Partnership: New Pedagogies for Deep Learning.

stantially improved the quality and the access to education in many aspects and in many countries but we still face the question of the “sustainability” of the different models of education for this century in front of the increasing challenges of the globalization process. The challenges we are facing today are not necessarily the challenges we will face tomorrow. This meeting is concerned with the conditions of a sustainable humanity and a sustainable nature. Education is key for both aspects. We will try to elaborate these issues on the light of the support that the digital environment of today offers for a sustainable education for all. A sustainable education implies equity, and equity in the case of education means to ensure learning to all children and youth in the new social and cognitive context of this century.

A case study: Uruguay's Plan Ceibal

Our proposal is to show a case of sustainable education in a digital environment that can be objectively evaluated and hopefully improved and expanded. A case study is a good starting point because we can detect errors, failures and obstacles as well as successes, predicted or unpredicted, in order to improve the model. Our case study will focus on the recent implementation of a digital educational platform for all children and youth in Uruguay. We will try to show some of the processes in place that support the sustainability of this plan, called Plan Ceibal (Conectividad Educativa de Informática Básica para el Aprendizaje en Línea), hoping that they will inspire other similar initiatives around the world (www.ceibal.edu.uy).

The one laptop per child model

At a joint meeting of the Pontifical Academies of Sciences and Social Sciences – 16-17 November 2005 – dedicated to Globalization and Education, Nicholas Negroponte, then director of the Media Lab of MIT, presented his project to give to every child and teacher a connected laptop in order to produce a global change in education (Negroponte, 2007). This idea was implemented by OLPC, One Laptop Per Child Foundation, in 2006 and today it has reached forty-seven countries with more than two and a half million laptops and thousands of pedagogical resources (www.laptop.org).

OLPC has established five principles that are enforced in different implementations around the world:

1. *Early age*: Children start to use the laptops in the first years of schooling and even in preschool
2. *Property*: the laptops are the property of the children and teachers. They take them home.

3. *Connectivity*: all equipment should be connected to the Internet. The school server acts as filter to ensure a proper use of the communications. Many public places are specially devoted to the connectivity of the children's equipment.
4. *Free and open source*: all digital resources can be freely used and modified at will by the user.
5. *Saturation*: the laptops are given to all students and teachers of a given community. The scale or the community can be a town, municipality, province, state, country or region.

Uruguay is leading the “one to one model” with Plan Ceibal that supports the full saturation of the public school system reaching 559,836 students and 47,623 teachers and has implemented a robust digital platform with connectivity in 2,750 institutions and distributed a multiplicity of pedagogical and technical resources that are in permanent process of improvement and revision. This year thousands of tablets will be also introduced in pre-school and first grades.

Political and economical sustainability

Uruguay has a population of 3.3 million on a territory of 176,220 sq km. Uruguay has a valuable tradition of public education and started the new millennium with the implementation of Plan Ceibal by Presidential Decree in April 16, 2007. The first laptop (popularly called “ceibalita”, the green XO designed and produced by OLPC) was given in 2007 by the President of the Republic Tabaré Vázquez to a child of the first grade at a primary school of the small town of Cardal.

The political sustainability of the plan was established by law 18640 (April 8, 2010) that created the *Ceibal Center for the support of education of children and youth*. The Board of Directors of Ceibal is currently formed by the delegate of the Presidency and president of the Board, the delegate of the National Administration of Public Education, the delegate of the Ministry of Education and Culture and the delegate of the Ministry of Economy and Finance. The President of the Board is Miguel Brechner.

The economical sustainability of Plan Ceibal is currently supported by law 18719 (national budget 2010–2014) that includes the entire public school system of the country: preschools, elementary and secondary schools, technical schools and institutes for teacher education and training. Ceibal is spending 100 dollars per child per year, 5% of the annual budget of the public primary and middle school system (0.12 % of the GDP).

Social sustainability

Plan Ceibal has a very positive image in the population, and its social impact is measured regularly. The main points under survey are related to the digital gap between families, urban or rural, of different social and economic status revealed by the number of computers at home and connectivity to Internet, multiple use of the laptops by the children and other members of the family, changes in the motivation and behavior of the children reported by parents and teachers, increasing social and civic inclusion, in particular for disabled kids, support of the community by exhibits, working groups, public events and media, role of volunteers, new working opportunities for many families, new capacities promoted by digital resources at all ages in urban and rural environments.



Figure 1. Children going to a rural school on horseback with their laptops.

Technical sustainability

Since its inception Ceibal covers the deployment and management of laptops, and now also tablets, platforms, portals, call centers, spares and field service, connectivity, maintenance, Internet services, laptops remanufactures,

support areas (systems, administration, finance, legal), videoconferences and logistics. At the moment Ceibal has installed and is maintaining:

- Priority Access Points (outdoor and neighborhoods): 1,879
- Optical fibers: 1,222 locations, 536,000 beneficiaries
- Solar panels: 220 in 55 schools

And it must be stressed that thanks to Plan Ceibal many teachers and families have acquired more computers and digital devices with the help of special credits and constantly upgrade and extend their own information and communication equipment (RADAR 2013).

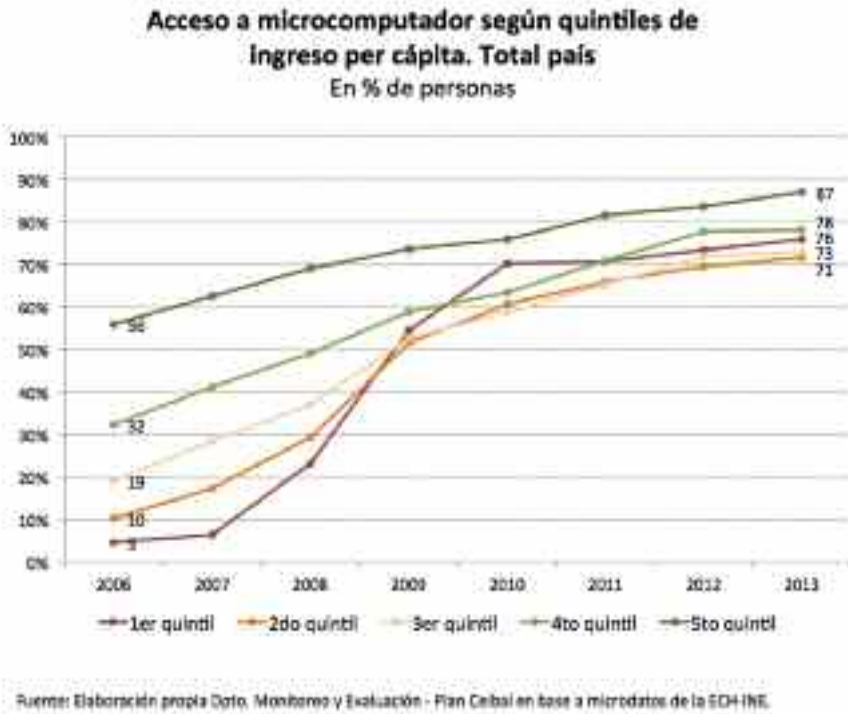


Figure 2. Overcoming the digital divide. Deployment of laptops (2006-2013) per personal income, in % of the population of the whole country.

Pedagogical sustainability

Ceibal is engaged in a multiplicity of pedagogical activities at all levels with a free, open source system that allows a great variety of activities. In particular the XO laptops use the Sugar platform and are equipped with vast resources of connectivity that support collaboration in a variety of common projects (messages, blogs, websites), programming (Logo, Scratch, E-toys), arts (painting, music, photo, video), science (robots, sensors, motors), etc. The new Tablets with Android allow Wi-Fi access and have a large collection of resources. A massive introduction of the Tablets in 2014 will reach children from 4 to 6 years old and will open new learning possibilities to the very young. The earlier the better.

Just to give a feeling of the large spectrum of interests in schools and communities we can mention the titles of the Ceibal presentations by students and teachers at the recent very popular exhibit EXPO APRENDE, November 2013:

Playing science, critical thinking in English (videoconferences), young journalists, we all can study robotics, the XO as source of information for recycling, mathematical art, digital culture in the school, creativity and visual arts, robotics and the disabled, digital and social inclusion, bridging the urban-rural gap, animated families, creating videogames, biology laboratories at home, learning to program with videogames, moving music, nutritional value of transgenic crops, 3D programming, cooking with the XO, chess, robotics and videogames, community work with the XO, the positive use of error in mathematics, health and smiles, learning with PAM (Mathematics Adaptive Platform), empowering our communities, linguistics and the local communities, “beyond access” – libraries for development, online lessons in teacher training, knowledge and self-esteem, videoconferences: beyond the classroom walls, close your eyes and you will see, networking of slums, secure driving, cultural exchange among neighbors, the XO and the environment, promoting artisans, composing music together, learning with CREA (Contenidos y Recursos para la Educación y el Aprendizaje – content and resources for education and learning).

The following numbers give the magnitude of this very large laboratory for learning and teaching that Ceibal represents:

- Educational contents: 8,454
- Books: 3,454 (accessible online at the Ceibal Library)
- Learning Management System, LMS platform: 4,000 resources
- Videoconferences: in 800 schools and teacher training centers (1,000 groups attending English lessons)

- Adaptive Mathematics Platform (PAM): 50,000 users.
- Robotics: 3,871 kits delivered in 707 schools

Because of this heavy investment in pedagogy Ceibal has found considerable support from the general public and the people directly involved, in particular in the urban and rural communities with poor resources (RADAR, 2013). Great emphasis is given by Ceibal to ensure the collaboration and engagement of the teaching community of the country. For this purpose Ceibal has a program of permanent teacher training, which is key.

Digital literacy

The fascinating history of the evolution of the technology of writing and the skills of reading, from clay to papyrus, from paper to digital screens, is a good example of how literacy itself has changed (Dehaene, 2007, Wolf, 2007, 2013). The radical novelty is that the new literacy of the digital era must include the ability to “code”, to program. This cognitive skill is becoming a social requirement but the number of those excluded from a sustainable digital education is still considerable. In this sense we are facing a new challenge to construct a sustainable education for all and we urgently need the collaboration of many experts and institutions (Pasquinelli *et al.*, 2013).

It is our responsibility – and the purpose of our meeting – to notice that with the unfolding of the new digital skills the universal requirement of literacy must go beyond basic reading, writing and arithmetic and should include programming. In other terms, elementary literacy in a digital environment is going beyond “concrete operations”, such as classification and seriation, and reaches pure “formal operations” (operations upon operations) that can be expressed, for instance, in propositional form such as “if A then B”. In the sense of the stages proposed by Jean Piaget, children who can program at early ages collapse two developmental stages, concrete and formal operations, into one. This means a very profound transformation of our culture as we can see in the most advanced digital societies. But even in the rich countries millions are not receiving an appropriate education for the digital era: in fact many of those children and youth that use the Internet or play digital games cannot write a program. There is also an economic side to the ability to program because it is becoming a most required “literacy skill” in many professions, another practical dimension of education sustainability. Education pays.

In other words, we should learn from what we know of the acquisition of traditional literacy skills and make a similar effort to understand the specificity of *digital literacy* by exploring the neurocognitive processes of these new skills. We can say that children growing up in digital environments –

those who are called “digital natives” – “speak digitalese” as a kind of second language, and that they develop a specific “digital intelligence” (Battro & Denham, 2007; Battro, 2009). In particular many children unfold remarkable skills and talents in the new digital environment. This is the case of the two young students of Uruguay who were awarded the Google “Code-in” Prize for exceptional performance in programming. Both were involved in Ceibal activities since their early years.

Sustainable education for the disabled

Consistent sustainable education also requires a formidable effort towards the inclusion of those who are “in the margins” (Rose, 2000). In particular it is our responsibility to give a sound education to disabled children. It is a recent and promising fact that the use of new digital technologies and prosthetic devices of all kinds are changing the world of special education and we must recognize that our advanced technologies are enhancing the quality of life of many disabled persons but the challenges are still enormous and require the cooperation of many in education, health, economy and politics. The good news is that the trend towards enhancing human capacities with the help of new technologies is significantly growing. For instance, voice recognition and synthetic speech are now the most common examples to overcome the limits of impaired communication. Another dramatic example is the introduction of cochlear implants for hearing-impaired children. In a sense the cochlear implant is the first neuroprosthesis that became effective and has radically transformed the education of the deaf in many parts of the world. And most promising, new brain-computer interfaces are expected to bring hope to many disabled persons (Donoghue, 2013). Ceibal is also ready to perform as a universal platform for research and development in the area of disabilities (Mangiatordi, 2012). Some 300 laptops are already installed in centers for the disabled.

The problem of scale

A change of scale creates new phenomena. Very large numbers of students and teachers change the nature of pedagogy itself. We need an “epidemiological” approach in education to answer to the new challenges (Battro, 2014). For instance, the face-to-face interaction in a sound and manageable learning environment is becoming increasingly difficult as the number of children attending school grows. The good news is that in a digital environment the restrictions in time and space for teaching and learning tend to disappear and new kinds of pedagogic interactions develop in the most different socio-cultural conditions inside and outside the school.

In Ceibal we are creating an *expanded school* because the same digital platform is available in the classroom and at home but we still need a great effort in order to take advantage of this radically new situation. In this sense Ceibal actively promotes the involvement of the whole family at home with the new digital tools with the program “aprender tod@s” in particular in rural environments. In many cases children turn spontaneously into teachers of their parents and other family members and friends. A new “teaching power” is expanding in all digital environments because children teach! And this “natural cognitive ability” must be taken into account in the digital pedagogies of today (Strauss & Ziv, 2013). In a recent evaluation of the impact of the new Tablets introduced by Plan Ceibal, 67% of the teachers recognized that the children helped them to learn how to use the equipment and the resources. This is certainly one of the most important assets of the massive introduction of laptops and tablets by Ceibal: to empower children to teach. In fact, hundreds of thousands of (very young) teachers are practicing their teaching skills every day in Ceibal, and “do-cendo discimus”, when we teach we learn...

The problem of evaluation

The quality of teaching and learning must be constantly evaluated but the great problem is that standard tools for assessment are not always scalable. We must invent new ones to deal with very big numbers of items and students. We need to promote a “new culture” of measurement and evaluation.

In Uruguay, where all public schools are connected to the Internet and all children and teachers own their own laptops, Ceibal has implemented the Online Formative Assessment (SEA), which allows online mathematics, language and science evaluations. These routine assessments can reach some 20,000 students simultaneously. The advantage is that teachers and directors can immediately compare individual performances in different classes and schools throughout the country with sound statistics in a very short time and at low cost (www.anep.edu.uy/sea).

But the main innovation of the Online Formative Assessment is that it enables a dialogue across classrooms. This opens the classroom to other professionals beside the school teacher.

If a school system wants to improve it has to connect all professionals on a path of constant action and reflection, define a set of priorities to achieve and a way to monitor them (www.michaelfullan.ca).

At Ceibal the SEA was clearly an improvement in two ways. Firstly, because it changed the information management about learning within the public education system. Since every teacher knew their results in real time,

the headmaster had on his portal the results of his school – once every teacher had finished the test application – and the inspectors had a glimpse of what happened in their jurisdiction after a test cycle. A new dialogue about the weaknesses and the strengths at different levels started to emerge.

Secondly, the assessment system brought a new discussion about the importance of an enhanced curriculum development. The discussion was not only about what the students had been able to master and what were their weaknesses but also on the nature of the proposed tests and their underlying cornerstones. The online formative assessment system has certainly fostered increasing levels of school autonomy in a continuous dialogue among levels. It has promoted teacher development by proposing a challenging assessment where the teacher should get together with other teachers to analyze persistent student errors and find common school strategies to tackle them. This balance between autonomy and common features was critical for its success.

Finally, the digital platform in place in the whole country allows not only a transversal evaluation but also a longitudinal assessment of each student during the years of schooling. This capacity of the one to one model is unique and must be enhanced and promoted. In fact each child could be followed throughout his years of schooling and the teachers could monitor his or her progress during a long period. Of course we need to develop a culture of “personal mentors on line” to guide the student step by step and we expect that new kinds of “digital dialogues” will hopefully unfold.

The new pedagogies

It seems clear that the irruption of digital tools has made a major revolution in education. We cannot conceive today a sustainable education without the help of information and communication devices. There is a whole expanding universe of innovations of all kinds, from QRs (quick response barcode) to 3D printers, from AR (augmented reality) to videoconferences, from robots to mobile and portable equipment, to mention only some of the relevant resources that are being currently incorporated at several stages of education by Ceibal.

For instance, a child in primary school who has some experience with programming in Logo to create forms and figures on the 2D screen of his or her laptop can easily learn to program 3D concrete objects to be produced with a 3D printer. Ceibal is now introducing 3D printers in technical schools that can be reached online from other schools. We believe that this deployment will produce a significant enhancement in science education and also in the arts. In a sense 3D printer technology opens a new chapter of the success story of the “hands-on” and “learning-by-doing” pedagogies promoted

in many countries by organizations like *La main à la pâte* (www.fondation-lamap.org). The focus is on “doing” and the pedagogy is based on “construction” and on the “dialog” between teacher and student. In this sense, recent neurocognitive research is offering new insights on a pedagogical dialogue at the level of the simultaneous brain activations of teacher and student during a lesson (Battro *et al*, 2013). We can expect that mobile devices for brain imaging will offer plenty of new results in the classroom. These devices will function within the Ceibal digital platform soon.

The Ceibal Foundation

As we can understand, in order to implement new pedagogies it is necessary to expand the scientific basis of the emerging initiatives around the world. In this sense Ceibal is implementing a Foundation focused on research from the academic perspective at an international level. Its goal is to develop projects that are specifically designed for the institutions that request the study. It will be able to benefit from experts coming from different countries, receive funding from specialized financial institutions and offer an open space for discussion on education plans. The ultimate goal is to offer all institutions interested in 1:1 education model our specialized knowledge to contribute in the creation of citizens for the future all over the world.

Several prestigious institutions are already interested in collaborating with Ceibal and using the very large digital platform of Uruguay, which must be considered as a *big cognitive laboratory open to all*. In this sense the new Foundation will give the opportunity to engage in multiple international implementations. Some have already been successfully tested in small samples with the XO platform in other countries and will soon be implemented on a large scale in Ceibal (López-Rosenfeld *et al*, 2013). This important change of scale will certainly provide new insights in education.

Conclusions

For centuries education was submitted to a very slow process of change that has shaped the different cultures of the planet. Today the rate of change of innovation has increased by several orders of magnitude and we face a totally different educational environment. This dynamism is intrinsic to the digital environment and is producing profound changes in education. And last but not least these formidable changes are contributing to shape a global appropriation of the digital tools in the most diverse cultures. Sustainable education will become more and more universal without losing the local flavor. Ceibal is a good model of this transformation, which is open to all.

Acknowledgments

We thank Miguel Brechner and Miguel Mariatti for their support to this presentation. We are grateful to Matías Mateu Graside, Magela Fuzatti and Andrés Peri for their invaluable help with statistics and documents on the Ceibal projects discussed in this paper.

References

- Battro, A.M. and Denham, P.J. (2007). *Hacia una inteligencia digital*. Academia Nacional de Educación. Buenos Aires.
- Battro, A.M. (2009). Digital intelligence. The evolution of a new human capacity. In *Scientific insights into the evolution of the universe and of life*. (W. Arber, N. Cabibbo and M. Sánchez Sorondo, Eds). Pontifical Academy of Sciences. Acta 20. Vatican City.
- Battro, A.M., Calero, C.I., Goldin, A.P., Holper, L., Pezzatti, L., Shalom, D.E. & Sigman, M. (2013), The cognitive neuroscience of the teacher-student interaction, *Mind, Brain and Education*, 7, 3, 177-181.
- Battro, A.M (2014). A digital educational environment in poor populations. In *Bread and Brain. Education and Poverty* (A.M. Battro and Ingo Potrykus, Eds) Pontifical Academy of Sciences. Vatican City.
- Dehaene, S. (2007). *Les neurones de la lecture*. Odile Jacob. Paris.
- Donoghue, J. (2013). New interfaces for the brain. In *Neurosciences and the human person: New perspectives on human activities* (A.M. Battro, S. Dehaene, M. Sánchez Sorondo and W. Singer, Eds.) Scripta Varia 121, Pontifical Academy of Sciences, Vatican City.
- López-Rosenfeld, M., Goldin, A.P, Lipina, S., Sigman & Fernández-Slezak, F. (2013). Mate Marote: a flexible automated framework for large-scale educational interventions. *Computers and Education* 68, 307-313.
- Mangiatordi, A. (2012). Inclusion of Mobility-Impaired Children in the One-to-One Computing Era: A Case Study. *Mind, Brain, and Education*, 6(1), 54-62.
- Pasquinelli, E., Zimmerman, G., Descamps-Latscha, & Bernard, A. (2013) *Les écrans, le cerveau... et l'enfant*. Le Pommier, Paris.
- RADAR: El perfil del internauta uruguayo. Septiembre 2013.
- Rose, D. (2000). Universal design for learning. *Journal of Special Education Technology*, 15 (1), 67-70.
- Strauss, S. & Ziv, M. (2012) Teaching is a natural cognitive ability for humans. *Mind, Brain, and Education*, 6(4), 186-196.
- Wolf, M. (2007). *Proust and the squid. The story and science of the reading brain*. Harper, New York.
- Wolf, M., Gottwald, T., Galyean, T., Morris, R. & Breazeal, C. (2014) The reading brain, global literacy and the eradication of poverty. In A.M. Battro & I. Potrykus (eds). *Bread and Brain. Education and poverty*. Pontifical Academy of Sciences. Vatican City.

BEING TRAFFICKED TO WORK: HOW CAN HUMAN TRAFFICKING BE MADE UNSUSTAINABLE?

■ MARGARET S. ARCHER

Prologue

The first theme that the Pontifical Academy of Social Sciences tackled after its foundation in 1994 was that of 'Work and Employment'. Three Plenary sessions and Acta were devoted to the *sustainability* of 'work' and its corollary *full employment: The Future of Labour and Labour in the Future* (1996),¹ *The Right to Work: Towards Full Employment* (1997),² *Towards Reducing Unemployment* (1999).³

Since the economic crisis of 2008, unemployment has risen to unprecedented proportions around the world and ones disproportionately affecting the young. 'Austerity measures' have intensified this but no new solutions have been offered beyond those we examined in the 1990s. Indeed, some of those are dismissed as unaffordable.

Within weeks of assuming office, Pope Francis wrote to our Chancellor Msgr. Marcelo Sánchez Sorondo making a radical suggestion, effectively, that instead of re-entering this murky and often disingenuous political debate about overcoming 'the crisis', we should concentrate upon one form of work, namely 'forced labour', that was indeed growing globally.

Marcelo:
Crees que sería bueno tratar sobre trato de personas
y esclavitud moderna.
La trato de dignum puede tratarse en conexión con
el trato de personas.
Muchas gracias. Francis

Translation: Marcelo, I think it would be good to examine human trafficking and modern slavery. Organ trafficking could be examined in connection with human trafficking. Many thanks, Francis.

¹ Available online, <http://www.pass.va/content/scienze-sociali/en/publications/acta/futureoflabour.html>

This is how our concern in PASS about ‘Human Trafficking’ began and its objective is precisely to define the conditions under which this practice – as an affront to human dignity – *can be rendered unsustainable*. That is what I wish to introduce today because the Workshop⁴ organized by Bishop Sánchez Sorondo (November 2013) and the ecumenical meeting (April 2014) have already had a notable social impact – within and outside the Church – as we hope will be the case for our Plenary meeting in 2015.

1.a. The Magnitude of Human Trafficking

Conceptual clarity has to precede discussion of ‘human trafficking’. Without it, legislation is ambiguous and non-comparable, statistics convey a seeming precision that can be meaningless, and protocols, conventions or policies are open to different interpretations of to whom their directives apply. The same is the case for well-meaning ‘oppositional groups’ when those they seek to help and defend remain ill-defined. Such a lack of conceptual precision characterizes much of the documentation available. Some of this is unavoidable because the overall phenomenon, within which particular concepts seek to capture distinct elements (such as ‘forced labour’), is itself dynamic. It changes frequently in terms of the three ‘M’s: the *motives* of the ‘victims’ – itself a term varying in appropriateness; the *means* employed to recruit, transport and re-locate these human subjects, one that grows in organizational sophistication year upon year; and the *measures* taken by statutory bodies – global, interregional, national and local – that have undergone considerable revision and reformulation during the last two decades. One aim of this paper must thus be to avoid adding to conceptual confusion.

In this context, there are two words in the title of our current meeting that need to be scrutinized conceptually before a sociological discussion can begin: one is ‘trafficking’ and the other is ‘slavery’. Both repay attention because examining them alerts us to the complexities involved and also because only in that way can we identify which part of a large corpus of publications and statistics can contribute towards a sociological understanding of what is at stake.

² Available online, <http://www.pass.va/content/scienzesociali/en/publications/acta/righttowork.html>

³ Available online, <http://www.pass.va/content/scienzesociali/en/publications/acta/unemployment.html>

⁴ Available online, <http://www.pass.va/content/scienzesociali/en/events/2009-13/trafficking/traffickingstatement.html>

1.b. Can ‘Trafficking’ and ‘Smuggling’ be clearly distinguished?

What could be called the foundational document opposing ‘trafficking’, the 2003 United Nations’ ‘Protocol to Prevent, Suppress and Punish Trafficking in Persons’, offers the following definition. Trafficking involves:

‘the recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other means of coercion, of abduction, of fraud, of deception of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation. Exploitation shall include, at a minimum, the exploitation or the prostitution of others or other forms of sexual exploitation, forced labour or services, slavery or practices similar to slavery, servitude or the removal of organs’.⁵

In the above, ‘trafficking’ and ‘forced labour’ are explicitly elided, as implicitly is illegal migration if ‘fraud’ and ‘deception’ are incorporated into the meaning of ‘coercion’. Conversely, the earlier Migrant Smuggling Protocol (2000), (part of a UN package of legal instruments proposed to combat organized transnational crime), maintains that in contrast with trafficked persons, smuggled migrants are those moved illegally for profit. This latter construes the smuggled as willing partners in a commercial transaction because it assumes that they have acted voluntarily.

However, the presumption that ‘voluntary action’ suffices to differentiate ‘smuggling’ from trafficking is also unworkable if one backtracks to the International Labour Organization’s (ILO) Forced Labour Convention (1930, no. 29). Its definition of ‘forced labour’ covers ‘all work or service that is exacted from any person under the menace of any penalty for which the said person has not offered himself voluntarily’. Here, ‘forced labour’ subsumes ‘trafficking’ and *also* illegal migration, if and when ‘fraud and deception’ effectively defy voluntary action.

On the presumption of ‘voluntary action’, not only are the three categories blurred but, in consequence, the primary emphasis shifts away from human rights. Importantly, where human rights are concerned, neither of the two treaties (protocols) adopted by the UN General Assembly in 2000 contains guidelines on how people deemed to be ‘trafficked’ or to be ‘smuggled’ are to be assigned to one category or the other. In both cases, their identification documents are likely to have been confiscated and those in

⁵ United Nations Office on Drugs and Crime, *Global Report on Trafficking in Persons*, New York, 2012, p. 16.

transit can believe they are doing one thing and find another is being done to them as their journey or voyage unfolds.

Such confusion casts doubts on the careful pie charts and statistics offered in reports such as the UNODC (2012), which collects together national data that necessarily embodies national interpretations. Such figures are likely to inflate ‘smuggling’ and decrease recorded ‘trafficking’, because the Protocol on ‘trafficking’ recommends a number of ‘victim protection measures’ that nation states would have a financial interest in minimizing, unless human rights were high on their agendas.

Since these categories are not clear-cut (and probably cannot be since individuals can change category *whilst in transit*), little reliance will be placed in this paper upon the detailed quantitative analyses usually provided, as their repetition serves to accord them a spurious validity. The distinction between ‘sex trafficking’ and ‘forced labour’ seems particularly difficult to uphold because both can involve ‘bonded’ workers, individuals can move or be moved between the two categories, and distinguishing between them somehow implies that sex working is other than forced labour.⁶

However, there is one significant point of agreement between the UN and ILO protocols and conventions *together with* the aims and objectives of ‘opposition groups’. This is their consensus that it is correct to use the term ‘slavery’ to cover both ‘forced labour’ and ‘trafficking’. Take, for example, ‘Anti-Slavery International’ (founded in 1839), the only U.K. charity to work exclusively against slavery and that takes its definitions from UN and ILO sources. It asks ‘What Types of Slavery Exist Today’ and responds with the following list of malpractices: Bonded labour, Child Slavery, Early and forced marriage, Forced labour, Descent-based slavery, and Trafficking.⁷ In the context of some excellent sociological and historical work, we can be on firmer ground in determining whether or not it is appropriate to use the term ‘slavery’ today. Allowing that ‘historic’ slavery covered a great variety of practices, what were its crucial common denominators? If these can be disengaged, then it is possible to ask about what the contemporary practices listed above share with past forms of slavery and whether or not there are any important differences.

⁶ I will thus restrict myself to statements about ‘more’ and ‘less’, ones that themselves should be treated with caution.

⁷ http://www.antislavery.org/english/slavery_today/what_is_modern_slavery.aspx (downloaded 19.09.2013).

II. Is Trafficking in Human Beings ‘modern slavery’?

In this section, I am going to consider ‘trafficking’ and ‘forced labour’ together, as distinct from ‘smuggling’, at least conceptually. This is because although the latter may involve fraud, deception and brutality, illegal migration does not meet most of the criteria detailed below. The first two phenomena do, by and large, conform to them. Nevertheless, I will argue that there is one major difference between ‘contemporary’ and ‘historic’ slavery, one that is held by many historians to be a precondition of holding someone to be enslaved in a system of slavery. This is the absence of any approximation to, let alone equivalent of *manumission*. Its lack is both a source of objective and subjective personal hopelessness for those trafficked but it also means that contemporary slavery sets a completely new policy agenda in late modernity for combating practices of domination that are literally without any determinate end.

In his acclaimed socio-historical study, *Slavery and Social Death*,⁸ Orlando Patterson lists three distinctive features of the ‘master-slave relationship’ (Hegel), constitutive of slavery and together defining it. Although the book ends before the last decades of the twentieth century, his framework can be used to ask whether or not the organized forms of human trafficking (that appear to have increased over the last twenty-five years) do in fact share the defining features of slavery over the millennia.

Patterson holds the defining features of slavery to be structural, cultural and socio-psychological, despite the variegated social contexts in which they occurred.

Domination

*Slavery is one of the most extreme forms of the relation of domination, approaching the limits of total power from the viewpoint of the master, and of total powerlessness from the viewpoint of the slave.*⁹

The ‘trafficker/trafficked’ relationship is ultimately reliant upon coercion in its most violent forms. It may begin with trickery (the promise of work abroad) and can involve ‘wooing’ (the recruiter may promise to marry the subject on arrival),¹⁰ but such complicity gives way to naked violence on the

⁸ Orlando Patterson, *Slavery and Social Death*, Harvard University Press, Cambridge Ma., 1982.

⁹ *Ibid.*, p. 1.

¹⁰ UNODC.

stages of what can be an extremely complex journey.¹¹ In its course, ‘masters’ can change frequently (and the ‘mastermind’ may never be encountered), thus excluding the possibility that any ‘relationship of duty’ can emerge between the trafficked and the traffickers and meaning that violence will surface quickly and regularly when exigencies arise. As fear alone motivates obedience, relations of domination cannot be transmuted into ones of authority; on whatever conceivable basis it might be claimed. ‘Contemporary slavery’ not only meets the first criterion but appears to exemplify ‘total power’, with no attempt to conceal its nature after the *début*. With ‘forced labour’, those who are picked up living homeless on the streets and are often alcohol/drug users,¹² domination may be unconcealed from the start.

Social Death

*The definition of a slave, however recruited [is] as a socially dead person. Alienated from all “rights” or claims of birth, he ceased to belong in his own right to any legitimate social order. All slaves experienced, at the very least, a secular excommunication ... the slave was socially alienated and ceased to belong to any formally recognized community.*¹³

The importance of this aspect had first been accentuated by Moses Finley in relation to Greco-Roman slavery, when he emphasised the ‘outsider’ status of the slave as a crucial feature of his position.¹⁴ Alienation from natal kin is a continuing feature of trafficked people, despite data from a small ‘sample’ who listed their desire to ‘send money home’ as their prime motive for initial acquiescence.¹⁵ For many, there appears to be nothing to send and no means of sustaining contact. (This was one of the improbable parts of the film *Sex Traffic*, where an isolated phone box in rural Moldova proved

¹¹ Although UNODC, *Ibid.*, reports that more than 75% of trafficking flows are of short or medium range (i.e. within a given region), it also states that 74% of detected victims are exploited in a different country from their own. p. 12. This minimises costs and risks for the trafficker, but the report also details a pattern of trafficking that is becoming increasingly cross-border and transcontinental p. 41f.

¹² BBC News, 1 February 2012. <http://bbc.co.uk-11012084> (downloaded 19.0.9.2013).

¹³ Patterson, *Ibid.*, p. 5–6.

¹⁴ Moses Finley, 1968, ‘Slavery’, *Encyclopedia of the Social Sciences*, Vol. 14, New York, Macmillan and Free Press, pp. 307–313.

¹⁵ European Commission, 2003, *Research based on case studies of victims of trafficking in human beings in 3 EU Member States*, Hippocrates program, project no JAI/2001/HIP/023, p. 195.

a reliable means of communication.) Such informal personal relations as the trafficked do develop were, like those in ‘historic’ slavery, never recognized as legitimate or binding.

As Patterson notes: ‘It was this alienation of the slave from all formal, legally enforceable ties of “blood” and from any attachment to groups or localities other than those chosen for him by the master, that gave the relation of slavery its peculiar value to the master’.¹⁶ The slave was moveable, removable and disposable. One of the significant features today amongst transnationally organized traffickers is that their victims can later be circulated between cities and countries to reduce chance of detection. Whether on construction sites or in brothels, subjects have little chance to learn the local language or local geography, to form meaningful social relationships, let alone to know, acquire or exercise any civil rights that might in fact be theirs. They are socially dead because severed from any form of social integration, past, present or future. As persons, the Universal Declaration of Human Rights (1948) and its explicit ban upon slavery and servitude may as well not exist; they are non-persons denied their humanity.

Dishonoured and Degraded

Honour or reputation is both externally expressed and internally felt, which is what makes it a socio-psychological phenomenon. In the words of the anthropologist Julian Pitt-Rivers, ‘it is a sentiment, a manifestation of this sentiment in conduct, and the evaluation of this conduct by others, that is to say, reputation. It is both internal to the individual and external to him – a matter of his feelings and the respect he receives’. What generically makes the difference between positive and negative ‘sentiment’ and ‘evaluation’? To Pitt-Rivers, ‘the essence of honour is personal autonomy’.¹⁷ Absence of freedom is the other face of total domination, which is what makes disrepute characteristic of slavery. Human subjects who are treated as objects are beyond the pale of repute.

However, there is nothing inherently disreputable in being a construction worker, someone who can become known as a good and reliable workmate. Equally, a person who has exercised some degree of freedom in choosing to run a house of disrepute can acquire a certain repute, at least in her own circles, as illustrated from Shakespeare to the traditional Western

¹⁶ Patterson, *Ibid.* p. 7.

¹⁷ Julian Pitt-Rivers, ‘Honor’, in *Encyclopedia of the Social Sciences*, *Ibid.*, Vol. 6, pp. 503–511.

cowboy movie. What distinguishes these two stereotypes from slavery is that both are part of the social order rather than outside it. Indeed, this may be a contributory factor (besides having little other experience or qualifications to draw upon) accounting for some older women coming to collaborate with their trafficking network in running/staffing their enterprises.

Thus, Patterson's third criterion loops back to his first (total domination) and his second (social death) as well as to philosophers from Hobbes to Nietzsche who saw *repute* as inherently linked to power. '[T]hose who do not compete for honour, or are not expected to do so are in a real sense outside the social order. To belong to a community is to have a sense of one's position among one's fellow members, to feel the need to assert and to defend that position, and to feel a sense of satisfaction if that claimed position is accepted by others and a sense of shame if it is rejected. It is also to feel that one has a right to take pride in past and current successes of the group, and to feel shame and dishonour in its past and present failures'.¹⁸

From the three criteria taken together comes his definition: '*slavery is the permanent, violent domination of natively alienated and generally dishonoured persons*'.¹⁹ As we will see in a moment, the word 'permanent' refers to the duration of enslavement, rather than to slavery necessarily being in perpetuity for those once enslaved. On the contrary, to Patterson, the prospect and enactment of *manumission* is integral and indispensable to the system of slavery.

The importance of 'historic' manumission and its contemporary absence

*[i]t is not possible to understand what slavery is all about until we understand it as a process including the act of manumission and its consequence. Enslavement, slavery and manumission are not merely related events; they are one and the same process in different phases.*²⁰

If it is the case that manumission is integral to systems of slavery – and Patterson maintains that it is 'an essential condition'²¹ – we need to clarify why it is held to be so, because in contemporary trafficking this condition is usually lacking in formal terms. Thus, although today the trafficker/trafficked relationship conforms to the three defining characteristics of slavery just discussed, the absence of manumission may well cast doubt upon re-

¹⁸ Patterson, *Ibid.*, p. 79.

¹⁹ *Ibid.*, p. 13.

²⁰ *Ibid.*, p. 296.

²¹ *Ibid.*, p. 101.

garding contemporary practices (that exemplify (a), (b) and (c) above, and often do so more brutally than quite a number of historic practices) as falling within the concept of slavery. After all, there are other terms that capture trafficking, such as ‘abduction’ or ‘kidnapping’, which might be considered more appropriate. However, it is the supreme conformity of trafficking to the criteria of ‘total domination’, ‘social death’ and ‘dishonouring and degradation’ that makes me reluctant to regard it as other than slavery without further consideration.

Let us begin by unpacking Patterson’s reasons for holding manumission to be ‘an essential condition’, above and beyond the fact that he has empirically documented that ‘most slave populations had high manumission rates’, despite their differences in type.²² He poses the seeming paradox that the *effect* of the three criteria was indeed to make the slave’s yearning for human dignity more intense, yet that this itself could be exploited to benefit the individual master and to buttress the slavery system as a whole. How can this apparent contradiction be resolved?

At the micro-level, the master ‘does so by manipulating it as the principal means of motivating the slave, who desires nothing more passionately than dignity, belonging, and release. By holding out the promise of redemption, the master provides himself with a motivating force more powerful than any whip. Slavery in this way was a self-correcting institution: what it denied the slave it utilized as the major way of motivating him.’ At the macro-level, the dialectics of the system come into play. ‘The slave’s struggle made it necessary that the master, in order to make slavery workable, provide an opportunity for the negation of slavery. The conflict between master and slave became transformed from a personal into an institutional dialectic, in which slavery as an enduring social process, stood opposite to and required manumission as an essential precondition’.²³

What I am going to suggest is that in contemporary trafficking there is a natural and informal mechanism that operates in the same way and with the same consequences as the seven versions of formal manumission detailed by Patterson. This informal procedure works in much the same way for ‘sex trafficking’ and ‘forced labour’. Quite simply, *those trafficked also age* – faster in the sex trade than in the most common types of enforced labouring. Objectively, this means that trafficked people are of diminishing financial value to their exploiters. In cost-benefit terms, as they grow older, it is not

²² Ibid., p. 133.

²³ Ibid., p. 101.

worth further investment in order to retain them. Subjectively, the knowledge of their ineluctable superannuation (perhaps at 25 in sex work) performs the same function of placing a time limit on, if not their ‘release’, at least upon when they can drift away without strenuous attempts to detain them. (This similarity is another reason for considering the two groups of the trafficked together).

Moreover, in terms of their life-histories, the ‘historic’ and the ‘contemporary’ populations involved would not have been very different (adjusting for differential longevity). This is because most frequently, manumission involved purchasing it and was thus mainly a matter of which slaves were in a position to do so. Thus, Johnson found that in Buenos Aires, ‘the ‘crucial variable in determining whether a slave could accumulate sufficient capital to purchase manumission was independence from direct supervision of the slave owner, not gross earning capacity’.²⁴ In fact, females working in hawking, had more control over their earnings than males slaves hired out at negotiated wage rates paid directly to their owners, as was reflected in the higher manumission rate for women. This provides a reminder that the sex trade is not exclusive feminized nor is forced labour the preserve of males – then as now. Taking a broader canvas, Patterson concurs that ‘in general access to skill and opportunity to control part of earnings were found to be the major determinants of incidence’ (of manumission).²⁵

What is perhaps surprising is that virtually the same difficulties attended gaining and benefiting from ‘historic’ manumission as attach to obtaining and profiting from freedom amongst today’s trafficked people. First, is the problem of capital accumulation mentioned above, whose counterpart today is that even if a ‘contracted’ passage can be paid-off, and the size of these ‘debts’ can be huge (up to €50,000 from Nigeria to Italy),²⁶ the initial debt rises considerably because of new ‘costs’ imposed by middlemen, charges for a room, food, bills, clothes, the ‘place’ where they work and fines various. Secondly, all would be landless and homeless as well as penniless. Thirdly, if they had skills these would be undocumented and they would be without persons willing to vouch for them or provide ‘references’. Fourthly, whilst all of these factors would confine them to the lowest-paid jobs, they would also be confined to the localities they knew – and which

²⁴ Lyman L. Johnson, 1979. ‘Manumission in Colonial Buenos Aires, 1776-1810’, *Hispanic American Historical Review*, 59, pp. 275-276.

²⁵ Patterson, *Ibid.*, p. 295.

²⁶ European Commission, 2003, *Research based on case studies of victims of trafficking*, *Ibid.*, pp. 154-5.

also knew them! Finally, while the traditional slave may often have been detained by attachment to family members still in servitude, their contemporary counterparts are frequently restrained by un-dated threats to their families back home. Thus, in both cases the dependency established was hard to shed, just as freedom was a hard path to take.

I hope that the present section has served to justify the reference in our title to trafficking as ‘Modern Slavery’. It was something of a surprise after writing this to find Pope Francis declaring during the same week ‘Nowadays, “slave labour” is common coin!’²⁷ Interestingly, his reference to slave labour did not make a distinction either between ‘forced labour’ and ‘sex trafficking’. Both are coerced and both entail work that is degrading to human dignity.

III. What’s new about Human Trafficking in Late Modernity?

So far, I have dealt largely with those similarities between slavery old and new that justify regarding the *results* of contemporary trafficking as continuous with the past. In other words it is legitimate to regard the outcomes of such traffic as slavery today (with the one outstanding difference being the absence of any formal process(es) of manumission, to which I will return later). However, that is to say nothing about what *explains* this continuation and continuity of a practice that was morally condemned and ‘abolished’ in the West during the nineteenth century. Nor does it *account for how* slave trading continues to be conducted in the completely different social context of a globalised world.

Moreover, this explanatory weakness becomes acute when we confront one issue that is incontrovertible. *The criminalization of human trafficking is a phenomenon of the new millennium.* All of the protocols and conventions already mentioned date from 2000. Why was this so late? Why was it spear-headed by the United Nations and other INGOs? Why did 154 nation states ‘hurry’ to sign up within a decade? If the response is that trafficking had intensified – and doubtless it had never gone away – it is difficult to adduce robust evidence because that would imply the possibility of differentiating between ‘legal’ and ‘illegal’ migrants and showing that the ‘illegals’ represented a growing percentage. In fact, to this day, no nation state can provide other than an estimate of illegal migration.

It is even more difficult to disentangle xenophobic public reactions to the presence of migrants in general from opposition (let alone moral out-

²⁷ ‘Message for World Day of Migrants and Refugees’, September 4, 2013 (zenit.org).

rage) over the practice of trafficking. Indeed, the flourishing of ultra-right parties in Europe (such as the Le Pen Front National party in France and UKIP in Britain, both of which have the restriction of migration prominent on their agendas) soon after Social Democratic Parties suffered demise,²⁸ makes it impossible to explain ‘new abolitionism’ as some kind of millennial ‘change of heart’. *Sociologically, we must dig deeper to account for both ‘more’ transnational trafficking and the sudden flurry of globalized opposition to it.*

To do so, it is essential to think in sociological terms other than the type of explanation most favoured in official reports. These simply present accounts based upon social hydraulics. That is, there are ‘push’ factors and ‘pull’ factors and when the two coincide, a higher rate of trafficking is said to result (for example, the movement from poor to rich countries or regions). Yet, poverty *per se* cannot *causally account* for either the practice or its rate, any more than it directly accounts for crime or low school attendance. People can respond to ‘poverty’ in many different ways; from resignation to ‘their lot’, by doing what they can in their social setting (from scavenging the refuse tips to collecting the benefits for which they are eligible), from lone petty crime (stealing food) to organized criminal activities and so forth. In short, if someone, some group or collectivity is poor, this does not tell us what they will do. Nor does it even tell us that as an aggregate they will do something different from the rich, or in greater numbers or with higher frequency. Amongst the rich are plenty of criminals, many who cheat on their expenses, and some who engage in tax evasion and shoplifting.

These are ‘billiard ball’ accounts that treat human subjects as ‘passive agents’ and their contexts as ‘social forces’. These two assumptions are found linked together in the UNODC report: ‘The socioeconomic conditions of victims and their hope of improving their lives abroad are among the factors of vulnerability that traffickers leverage to exploit them’.²⁹ To brand any category of people as ‘vulnerable’ is today’s apology for an explanation. Semantically, the word has changed from its old adjectival or adverbial use (‘an argument vulnerable to refutation’) to become a noun. As the latter, ‘the vulnerable’ is a category to which people are held to belong involuntarily through circumstances beyond their control (they are not responsible), from which they cannot escape (they *are* ‘vulnerable’ whatever their strength of character) and this category is objectified or reified (to join real charac-

²⁸ David Bailey, 2009, *The Political Economy of European Social Democracy*, Abingdon, Routledge.

²⁹ David Bailey, 2009, *The Political Economy of European Social Democracy*, Abingdon, Routledge.

teristics such as ‘colour blind’ or ‘over 70 years old’). It perfectly describes the ‘passive agent’ who is simply prey to ‘non-passive actors’. It strips the ‘vulnerable’ part of humanity of its powers of resistance, of ingenuity and of human dignity; even in the zoological world, the preyed upon are granted ‘animal cunning’. It carries the non-judgemental connotation that in the same position, you would behave in the same way. The trouble is that those in similar positions do not behave in similar ways and rendering them passive is to render the investigator incapable of explaining the variety of the different things they do.

The same is the case for treating the social context as an aggregation of ‘socioeconomic factors’, as in the UNODC quotation above. It leads directly to empiricism, to the attempt to find statistical correlations between factors or variables. Yet, causality cannot be derived from correlations or regressions (that David Hume called ‘constant conjunctions’). When such measures of association are strong, they set a problem for the social scientist to explain because they themselves are not explanations. This is not the place to go into the detailed critique of ‘empiricism’ that has intensified over the last four decades in social science. Nor is it the place to enter lengthy debates about alternative explanatory frameworks. Suffice it to say that these are in unresolved contention about what precise process accounts for a social phenomenon, practice or problem.

There is no theory-neutral explanation of anything, but there does seem to be a growing agreement on the *constituents* of adequate explanatory accounts, though a lack of consensus about their definition, combination and importance. Social reality – any section of it or problem within it – is intrinsically, inherently and ineluctably ‘peopled’. Its ontological constitution is utterly activity-dependent, despite the fact that people’s thoughts and actions give rise to factors that are ‘not people’ – the most important of these being structure and culture. For any process to merit consideration as a generator of social change it must necessarily incorporate structured human relations (contextual-dependence), human actions (activity-dependence) and human ideas (concept-dependence). A more familiar way of putting the above is that every theory about the social order or explanation of a problem within it necessarily has to incorporate SAC: structure, agency and culture.³⁰

³⁰ The problem in hand will govern which of the three is accorded most attention and the acronym SAC is thus *not* a rank ordering of priority between the three elements. This is a logical point; if something is deemed indispensable to something else, it makes no sense to ask if one element is more indispensable than the other.

In these terms, I venture a rudimentary explanation that simultaneously would account for:

- the growth of ‘contemporary slavery’ as integral to the globalised capitalism of late modernity;
- the tension (a ‘constraining contradiction’)³¹ between multi-national production and responses by nation states;
- accounting for the ‘delayed’ cultural opposition of global institutions such as the UN to contemporary slavery, although they were the first officially to advocate its criminalization.

IV. The Social Shaping of Contemporary Trafficking

Slavery, like any other social phenomenon or practice, always takes a *particular form*. Explanation consists in identifying those processes or mechanisms that generate and shape a given form and increase its scope. Simultaneously, such an account must incorporate countervailing processes that diminish or reduce the impact of the first generative mechanism.³² In Figure 1, solid arrows indicate the processes shaping and intensifying contemporary slavery and dotted lines those operating to diminish or dilute the former. The dashed lines (in the middle) represent the ensuing conflicts between the two processes. Stages are numbered in (broad) historical sequence, from the 1970s until today. Each number is followed by an annotation that includes data where available.

(i) Just as the rise of cotton production in the southern States of the US and of coffee production in Brazil created a need for labour that was met by the slave trade,³³ so too the spread of multinational enterprises was associated with the exploitation of workers, both as cheap child labour and as ‘forced labour’. Increased market competition was the major driver. As part of being competitive, it should be stressed that whilst most factors of production were mobile – money, goods, services and, above all, the digital technology essential to the logistics, accounting and transport of geographically dispersed production – this was *not the case for labour*. The competition

³¹ This concept is discussed in Margaret S Archer, 1988, *Culture and Agency: the Place of Culture in Social Theory*, Cambridge, Cambridge University Press. For a contemporary treatment see Archer, 2013, ‘Introduction’ to Archer (ed.), *Social Morphogenesis*, Dordrecht, New York, Springer.

³² Margaret S. Archer, 1995, *Realist Social Theory: The Morphogenetic Approach*, Cambridge, Cambridge University Press.

³³ Patterson considers that the majority of slaves brought to the New World were kidnapped persons. *Ibid.*, p. 120.

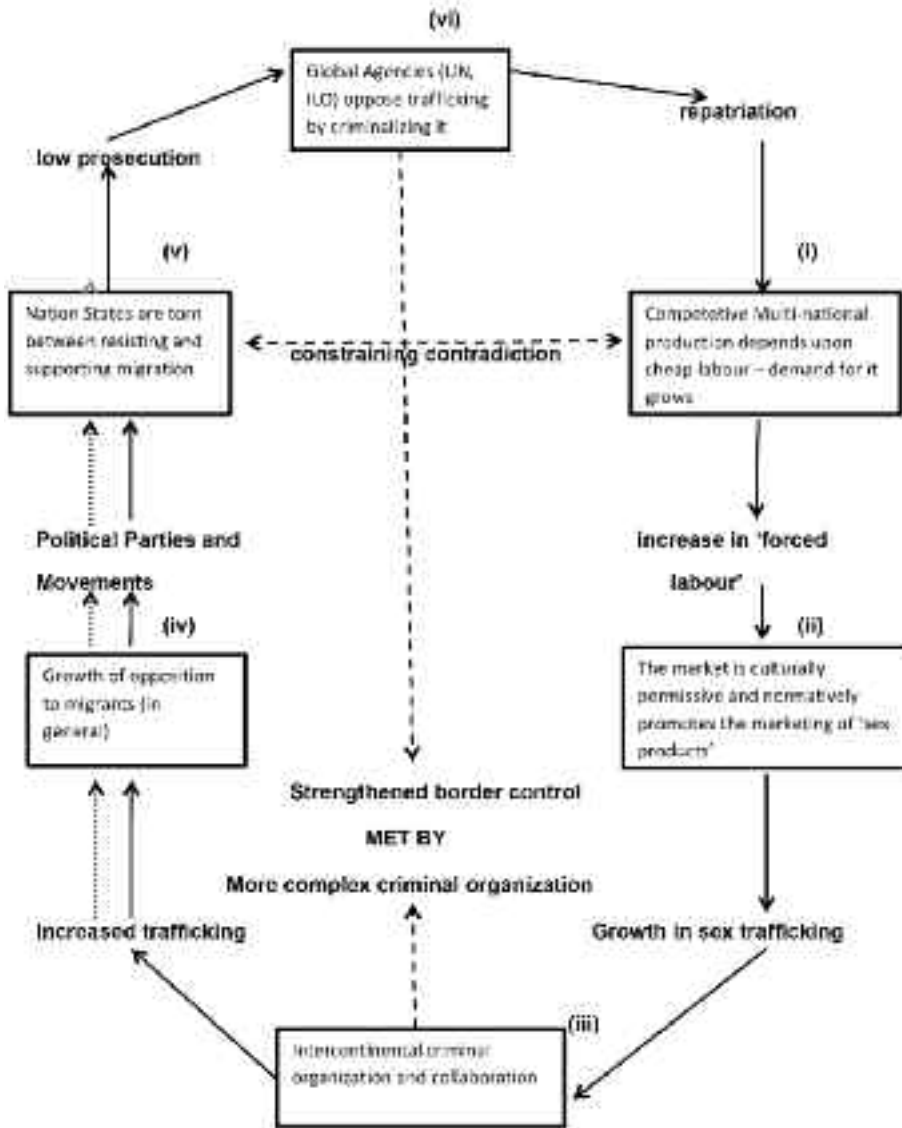


Figure 1.

intrinsic to capitalism accounts for the ‘demand’ for ‘forced labour’ and for the areas of the world where it was most prevalent, and considerably outweighed ‘sex trafficking’ (in Asia, the Pacific, Middle East and Africa). It is also consonant with the sharp and recent rise from UNODC’s estimated 18% of those trafficked in 2006 being for ‘forced labour’ to 36% of victims detected in 2010.³⁴ The direct connection with the multinational supply chain has been documented by both the ILO and the UN GIFT programmes,³⁵ as well as by much research.

(ii) Exactly the same technological breakthroughs based upon micro-electronic processing have, as is well known, promoted the marketing of sexual material: from DVD movies, photographs downloadable from the internet, the self-presentation fostered by the likes of *Facebook*, to sex tourism. Apart from imagery featuring children, it is un-regulated. Doubtless, we have all confronted and been affronted by the offer of ‘Adult movies’ in otherwise respectable hotels. That is a minor illustration of how normalization proceeds. However, this non-regulation is actively defended by the suppliers of computers who recently rejected the suggestion of a ‘non-dirty’ default setting, even if it could be turned off by the purchaser. In this way ‘demand’ is stoked and part of the response is the estimated 58% of trafficked persons destined to be for sex work in Europe or the Americas.³⁶

(iii) More than three-quarters of trafficking flows in 2012 were estimated to be confined to the same region. The UNODC report argues that this ‘maybe explained largely in terms of convenience and risk minimization for the trafficker ... Long- distance trafficking flows need to be supported by a well-structured organization that can take care of air travel and false documents and that sometimes also exercises long-distance control over the families of the victims in the origin country. This form of trafficking cannot be sustained over time unless a structured trafficking network is in place’.³⁷ Criminal organizations engaged in trafficking appear to follow growth pattern from domestic, to interregional and finally to transcontinental opera-

³⁴ UNODC, *Ibid.*, pp. 35–40. Although this entailed exploitation in another country for the majority this was largely intra-regional trafficking and working for the multinationals was the likeliest source of demand despite place of work was not included on the national submissions making up the report.

³⁵ ILO, *Eradicating Forced Labour from Global Supply Chains – Webinar presentation*, 2011. [http://www.ilo.org/empent/Eventsandmeetings/WCMS_165497/lang—en/index.htm](http://www.ilo.org/empent/Eventsandmeetings/WCMS_165497/lang-en/index.htm)

³⁶ UNODC, *Ibid.*, p. 39–40.

³⁷ *Ibid.*, p. 41.

tions, facilitated by the same technology as employed in multinational production. Manuel Castells was among the first to accentuate the parallel effect of information technology on criminal organization as a prominent feature established by the turn of the millennium: 'Mafia-like organizations around the world have also become global and informational, providing the means for stimulation of mental hyperactivity and forbidden desire, along with all forms of illicit trade demanded by our societies, from sophisticated weaponry to human flesh'.³⁸

Several concurrent features, clustered towards the end of the twentieth century, accelerated this development. Firstly, the collapse of Eastern European governments not only enabled organized crime to profit from reduced constraints, but falling living standards enlarged the pool of those seeking migration. Two of the earliest players were Albania and Moldova – 'failing countries' – rejected by East and West alike. For example, it has been estimated that out of the 1,346 Moldavian travel agencies operating around the turn of the century, only 340 were legal, thus providing a domestic infrastructure for recruiting the trafficked.³⁹ Secondly, other forms of smuggling experts – in cigarettes, drugs and arms dealing – diversified into the profitable venture of human trafficking, using their acquired knowledge of 'safe' means and routes. Thirdly, organizations in countries of recruitment, transit and destination were ready to collaborate in what became a complex criminal organization with a global reach. The part of the EU research report dealing with Italy, details deals between trafficking organizations from Albania, Nigeria, the former Soviet Union and China with Mafia organizations in various Italian regions, who profited when granting permission to operate on 'their' territory. The elaboration of this structured system also involved 'corrupt administrative bureaucrats, police officers and border control agents who directly (as representatives of the criminal groups) or indirectly (accepting bribes for not stopping the suspected traffickers and victims) take part in the profitable transnational business'.⁴⁰

(iv) Political opposition took the form of a general condemnation of migration – at least at on its current scale – whether legal or illegal, as was typical in most recipient countries, including fast developers such as India.

³⁸ Manuel Castells, 2010, *The Rise of the Network Society*, Vol I, Wiley-Blackwell, Oxford, p. 2.

³⁹ European Commission, 2003, *Research based on case studies of victims of trafficking*, Ibid., p. 158.

⁴⁰ Ibid., p. 168. See also P.C. van Duyne *et al.* (eds.), 2000, *Cross-border Crime in a Changing Europe*, Tilburg University, Institute of Criminology and Social Prevention, Prague.

These movements and parties are well known in Europe and America but, *until recently, they have rarely singled out trafficking as such* in their resistance to migration. Their grievances, often a form of scapegoating, can be grouped under three headings. First, the economic damage inflicted on the domestic economy, focussing on ‘taking our jobs’ and using ‘our social services’. Denmark’s stringent immigration reform is frequently cited favourably in this context as saving 6.7 billion euros a year.⁴¹ In calculating such ‘savings’, the contribution made by migrants to the national economy is not, to my knowledge, ever subtracted (despite their indispensability to the functioning of national health services, for example.) Since the onset of the current economic crisis budgetary austerity and the growth of youth unemployment has undoubtedly increased the impact of such arguments. Secondly, migrants are associated with a rise in crime rates,⁴² although this is statistically contested. Third, and importantly, since many states have experimented with multicultural programmes but without great success, the charge of diluting ‘national identity’ has been fuelled. In all of this, the trafficked are not differentiated (as deserving of humanitarian concern) but are assimilated to the abusive term ‘illegal’ and more easily subject to deportation.

However, all such anti-migration groups have difficulties in transforming themselves from single-issue movements into credible political parties. Nevertheless, Marine Le Pen obtained almost 18% of the vote for her Front National Party and *Le Monde* reported that 33% of the French electorate hoped she would occupy ‘an important political role’.⁴³ Nigel Farage and UKIP began to be taken seriously when recently well-placed in parliamentary by-elections, assisted by a blatant anti-European stance but undermined by equally blatant sexist comments at their 2013 Party Conference. This indicates that revival is possible for the ultra-right and constitutes a new pressure on existing parties and potential governing coalitions. Thus, these parties play an ambivalent role in terms of negative feedback since their general opposition to migration, includes, but does not single out the practice of human trafficking.

⁴¹ <http://www.telegraph.co.uk/news/worldnews/europe/denmark/8492822/Denmarks-immigration-laws-save-country-6-billion.html>

⁴² McDonald, William Frank. *Immigration, Crime and Justice*. Emerald Group Publishing. This is contested in French, Howard W. (September 30, 1999). “Disdainful of Foreigners, the Japanese Blame Them for Crime”. *The New York Times*. <http://www.nytimes.com/1999/09/30/world/disdainful-of-foreigners-the-japanese-blame-them-for-crime.html> Retrieved April 30, 2010.

⁴³ *Le Monde*, 03.10.2013.

(v) In the Western world, governments and political parties have an even more ambiguous stance. On the one hand, electoral considerations encourage giving serious attention to manifest popular resistance to migration in the general terms described above. On the other hand, most are economically compromised by the use of cheap, exploited and often trafficked labour in *their* multinational enterprises in the developing world. At home, they are not immune either, given disclosures of ‘sweatshops’ producing clothing, for example, for well-known national brands.⁴⁴ Although these are usually dismissed as bad tales from the last century, new disclosures continue to be made in Europe and the US. In other words, the black economy is still needed for the white economy to be competitive and, in Western countries, trafficked labour plays its part.

In the West, most political parties have compromised and now set targets restricting migration. In Asia, it is estimated that 700,000 people are trafficked annually (out of the ILO’s estimate of 20.9 million people being in forced labour globally). Here, Australia – perhaps because so much of the white population descends from transported ancestors – has played something of a lead in programmes to combat trafficking in South East Asia.⁴⁵ What is significant is that it has had to work regionally through ASEAN because of the (unstated) political complicity in trafficking within certain of its 10 member countries.

In sum, this means that nation states have been at best inactive towards human trafficking and only rarely pro-active towards combating it. The phenomenon of trafficking has increased, but the ‘constraining contradiction’ in which their ‘economic interests’ embroil them entails a negative feedback loop, rather than making even the most democratic governments pro-active in eradicating trafficking. That seems to account for the delayed opposition to it and equally for the main initiatives having come from supra-national agencies, particularly the UN and ILO.

By 2012, 154 countries had ratified the UNODC *Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children*. By the same date, 134 countries and territories had enacted legislation criminalizing trafficking, meaning that the percentage of those without an offence designating this activity as criminal had halved between 2008 and 2012.⁴⁶

⁴⁴ See Annie Phizacklea, 1990, *Unpacking the Fashion Industry*, Routledge, London.

⁴⁵ Australian Aid. ‘Prime Minister announces new programme to combat human trafficking’ <http://aid.dfat.gov.au/HotTopics/Pages/Display.aspx?QID=882> (downloaded 19.09.2013).

⁴⁶ Executive Director’s ‘Preface’, UNODC, *Ibid.*, p. 1.

Nonetheless, the Council of Europe's GRETA (Group of Experts on Action Against Trafficking in Human Beings), which produced the first assessment of the UK since its anti-trafficking convention came into force in 2009, stated that there were indications that increasing numbers were being brought in to work for purposes of sexual exploitation and forced labour. However, of the hundreds identified as having been trafficked only 29 people were reconvicted of the offence of being traffickers in 2010.⁴⁷ Thus, the last link (iv) in the array of positive and negative feedback factors influencing or diminishing trafficking still remains to be discussed: what effect does 'criminalization have?

V. Criminal Justice: necessary but insufficient?

The criminalization of human trafficking is a short story belonging to the 21st century. The parent instrument was the UN Convention Against Transnational Organized Crime, adopted by the General Assembly in 2000. From it sprang the Protocols and Conventions that have already been mentioned, all of which required not only ratification but embodiment in national legislation.

Significantly whilst the 2002 Protocol required state signatories to 'criminalize trafficking' and to 'strengthen border controls' the 'victim protection measures' proposed remained optional, among which featured 'adopting legislative or other measures permitting victims to remain in their territories temporarily or permanently'. The implication is that 'criminalization' and 'border control' take precedence over the human rights that 'victim protection' was intended to address. No protection was provided in the Protocol against the involuntary and immediate repatriation of those detected as having been trafficked. Moreover, lack of adequate 'witness protection' reduces the rate of criminal prosecution. The figures supplied in the 2012 UNODC report reflect little change in these respects. Finally, tighter border controls are most effective against small operators, thus reinforcing the monopoly of the globalised criminal networks (as illustrated in Figure 1).

'Deport or detain' (or vice versa if the aim is to secure witnesses), were the predominant national responses, although some relaxation has taken place in the major counties of destination.⁴⁸ However, what remains glaring through its absence are any forms of victim compensation (once mooted and to be funded through gains confiscated from traffickers). Even more importantly, what official

⁴⁷ BBC News, 12 September 2012, <http://www.bbc.co.uk/news/uk-19566617> (downloaded 19.09.2013).

⁴⁸ See A. Gallagher and E. Pearson, 2010. 'The High cost of Freedom: A Legal and Policy Analysis of Shelter Detention for Victims of Trafficking', *Human Rights Quarterly*, 32.

policies have been developed to equip the trafficked with basic skills for a normal life in the countries of destination in which they have been abused? In general, these remain the patchwork preserve of voluntary associations, with occasional exceptions where public and third sector providers collaborate.

The drawbacks of the Rapid Repatriation Response

Though doubtless favoured by ‘anti-migrant’ lobbies ([iv] in Figure 1), this ‘solution’ has the major drawbacks listed below and synthesised from the reports already cited. They summarize the limitations of Criminal Justice alone to tackle the problem of trafficking. In what follows, I maintain that the effects for the trafficker and the trafficked have to be considered alongside one another otherwise any balance sheet is skewed.

All reports agree that statistics for the identification, arrest and, above all, conviction of traffickers are exceeding small in relation to what is known about the size of the problem.

Rapid deportation does not allow the trafficked to become fully aware of their rights, overcome their fear of reprisals from their exploiters through secure witness protection schemes, or to recognize that they will not be ‘set free’ on paying the original debt-bond they had contracted. In fact, it can be argued that rapid repatriation deprives criminal justice of its key informants.

In qualitative studies, approximately half of the trafficked had known their recruiters in their country of origin and defined them as acquaintances, partners, family members and friends. Deportation puts them at risk from such persons who fear the trafficked disclosing their experiences.

Despite local, national and regional variations, those who have been pressed into forced labour often originated from minority or marginalized groups whose experiences of institutional discrimination may have facilitated their recruitment. Returning them to such contexts can mean that criminal justice places them in double jeopardy.

The criminalization of trafficking is necessary in all parts of the world, but involuntary deportation appears both counter-productive to the prosecution of perpetrators and is often doubly punitive of their ‘victims’.

‘Australia, the United States, and most countries of Western Europe, now provide special visa arrangements for victim-witnesses. Such arrangements often include a provision for victims to take some time – “a reflection period” – to think about whether or not they wish to be involved in criminal proceedings. At the end of this reflection period, the most generous schemes envisage granting residence permits to victims of trafficking who choose to cooperate. This approach, pioneered by the European Union through Council Directive 2004/81/EC, 2004 O.J. (L 261), has now been adopted as the European legal standard through the European Trafficking Convention, *supra* note 2, art. 13’.

How Voluntary Associations can help?

The following considerations are not confined to enforcement of human rights alone but deal more broadly with measures aimed at a social well being consonant with the human dignity of trafficked persons – what could be called meeting the needs of manumission in late modernity. These reflections stem from considering a brief window of opportunity in Italian law (between the Legislative Decree 286/98 and the passing of the ‘Bossi-Fini’ law in 2002). During these four years a plethora of voluntary associations⁴⁹ jump-started over 200 projects whose aim was the social integration within Italy of those who had been trafficked into sex work. Prior to the 1998 Decree, detention in 7 shelters run by the Ministry of the Interior had been followed by immediate enforced deportation.

The special permit ‘to stay’ was granted under Section 18 of the Decree on the assumption that ‘victims’ would press charges or at least supply the police with information. Indeed, the police and *carabinieri* were the main referring agents. Thus, one interpretation of the Decree was as an adjunct to criminal justice and the establishment of a national Freephone line (*Numero Verde*) could be seen in the same light. However, in the hands of the Voluntary Groups the practices and provisions greatly exceeded the aim of increasing the network of informants in the following ways.

- Since 90% of street prostitutes were estimated to come from (then) non-EU countries, ‘their illegal status and poor knowledge of the territorial services offered’ meant that Public Social Services were rarely used by them.⁵⁰ Instead, volunteers took the initiative of approaching them on the streets.
- The services offered included legal and social counselling, health protection, shelter, learning Italian, vocational guidance and training, and job placement. Those attending such Programmes of Social Assistance would receive a Permit for Social Protection, which could later become a regular ‘work permit’.
- The accommodation offered was usually arranged ‘stepwise’, leading progressively towards living autonomously.

The media were used to highlight the plight of the target population. However, although funded by the Italian Department for Equal Oppor-

⁴⁹ See European Commission, 2003, *Research based on case studies of victims of trafficking*, Ibid., p. 138-9.

⁵⁰ Ibid., p. 138.

tunities, there was no central co-ordination of the Programmes available in different areas. On the other hand, freedom from bureaucratic regulation allowed the voluntary associations to function as Research and Development agencies that innovated, monitored and evaluated their initiatives as they went along. Thus, it was concluded in the Research Report that ‘in the case of strategies to combat trafficking of human beings, NGOs have played, and still play an exemplary pioneering role. They, in fact, have always preceded – and often taken the place of – governmental bodies in planning activities and providing services in favour of weaker members of society at risk of social exclusion ... Public bodies generally follow suit after a certain delay’.⁵¹

VI. Conclusion: Is there social life after ‘Social Death’?

*Nina, ci vogliono scarpe buone,
e gambe belle, Lucia,
Nina, ci vogliono scarpe buone,
pane e fortuna e così sia,
ma soprattutto ci vuole coraggio a trascinare le nostre sole
da una terra che ci odia ad un'altra che non ci vuole.*

(Ivano Fossati, 2003)

Nina, good shoes are needed,
and beautiful legs, Lucia,
Nina, good shoes are needed,
bread and good fortune, so be it,
but, above all, it takes courage to drag our soles
from a land that hates us to another that does not want us.

Earlier in this paper it was argued that ‘ageing’ itself was the naturalistic form taken by manumission in late modernity. But, for those who live to see such ‘freedom’, what kind of social life, what degree of social re-integration is open to them? Do they remain strangers in strange lands, forever editing their pasts but never able to forget them? What kinds of friendships can a ‘success case’, who now works in a shoe factory, develop or is she drawn back to ‘Club-land’ where, at least, she knows ‘how to go on’? Can she find joy or is she socially condemned to rejoicing in the absence of abuse? We simply do not know. In the thousands of pages of reports – official and unofficial – no one seems to have undertaken research on middle-aged and old-aged human subjects and their lives after ‘social death’.

These lost lives are globalization’s own *desaparecidos*.

⁵¹ Ibid., p. 136.

PRECARIEDAD LABORAL, EXCLUSIÓN SOCIAL Y ECONOMÍA POPULAR

■ JUAN GRABOIS

Abstract

Human work has an extra economic value as social integrator and organizer, producer of dignity, fraternity and self-esteem. When unemployment becomes a structural condition of the global economic system and there is a vast multigenerational sector of the working poor without formal and productive employment, the gap between those economically integrated in global markets and those barred of the mere possibility of a decent job develops into a social duality that we call exclusion. Employment crisis is the logical consequence of what Pope Francis calls “exclusion economy”, an unjust paradigm that seeks for profit through productivity and efficiency understood just in monetary terms. As Pope Francis points out, there is no possibility of real improvement without structural changes that place mankind and the Creation in the center of the scene.

The end of bipolarity and Cold War, instead of bringing up a world that walks progressively towards a global social and inclusive democracy, gave birth to an increasingly aggressive capitalism that applies technological developments such as automation, robotics and biotechnology to the sole purpose of the enrichment of a happy minority, without any environmental or communitarian concerns. In this context, a large majority of the global workforce is now under precarious or informal jobs, especially in poor countries. Regular, stable, full time and well-paid jobs are no longer a reality or probable prospect for most working people.

The emergency of this new proletariat growing both inside and outside central countries is, as Arnold Toynbee described, a powerful sign of a civilization’s crisis. The new proletariat is composed “popular workers” within poor countries plus those who migrate from them to richer regions. The young *precariat*, sons and daughters of the neoliberal period in rich and intermediate countries, educated in unemployment and temporary jobs, completes the picture. Although the main features of both sectors differ, lack of realistic progress prospects makes them brothers in hopelessness.

We call “People’s Economy” the large economic networks – generally known as informal sector – built by the excluded out of sacrifice and available leftover means of production. People’s Economy is relatively detached

from global markets though there are no few cases where informal economic units integrate dislocated value chains of transnational companies that benefit from cheap work and lack of regulations.

In this paper we describe the main features and trends of “People’s Economy” and list a number of unconventional occupations that have emerged as a result of the contraction of the formal employment market. We also present some alternative schemes based on people’s prominence, respect for popular occupations, recognition of their struggle for dignity and promotion of base organizations. Finally, we provide a subjective interpretation of Pope Francis’ approach to the issue and some unpublished words that he recently directed to organizations of the excluded.

Introducción

“En el trabajo libre, creativo, participativo y solidario, el ser humano expresa y acrecienta la dignidad de su vida”, *Evangelii Gaudium*, Francisco.

La centralidad del trabajo en la vida humano excede con creces su dimensión económica. Ganar el pan con el sudor de nuestra frente produce dignidad, autoestima, fraternidad y nos permite organizar nuestros tiempos en torno a un proyecto de vida en el marco de la comunidad nacional. Es cierto que no todas las modalidades que adopta el trabajo permiten ejercer la creatividad y desplegar el potencial de cada uno. Las jornadas extenuantes, los salarios injustos, la alienación del trabajo rutinario o la exposición a condiciones laborales insalubres atentan contra el desarrollo integral de las personas.

Con todo, aún estas formas corrompidas de trabajo llevan en sí la posibilidad de transformarlas, están grávidas de esperanza, porque toda relación social, por contradictoria que sea, puede resolverse en una síntesis superadora. Cuando, en cambio, se expulsa de la ecuación social a uno de sus términos negándole el trabajo, desaparece cualquier horizonte de superación y la propia pertenencia a la sociedad queda anulada. Eso es exclusión. Y no hay ningún programa de asistencia que pueda remediarlo.

La crisis del empleo es consecuencia lógica de una economía de exclusión que consagra “*la eficacia y la productividad como valores reguladores de todas las relaciones humanas*”. Eficacia y productividad, en el esperanto del capitalismo global, significa reducción de costos, aumento de las ventas, maximización de las ganancias... deslocalización, externalización, subcontratación, automatización, robotización, extractivismo, depredación de la naturaleza, obsolescencia acelerada, ajuste estructural, reducción de personal; para los trabajadores es sinónimo de informalidad, tercerización, desempleo, reduc-

ción de salarios, trabajo a tiempo parcial y una amplia gama de modalidades precarias de trabajo que van desde los contratos “flexibles” hasta las nuevas formas de esclavitud laboral.

La situación de los trabajadores en el mundo no ha sido bien medida pese a un verdadero exceso de diagnóstico e investigaciones. Las estadísticas disponibles son insuficientes y en general sólo reflejan la realidad de una porción cada vez más pequeña de la masa laboral: los asalariados registrados. Los excluidos del “privilegio” de trabajar dentro de la formalidad de un mundo que pregona el Estado de Derecho pero no cumple sus leyes terminan agrupados en una categoría residual que no despierta el menor interés en los analistas.

La falta de visibilidad de los trabajadores que se sudan por el pan en la llamada economía informal no es un simple descuido académico o una omisión casual en las encuestas: expresa una concepción ideológica según la cual la informalidad laboral se resolverá algún día en virtud del crecimiento económico. Así, en tanto estadio transitorio hacia el trabajo formal, la situación de estos trabajadores no merece mayor análisis, son personas “en vías de desarrollo”.

Esta concepción no hace más que darse de bruces con la realidad en forma cada vez más violenta. Las altas tasas de crecimiento del PBI que algunos países periféricos evidenciaron en los últimos años no se tradujeron en la integración de los excluidos en el mercado institucionalizado de trabajo. La recuperación del nivel empleo vino acompañado del crecimiento de las actividades de carácter informal, sin reconocimiento ni derechos. El llamado derrame llegó a los de abajo en forma de trabajo mal remunerado, inseguro, insalubre, no registrado.

Para los pobres, los ciclos económicos de recesión y crecimiento constituyen un espiral descendente que va dejando ante cada crisis nuevas camadas de excluidos que se superponen como capas geológicas. En los momentos de auge económico la creación de empleo decente no absorbe a los que se cayeron del mapa durante el último período recesivo. Cuando llega el tiempo de las vacas flacas en cambio, el peso de la turbulencia parece siempre descargarse sobre las familias trabajadoras y humildes, a los que se castiga con políticas de ajuste de cuño neoliberal.

Estas de ajuste estructural – única respuesta que ofrece el sistema cuando tambalean los mercados – no sólo reducen las posibilidades materiales de las personas y el margen de acción de los gobiernos, también destruye el hogar, la familia, la comunidad, el tejido social y cultural de los pueblos. Como dice nuestro pastor Francisco “*la economía ya no puede recurrir a remedios que son un nuevo veneno, como cuando se pretende aumentar la rentabilidad redu-*

ciendo el mercado laboral y creando así nuevos excluidos”.

Sin embargo, los que detentan el poder económico hacen oídos sordos a estas palabras y protegen sus privilegios desahuciando a las mayorías populares y poniendo de rodillas a los estados nacionales. Con cuánto dolor hemos visto a los gobiernos del mundo dilapidar los ahorros de todo un país en el salvataje de algunos bancos mientras familias enteras perdían sus hogares o fuentes de ingreso. Esta inequidad se practica cotidianamente con un descaro que habla de una cierta pasividad de todos nosotros frente a la “tiranía del dinero”, ese culto siniestro que destruye la naturaleza y degrada al ser humano. Ahora más que nunca estamos llamados a resistirla.

Ya han pasado más de 40 años desde el surgimiento de esta economía de exclusión que se presentó pomposamente como “pensamiento único” o “fin de la historia”. La globalización neoliberal nace en la crisis del petróleo (1973) y alcanza su cenit con el Consenso de Washington y la caída del muro de Berlín (1989). De las cenizas del colectivismo soviético surgió un capitalismo más agresivo cuyos “cantos de sirenas” denunció el propio Juan Pablo II al ver con decepción la entronización del hedonismo consumista y el proceso de concentración económica tras la restauración democrática en Europa del Este.

Finiquitada la bipolaridad, el Capital – libre de amenazas y competidores – extendió su dominio a todo el globo y pasó como una topadora por sobre los derechos de los trabajadores y la dignidad de los Pueblos. La ofensiva privatizadora despojó a los Estados de cualquier control sobre la economía, los recursos naturales y los servicios públicos esenciales. La fraternidad social quedó disuelta, los lazos humanos privatizados y las organizaciones sociales pulverizadas. Creció la pobreza, el desempleo, la marginación; con ellas la violencia, el narcotráfico, la trata de personas y la esclavitud moderna.

También, de entre los basurales sociales dónde el Capital arroja a los trabajadores que ya no necesita, sumergido en la informalidad estructural, fue creciendo un nuevo proletariado¹ que subsiste en las periferias inventándose el trabajo con las sobras del sistema. Ellos son los trabajadores excluidos.

¹ El término “proletariado” que tanto molesta en algunos círculos no es exclusivo del vocabulario marxista. Ya el derecho civil romano lo utiliza para definir a los “pobres sin tierra que no pueden pagar impuestos” y Arnold Toynbee emplea el término en su magistral obra *Estudio de la Historia* distinguiendo el “proletariado interno” del “proletariado externo”. Benedicto XVI lo utiliza en su Encíclica *Spe Salvi*.

1. Desempleo y atomización social

El empleo asalariado estable, relación laboral que se fue configurando a partir de la revolución industrial, va dejando su lugar hegemónico a nuevas formas de estructuración del trabajo humano. La reconversión de las grandes empresas y del sector público efectuadas siguiendo las recetas de privatización, desregulación y deslocalización cambiaron para siempre el paradigma de pleno empleo y seguridad social universal propio de los “30 gloriosos” (1945-1973). A medida que se reducía el mercado formal de trabajo, brotaron o reverdecieron un sinnúmero de actividades de subsistencia en las que encontraron refugio las familias excluidas del nuevo orden.

El propósito de este documento es reflexionar sobre la realidad de estos nuevos trabajadores. No es este el espacio para realizar un análisis cuantitativo o un diagnóstico científicamente estructurado del mercado informal de trabajo. Podemos, sin embargo, aportar elementos conceptuales y retratar la situación de algunos oficios populares que predominan en esta etapa.

En primer lugar, consideramos que el concepto de empleo no puede utilizarse ya como sinónimo de trabajo, mucho menos de ocupación. Arrastrando un pensamiento obsoleto, sepultada por la cruda realidad desde hace décadas, aún se habla indistintamente de desocupados y desempleados cuando en verdad se trata de asuntos distintos, incluso desde el punto de vista de la técnica estadística.

Empleo es una relación bilateral que une empleado y empleador, capital y trabajo, de una manera relativamente estable, registrada, supone remuneración, jornada laboral y condiciones de trabajo convencionalmente fijadas y acceso a la seguridad social. *Trabajo* es el esfuerzo humano aplicado a la creación de riquezas para la satisfacción de las necesidades. *Ocupación* en sentido amplio es todo tipo de actividad humana... incluyendo las actividades ilegales que no abordaremos en este trabajo pero que explican gran parte del flujo económico global y someten a millones de personas sin alternativas laborales a una vida indigna y a una muerte violenta.

Entre trabajo y empleo existe una relación de género y especie. Mientras la composición sectorial de los empleados es fácilmente medible, los trabajadores sin empleo queda generalmente invisibilizados como si vivieran del aire o la caridad. Sin embargo, para los desempleados pobres, la lucha por la subsistencia es sin duda un trabajo más intenso que el de un empleado administrativo o un obrero industrial. Por eso, más que hablar de desocupación estructural como nota característica de nuestros tiempos, tal vez sea más preciso hablar de “desempleización”.

La desempleización consiste en dos fenómenos distintos pero interdependientes:

(i) Reducción de la oferta de empleo

La reducción del empleo, paradójicamente enmarcada en un contexto de multiplicación astronómica en la oferta de mercancías, no responde a un factor único. Podemos mencionar sin embargo el peso determinante de las políticas macroeconómicas contractivas y la aplicación del desarrollo tecnológico orientada exclusivamente por el lucro.

Los modelos de “línea de montaje” fordistas–toyotistas, como todos sabemos, son piezas de museo o van camino a serlo. Lo mismo ha sucedido con el campesino, el farmer o las grandes plantaciones. La biotecnología, la automatización y la robotización de los procesos productivos, junto a la financierización de la economía, reducen la necesidad de empleados, destruyen las empresas tecnológicamente atrasadas y atizan el proceso de concentración de capital, creando así al mismo tiempo una plutocracia oligárquica global y un ejército de desempleados que luchan por la subsistencia fuera del mercado laboral formal.

El sector terciario o de servicios, caracterizado como una suerte de salvador de la civilización salarial, lejos está de compensar la destrucción del empleo en la industria y el campo. El propio sector se encuentra inserto en el proceso de automatización: cada vez son más las máquinas o programas informáticos que cumplen funciones antes realizadas por personas, desde el despacho de alimentos hasta la atención bancaria. Las nuevas industrias tecnológicas y audiovisuales están reservadas para un número reducido de trabajadores capacitados.

(ii) La flexibilización del contrato de trabajo.

Por su parte, la llamada “flexibilización” permitió la reconfiguración de las relaciones laborales a tono con la restructuración de la matriz productiva. El contrato de empleo quedó desdibujado en sus notas características a partir de las nuevas modalidades de contratación: tercerización, subcontratación, contrato de locación de servicios o *part time*, teletrabajo, etc.

Esta nueva realidad impacta también en la esfera jurídica. En el derecho laboral, el empleo se configura tradicionalmente a partir de tres atributos: (a) la dependencia técnica, (b) la dependencia jurídica y (c) la dependencia económica. El nuevo paradigma lo despoja de los dos primeros. Los trabajadores ya no reciben indicaciones precisas sobre las tareas a cumplir en un horario determinado a través de un sistema jerárquico (dependencia técnica) ni pueden alegar legalmente la responsabilidad empresaria sobre sus condiciones de vida (dependencia jurídica). Sin embargo, la dependencia económica se mantiene.

Estos cambios, en general, han traído aparejadas una fuerte precarización de la vida humana. La familia, el hogar, el deporte, el esparcimiento, la salud, la educación, antes ordenadas en torno al empleo, quedaron completamente desestructuradas o a merced de esa inestabilidad crónica eufemísticamente llamada flexibilidad contractual. Las nuevas generaciones de trabajadores jóvenes, el llamado *precariado*, son las principales víctimas de la falta de horizontes laborales que les permitan desarrollar un proyecto de vida digno.

Otra de las consecuencias evidentes del nuevo paradigma es una profunda fragmentación al interior del mercado de trabajo que no sólo implica una distribución injusta de la masa salarial sino que va creando subculturas diferenciadas que se superponen unas sobre otras como capas geológicas en un proceso de degradación que parece no tener fin.

En muchos países, un 20% de los trabajadores acapara el 80% de la masa salarial. Los que lograron mantener las conquistas de los extintos estados de bienestar, acceden a estándares de consumo similares a los de la clase media y van transformándose de a poco en una suerte de “aristocracia obrera” que en general defiende sus derechos en forma corporativa, aislada de la suerte de los trabajadores menos favorecidos. En consecuencia, la fragmentación también impacta en la solidaridad popular y en las organizaciones sindicales tradicionales cuya nómina de afiliados se reduce en la misma proporción que su rol como herramienta de inclusión social.

Esta atomización de los trabajadores se da en un contexto de diferenciación creciente entre empresas según su grado de desarrollo, institucionalización, concentración económica, incorporación de tecnologías y fundamentalmente su nivel de integración en el mercado global. A grandes rasgos, podemos distinguir cuatro sectores: (i) las empresas transnacionales monopólicas, (ii) un sector de alta densidad tecnológica plenamente inserto en el mercado global, (iii) una amplia gama de empresas formales de desarrollo intermedio subsidiarias a los monopolios o destinadas al consumo interno, (iv) un sector totalmente informal basado en la explotación intensiva del factor trabajo y la aplicación de tecnología residual.

El cuadro no estaría completo sin mencionar una amplia gama de empresas criminales que operan en los cuatro niveles descriptos anteriormente y ofrecen una suerte de carrera profesional a millones de excluidos que ven allí el único puente hacia metas de consumo también globales.

En el mismo sentido, debe tenerse en cuenta que aunque la economía esté globalizada en términos de circulación de capitales y mercancías, no han dejado de existir enormes y crecientes brechas entre países ricos y países pobres que impactan en el mundo del trabajo.

La combinación entre (i) la fragmentación de los trabajadores, (ii) el desarrollo desigual de los sectores económicos (iii) el crecimiento de la brecha entre países ricos y países pobres, ha creado un verdadero rompecabezas laboral (cuadro 1).



La reestructuración del sector público que en muchos países funcionaba como refugio para los trabajadores complejiza el cuadro. Tenemos empleados públicos de planta permanente, de planta transitoria o “contratados” bajo distintas figuras jurídicamente “no laborales”.

2. Los últimos de la fila: precariedad y economía popular

Breve panorama de la precariedad

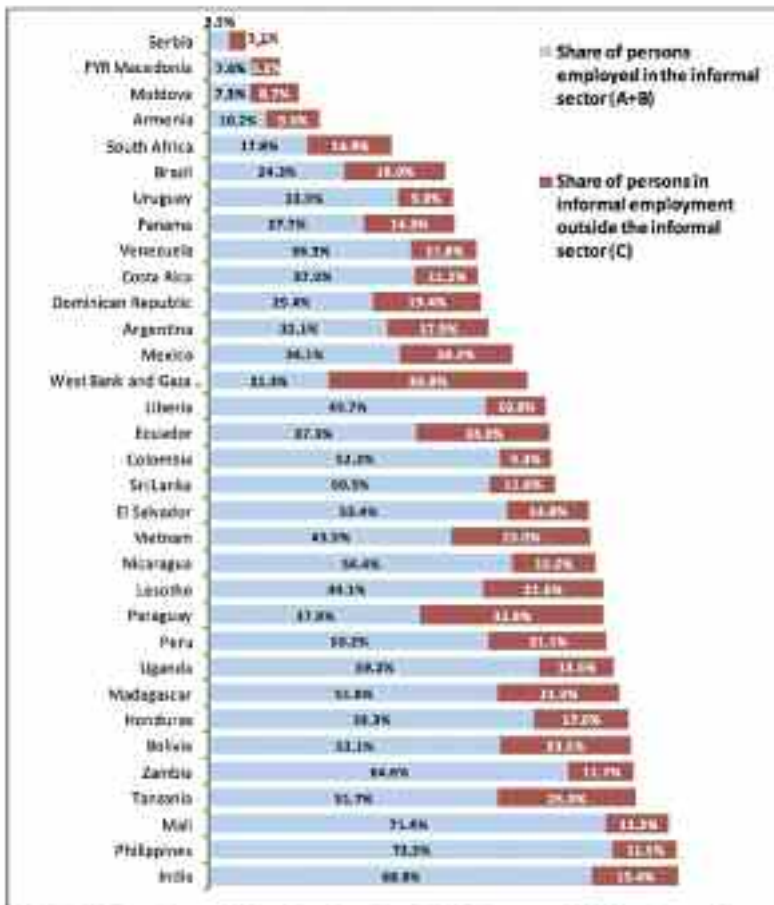
El fenómeno del trabajo precario es transversal a todos los sectores de la economía y se produce en todos los países del mundo. Cuando hablamos de precariedad laboral nos referimos a cualquier forma de trabajo que esté por debajo de los estándares mínimos que fija la OIT sin importar la forma jurídica que adquiera ni el sector económico al que pertenece. La precariedad, sin embargo, se expresa de manera distinta en la economía formal y en la economía popular, en los países ricos y los países pobres. Veamos en el cuadro 2 para clarificar esta perspectiva.

Trabajadores					
Economía formal		Economía popular (informal)			
Registrado	No registrado	Propiedad propia	Partenaria	Cooperativa o Comunitaria	
	Asistido		No Asistido		
Control de trabajo "flexible": temporales, temporales	Fraude laboral, trabajo no registrado o parcialmente registrado	Asistencia en unidades productivas informales	Trabajadores independientes o familiares de subsistencia	Trabajadores por cuenta ajena, a domicilio	Trabajadores cooperativistas, comunitarios y de programas sociales

En la economía formal tenemos dos formas básicas de precarización: (i) el contrato flexible o “basura” y (ii) el trabajo no registrado. En la economía popular, salvo contadas excepciones, el trabajo siempre es precario. Sin embargo, en las estadísticas se agrupa el trabajo no registrado y a los trabajadores de la economía popular bajo la misma categoría: trabajo informal.

Conforme a la OIT “entre los trabajadores de la economía informal hay trabajadores asalariados y trabajadores por cuenta propia. La mayoría de los trabajadores por cuenta propia se encuentran en condiciones tan inseguras y vulnerables como las de los trabajadores asalariados, y pasan de una situación a otra. Dado que carecen de

Figure 1. Share of persons employed in the informal economy, latest year available



Note: The data refer to non-agricultural employment and the latest year available for each country.

protección, derechos y representación, esos trabajadores suelen quedar atrapados en la pobreza” (Resolución OIT 2002).

Para tener una dimensión del drama de la informalidad, basta ver las cifras de la OIT sobre el fenómeno en algunos de los países considerados pobres o periféricos. Podemos observar que los porcentajes de trabajo informal, tanto en empresas formales como en la economía popular, son elevadísimos. Así, en Asia del Sur, la economía popular da cuenta del 69% de todos los trabajos no agrícolas y los trabajadores no registrados en empresas formales del 15%; en Asia oriental y sudoriental los porcentajes son 57% y



14% respectivamente; en África Subsahariana, 53% y 14%, en América Latina y el Caribe 34% y 16%; en Europa del Este y Asia Central 7% y 16%.

En los países ricos, el drama de la precariedad también existe pero adquiere la forma de trabajo flexible o “basura”. Se trata de una precariedad institucionalizada, basada en formas contractuales no convencionales, aunque cada vez más generalizadas, donde ingresos, beneficios y estabilidad se reducen sensiblemente en relación a los empleos de jornada completa y por tiempo indefinido. Estas modalidades no convencionales pueden agruparse en cuatro categorías fundamentales: el contrato de tiempo parcial, el contrato temporario, la pseudoautonomía o parasubordinación y el teletrabajo.

El empleo *part time* afecta al 20% de los trabajadores de la OCDE, el empleo temporario aproximadamente el 15% y el trabajo parasubordinado (o pseudoautónomo) al 10%. Así, casi la mitad de los trabajadores del llamado primer mundo tienen trabajos inestables, con menos derechos laborales y sin representación sindical. Todas las encuestas coinciden en que la mayoría de estos trabajadores no eligieron esas modalidades precarias de trabajo y preferirían tener contratos permanentes de jornada completa.

El problema se agrava en el caso de los jóvenes donde las altísimas tasas de desempleo se combinan con altísimas tasas de precariedad, dejando a las nuevas generaciones trabajadoras – el precariado – sumidos en la exclusión y mazzcando rabia.



La economía popular, fuente de trabajo de los excluidos

Durante los últimos años, en todas las grandes ciudades y conurbaciones, especialmente en los países pobres, se expandió geométricamente el número de familias que encuentran sustento en el llamado mercado informal. Allí desempeñan oficios populares de subsistencia, mal remunerado, riesgoso, sacrificados, muchas veces despreciados y en algunos casos perseguidos o criminalizados. Son los trabajadores más sufridos de nuestros tiempos, los descamisados del siglo XXI, los desamparados de la sociedad de consumo: un nuevo proletariado.

Los sectores socialmente integrados entran en contacto con esta realidad cotidianamente al toparse en calles, plazas y esquinas con esa prole laboriosa que desde las periferias invaden las zonas céntricas para recoger con esfuerzo y coraje las migajas del sistema. Con sus mantas, carritos, improvisados puestos de venta, recuperando materiales de la basura, cuidando autos frente a los restaurantes, limpiando los vidrios en los semáforos, transportando personas con vehículos destartados y empeñándose en un sinnúmero de actividades precarias, una creciente masa humana ajena a todos los beneficios de la civilización occidental pone ante los ojos del mundo la evidencia viva del fracaso de esta economía de exclusión.

Aunque las minorías satisfechas que detentan el poder económico les cierre las puertas de sus corazones y barrios exclusivos, aunque la cultura del bienestar burgués los reciba con indiferencia en las ciudades, estos invasores – tan sólo la vanguardia del ejército de los excluidos cuya masa permanece sumergida extramuros – empiezan a desafiar la institucionalidad excluyente plantándose con dignidad en el medio de la opulencia urbana.

Los que nada tienen para vender más que su fuerza de trabajo y ya no encuentran quien quiera comprarla, no se resignan al hambre y se empeñan en existir. Innecesarios como obreros, superfluos como consumidores, descartados por el mercado y librados a su suerte por el Estado, los sujetos descartados utilizaron objetos también descartados para edificar su propia civilización. Desde el subsuelo de la humanidad globalizada, los excluidos construyeron un complejo subsistema económico que garantiza el sustento de millones, una ciudad oculta que coexiste en inestable equilibrio con la ciudad evidente.

Llamamos Economía Popular al conjunto de actividades, procesos y unidades productivas propias de los sectores populares que surgieron, reverdecieron, mutaron o se expandieron con la contracción relativa del mercado formal de trabajo. La economía popular tiene su base territorial en los asentamientos informales suburbanos pero se inserta en los intersticios céntricos pese a las regulaciones contravenciones, impositivas y marcarias.

La organización económica de los excluidos: Unidades Productivas Populares

Las Unidades Productivas Populares (UPP) tienen como característica esencial que los factores de producción – espacios, materiales, herramientas y saberes – están al alcance de los sectores populares. Este acceso a estos recursos no es siempre universal ni libre ni gratuito ni ecuaníme, pero sí posible. Combinando estos precarios recursos, los excluidos construyen una red popular de producción e intercambio relativamente dissociada de la economía global de mercado.

La relación que establecen los productores con los medios de trabajo no es de propiedad en el sentido institucional sino en todo caso de mera tenencia. Se trata de una masa popular no asalariada ni propietaria que se gana el pan cotidiano a partir de la aplicación de su fuerza de trabajo sobre el “capital muerto” (Hernando del Soto) descartado por el mercado formal.

Otras características de muchas UPPs son su escasa rentabilidad económica, baja densidad tecnológica, intercambio informal de los productos, malas condiciones laborales y malas condiciones de comercialización.

Unidades Productivas Populares			
Espacio	Modalidad	Forma legal	Actividad Popular
			Agricultura Familiar
			Residuo
			Grandes Fincas
			Artesanías
			Venta ambulante
Hinca familiar			Mensajería
Hinca sumera	Individual	Prohibida	Transporte
Espacio público	Familiar	Tolerada	Indumentaria
Barrio Periferico	Cooperativa	Regulada	Autoconstrucción
Domicilio	Patronal / Dependiente	Fomentada	Mejoramiento Barrial
Feria			Reciclado
Establecimiento			Laborer en Semáforos
			Trabajo del Hogar
			Microemprendimientos
			Servicios Comunitarios
			Etc...

Podemos clasificar las UPP de acuerdo a distintos criterios. Considero que la clasificación más útil debe tener en cuenta el espacio, la actividad, la modalidad laboral y el grado de tolerancia institucional.

Este cuadro es útil más allá de la forma jurídica que eventualmente revistan las UPP (monotributistas, cooperativas, precoperativas, consorcios, asociaciones civiles, mutuales). En ese sentido, debemos siempre regirnos por el principio de primacía de la realidad sobre la forma.

Una clasificación de este tipo permite distinguir diversos aspectos que contribuyen a comprender la naturaleza de cada unidad productiva y su problemática asociada, a saber:

Espacio		
	Descripción	Problemática Principal
Finca familiar	Parcelas rurales explotadas familiarmente	Tenencia insegura de tierras
Finca comunal	Campos explotados en forma colectiva	Conflictos de límites, desmantelamiento
Espacio público	Calles, plazas, semáforos, basurales y otros espacios de las zonas céntricas	Corrupción institucional e paramilitar
Ramo	Las barriadas populares de la periferia	Falta de escala del mercado
Domicilio	El lugar de residencia de los trabajadores	Ambiente inseguro e insalubre
Feria	Conjuntos de puestos comerciales informales	Excesivos de los puestos
Establecimiento	Talleres, galpones o fábricas recuperadas	Infraestructura precaria

Modalidad de trabajo		
	Descripción	Problemática Principal
Individual	El trabajo se realiza en forma personal sin asistencia alguna	Autoexplotación, aislamiento
Familiar	El trabajo lo realizan algunos o todos los integrantes del grupo familiar	Trabajo infantil, violencia de género
Cooperativa	El trabajo se realiza en forma colectiva con una distribución equitativa de los frutos	Falta de democracia interna
Patronal	El trabajo se realiza en forma colectiva sin un reparto equitativo de los frutos	Explotación extrema

Status legal		
	Descripción	Problemática Principal
Prohibida	Sin llegar a ser un delito penal, la actividad constituye una contribución	Persecución y hostigamiento
Tolerada	No constituye una contribución pero no está sujeta a regulaciones o apoyo	Falta de asistencia
Regulada	La actividad está regulada por el estado	Regulación excesiva o excluyente
Asistida	La actividad recibe algún tipo de asistencia estatal	Asignación arbitraria de recursos

La “problemática principal” que se presenta en los cuadros precedentes para cada categoría tiene por objeto ilustrar una metodología para los proyectos transformadores e inclusivos... está claro que puede variar en distintos ámbitos en los que se acentúan otros problemas.

Por su parte, cada actividad, oficio o grupo ocupacional de la economía popular particular tiene asociadas problemáticas específicas cuyo desarrollo excede el propósito de este trabajo pero que veremos someramente en el capítulo 3. También es importante considerar las problemáticas más comunes de las UPP que afectan los derechos humanos elementales:

1. Explotación infantil
2. Trabajo esclavo
3. Jornada excesiva
4. Trabajo insalubre
5. Alto riesgo de accidentes
6. Coerción institucional (sobornos, desalojos, persecución, proscripción)
7. Coerción para-institucional (organización mafiosa de la actividad)
8. Estigmatización social
9. Ingresos de subsistencia

La organización reivindicativa de los excluidos

Es importante no confundir la organización económica de los sectores excluidos con su organización sindical. Mientras las primeras tienen como objeto la gestión de unidades productivas populares, la segunda apunta a la lucha reivindicativa por los derechos sociales y laborales conculcados.

La organización sindical consiste en el agrupamiento de los trabajadores de una misma actividad, oficio o zona geográfica para luchar por sus reivindicaciones: mejores ingresos, mejores condiciones de trabajo, derechos sociales.

Aunque algunos sindicatos desprecian a este nuevo proletariado informal, es necesario apuntar que “*En sus orígenes, todos los sindicatos fueron creados por trabajadores informales, ya que en la época cuando los sindicatos fueron inicialmente organizados toda la economía era informal. Los sindicatos eran, y todavía lo son, organizaciones de autoayuda de trabajadores que, a través de la acción colectiva, buscan regular sus salarios y condiciones laborales con el fin de eliminar las peores formas de explotación, es decir, formalizar una situación informal*”.²



3. Oficios populares

Recordemos que la economía popular se caracteriza la precariedad de medios y condiciones de trabajo, la escasa densidad tecnológica de las unidades productivas, la preminencia del trabajo por cuenta propia y la informalidad o semiformalidad en las relaciones laborales, civiles y comerciales. Su nota esencial, sin embargo, es que los medios de trabajo están al alcance de los sectores populares.

A continuación presentaremos una breve semblanza de algunos oficios de la economía popular. En general, se trata de ocupaciones que también existen en la formalidad pero que dentro de la economía popular adquieren nuevas dimensiones, espacios y modalidades. Como regla general, las dis-

² Gallin, Dan. 2012. *Informal Economy Workers and the International Trade Union Movement*. Geneva: Global Labour Institute.

tintas actividades y oficios populares se estructuran en una red endógena, relativamente dissociada de la economía global de mercado.

Sin embargo, en no pocas ocasiones, las UPPs se integran como proveedores en cadenas de valor de grandes empresas que aprovechan las “ventajas comparativas” de la economía popular. Así logran minimizar costos a partir de la sobreexplotación de una fuerza externalizada de trabajo que por su naturaleza periférica se presenta como propicia para encubrir impunemente la evasión de toda la normativa laboral e impositiva.

Los datos estadísticos disponibles son realmente escasos y provienen de estudios en regiones específicas. No existen datos fiables a escala nacional y mucho menos global. Por ese motivo, todos los números que se ofrecen en el presente texto son estimativos. La mayoría de los datos pertenecen a la base estadística de la OIT, las publicaciones de la Red WIEGO y los estudios realizados por la Confederación de Trabajadores de la Economía Popular (CTEP-Argentina).

Las fotografías fueron extraídas de distintas fuentes, muchas del archivo multimedia de la CTEP. Los gráficos pertenecen a la OIT o a Eurostat. Las ilustraciones son obra del compañero Esteban Videla y forman parte de los *Cuadernos de Organización y Economía Popular* (Pérsico, Grabois; CTEP Ediciones; 2013).



1

CARTONERO/A – RECICLADOR/A

WASTEPICKERS – CATADORES – PEPENADORES – BUZOS – BIFFINS

Son trabajadores/as que con sus propias manos recuperan residuos sólidos urbanos (RSU) en basurales, plantas de clasificación, la vía pública y otros lugares de “disposición” como contenedores, cestos de basura e incluso los propios camiones que realizan la recolección. En algunos casos los cartoneros reciben el material ya clasificado en origen de generadores domiciliarios o comerciales. El material luego es transportado – en base a tracción humana,

bicicleta, tracción animal o vehículos en general precarios – hacia lugares de acopio que pueden ser incluso los propios hogares de los trabajadores o directamente los comercializan informalmente tras la jornada de trabajo.

Cientos de millones de personas sobreviven recuperando la basura de la sociedad de consumo en todo el planeta y cada vez son más. El BM estimaba en 1998 que entre el 1% y el 2% de la población mundial vivía de la basura y es evidente que esa cifra creció exponencialmente en los últimos años. La existencia de un verdadero submundo que vive de los desechos de lo que se nos presenta como una sociedad opulenta debería ser un llamado de atención para los gobiernos. Sin embargo los trabajadores del reciclado sufren fuertes persecuciones y en muchos países deben ejercer el oficio de manera clandestina.

En efecto, los problemas principales de la actividad son la criminalización, el hostigamiento policial, la explotación a través de bajos precios, el trabajo infantil, las pésimas condiciones de higiene y salubridad, la falta de cobertura social y sanitaria, los bajos ingresos y la estigmatización social. Asimismo, aquellos trabajadores que viven dentro de los basurales o los que utilizan su hogar como espacio de acopio pagan con su salud el derecho a subsistir.

El trabajo de los cartoneros tiene aparejados gran cantidad de beneficios para la comunidad toda como el cuidado del ambiente, la disminución de los gastos municipales de enterramiento, la reducción de la extracción de materia prima para la producción industrial, además de la generación de millones de fuentes de trabajo.

Los cartoneros y recicladores se han organizado en algunos países fundando cooperativas, asociaciones y sindicatos. Incluso en algunas ciudades lograron su incorporación formal en el sistema municipal de recolección de residuos.

Extensión del sector: 100.000 (Argentina), más de 100 millones (en el mundo).

Modalidades: la más usual es el trabajo individual y familiar, pero existen experiencias de cooperativización, algunas de gran escala como en Buenos Aires, que permiten no sólo precios mayoristas sino el acceso a otros derechos (transporte, acceso a la seguridad social, etc.). También existen unidades de carácter patronal donde el trabajador recibe un jornal diario o bien un porcentaje del material recuperado. En ocasiones, estas UP revisten en estatus jurídico de cooperativas de manera fraudulenta.

Status legal: En la mayor parte de los países pobres es una actividad tolerada. En algunos, es una actividad regulada y en unos pocos, asistida, siempre a partir de la lucha de los trabajadores. En los países ricos, la actividad está criminalizada y es poco usual, aunque con la crisis comienzan a aparecer cartoneros en países como España o Portugal.

Espacios de Trabajo Usuales: calles, basurales, plantas de clasificación, grandes generadores de residuos, contenedores de residuos, camiones de recolección.

Medios de trabajo típico: carro manual, bicicleta, camionetas, carro a tracción animal, bolsones, cintas clasificadoras, enfardadoras.

Algunas experiencias organizativas: Movimiento de Trabajadores Excluidos (Argentina), Zabaleens (Egipto), Asociación Nacional de Recicladores (Bogotá), Movimiento Nacional de Catadorer (Brasil), Kagad Kach Patra Kashtakari Panchayat (KKPKP – India), Association Pengdwende (Burkina).



Cartonera (MTE – Argentina)



Recicladora (ARB-Bogotá)



Zabaleeni (El Cairo –Egipto)



(Recicladora – India)



2

VENDEDOR/A AMBULANTE

STREET VENDOR – CAMELOS – BUHONEROS

Trabajadores/as que se dedican a la venta de artículos de bajo costo en la calle, los medios de transporte y otros espacios públicos. Se trata de un oficio antiquísimo que en los últimos años se ha multiplicado exponencialmente como producto de la contracción del mercado formal de trabajo.

La venta ambulante en sus diversas modalidades permite la subsistencia de decenas de millones de personas en todo el mundo, sobre todo en los países pobres, aunque en los países ricos, la venta ambulante es a veces la única salida laboral para trabajadores migrantes que desarrollan la actividad bajo una fuerte presión discriminatoria, social e institucional. En ocasiones, una colectividad se especializa en la venta de un producto particular.

El vendedor ambulante solía ser una figura apreciada por la sociedad, pero con el aumento sideral de la cantidad de trabajadores, el empobrecimiento de la actividad y la implementación de métodos de venta a presión, el sector comienza a verse afectado por nuevos estigmas.

El principal problema de la actividad es la persecución institucional, la extorsión policial y los monopolios para-institucionales que acaparan los mejores sitios de venta. Los vendedores ambulantes en general trabajan largas jornadas, todos los días de la semana y no tienen acceso a la seguridad social.

El sector está compuesto principalmente por trabajadores por cuenta propia que ofrecen productos a bajo costo, accesible principalmente a los sectores medios y populares. También existen importantes firmas que basan su fuerza de venta en sistemas piramidales donde el vendedor termina siendo económicamente dependiente de la empresa pero no recibe ninguna contraprestación salarial o beneficios.

Extensión del sector: Entre 2% y 9% de los trabajadores del mundo son vendedores ambulantes (unos 150 millones). En los países pobres los porcentajes se elevan: en África, por ejemplo, promedian el 15%. En Amé-

rica Latina, algunos datos disponible indican que hay 240000 vendedores Lima, 558000 en Bogotá, 49000 en Caracas y 100000 en San Pablo (WIEGO, 2013).

Modalidades: la modalidad más usual es el trabajo individual por cuenta propia. En menor medida, existe trabajo con auxiliares familiares no remunerados. También hay unidades productivas populares con empleados e incluso empresas formales que utilizan la venta ambulante como canal de comercialización.

Status legal: en la mayor parte de las ciudades el trabajo de los vendedores ambulantes está regulado de manera restrictiva. Existen una gran cantidad de prohibiciones que se convierten en la excusa perfecta para la extorsión policial. La presión de los comerciantes formales es constante.

Espacios de trabajo usuales: los vendedores ambulantes se han inventado una enorme cantidad de espacios para el desarrollo de la actividad. Al vendedor que deambula por la calle u ofrece sus servicios en el transporte público se le suman los vendedores con puestos móviles y todo tipo de vehículos adaptados que se estacionan durante toda la jornada en plazas, calles o estaciones. Muchos vendedores ofrecen sus productos puerta por puerta, en estadios o eventos deportivos.



Vendedor Transporte Público



Montero (Calle Florida, Bs As)



Puesto de Venta de "Charipan"



Vendedor Gahanes de Bifuteri (Onca, Bs As)

Medios de trabajo usuales: los medios de trabajo más comunes, además de las mercancías que se obtienen por lo general en mayoristas o productos decomisados, son los puestos móviles en sus múltiples variedades que van desde una simple manta o paño hasta carros y vehículos modificados para la actividad. La topología de los puestos móviles de venta es un tema que podría ocupar un interesante estudio y habla de la creatividad de los trabajadores a la hora de subsistir.

Algunas experiencias organizativas: Vendedores Libres (Argentina), NASVI (India).



3

ARTESANO/A Y MANUALISTA

Trabajador/a que fabrica con sus propias manos y de manera artística (no en serie) distintos objetos que en algunos casos vende personalmente en la vía pública, ferias, negocios o por encargo. Si bien estos términos abarcan una gran cantidad de actividades y sectores sociales, habiendo incluso artesanos de alto poder adquisitivo, nos referimos en este artículo a los artesanos y manualistas que no generan un excedente importante ni tengan bienes de fortuna que los ponga por fuera del campo popular.

La actividad es practicada por personas en todo el mundo y se caracteriza por requerir saberes técnicos y artísticos. Muchos artesanos incorporan objetos típicos de su región en los productos y en ocasiones la producción de artesanías es la principal salida laboral de las comunidades indígenas y originarias.

La vinculación de la artesanía con el turismo altamente significativa. Los mejores sitios de venta son aquellos visitados por turistas que a su vez tienen el dinero disponible para comprar las artesanías.

Las ramas del artesanado son innumerables, sólo por nombrar sólo algunas podemos mencionar a los alfareros, herreros, sopladores, tapiceros, ebanistas, talladores, hilanderos, talabarteros, ceramistas, orfebres, plateros, marroquinos y tejedores.



Feria "Oso Cisneros" (La Boca, Bs As)



Poses Artesanal "El Adoquín" (San Telmo, Bs As)

Los artesanos suelen tener un fuerte reconocimiento social, un alto nivel de tolerancia institucional e incluso en algunos casos leyes de fomento de la actividad. Sin embargo, en cuanto a sus condiciones de trabajo, la mayoría de los artesanos son trabajadores sin derechos ni acceso a la seguridad social.

La principal problemática de la actividad consiste en la competencia de objetos manufacturados en serie que simulan productos artesanales. Asimismo, los artesanos tienen problemas para llegar a los mercados y las ferias artesanales institucionalizadas suelen tener procedimientos arbitrarios para la asignación de puestos.

Es común que en la vía pública haya rivalidad entre artesanos y vendedores ambulantes aunque también en caso de conflicto con las autoridades suele haber unidad para la defensa del derecho al trabajo.

Extensión del sector: 28.000 (Argentina) más de 40 millones (mundo).

Modalidades: la modalidad más usual es el trabajo individual por cuenta propia o en pequeños grupos. Existen cooperativas pero exclusivamente vinculadas a la comercialización o gestión de la feria. También existen unidades productivas patronales que realizan imitaciones de artesanías explotando trabajadores.

Status legal: en la mayor parte de las ciudades y pueblos el trabajo de los está regulado e incluso fomentado por los gobiernos. Existen, sin embargo, limitaciones municipales y regulaciones restrictivas en cuanto a sitios de venta.

Espacios de trabajo usuales: para la producción, los artesanos en general trabajan en sus propios talleres habitualmente dentro de sus domicilios particulares. Para la comercialización se destacan las ferias artesanales, playas y calles céntricas.

Medios de trabajo usuales: los medios de trabajo para la producción dependen fundamentalmente del tipo de artesanía pero podemos mencionar

la piedra, el cobre, el alambre, los hornos para la producción, y los puestos o mantas para la venta.

Algunas experiencias organizativas: El Adoquín (Argentina), Ghana Construction Artisan Association, Gold and Silver Trade Union of Nepal (GOSITUN), Kenyan Federation for Alternative Trade (KEFAT), National Arts & Crafts Association (Zambia), South African Self Employed Women's Association (SASEWA).



4

FERIANTES

Trabajador que desempeña alguno de los múltiples oficios que se desarrollan dentro de las grandes ferias informales – techadas o a cielo abierto – como la comercialización de mercancías (puesteros), el armado de los puestos (armadores), o el traslado de los bultos (carreros).

El crecimiento de las grandes ferias informales – casi en contrapunto con el de los lujosos *shopping malls* – es uno de los fenómenos más llamativos de los últimos años que muestra la creciente incapacidad del capitalismo global para encarrillar institucionalmente las múltiples realidades socioeconómicas que produce.

Una enorme multitud de personas vive de manera directa o indirecta a partir de la Feria que en muchos casos es el corazón económico de amplias regiones suburbanas. Además de los puestos de venta y de las fuentes de trabajo directas – armadores, personal de seguridad, personal de limpieza, estacionadores, carreros – miles de talleres producen exclusivamente para la Feria, los recicladores pueden vender allí los objetos reutilizables que recuperan y todos las unidades productivas populares encuentran allí salida para sus productos.

El fraude marcario y el incumplimiento de todo tipo de regulaciones permiten a la Feria ofrecer productos a un costo extraordinariamente

menor. Esto, por un lado, posibilita el acceso de los sectores populares a estos productos (principalmente indumentaria), pero también implica literalmente la esclavitud de quienes producen las mercancías.

También es cierto que, si bien son miles los puestos de trabajo que genera cada feria, al interior de la misma funciona el mercantilismo más descarnado. Las ferias que en general se iniciaron a partir de la auto-organización espontánea de vecinos humildes muchas veces, por la propia lógica del sistema en el que están subsumidas, degradan en estructuras fuertemente jerarquizadas dominadas por formas de poder violento y despótico. Llama la atención la defensa que intelectuales liberales realizan de este modelo considerándolo un maravilloso producto del “orden espontáneo”.

También existen una enorme cantidad de ferias francas o de productos usados pero con características bien distintas donde la modalidad fundamental es la autogestión y la colaboración entre productores.

Extensión del sector: 60.000 (Argentina) más de 40 millones (mundo).

Modalidades: la modalidad de trabajo varía de acuerdo al oficio espe-



Feria Punta Magotes (La Salada, Lomas de Zamora)



Feria Franca de la Agricultura Familiar



Feria Mesa Redonda (Perú)

cífico que se desempeñe en la feria. Los puesteros son en general trabajadores por cuenta propia con auxiliares familiares no remunerados o auxiliares. Los armadores y carreros suelen ser trabajadores jóvenes dependientes de un jefe. En las ferias techadas, todas las personas que trabajan aportan un canon a los “administradores”; en las ferias al aire libre, suele existir menos presión para los puesteros aunque en ocasiones este rol lo cumple la policía, grupos internos de poder o terceros a cuenta suya.

Status legal: las ferias internadas suelen estar habilitadas aunque no es un misterio que los productos que se comercializan son de origen ilícito. Las ferias a cielo abierto sufren un mayor riesgo de desalojo y hostigamiento institucional.

Espacios de trabajo usuales: grandes galpones o terrenos baldíos en las periferias urbanas. Se colocan puestos que suelen ser de hierro y madera.

Medios de trabajo usuales: en primer lugar destacan los puestos que no suelen ser del puestero sino de los “armadores” o el “administrador”. También se utilizan bolsones y carros para trasportar la mercadería.

Algunas ferias importantes: La Salada (Punta Mogote, Urkupiña y Ocean) – Gamarra y Mesa Redonda (Perú).



5

MENSAJERO/A

Trabajador que realice por cuenta propia el trabajo de transportar mensaje o encomiendas a pie, en bicicleta o motocicleta. Los mensajeros promocionan su trabajo principalmente a través del “boca en boca” ya que es una tarea que implica ciertos niveles de confianza de los clientes. De esta forma, los trabajadores del oficio van generando su propia cartera de clientes y en algunos casos logran estabilizar un buen ingreso.

Los mensajeros independientes coexisten con trabajadores en relación de dependencia que realizan la misma actividad como empleados de agen-

cias de mensajería. En ocasiones, esta coexistencia genera roces y conflictos entre ambos grupos muchas veces alentados por las patronales para combatir la competencia de miles de trabajadores independientes.

El sector se caracteriza por la hegemonía de los jóvenes varones y un gran sentido de la solidaridad interna que se traduce en cotidianos gestos de ayuda mutua frente a desperfectos mecánicos en los vehículos o accidentes de tránsito. Existe un mito en algunas ciudades de que los mensajeros son conspicuos consumidores de drogas. Si bien se trata de una generalización prejuiciosa, muchas veces para soportar el alto nivel de stress de la actividad los trabajadores recurren a distintas sustancias psicoactivas.

El principal problema de la actividad está vinculado a los accidentes que se llevan cientos de vidas cada año y dejan incapacitados para el trabajo a miles de mensajeros que no tienen ninguna cobertura social para el periodo de recuperación. Otro aspecto problemático son las regulaciones estatales, tanto para el tránsito de los vehículos como para la realización del trabajo propiamente dicha. Los mensajeros se ven sometidos a malos tratos y la incautación de sus vehículos por parte de las autoridades.

La organización de agencias cooperativas y mutualidades que brindan salud y asistencia frente a accidentes ha tenido un gran éxito en muchas partes del mundo y es un camino interesante para la dignificación del sector.

Extensión del sector: 60.000 (Argentina), cientos de miles (mundo).

Modalidades: la forma más usual es el trabajo independiente aunque existen algunas experiencias de cooperativización. Los trabajadores asimismo forman grupos y comparten clientes con frecuencia.

Status legal: se trata de una actividad que en general presenta regulaciones restrictivas.

Espacios de trabajo usuales: la actividad se desarrolla en la vía pública.

Medios de trabajo usuales: motocicletas y bicicletas por su agilidad para recorrer las ciudades.



Motocicleros (MTE, Bs As)



Delivery Sustentable (Weste Lopez)

Algunas experiencias organizativas: MTA (ex SIMECA – Argentina), Confédération Des Syndicats Autonomes Du Benin (CSA-Benin), Syndicat Des Travailleurs Des Transports (STT).



6

OBRAERO/A DE EMPRESA RECUPERADA

Trabajador que se desempeña en una fábrica o establecimiento que perteneció a una empresa de capital privado y que, tras su quiebra, fue recuperada, reactivada y puesta producción por sus propios trabajadores.

La experiencia de recuperación de empresas bajo formas autogestivas se ha desarrollado fuertemente en los últimos años con la multiplicación de la quiebra y cierres de establecimientos productivos en todo el mundo.

Consiste básicamente en la continuidad productiva bajo formas asociativas de trabajo de aquellas fábricas abandonadas, quebradas o inoperativas y tiene como objeto principal la preservación de las fuentes de trabajo y como fundamento jurídico el reconocimiento de los créditos laborales adeudados.

El proceso de recuperación de empresas expresa cabalmente el conflicto entre una concepción de la propiedad como valor absoluto o como una forma de disponer de los bienes en función del bien común. Asimismo, permite explorar formas autogestivas de trabajo industrial en el marco de proyectos con fuerte inserción comunitaria.

La experiencia Argentina se destaca por su magnitud. En efecto, a partir de la crisis de 2001 se recuperaron más de 200 establecimientos. Tras una primera etapa de confrontación esta modalidad fue paulatinamente institucionalizada, las empresas accedieron a subsidios estatales e incluso se logró una importante reforma en la ley de quiebras que consagra la prioridad de los trabajadores organizados en cooperativas para lograr la continuidad pro-

Empresas Recuperadas (Argentina)

RUBRO	CANTIDAD	TRABAJADORES
Metalúrgicas	48	1971
Gráficas	16	503
Textiles	13	473
Gastronomía	4	72
Vidrio	7	264
Químicas	3	158
Plástico	5	85
Industria de la carne	13	1565
Astilleros	2	62
Alimenticia	26	640
Construcción	12	764
Industria del cuero	5	481
Salud	10	431
Educación	4	118
Hotelería	5	243
Armas deportivas	1	13
Maderera/aserradero	4	74
Combustible	5	95
Papelera	2	71
Calzado	4	520
Transporte	6	375
Logística y mantenimiento	3	316
Medios de comunicación	4	181
Caucho	1	25
Comercio	2	95

ductiva. Muchos establecimientos fueron finalmente adquiridos por el Estado o las propias cooperativas mediante leyes de expropiación o incluso la compra directa por parte de los trabajadores.

Las empresas recuperadas enfrentan múltiples problemáticas vinculadas a la falta de capital productivo, insumos, materias primas y en algunas ocasiones, personal técnico calificado. Sin embargo, con la debida asistencia, las experiencias existentes demuestran la viabilidad de esta novedosa forma de trabajo popular.

Extensión del sector: 12.000 (Argentina), sin datos (mundo)

Modalidades: la forma más usual es la cooperativa de trabajo.

Status legal: en la Argentina la actividad está regulada por la ley de quiebras. En otros países del mundo, la recuperación de fábricas por sus trabajadores entra en conflicto con distintas leyes y puede considerársela prohibida.

Espacios de trabajo usuales: la actividad se desarrolla en establecimientos fabriles que en el pasado fueron empresas productivas del sector formal.

Medios de trabajo usuales: instalaciones y maquinarias remanentes en la empresa.

Algunas experiencias organizativas: Movimiento Nacional de Empresas Recuperadas (MNER) –Movimiento Nacional de Fábricas Recuperadas (MNFR).



Fábrica Recuperada IMPA (Bs As)



Frigorífico Recuperado SUBPGA (Berazategui)



Biscuiterie Jeannete (Francia)



Officine Zero (Italia)



7

TRABAJADOR/A DEL HOGAR Y DEL CUIDADO

Trabajadores/as – en general mujeres – que desarrollan distintas labores relacionados al hogar, la familia y el cuidado de las personas como limpieza de hogares, ropa y vajilla, mantenimiento de hogares, cuidado de niños y ancianos. También incluye amas de casa.

Se trata de cientos de millones de personas que ponen su esfuerzo y dedicación en hacer más llevadera la vida de las familias, ya sean la suya propia u otras. Sin embargo, en este oficio la explotación es moneda corriente, sobre todo para las trabajadoras migrantes.

Tanto los países ricos como los sectores acomodados de los países pobres emplean una o más personas para el servicio doméstico, en muchos casos migrantes. En la Argentina, por ejemplo, más del 70% de las trabajadoras del hogar son migrantes de países limítrofes. En los países europeos y en Norteamérica, los porcentajes son incluso superiores. Existen infinidad de casos de trata de personas con fin de explotación laboral en este sector.

La explotación del trabajo doméstico es, lamentablemente, muy frecuente. Los empleadores a menudo se abusan de situaciones de irregularidad migratoria o regulaciones laxas. En casi todos los países, el contrato doméstico no está amparado por leyes del trabajo o tiene estándares diferenciados. El sector también se caracteriza por un alto nivel de trabajo infantil y múltiples casos de violencia de género.

La situación de las trabajadoras del hogar ha sido objeto de múltiples pronunciamientos de la OIT, en particular el Convenio 189 y Recomendación nr 201 de dicho organismo. Sin embargo pocos países la han ratificado y menos aún acatado plenamente.

El Convenio 189 establece entre otras cosas el derecho a un salario digno y condiciones laborales decentes, como vacaciones y licencias, pago por horas extras, licencia por enfermedad, seguro de salud y jubilaciones y/o

pensiones, inspecciones para evitar trabajo infantil, sanción a empleadores acosadores, prohibición de reubicaciones forzosas. Las organizaciones sindicales del sector exigen su pleno cumplimiento.

Extensión del sector: 910.000 (Argentina); 10% de la fuerza de trabajo en los países pobres, 2,5 en los países ricos (OIT 2010), alrededor de 200 millones de personas. La mayor parte de los trabajadores del sector son mujeres y en algunos lugares, la mayoría de las mujeres son trabajadoras del hogar. En algunos países árabes como Qatar, Arabia Saudita y Emiratos Árabes, el 40% de las mujeres son trabajadoras del hogar. En América Latina, Asia y África los porcentajes van entre el 10% y el 20%. El 60% de las mujeres migrantes son trabajadoras domésticas en América Latina. El 50% de las trabajadoras del hogar en EEUU son migrantes latinoamericanas. El trabajo infantil en el sector es enorme, más de 175.000 en Centro América y unos 680.000 en Indonesia.

Modalidades: la forma más usual es el trabajo informal en relación de dependencia. También son habituales las agencias de colocación.

Status legal: en muchos países la actividad está regulada aunque con un estándar marcadamente inferior al del resto de los trabajadores. La violación a las regulaciones tiene una alta incidencia.

Espacios de trabajo usuales: la actividad se desarrolla en hogares particulares.

Medios de trabajo usuales: distintos elementos de higiene, maquinaria de jardinería, etc.

Algunas experiencias organizativas: Federación Internacional de Trabajadoras del Hogar, Syndicat travailleurs domestiques (SYNTRAD), Tamil Nadu Domestic Worker Union (India).



Presidenta de la Federación Internacional de Trabajadoras del Hogar



Asociación de Madres Cuidadoras Gualeguaychú – Entre Ríos



8

COSTUREROS/A Y TRABAJADOR/A DE LA INDUMENTARIA

Trabajadores/as que se desempeñan en la producción de prendas de vestir e indumentaria en general, aunque el trabajo a domicilio se registra en múltiples actividades económicas. Se trata de una de las principales fuentes de trabajo industrial con decenas de millones de trabajadores en todo el mundo.

Por fuera de las fábricas y empresas formales, una gran masa de trabajadores se desempeñan bajo la modalidad de trabajo a domicilio, ya sea en sus propios hogares o en talleres que ofician de residencia de los trabajadores. El sector se destaca por tener altísimos niveles de trabajo esclavo y la trata de personas con fines de explotación laboral en esta industria es moneda corriente. Los bajos salarios, las indignas condiciones de labor, las jornadas extenuantes son algunos de los problemas más acuciantes del sector.

La industria de la indumentaria expresa cabalmente el modelo de producción deslocalizado, con cadenas de valor integradas internacionalmente. Asimismo, muestra las conexiones entre la economía informal y la formal. Las grandes marcas de ropa se sirven del trabajo informal, a veces esclavo, para la producción de sus prendas. Esta situación ha sido denunciada en muchísimos países pero continúa expandiéndose.

En ese sentido, es importante distinguir las unidades productivas que confeccionan prendas que se comercializan entre los sectores populares (principalmente en las grandes Ferias) de aquella que forma parte de los encadenamientos de las grandes marcas. Muchas veces, sin embargo, un mismo taller confecciona para ambos públicos.

El tallerista es una figura intermedia entre el fabricante y la marca, y el costurero. En general funciona casi como un capataz y también está sometido a muy malas condiciones de labor. A pesar de múltiples regulaciones que establecen la responsabilidad laboral y penal entre fabricantes, marcas y talleristas, en general las pocas veces que

Existen importantes experiencias de cooperativas textiles que permiten un trabajo decente a sus asociados. También hay precedentes de incautación

de maquinaria utilizada en talleres esclavos y reutilización social de la misma en entornos cooperativos.

Extensión del sector: Más de 100 millones en el mundo (Sinha 2006) trabajan desde sus domicilios o el de sus empleadores en la industria de la indumentaria, artículos deportivos y otras actividades a domicilio. En los países pobres, son altísimos los porcentajes de estas actividades por sobre el total de la mano de obra: Guatemala (26%), India (16%), Kenya (15%), Mexico (17%), Filipinas (14%), Tunez (11%), Venezuela (18%). En la Argentina existen más de 40.000 talleres textiles clandestinos, con alrededor de 400.000 trabajadores.

Modalidades: Hay dos grandes grupos: los que trabajan por cuenta propia para vender en el mercado popular y los que trabajan para un fabricante. A su vez, los que trabajan para un fabricante pueden hacerlo en su propio domicilio sin supervisión cobrando por prenda o en el del dador de trabajo bajo su supervisión, incluso aportando a cadenas de valor nacionales o globales.

Status legal: es un trabajo regulado pero las regulaciones no se cumplen. Las sanciones por violaciones a regulaciones del trabajo únicamente se apli-



Taller Textil Cooperativo (La Boca)



Taller Clandestino (Bs As)



Cooperativa Textil Iriza (Ruanda)



Confección de Peñotas (India)

can sobre los talleristas, nunca sobre las grandes marcas o las cadenas globales de valor.

Espacios de trabajo usuales: la producción se realiza generalmente a domicilio o en pequeños talleres. Casi siempre las condiciones de labor son deplorables.

Medios de trabajo usuales: máquinas de coser, tejedoras automáticas, bordadoras y demás maquinaria de baja densidad tecnológica. Materias primas como telas y cueros.

Algunas experiencias organizativas: Cooperativa Textil Los Pibes; Cooperativa 20 de diciembre; Dignity Returns, CDI Barracas, Textil La Dignidad.



9

LIMPIAVIDRIO, CUIDACOCHE Y TRABAJADOR/A DE LOS SEMÁFOROS EN GENERAL

Limpiavidrios es una de las denominaciones que reciben aquellos trabajadores que se desempeñan en las esquinas limpiando parabrisas cuando el semáforo se pone en rojo. Los cuidacoches son asistentes de estacionamiento que en general toman una o dos cuadras y piden un pago por cuidar los autos. En los semáforos también hay malabaristas y todo tipo de artistas callejeros.

Estos trabajadores suelen recibir maltratos y para lograr sus clientes a veces tienen que asumir actitudes agresivas. En las mejores paradas suelen ser víctimas de hostigamiento institucional y para institucional, en general con el objeto de que entreguen una parte de sus ingresos como sobornos o peajes para poder desarrollar la actividad.

Las principales problemáticas de la actividad son el trabajo infantil, la organización coercitiva de las paradas y la exposición cotidiana a los peligros de la calle. El trabajo en los semáforos es a menudo asociado con la mendicidad y despreciado. Sin embargo, las personas que allí se desempeñan se reivindican trabajadores.

En muchos países, estos trabajadores lograron organizarse e incluso obtener algún grado de reconocimiento estatal como la extensión de permisos e incluso la incorporación en servicios municipales de estacionamiento medido o limpieza de automóviles.

Extensión del sector: 15.000 (Argentina), millones en el mundo.

Modalidades: la forma más usual es el trabajo por cuenta propia pero con una organización coercitiva del mismo. Existen experiencias exitosas de cooperativización.

Status legal: en muchos países la actividad está prohibida, en otros es tolerada.

Espacios de trabajo usuales: la actividad se desarrolla en la vía pública, principalmente en los semáforos y calles.

Medios de trabajo usuales: trapos, limpiavidrios, artículos de malabarismo.

Algunas experiencias organizativas: Confederación Nacional de Trabajadores por Cuenta Propia (CNCT – Nicaragua), Naranjitas (Córdoba), Estacionamiento Medido Municipal (Bariloche).



Trabajo infantil en la calle (Bs As)



Cuidacoches "Naranjita" (Córdoba)



Limpiavidrios (Santa Rosa)



Joven malabarista (Chile)



10

TRABAJADOR/A DEL TRANSPORTE INFORMAL

Trabajadores que se dedican al traslado de personas u mercancía sin autorización de la autoridad correspondiente ya sea por el mal estado de los vehículos, por el alto costo de las licencias o por otros motivos. En general esto se realiza en colectivos, autos y camiones viejos, pero en algunos países incluso se realiza con caballos, bicicletas y hasta tracción humana.

El transporte informal es un elemento esencial dentro de la economía popular dado que permite el traslado en sectores dónde el transporte público urbano no llega, fundamentalmente en las periferias más empobrecidas. Allí, las modalidades informales de transporte permiten la movilidad de trabajadores y objetos dentro y fuera de las barriadas.

De esta forma, el transporte informal constituye el medio principal de circulación tanto de los trabajadores como de los productos de la economía popular. Sin embargo, su ámbito de actividad no se restringe a las periferias. En muchos casos, son los centros urbanos los mayores generadores de trabajo para el sector.

Es allí donde se generan los conflictos con las autoridades gubernamentales que en general responden al fenómeno a través de la criminalización de la actividad. Asimismo, la competencia con los taxis, colectivos y otras formas de transporte formal llegan en algunos lugares hasta la violencia física.

La creación de rutas fijas, paradas y un estándar especial para el sector diseñado de manera tal que permita una convivencia entre transporte formal e informal en el camino hacia la formalización y el mejoramiento de los vehículos es la principal reivindicación del sector.

Desde ya, consideramos que las formas degradantes como el transporte por tracción humana deben ser erradicadas siempre previendo escenarios alternativos que permitan mejorar – no empeorar – la calidad de vida de los trabajadores.

Extensión del sector: 60.000 (Argentina) más de 40 millones (mundo).

Modalidades: en general estamos frente a trabajadores por cuenta propia

pero también existen unidades productivas cooperativas o de carácter patronal.

Status legal: en general es un sector prohibido y perseguido.

Espacios de trabajo usuales: barrios periféricos y centros urbanos.

Medios de trabajo usuales: amplia variedad de vehículos a motor, vehículos a tracción animal y vehículos a tracción humana. La tipología de vehículos informales podría llevarnos varias páginas.

Algunas experiencias organizativas: Union des Conducteurs de Taxi-Moto de Cotonou (UCOTAC Africa), Syndicat National des Travailleurs des Transport Routiers du Senegal (SNTTR).



Bicitaxi (Bogotá)



Guarandinga (Cuba)



Tracción Humana (India)



11

TRABAJADOR/A POPULARES DE LA CONSTRUCCIÓN

Trabajadores que desarrollan labores de construcción en unidades productivas populares o barrios periféricos. En general, el trabajo está orientado a la construcción, refacción o ampliación de viviendas unifamiliares para sí (autoconstrucción) o para terceros (ayuda mutua).

Como en otros oficios, es muy importante distinguir la situación de los trabajadores en la economía popular del fraude laboral (trabajo informal o registrado) que practican las constructoras y contratistas integradas en la economía formal. Esta distinción es fundamental en el rubro porque existen decenas millones de obreros de la construcción asalariados en empresas formales, comercios o familias de alto poder adquisitivo pero en situación de informalidad. Aunque parezcan escenas propias del Egipto faraónico, se han detectado centenares de casos de trabajo semiesclavo en subcontratistas empleadas en la construcción de estadios de fútbol durante los dos últimos mundiales.

Distinta es la situación de los trabajadores populares de la construcción. La “informalidad” no está aquí vinculada a la evasión de normas laborales por parte de empresas con ánimos de lucro dedicadas a desarrollar construcciones modernas sino de trabajo aplicado en pequeña escala que permite un mínimo o nulo excedente para estos obreros sin patrón. De todas formas, ambos sectores comparten muchas problemáticas.

Las construcciones populares tienen diversas características según el emplazamiento, las tradiciones culturales y la habilidad de cada trabajador. Sin embargo, en general se observa menor preocupación por las terminaciones y detalles estéticos, la utilización de materiales de menor calidad y un mejor aprovechamiento de los espacios que en algunos casos demuestra una creatividad que ha dejado perplejos a arquitectos y urbanistas.

La principal problemática de la actividad está vinculada a los bajos ingresos, la falta de una cobertura de salud adecuado, la falta de utilización de elementos de seguridad laboral, la gran cantidad de accidentes, la imposibilidad de jubilarse a una edad razonable.

Extensión del sector: Decenas de millones de personas trabajan en la construcción informal fuera de las empresas privadas formales. En India, Filipinas, México o Brasil, los índices de trabajo no registrado en la construcción superan el 70% (WIEGO).

Modalidades: la gran mayoría de trabajadores de la construcción en la economía popular se desempeñan de manera independiente y en un creciente número de cooperativas de trabajo. Entre ellas destaca la construcción de viviendas por ayuda mutua y los distintos esquemas de autoconstrucción como el desarrollado por Cáritas en distintas partes del mundo. Por otro lado, millones de trabajadores del sector tienen empleos no registrados en la economía formal.

Status legal: la actividad está permitida y en algunos casos fomentada con subsidios.

Espacios de trabajo usuales: barrios periféricos.

Medios de trabajo usuales: todo tipo de herramientas de trabajo para la construcción.

Algunas organizaciones: FUCVAM (Uruguay), Caritas (Internacional), Covilpi, (Argentina) Federasi Konstruksi, Umum dan Informal (Indonesia), SELVyHP (Latinoamerica).



Covilpi (La Boca)



Programa Autoconstrucción (Cáritas)



Federación Uruguaya de Construcción de Viviendas por Ayuda Mutua (FUCVAM)



12

TRABAJADOR/A DE MEJORAMIENTO BARRIAL Y CUIDADO DEL HÁBITAT

Trabajadores que sin ser empleados estatales ni de empresas prestadoras de servicios públicos se desempeñan en tareas de mejoramiento barrial (refacción de plazas, colocación de luminarias, cordón cuneta, asfaltado, zanjeo, desagües, etc.) o en el cuidado del hábitat (limpieza de arroyos, recolección de residuos, mantenimiento de espacios públicos).

Estos trabajos se realizan fundamentalmente por dos motivos: por la autoorganización barrial basada en el trabajo gratuito y voluntario de los vecinos o a partir de programas públicos de transferencia de ingresos con contraprestación laboral. En ambos casos las condiciones de labor son precarias pero la satisfacción de estar contribuyendo al bienestar general incentiva el trabajo e impulsa la cooperación entre las personas.

No son pocos los ejemplos en que los vecinos se autoorganizan para levantar una plaza o colocar luminarias. En ocasiones, se crean “Sociedades de Fomento” para desarrollar estas labores y hasta se recaudan fondos para que algunos vecinos puedan dedicarse de manera permanente y remunerada al cuidado del barrio.

También existen en distintos lugares del mundo experiencias de cooperativas promovidas desde el Estado para la realización de tareas de mejoramiento barrial y cuidado del hábitat con resultados disímiles. A veces estos emprendimientos se estructuran con el único objetivo de generar una transferencia de ingresos, terminan siendo subsidios directos encubiertos y adoptando el carácter de políticas asistenciales. Distinto es el caso cuando se da independencia a las cooperativas que cobra por las obras que efectivamente realizan y se prioriza el impacto comunitario del programa.

Los proyectos de mejoramiento del hábitat popular, planificados con un enfoque respetuoso de las tradiciones barriales, son una de las herramientas más adecuadas para propiciar la integración y la justicia social. Permiten la

creación de empleos, la reconstrucción de la cultura del trabajo y la dignificación de las barriadas periféricas en forma participativa y colaborativa entre distintos sectores sociales.

Extensión del sector: Existen en la Argentina más de 250.000 trabajadores afectados a programas de estas características. En Colombia y en México se han desarrollado múltiples programas de mejoramiento barrial o del hábitat popular con decenas de miles de trabajadores involucrados.

Modalidades: en general, los trabajadores se organizan por cuadrillas bajo la forma jurídica de cooperativas de trabajo.

Status legal: en algunos países son fomentados por los estados aunque con recursos y prioridad insuficientes.

Espacios de trabajo usuales: espacios públicos e intersticios de los barrios periféricos. En ocasiones las cuadrillas de trabajo son enviadas a realizar trabajos en zonas céntricas.

Medios de trabajo usuales: los que provee el Estado, palas, rastrillos, desmalezadoras, motosierras, arneses, etc.

Algunas experiencias y organizaciones: CTEP Rama Infraestructura Popular – Programa Argentina Trabaja – Programa Comunitario de Mejoramiento Barrial (México).



Cooperativa El Maycoco, Quilmes



Cooperativa Evita, La Matanza



Pintada de vecinos de asentamiento precario después de una jornada de trabajo voluntario



13

TRABAJADORES DE PRODUCCION POPULAR

Aunque la denominación “emprendimientos populares” puede hacer referencia a cualquiera de las actividades que mencionamos, en este caso utilizamos la categoría para un grupo específico de trabajadores que se desempeña en pequeñas unidades productivas populares surgidas a partir de una iniciativa individual o colectiva totalmente independiente de intermediarios dedicados a la elaboración de bienes o servicios. A diferencia de los artesanos, no tienen componente artístico.

No acordamos con la denominación usual para este sector es “microempresarios” o peor aún “microempresarios”. Esos términos tienen una profunda carga ideológica vinculada a una concepción de la pobreza como consecuencia de la falta de iniciativa empresarial de las propias víctimas. Asimismo, asimila a los sectores populares excluidos con los empresarios integrados al mercado planteando una diferencia de escala únicamente.

Los trabajadores de las industrias populares no cuentan con capital en sentido estricto y la dependencia con el entorno económico no determina la viabilidad de los emprendimientos sino de la propia subsistencia de los trabajadores-empresarios. Asimismo, usualmente las formas de intercambio son informales, los ingresos bajos y las condiciones de trabajo precarias e inseguras.

Muchos programas estatales apuntan a entregar pequeñas maquinarias o microcréditos para el desarrollo del sector. En muchas ocasiones el fracaso de los emprendimientos es la crónica de una muerte anunciada: sin tecnología, sin mercados, sin redes de distribución, sin financiamiento las unidades productivas marcha directo al fracaso.

Pese a ello, es importante destacar que una gran cantidad de emprendimientos – panificadoras, bloqueras o peluquerías – encarados por pequeños grupos de trabajadores han permitido la subsistencia de los mismos sobre

todo durante períodos de crisis económicas. También existen emprendimientos vinculados al agregado de valor de otras actividades de la economía popular como la producción de artículos con materiales reciclados o el estampado de prendas de cooperativas textiles.

Extensión del sector: en la Argentina hay más de 200.000 trabajadores de emprendimientos populares registrados como “efectores sociales”. En el mundo son millones los que optan por esta actividad, al menos en forma temporaria.

Modalidades: en general se trata de emprendimientos individuales o pequeños grupos de trabajo de carácter cooperativo (pre-cooperativas).

Status legal: son permitidos y en ocasiones asistidos.

Espacios de trabajo usuales: domicilios y pequeños talleres anexos.

Medios de trabajo usuales: depende del emprendimiento. Pueden ser hornos de pan, maquinas bloqueras, o elementos de carpintería.

Algunas experiencias organizativas: Tras Cartón Diseño, Polo Carpintería, Panadería la Pacha Pana, Cooperativa Manos Solidarias, Frente Nacional de Defensa del Trabajador Autónomo o Ambulatorio del Peru (FENDETAP).



Tras Cartón, MTE, Buenos Aires



Bloquera Domicilio, Entre Ríos



Panadería La Pochopona, Villa Fiorite



14

CAMPESINO/A, AGRICULTOR/A FAMILIAR Y TRABAJADORES DE LA TIERRA

El campesino cultiva la tierra o cría animales en pequeña escala con sus propias manos, en ocasiones con asistencia de tractores y otras maquinarias, sin un patrón, sea esta tierra suya, sea comunitaria o sea arrendada. También se los llama agricultores familiares y a veces pequeños productores. Podemos incluir en esta categoría a otros trabajos que se hacen en espacios rurales como la producción de ladrillos. Los trabajadores de la tierra en relación de dependencia son en cambio obreros o peones rurales.

La principal problemática del campesinado siempre ha sido el derecho a la tierra. La imposibilidad de acceder a un lote con título formal de propiedad o tener las suficientes garantías jurídicas para vivir con un margen razonable de seguridad en la posesión y la tenencia sigue siendo un azote para los campesinos. A ello se suma la competencia de la agricultura industrial, altamente tecnificada y regida hoy por los avances de la biotecnología, en particular la aplicación de OGM.

Con independencia de las discusiones de carácter científico sobre los eventuales perjuicios de la aplicación de esta tecnología, es evidente que desde el punto de vista socio territorial la aplicación de transgénicos ha acelerado el proceso de éxodo rural. Esto es así porque las semillas genéticamente modificadas incentivan la explotación extensiva de la tierra, con altos márgenes de rentabilidad, y esto deriva en el acaparamiento de tierras para la producción de commodities ya sea mediante la compra de tierras campesinas o mediante el desplazamiento forzado de las poblaciones rurales sin título perfecto.

El acceso al agua, las semillas, infraestructura adecuada, fuentes de energía y maquinaria, además de la intermediación y bajos precios por los productos, se suman como factores negativos para agravar el cuadro.

La resolución de la problemática campesina está íntimamente relacionada con la superación de la pobreza urbana. Una distribución más armoniosa de

la población en el territorio fundada en mayores oportunidades para el ámbito rural permitirá mejorar la calidad de vida de las personas en ambos sectores.

Asimismo, la presencia de campesinos contribuye el cuidado de la tierra y la soberanía alimentaria.

Extensión del sector: En Argentina existen unos 250.000 núcleos de Agricultura Familiar. Se estima que en el mundo unas 660 millones de personas se dedican a la actividad. De todos los trabajadores rurales, se estima que el 40% son peones asalariados y el 60% campesinos y agricultores familiares.

Modalidades: Las modalidades más usuales son la pequeña propiedad, el arriendo, la agricultura comunitaria y las ocupaciones de hecho.

Status legal: el problema de la regularización de la tenencia de la tierra, ya sea como propiedad privada, comunitaria o colectiva, determina el status legal de la actividad. En algunos países como Brasil y Argentina existen programas de apoyo al sector. La FAO considera esta actividad fundamental para la seguridad alimentaria mundial.

Espacios de trabajo usuales: áreas rurales.

Medios de trabajo usuales: herramientas, maquinaria agrícola, semillas, bombas de agua, paneles solares.

Algunas experiencias organizativas: Vía Campesina Mundial, Movimiento de los Sin Tierra (MST), Syndicat des Femmes Vendeuses de Poisson (SYFEVEP – Chad).



Granja Hortícola (UTT, La Plata)



Cooperativa Ladrillera Entre Ríos



Comunidad Ayllu (Bolivia)



Acampamento MST (Brasil)

5. Alternativas comunitarias por un mundo sin esclavos ni excluidos

Francisco dice con acierto que padecemos de un cierto “exceso de diagnóstico”. Podemos llenar páginas con aportes teóricos, datos estadísticos, compendios normativos e historias de vida que nos conmueven hasta las lágrimas mientras los excluidos siguen esperando. Menos abundantes son, sin embargo, los proyectos superadores de la actual situación de exclusión y en términos particulares, los que apuntan a la dignificación de los trabajadores excluidos que es mucho más que la mera formalización.

Hemos dicho que la informalidad laboral tiene causas estructurales profundamente arraigadas en el paradigma de la globalización capitalista. Citando nuevamente a Francisco, reafirmamos que sin transformar estructuralmente este paradigma para reemplazarlo por otro que ponga en el centro la dignidad humana, difícilmente puedan superarse las grandes injusticias que hemos reseñado.

Sin embargo, el camino se hace al andar y posiblemente en las experiencias de organización popular surgidas desde las entrañas mismas de la exclusión, desde las periferias geográficas y existenciales, podamos encontrar el germen de este nuevo modelo de desarrollo humano que anhelamos. Todos estamos llamados a colaborar respetuosa y humildemente en la lucha de nuestros hermanos más sufridos por su dignidad.

Hasta hoy y en líneas generales, el combate focalizado a la pobreza, si bien permitió aliviar la situación de muchas personas en el mundo, ha generado también estructuras elefantiásicas y una verdadera casta burocrática que más que herramienta al servicio de los pobres pareciera ser máximas beneficiarias de los fondos destinados a tan noble finalidad. Muchos proyectos fracasan o por corrupción de las autoridades o por la errónea orientación de los mismos.

En muchos casos, las políticas invierten el precepto franciscano de que “la realidad es superior a la idea”. En ese sentido, los criterios asistencialistas y salvacionistas priman en los proyectos de inversión social que en general vienen empaquetados desde los organismos multilaterales de crédito como el Banco Mundial y para peor, con la imposición de consultoras que se quedan con no menos de un 30% de los fondos. En nuestra experiencia, cualquier proyecto social que no se asienta sobre bases sólidas, que se diseñe sin la participación de los excluidos, que desconozca la realidad material, cultura y tradiciones de los sectores a los que va dirigido, termina ineludiblemente en frustración y dilapidación de recursos.

Paradójicamente, muchas veces los programas asistenciales con financiamiento internacional redundan en mayor endeudamiento para los países cuyo desarrollo es inviable si siguen cargando el pesado fardo de deudas ex-

ternas ilegítimas e inmorales. En el mismo sentido, las condiciones macroeconómica que los financiadores ponen a los Estados terminan agravando la situación que pretenden resolver

Comprender la centralidad del trabajo en la vida humana, su valor extraeconómico, su rol como ordenador de la existencia comunitaria, implica dejar de pensar únicamente en términos de ingresos o acceso al consumo. Las transferencias directas de ingresos, sumamente necesarias y tan escasas, no alcanzan y muchas veces terminan reabsorbidas por las empresas monopólicas que ofrecen precios más bajos y destruyen las economías locales.

En mi opinión la orientación correcta de los esfuerzos de estados e instituciones para la erradicación de la pobreza deben apuntar a fortalecer y dignificar las actividades laborales popularmente creadas, respetando sus tradiciones, reconociéndolas, integrándolas institucionalmente con miras a garantizar el pleno ejercicio de los derechos humanos, económicos, sociales y culturales.

Quisiera aportar algunas líneas de acción con tres ejes: políticas de alcance general, políticas sectoriales vinculadas a los oficios populares descriptos en el capítulo anterior y políticas de generación de empleo popular comunitario.

Queda claro que estas políticas no son gratuitas. Implican necesariamente la aplicación de cuantiosos subsidios que el poder político debe recaudar imponiendo tributos a los sectores concentrados del poder económico. Debemos erradicar la idea de una economía social autosustentable dentro de un mercado dominado por monopolios y empresas altamente tecnificadas. El sentido de una política popular comunitaria es la maximización del trabajo y no de la ganancia.

a. Políticas generales

INGRESOS Y DERECHOS.— Acceso Universal al Trabajo Decente y al Salario Social Integral: la consagración del derecho al trabajo decente como norma universal de la más alta jerarquía constitucional en todos los Estados, la universalización de un ingreso mínimo garantizado, la ampliación de la seguridad social a los trabajadores populares y la asignación de tareas comunitarias remuneradas a quienes no puedan conseguir un trabajo. Los trabajadores por cuenta propia no deben ser tratados como empresarios de pequeña escala sino como trabajadores jurídica y técnicamente autónomos, pero económicamente dependientes del mercado para su subsistencia, y por tanto el principio protectorio del derecho laboral debe extenderse al sector.

VOZ Y PROTAGONISMO.— Reconocimiento Sindical y Negociación Colectiva: Tanto los trabajadores de la economía popular como aquellos dedicados

a tareas comunitarias remuneradas por el Estado deben tener derecho a formar sus sindicatos y acceder a la negociación colectiva con todos los actores que incidan en sus condiciones de labor.

TRABAJO PRODUCTIVO.— Redes de distribución y compra estatal: Los Estados deben fomentar los emprendimientos populares a través de la compra preferencial de sus productos y el desarrollo de redes de distribución subsidiada de los mismos.

REPARACIÓN DE DAÑOS.— Reutilización social de bienes incautados a empresas que utilizan trabajo infantil, trabajo esclavo u organizaciones criminales: Los Estados deben adaptar su legislación para que los bienes incautados o decomisados en el marco de procesos penales vinculados al crimen organizado (narcotráfico, evasión, lavado de activos, trata de personas, contrabando) se asignen a las organizaciones sociales para su utilización en emprendimientos productivos.

ESTADOS CERCAS DEL PUEBLO.— Nueva institucionalidad y políticas sectoriales congruentes: Los Estados deben readaptar su estructura institucional a la nueva etapa histórica con la creación de agencias desburocratizadas especializadas en la economía popular y descriminalizar las actividades laborales de mera subsistencia. En ese sentido, es fundamental que se desarrollen líneas de trabajo que contemplen la especificidad de cada actividad popular para abordarla sin recetas empaquetadas sino adaptando las acciones a las necesidades real del oficio, la región y las características de los trabajadores. Por otro lado, es importante contar con fueros judiciales o administrativos especiales que apliquen correctamente el derecho consuetudinario para resolver conflictos y diferendos contemplando la realidad de los sectores populares.

b. Políticas sectoriales de integración del trabajo popular

CARTONEROS Y RECICLADORES.— Integración de los recicladores en los servicios públicos de tratamiento de residuos: los recicladores de todo el mundo prestan un servicio necesario para la comunidad y con importantes beneficios ambientales. Este importante nicho debe preservarse para los sectores populares, dignificarse mediante programas de mejoramiento laboral y evitar su privatización restrictiva.

VENDEDORES AMBULANTES.— Regulación inclusiva de la venta ambulante: la venta ambulante debe ser regulada de manera inclusiva desarrollando esquemas que permitan la coexistencia no competitiva de los vendedores am-

bulantes con los pequeños comercios. La provisión de mercancías para la venta a precios subsidiados provenientes de otras actividades de la economía popular permite multiplicar el potencial para la creación de empleos del sector en su conjunto.

ARETESANOS.— Promoción del trabajo artesanal: el trabajo artesanal no solamente debe ser tolerado permitiendo la instalación de puestos o ferias en todos los puntos de atracción de las ciudades sino que debe ser promovido a través de la creación de escuelas de artes y oficios principalmente en los barrios periféricos.

GRANDES FERIAS.— Cooperativización de las grandes ferias: debe erradicarse la estructuración patronal del comercio popular en grandes ferias donde la desregulación del trabajo propia de la informalidad beneficie con cuantiosos ingresos a personas inescrupulosas y funcionarios corruptos. Esto implica la expropiación, coopeartivización y supervisión estatal de todas las grandes ferias donde se verifique un alto nivel de incumplimiento de las leyes laborales y la comercialización de productos provenientes de unidades productivas populares.

TEXTILES.— Regularización de talleres textiles y creación de polos productivos: la erradicación del trabajo esclavo en la industria de la indumentaria y en general de todas aquellas que tengan una alta incidencia de trabajo precario a domicilio es absolutamente imposible sin generar escenarios alternativos. Los programas de regularización de talleres bajo condiciones laborales dignas, la construcción de grandes polos textiles y la imposición de condiciones estrictas de control en las cadenas productivas de las grandes marcas que impliquen la responsabilidad solidaria de todos los integrantes de las cadenas son un imperativo ético para la eliminación de estas aberrantes formas de explotación.

EMPRESAS RECUPERADAS.— Política de continuidad productiva y recuperación de fábricas: la existencia de infraestructura productiva ociosa en el campo o la ciudad, ya sea por negligencia de los propietarios o por la inviabilidad económica de los emprendimientos dentro de la economía de mercado es un verdadero crimen en un marco de creciente desocupación. La recuperación de estas estructuras bajo esquemas autogestivos dirigidos por sus trabajadores y subsidiados y complementados por el Estado permitirá la recuperación de millones de puestos de trabajo. Es indispensable, en este sentido, la modificación de las leyes de quiebra para que permitan la conti-

nidad operativa de los emprendimientos bajo gestión cooperativa y la compensación de los créditos laborales para la adquisición de la empresa por parte de los trabajadores.

AGRICULTURA FAMILIAR.— Fomento y protección de la Agricultura familiar: más allá de las discusiones de carácter científico sobre los perjuicios ambientales o sanitarios de la agricultura industrial de base transgénica, la preservación de la agricultura familiar individual o comunitaria cumple una función social imprescindible para evitar las migraciones masivas a las ciudades. Esto implica también una fuerte intervención del Estado para sostener económicamente al sector mediante esquemas de compra anticipada estatal, ferias francas, etc. La producción de la agricultura campesina puede utilizarse masivamente para paliar el hambre en el mundo ya que no tiene un fin de acumulación económica sino de proyección de una vida digna.

TRABAJADORES DE LOS SEMÁFOROS.— Integración de trabajadores de los semáforos: no criminalización ni hostigamiento de la actividad. Incorporación de los trabajadores en los sistemas de estacionamiento medido y otorgamiento de paradas oficiales e infraestructura para limpieza de vehículos.

TRABAJADORES DE TRANSPORTE INFORMAL.— Integración y coexistencia con el transporte formal: La creación de rutas fijas, paradas y un estándar especial para el sector diseñado de manera tal que permita una convivencia entre transporte formal e informal en el camino hacia la formalización y el mejoramiento de los vehículos es la principal reivindicación del sector. Desde ya, consideramos que las formas degradantes como el transporte por tracción humana deben ser erradicadas siempre previendo escenarios alternativos que permitan mejorar – no empeorar – la calidad de vida de los trabajadores.

TRABAJADORAS DEL HOGAR.— Reconocimiento y plenos derechos laborales: las trabajadoras del hogar que se desempeñan en domicilios particulares deben estar amparadas por las leyes del trabajo en igualdad de condiciones que el resto de los empleados en relación de dependencia. Esto implica derecho a un salario digno y condiciones laborales decentes, como vacaciones y licencias, pago por horas extras, licencia por enfermedad, seguro de salud y jubilaciones y/o pensiones. Del mismo modo, las “amas de casa” deben ser reconocida por su invaluable servicio la célula básica social que es la familia.

TRABAJADORES DE SERVICIOS COMUNITARIOS.— Financiamiento público y reconocimiento social: Los gobiernos deben fomentar la creación de nodos

para la integración comunitaria que permitan a los vecinos de las barriadas populares acceder al deporte, la cultura, la recreación, la atención primaria de la salud, el cuidado de niños, etc. Los espacios existentes destinados a esos fines y sus trabajadores deben ser reconocidos y remunerados por su tarea.

c. Políticas de generación de trabajo popular (tres ejes)

INFRAESTRUCTURA COMUNITARIA Y MEJORAMIENTO BARRIAL.— Los programas que apuntan a la integración urbana de los barrios periféricos pueden ser grandes generadores de empleo y al mismo tiempo cumplir un rol comunitario fundamental. Algunas de las actividades que las comunidades excluidas pueden realizar en forma cooperativa con apoyo de los Estados son limpieza y recolección diferenciada de residuos, mantenimiento de la infraestructura social como escuelas o clubes, poda de árboles, el desarrollo de veredas y calles, limpieza de arroyos y riveras, la colocación de luminarias, bacheo, mantenimiento de plazas y juegos infantiles, etc.

AUTOCONSTRUCCIÓN DE VIVIENDAS Y MEJORAMIENTO HABITACIONAL.— La construcción de viviendas populares y, fundamentalmente, el mejoramiento de las mismas es otra oportunidad para generar trabajo a gran escala resolviendo al mismo tiempo uno de los déficits más acuciantes de las ciudades modernas. Esto permite, además, la formación de clusters para la fabricación de las partes y materiales necesarios para la labor.

SERVICIOS COMUNITARIOS.— Millones de personas pueden ser empleadas en la promoción del deporte y la salud, además de prestar servicios en el cuidado de niños, enfermos y ancianos, apoyo escolar y otros servicios comunitarios. La organización y capacitación de este sector, así como su remuneración y derechos laborales, deben ser garantizadas principalmente por los Estados.

Las políticas de generación de trabajo popular pueden catalizar una poderosa sinergia si se pone en contacto a las comunidades excluidas con los jóvenes del precariado que en general provienen de hogares socialmente integrados. La integración de estos dos sujetos, los más golpeados por la globalización capitalista, sin duda fomentará la colaboración intersectorial y pueden contribuir decisivamente a la justicia social, dotar de sentido la vida de millones de jóvenes sin esperanza y avivar la llama de solidaridad intergeneracional que anida en el alma de nuestros pueblos.

6. Francisco y los trabajadores de la Economía Popular

La foto de portada de este trabajo no está ahí por casualidad. Tampoco tiene por objeto legitimar mi posición respecto a los temas tratados mostrando la cercanía de nuestro Pastor con los compañeros de la organización social que integro. Elegí esta foto, de entre cientos de fotos donde ese hombre que hoy conocemos como Francisco aparece junto a los excluidos, porque encierra para mí un profundo simbolismo.



Cada año, cerca de septiembre, el entonces cardenal de Buenos Aires celebraba una misa bajo la consigna “Por una Patria sin Esclavos ni Excluidos”. Junto con la Pastoral Migratoria de Buenos Aires y la Fundación Alameda nos tocaba organizar la celebración desde el Movimiento de Trabajadores Excluidos (MTE). La convocatoria era abierta pero ese día el protagonismo lo tenían cartoneros, costureras, víctimas de trata de personas y en general las personas más golpeadas en su dignidad por la injusticia social.

Durante la celebración eucarística, después de la apasionante homilía que ofrecía el Cardenal Bergoglio, cada grupo entregaba como ofrenda un símbolo de sus luchas, sufrimientos y esperanzas. En ese momento, los compa-



ñeros disponían del micrófono para explicar su significado de la ofrenda a la concurrencia y los medios de comunicación.

La escena se repetía año tras año: las palabras que surgían espontáneamente de los trabajadores levantaban polvareda pues hablaban de sus padecimientos reales, señalaban responsabilidades concretas, criticaban a los gobiernos indiferentes, reivindicaban sus formas de luchar por trabajo, dignidad y cambio social. Muchos se ponían nerviosos en ese momento. Más de una vez, personal del Arzobispado no llamó la atención a quienes ellos identificaban como dirigentes sobre el contenido de la intervención de nuestros compañeros. No entendían que allí nada estaba digitado.

Bergoglio permanecía siempre en la postura que vemos en la foto escuchando atentamente con el corazón abierto y la cabeza inclinada, con un respeto infinito por la voz del pueblo sufriente que se filtraba entre las palabras de estos cartoneros. Su actitud era todo un llamado de atención para quienes no querían escucharlas: le estaba dando voz a los sin voz en la presencia de Jesús y frente a toda la comunidad reunida; sin sustituciones, sin maquillajes, sin poses.

Más allá de las experiencias, posiciones, proyectos o lineamientos que podamos aportar en la lucha contra la exclusión y por la justicia social, creo que nuestro trabajo como cristianos comprometidos, como pensadores, como militantes, como organizadores, como dirigentes políticos, sociales o

sindicales, debe estar imbuido de la misma actitud que Francisco demostraba antes de llegar del fin del mundo hasta el trono de San Pedro y que sostuvo durante su primer maravilloso año de pontificado.

No hay soluciones mágicas, no hay recetas infalibles, no hay iluminados ni tenemos otro salvador además de nuestro Salvador Jesucristo. Debemos escuchar atentos la voz del Pueblo humilde y fortalecer a los que sufren la injusticia para que sean artífices de su propio destino. En mi opinión, la expresión práctica de esta concepción es el fortalecimiento de las organizaciones populares que desde abajo, en la lucha por la subsistencia y el trabajo, van marcando un camino de solidaridad hacia un mundo mejor posible.

Para finalizar, quisiera compartir el mensaje que Francisco grabó para los cartoneros y campesinos el 5 de diciembre de 2013.

Mensaje a los campesinos: *“Un saludo a los que están participando de la asamblea de la Vía Campesina, que expresa de alguna manera el amor a la tierra, que hay una relación entre quien cuida la tierra y quien cultiva la tierra...y que la tierra como que responde dando su riqueza y sus frutos, cuidar la tierra, no abusar de ella, trabajar la tierra, pero a la vez trabajarla en comunidad, trabajarla como hermanos, esa relación entre la creación que Dios nos dio, entre la hermandad que Dios quiere con nosotros, nos va hacer bien a todos, no maltratar la tierra, no maltratarnos entre nosotros , y seguir adelante, que dios los bendiga...”*³

Mensajes a los cartoneros: *“En esta asamblea de cartoneros y recicladores, piensen cómo seguir adelante en este trabajo de reciclar – perdónenme la palabra – lo que sobra. Pero lo que sobra es rico. Hoy día no nos podemos dar el lujo de despreciar lo que sobra. Estamos viviendo en una cultura del descarte, donde fácilmente hacemos sobrar no solo cosas, sino personas. Ustedes reciclan y con esto producen dos cosas, un trabajo ecológico, necesario, y por otro lado una producción que fraterniza y da la dignidad al propio trabajo. Son creativos en la producción y también son creativos en el cuidado de la tierra, del mundo, con esta dimensión ecológica. Ustedes saben que con el alimento que se tira se puede dar de comer a toda la gente hambrienta del mundo. Piénsenlo ustedes que están descubriendo continuamente el alimento que se tira y vayan creando esa conciencia de que un reciclado no sólo es ecológico, lo que es una gran cosa, sino también productivo en lo demás, y creando la conciencia de que no se desperdicien alimentos porque hay chicos que pasan hambre. Gracias por lo que hacen”*⁴

³ <http://www.youtube.com/watch?v=Bkm88broxUE&feature=youtu.be>

⁴ http://www.youtube.com/watch?v=FyjErsX-Zd8&feature=c4-overview&list=UUSzw85TN14TEvUCaZDq_xlg

En este 1° de mayo quiero hacerles llegar a los trabajadores de la economía popular un saludo, hoy es el día del trabajador y ustedes tienen en la sociedad una función muy significativa no solo el trabajo para producir, sino, algo testimonial el trabajo desde donde hasta donde. El testimonio de lo artesanal, de la búsqueda de todo aquello que parece que no puede dar algo más de sí mismo y ustedes con su artesanidad con su búsqueda, con su trabajo comunitario, lo logran. Me refiero a los cartoneros, me refiero a los artesanos, me refiero a formas de campesinos, tipo cooperativas me refiero a todo aquello que desde lo... quizás, desechable o no atendible tomado por la manos de ustedes se juega en una producción para el consumo de la sociedad y eso... perdonenme por la palabra pero además de trabajo hay poesía. Y la dignidad, cuando narra la creación, el relato de la creación, de una manera nos hace sentir q dios creo al mundo hizo algo, pero con poesía y esa capacidad de transformación que tiene el espíritu humano, mucho más rica cuando se hace comunitariamente, cuando se hace hombro a hombro con el hermano, es mucho más rica cuando desde situaciones de exclusión social por un sistema económico, de tipo idolátrico de dinero se hace el esfuerzo de dar una respuesta constructiva a la propia familia y a la propia sociedad. Este trabajo de ustedes de esfuerzo, de salir de la exclusión, de formar comunidad, de artesanidad es un testimonio y hoy día de trabajador los quiero felicitar por todo esto sigan adelante que dios lo bendiga, recen por mí y manden buena onda.⁵

El trabajo es para el hombre, el trabajo está muy unido a la dignidad del hombre, la persona que no trabaja, que vive de arriba o que no tiene la posibilidad de trabajar y no llevar el pan a su casa de alguna manera siente herida su dignidad, siente q disminuye. Y el trabajo es un deber que la sociedad tiene q ofrecer para que todo hombre y toda mujer pueda crecer en dignidad, sentir la fuerza de su dignidad. Evidentemente que cuando en el organigrama normal no caben todos por una mística o una opción, no por una mística, por una opción social de tipo "X" se dan los trabajo excluidos los trabajos al margen, el hecho de que se den trabajadores excluidos del sistema normal no justifica que no tengan derechos sociales, la doctrina de la iglesia dice que sus tienen derechos sociales y tienen que, de alguna manera, luchar por ellos, reagruparse, sindicalizar, etc. para lograr los derechos sociales que todo trabajo se hace. Trabajo no es: yo hago y vos me pagas, no, yo hago, creo algo y tengo derecho sobre eso que he creado y la sociedad me lo retribuye hoy con un sueldo y mañana con una asistencia social jubilatoria y durante todo este tiempo con la asistencia social de educación salud, etc. Aun el trabajo excluido tiene que unirse para trabajar por esto no es nada raro, esto es la doctrina social de la iglesia.⁶

⁵ <https://www.youtube.com/watch?v=w74dI3nyq9w>

⁶ <https://www.youtube.com/watch?v=znvsMiyYHk>

THE INFLUENCE OF VIRTUOUS HUMAN LIFE IN SUSTAINING NATURE^{1*}

■ STEFANO ZAMAGNI

1. Introduction and motivation

“Can philosophical ethics still offer a way out of the ecological crisis?” – the German philosopher P. Kampits asked himself in 1978. Up to the present time environmental ethics, in their various forms (ecological, utilitarian, Rawlsian, the ethics of rights), have demonstrated with mixed results how and why humanity’s relationship with the environment may reasonably be held to be also a moral problem, a problem that implies a redefinition or extension of the concepts of duty and responsibility, and an alteration in the very image humanity has of itself and its relationship with nature. Effective in dismantling the barrier of indifference that until now mankind has placed between itself and nature, and breaking through the limitations of a claustrophobic anthropocentricity deaf to the problems of environmental integrity, environmental ethics remain impotent over establishing adequate criteria to choose an order of priorities for concrete issues.¹ Indeed, if the ethical perspective does not manage to affect the foundations of scientific economic thinking, not much can be expected of it. It is not hard to see why. For good or ill, for at least a couple of centuries, it is economic thought – with its double function of representation of reality, and provision of models of intervention to change that reality – that directs the choices of the various economic actors, and that guides decision-making in politics.

It must be recognized that the ecological problem is first of all a problem of public *ethos*, hard to solve without bringing into dispute certain ways of organizing society, without questioning ourselves on the ways we live together and on the values held in civil society. In this precise sense, we should realize at once that economic theory is still quite inadequate to fully deal with questions like the environment. At the heart of this inadequacy lies the formalistic conception, that is still prevalent in economic discourse, with its claim to be able to solve every conflict and controversy by separating

¹ For a historical excursus into ethical thinking on environmental matters, and for a convincing defence of the thesis that the environment has to be included in the realm of ethics as such and not just insofar as it is a system of resources for humanity, see C. Vigna (2001).

form and content and putting itself forward to seek laws and institutions that are “neutral”, i.e. that do not presuppose any adherence to values or cultural assumptions, and are thus acceptable to all actors independently of the historical context in which they are operating.

But formalism is not just this. It is also the idea that a society can find its cohesion and identity in efficient “rules of the game”, concerning the spheres of both income distribution and the formation of collective choices. One of the false necessities a certain tradition of thought has got us accustomed to is to see the terms describing independence and belonging, efficiency and justice, self-interest and solidarity, as alternatives: a strengthening of the sense of belonging is seen as a reduction of the subject’s independence; progress in efficiency is seen as a threat to justice; improvements in the individual’s interest as an enfeebling of solidarity. These antinomies have to be eliminated, because they are false. While need, equality, efficiency and entitlement may arguably be described as competing criteria during the Industrial age, these have become necessary conditions for each other in the post-industrial era. In the new regime in which human capital has become the source of value and wealth creation, need satisfaction, distributive justice, efficiency and entitlement turn out to be complementary elements of a necessary comprehensive approach to sustainability.

It is remarkable, but not to be wondered at, that it is precisely the subject of sustainable development that today forces the economist to rediscover the centrality of values in his/her scientific work. Which, it should be carefully noted, is never just a mere instrument to help us know reality, for if it is true, as I believe it is, that our beliefs concerning human nature contribute to the formation of human nature itself, and if it is likewise true that what we think of ourselves and our possibilities helps to determine what we aspire to become, then our economic theories on human behaviour lead to changes in the ways we behave, and hence contribute to a greater or lesser extent to modify reality itself. The recent work by Dasgupta (2012) proceeds in such a direction. I find the following statement remarkable: “Economic evaluation requires data, to be sure, but it also requires a conception of the good. More tellingly, without a conception of the good we wouldn’t know what data we should seek to study” (p. 5).

In what follows, I shall first be examining the way in which economics “discovers” the environment question. I shall then discuss the link between intergenerational fairness and sustainable development, with the intention of showing how the lack of a holistic approach to environmental matters explains the systematic alternation of the official positions so far taken, which has certainly not helped the birth, over the last three decades, of an

adequate critical consciousness. Finally, I shall try to defend the thesis that the struggle against poverty and for sustainable development are two sides of the same coin. Which is to imply that the projects and strategies of intervention based on the separation between poverty and environmental quality are doomed to fail. The essay closes with a proposal to set up a World Organization for the Environment, an agency deemed necessary to overcome the limits of unilateral measures as well as the objective difficulties of putting international treaties into practice.

2. Economics “discovers” the environment

Right from its beginnings as an independent scientific discipline, economics has focused on two central questions: how the social product is formed, and how it is distributed. The most important problems discussed by economics as a science over the last two centuries all lead, directly or indirectly, back to these two central themes. The new phase of economic development, concerning the transition from industrial to post-industrial society, has led to the gradual emergence of new, more urgent and decisive problems. Among these, the one most macroscopically obvious today involves the ecological limitations that weigh on the process of production, which was able to advance until some decades ago in a way substantially free from constraints. Nature was never actually presented as an absolute limitation: the scarcity of resources was of course a factor influencing the forms and rhythms of development, but the economic system, through its own mechanisms, managed to overcome the scarcity (of fertile lands, of certain minerals etc.), thanks to an intense flow of technological innovations that removed the bonds of scarcity via productivity increases. For this reason, looking back to the process of industrialization, one almost has the impression of a dizzy growth towards unlimited plenty, as if nature was not hostile and niggardly, as the ancients thought.

The contemporary picture is completely altered. Industrial growth involves “external” effects on the environment that if held to be negligible at the beginnings of the process (and economists almost completely did neglect them), later showed to be devastating in their development: some indispensable natural resources such as air and water have been degraded to an extent that has led to fears that the equilibrium of the biosphere itself may turn out to have been definitively altered by irreversible processes. We only have to think of the greenhouse effect, the gaps in the ozone layer, the effects on climate of the disappearance of the rain forests, the regulation of the chemical composition of the atmosphere, the fixation of solar energy and the conversion of raw materials: the great services the ecosystems provides, continuously, for the normal functioning of natural systems, are today at risk.

It is not just a question of decreasing returns, as some people insist on thinking. Without a more rigorous control of the effects of pollution caused by the economic system overall, the human race will risk extinction. Starting from the second half of the twentieth century, humanity's capacity for destruction has become a "biocide" phenomenon in the sense that for the first time, humanity sees itself as able to bend nature to its own ends, able not just to control it but to manipulate it. The moment has arrived to recognize that an ever-increasing production of goods and services is incompatible (*given* the known productive techniques, the present organization of the economy and the rate of increase of the population) with the safeguarding of the natural and urban environment. Above all, the moment has arrived to recognize that when humanity modifies the environment too rapidly (for example transforming the seas of oil from the earth's crust into gas in the atmosphere) it creates a situation in which the speed of these changes is superior to the speed of its own adaptation to them.

We should be asking ourselves whether the challenge of ecology does not only direct us, today, towards a politics of restructuring of the present methods of production, but above all towards finding new categories of thinking for a discipline – economics – which for too long has been extraneous to this problematic field. Indeed, when public opinion began to be aware of the environmental question at the beginning of the sixties – the influence of Rachel Carson's *Silent Spring*, published in 1962, will certainly be remembered – the economists felt they were able to face up to the problem by using their own specific ways of thinking. However, the more influential subjects for the formation of public opinion were not quite up to focusing adequately on this, and hence passed on the idea that economics was synonymous with pollution, and the destruction of nature. Economics and ecology were thus seen as alternatives, as opposite poles, despite the fact that the common root of the two words links respectively government (the economy) and knowledge (ecology) of what happens in an *oikos*, i.e. in a "house", in a territory. Yet, since the good management of anything has to be based on knowledge, the conflict between the two disciplines conceptually should not be possible.

What are the reasons for misunderstandings of this kind? In my opinion, the most significant one is that when the economists believed (starting from the end of the sixties of last century) they should be getting involved in ecological problems, they thought they could make use of the instruments of analysis specifically designed for the branch of the discipline known as public economics, in its turn born of the merging of the older welfare economics and the younger theory of social choice. What is there, the econo-

mists thought, at the bottom of the environmental issue? There is that, beyond the great variety of individual cases, resources are involved (land, air, water, species of animals, forests) that have some basic characteristics in common, whatever unit of measurement is applied to them. To be precise, these are resources that: 1) can be regenerated naturally; 2) are often common property; 3) their over-use can lead to irreversible damage, in the sense of their total exhaustion; 4) the existing stocks of these resources, and not only their flows, directly influence people's well-being; 5) the impact of economic activities on these resources is often cumulative and can be seen only after a certain stretch of time; 6) the environmental consequences of economic activities are basically uncertain ("hard" uncertainty in the sense that environmental uncertainty cannot be dealt with by using the tools of the familiar theory of probability).

Now, the treatment at an analytical level of the problems in which resources of this kind appear, could be carried out – the economist thought – by starting from the two central notions of public economics: externality and public good. The economist could thus conclude that the much deprecated damage to the environment caused by economic activities was in the final analysis to be imputed to a typical "market failure", i.e. to the fact that in the presence of environmental resources market mechanism no longer guarantees, on its own, the achievement of that result of allocative efficiency that, from Adam Smith onwards, had been considered its most important virtue. Whence the recommendation to intervene to remedy the need, through a suitable system of taxes and subsidies, as C. Pigou (the inventor of welfare economics) had already suggested (see P. Dasgupta's contribution to this volume).

Until recent times, economic theory has developed two main lines of research to deal with the environmental question. The first one aims at devising allocative mechanisms which are both not manipulable and efficient. According to this line, environmental goods are treated as factors of production. The advantage of such an approach is that an externality, e.g. pollution, is merely an unaccounted-for consumption of a scarce good. This means that those inflicting an externality on others are consuming society's resources without redistributing the therewith-connected rent. As long as the good is scarce, hence depletable, its consumption should be accounted for. The fact that it is not accounted for implies a sub optimal situation. This view of the problem of pollution is reminiscent of Frank Knight's statement in his article "Some fallacies in the interpretation of social cost" (1924) that reads: "The point is that any opportunity, whether or not it represents a previous investment of any sort, is a productive factor if there is

sufficient demand for its use to carry into the stage of diminishing returns the application to it of transferable investment” (p. 23).

Is the Pigouvian proposal a satisfactory remedy to the problem of international externalities? Not at all, since Pigouvian taxes have never appealed to politicians or the general public. Let’s understand why. Robert Hahn (1989), for one, provided an interesting explanation based on the recognition of the fact that “the theoretical structure underlying environmental economics ... often emphasizes elegance at the expense of realism” (p. 95). A careful examination of the emission charge and marketable permits schemes reveals that they are rarely, if ever, introduced in their textbook form. Virtually all environmental regulatory systems, using charges and marketable permits, rely on the existing permitting system. They are not implemented from scratch; rather they are grafted onto regulatory systems in which permits and standards play a dominant role.

The consequence of these hybrid approaches is that the level of cost savings resulting from implementing charges and marketable permits is generally far below their theoretical potential. Polluters have not been induced to search for a lower cost mix of meeting environmental objectives as a result of implementation of charge schemes. The experience in marketable permits is similar. In other words, in order to function the economist’s proposals presuppose both that a competitive set-up actually exists and that it is possible to easily monitor and enforce a system of permits and taxes. Since this is not the case, firms will prefer emission standards to emission taxes because standards result in higher profits. Emission standards serve as a barrier to entry to new firms, thus raising firms’ profits. Charges, on the other hand, do not preclude entry by new firms, and also represent an additional cost to firms (see Hintermann, 2013).

The second line of research is concerned with the design of political institutions that are both feasible and efficient. An institution saves on the costs of economic transactions. Therefore, rational agents, in the sense of *homo oeconomicus* rationality, will devise mechanisms in order to overcome the pitfalls of the prisoners’ dilemma. Without some regulatory entity, the only alternative would be rent dissipation, leaving temporary gains to the quickest and most inefficient users. If one further assumes that the set-up cost of this entity does not use up all the captured rent – i.e. it is assumed that the “internal” transaction costs of the agency are lower than those of all single agents bargaining among each other – and if there is some room for repayments in the form of non-distorting lump-sums, then one can conclude that the existence of an authority raises welfare in the presence of environmental goods.

Well, it is not easy to escape the feeling that we are faced with a sort of “tin-opener” argument: suppose we have the best solution to the problem, then the problem will be solved! The truth of the matter is that it is not enough to have discovered the Pareto-improving character of the institution to be certain that it will come into existence automatically. Ascertaining the conditions for the bringing into existence of such an institution is the key question.

The point I would like to stress is that the conceptualization of the environmental problem in terms of a problem of externalities conceals a serious theoretical gap, briefly summed up as follows: the notion of externality, as the effect of the action of an economic agent on the welfare of other individuals that is not captured by the price system, is not a primitive notion. It depends, in fact, on the definition of economic actor and on the existence of markets. For example, if two companies operate in a way that the one damages the other – the foundry that through its emissions of smoke damages the company nearby – an eventual merging of the two will mean that what were external effects beforehand now becomes a question raised within the same decision-making unit: the externality is internalized, but the pollution is still there!

It follows that we can speak of externalities only after an explanation has been provided for the number of economic actors and markets in existence. And since the number of firms and markets depends on very precise economic factors (non-convexity of production sets; transaction costs; access to information etc.), it turns out that only an analysis of general equilibrium that, starting from market fundamentals, determined endogenously the number of firms and markets, could be a conceptually satisfying way of dealing with the question of externalities. Which it isn't, given that the two conditions that allow us to identify the existence of externality are put forward axiomatically. To give an extreme example, if only one firm existed in the economy, there could be no externality. And yet, if this firm polluted and destroyed non-renewable resources the integrity of the environment would turn out to be damaged just the same. Among other things, this simple consideration allows us to understand why in the countries of the ex-Soviet block, where there was certainly no market economy, the destruction of the environment was not at all inferior to that of western countries. A new and promising approach, within economics, to the sustainability question is that of Arrow and Dasgupta (2010) who develop a theoretical framework for assessing whether economic growth is compatible with sustaining well-being over time.

The conclusion has to be that economic science must, at the level of its very foundations, rethink the relationship between humanity and nature,

leaving behind the idea of a “humanity without constraints” that leads us to believe that any devastation is legitimate, in homage to certain anthropomorphic myths of omnipotence.² Rather, what is needed is the recovery of the basic recognition that humanity is part of nature, is internal to it, and has a cognitive exchange with nature, which is its necessary term. The relationship is of being born into it, and also of orderly change, because humanity, as part of nature, changes it: something inevitable and also useful. But this must not mean destruction. Neither extreme anthropocentrism – which visualizes the human being as a predator – nor ecological pantheism – according to which the human species is an element of disturbance for the environment – are the solutions to the present crisis. The ideology of man the predator, according to which knowledge is used only to produce more, and more quickly, should be removed from the cultural horizon of economics.³ The anthropological foundation of environmental responsibility that the present writer favours is based on the concept that the human being is the only moral subject who has responsibility for mankind, nature and future generations.

3. Intergenerational fairness and sustainable development

I set out from the by now familiar idea of sustainable development – a notion, however, not without its conceptual ambiguities. Whereas sustainability is a term that refers us to the idea of conservation of a particular state of nature, development is a term that implies the transformation into one form or another of that state. It is not without interest to recall that the expression “sustainable development” was originally chosen for reasons of political rhetoric. Today, it would be better to speak of intergenerational solidarity. Leaving aside questions of semantics, what I want to bring out here is that the plurality of meanings attributed to the notion of sustainable development is itself a symptom of a profound sense of unease at the conceptual level.

As is well known, it is in the famous Brundtland Report of 1987 that this notion received what we may call its official formulation: “We mean by sustainable development a development capable of satisfying the needs

² See A. Stres, 2000, for an excellent treatment of the specifically cultural roots of environmental questions.

³ An important line of philosophical and theological thinking on the subjects discussed here is K. Golser, 2001. Referring to St. Bonaventura, Golser argues that the realities of creation were in the first place created for the glory of God and only secondly for humanity’s benefit. That is why before being *useful*, these realities are *good*.

of the present without compromising the capacity of the future generations to satisfy their own". But already a few years afterwards, Nobel laureate Robert Solow published an essay (1993) in which he claimed that sustainability is a generic moral obligation of the present generation to future ones. He writes: "Insofar as it is a moral obligation, sustainability is a generic obligation, not a specific one. It is not an obligation to preserve this or that. It is rather the obligation to preserve the welfare capacity of those who come after us" (p. 187). From this it can be deduced that the destruction of natural resources is acceptable insofar as it is compensated for by investments capable of generating other goods or services able to increase welfare. In fact, this position of Solow goes back to 1974, the year in which the American economist, inserting a non-renewable resource into a standard model of inter-temporal growth, fixed a result that would afterwards become a basic reference point for the entire literature on sustainable development: a level of sustainable consumption can be guaranteed, in principle, every time it turns out to be technologically possible to guarantee a sufficient degree of substitutability between natural resource and physical capital.

For other writers, on the other hand, sustainability has to do with the property rights of future generations, an idea rendered by the phrase: "We have not inherited the earth from our parents; we are borrowing it from our children". This emotional phrase is often attributed to Ralph Waldo Emerson, though in actual fact its origin is by no means clear (cf. Keyes, 1992). In any case, this point of view is firmly shared by Howarth (1992) and Norgaard (1992) who, though accepting Solow's idea of sustainability as a question of equity between generations, do not accept its reduction to a problem of substitutability between natural resources and produced goods such as capital goods. They start here from a consideration it is easy to share, that the fact that two goods are perfect substitutes for the present generation does not imply that they are so for future generations also.

Again for other scholars, sustainability would not involve considerations about issues of distribution between generations, but considerably more traditionally, questions of economic efficiency. Starting from the premise that most environmental goods admit two alternative uses – one destructive, according to which the environment is converted into a private good enjoyed by the present generation; and one as a public good, to be used also by future generations – Silvestre (1994) develops a model in which sustainability may be defined only in terms of the allocation of resources between generations. The interesting conclusion of the model is that, if future generations are considered as being part and parcel of present-day society, allocative efficiency requires that environmental resources be maintained in

their state of nature for a rather high number of decades. And all this, ignoring the principle that the living should inherit the earth from their parents, or that they borrow it from their children.

Well, whatever the approach one believes should be adopted, the relevance of sustainability to the wider question of the conflict between generations due to global environmental change will be obvious to everyone. Indeed, if the scarcity of natural resources and environmental degradation did not for one reason or another, constitute a serious threat to the well-being of future generations – as is postulated by the notion of sustainability – economists could happily ignore questions of fairness among generations and concentrate their attention just on problems of efficiency of inter-temporal allocations. The great flowering of scientific publications in the seventies and eighties on the subjects of externalities and, more in general, of the market failures caused by the presence of environmental goods owes its *raison d'être* precisely to that.

A radical change of perspective can be noticed starting from the end of the eighties, as the awareness spread that environmental problems were global in scale, pervasive in their effects, and above all generators of important consequences for future generations. Global climate change, the reduction of the ozone in the atmosphere, and irreversible damage to bio-diversity, presented features that made the even quite elaborate approaches to sustainability up until that moment useless. This was for the simple reason that the actions of today determine potential costs for future generations that are inherently unforeseeable, given the dynamics and complexity of ecological systems. For example, climate change can jeopardize subsistence agriculture in many areas of the world, just as it may increase the frequency and dangers of tropical storms. Again, the gaps in the ozone layer could noticeably increase the risk of skin cancer after exposure to ultraviolet rays, etc. Faced with perspectives of this kind, it does not make sense to speak of sustainability of development in terms of generic guarantees offered to future generations, so that these can satisfy their needs.

We thus succeed in explaining why, in recent years, it has become obvious that the theoretical apparatus environmental economics had set out with was inadequate to deal with the “new” questions. Not only is Solow’s model, and before that Hotelling’s famous model of 1931 (according to which competitive markets would be able to induce firms to administer the stocks of non-renewable resources in such a way as to maximize the present value of profits), based on the assumption of perfect foresight. What is worse is that these models, as well as the literature on the so-called optimal growth, do not face up to the question of the institutional mechanisms nec-

essary to realize a sustainable future. What institutions would be able to make private and social discount rates correspond so as to bring about Hotelling's equivalence result? More in general, what policies would be necessary to ensure that a path of sustainable development could be implemented? In addition, it is by now obvious that social and environmental problems are closely inter-linked. To be solved satisfactorily they must be dealt with together; so the assumption of *ceteris paribus* that characterizes the whole of the analysis of partial equilibrium turns out to be of very dubious usefulness (Norgaard, 1993).

This is the context of the ongoing debate on sustainable development today, starting from a different perspective from that of the quite recent past. Some economists continue to believe that sustainability can be adequately talked about while remaining within the apparatus of cost-benefits analysis. For them, the institutions needed to ensure the internalization of environmental externalities, the efficient management of common property resources and the efficient inter-temporal allocation of resources are also sufficient to guarantee the rights of future generations. But a moment of reflection is sufficient to convince us that this is not the proper way to go about thinking of these things.

Cost-benefits analysis is very useful when we need to identify potential Paretian improvements – opportunities to improve the welfare of all without worsening the welfare of anyone. But – as we know – the prices and shadow prices on which the analysis in question is based depend on the initial endowments possessed by each agent. If these are assigned in a markedly distorted way, efficiency by no means guarantees the sustainability of the development – it may even make it worse. The objective of sustainability, in other words, requires a good deal more than improvements in efficiency in the Paretian sense. It requires the carrying out of policies that enable the realization of the transfer of goods and resources from one generation to another. See Dasgupta (2008): caring for future generations is not an altruistic concern only. Improving the position of future generations enhances the future of the present generations too.

Two important consequences derive from this. In the first place, what makes the sustainability objective difficult are not just the familiar market failures, but also and above all the various forms of distributive unfairness. Secondly, the way out cannot derive from cost-benefit analysis, precisely because it possesses the tools for solving problems of efficiency but not of fairness. So the pursuit of an objective like sustainable development also means taking into consideration political and ethical aspects. To put it another way, the horizon of efficiency is not wide enough to contain the

issues raised by sustainability, which is first of all a problem of the definition of the rights of different generations. A proposition of this kind involves quite a weighty problem that has not yet received the attention it deserves. Let me clarify.

The vast literature on the subject under discussion, aside from the differences between individual writers, is founded on a shared theoretical scheme that runs as follows. On the one hand, it is assumed that all individuals are selfish, having self-interested preferences; on the other hand, that questions of fairness between generations are the concern of institutions or collective agents whose task is basically to operate transfers of resources from the present to the future generations. However, a framework of this type contains a paradox: since the social choice function on whose basis decisions at a collective level are taken is rooted in individual preferences, why should the public decision-maker, let us say a government, take responsibility for the welfare of future generations if the individuals (of which that government is the expression, and to which it answers electorally) couldn't care less about it? On the other hand, if the economic actors had solidaristic preferences towards the generations to come, what need would there be for the intervention of a government to carry out transfers of resources to future generations?

As is well known, in economics the traditional way to dissolve paradoxes of this kind is to assume that the members of present and future generations are linked to each other by bonds of a family kind that guarantee the actual transfer of goods from "parents" to their immediate descendants, i.e. their "children" (Barro, 1974). This is so whenever the welfare of the children enters positively into the utility function of the parents. A way out of this kind, however ingenious, is not a great help when it comes to the problem of sustainable development, for an obvious reason. In the long term, that is the temporal perspective needed to deal with the issue at stake, it is not very useful to restrict ourselves to considering only two consecutive generations. As Daly and Cobb wrote (1989): "Families last in time only by fusing and mixing their identities by means of sexual reproduction. They are thus not independent or clearly defined over the period of time embracing more than two generations. Your great-great-grandchildren will also be the great-great-grandchildren of fifteen other people belonging to the present generation, whose identity is unknown. Presumably, the welfare of your great-great-grandchildren will depend on the inheritance of each of these fifteen other individuals as much as yours. This is why it doesn't make much sense that you worry overmuch about your descendants" (p. 39).

As will be readily understood, the paradox discussed here cannot be re-

solved in the way Barro suggests, because it is inconceivable that the families of the present-day generation can organize among themselves an adequate transfer of resources for the welfare of their children, who in turn will set up families of their own in the future. The simple reason for this is that the more important transfers between generations have to be carried through before the children have reached the stage of personal independence. It will thus be evident that it is on society as a whole that the burden falls of ensuring to future generations what is necessary to satisfy their needs. And this is also the case where living individuals show altruistic preferences towards their distant descendants. Indeed, in circumstances of this kind, the welfare of future generations would take on the features of a public good and the individual transfers, in the absence of some kind of mechanism of a collective nature, might generate suboptimal results for the future generations, or even unfair ones, as Sen (1982) has persuasively demonstrated.

The argument sketched above exposes a serious shortcoming in economic theory, which while it busies itself *ad abundantiam* with individual behaviour and its consequences, shows no interest at all in the beliefs and motivations that lie behind human action. This gap is sometimes concealed by the consideration that, since in a market economy the consumer is sovereign and hence free to express any kind of preference, including altruistic ones, there would be no reason to worry about the motivations behind his or her choices (it should be noticed in passing that this is the commonest justification in economics of consequentialism as an ethical doctrine). That things do not stand like this is shown by the realization that caring for the needs of others (sympathy in Adam Smith's sense – the spirit of solidarity) is not an innate virtue in the human being. It is rather the result of a slow and systematic process of education. This is why the argument on lifestyles that respect Creation is so centrally important for a sustainable development.⁴

As long as a culture founded on the models of a consumeristic society prevails, especially among the young, it is obvious that politics will not be able to do otherwise than respond to this kind of signal and translate it into choices that are a logical consequence of it: increasing the levels of productivity to diminish the prices of goods and services to further increase their production and consumption, etc. C.F. Weizsacher's words to the Seoul ecumenical assembly of 1990 are relevant here: "I know some politicians who want to do the really necessary things, but who know that as soon as they

⁴ See A. Giordano's provocative text, *La spiritualità e gli stili di vita sostenibili*, mimeo, May 2001. The treatment of this subject in Keenan, 2000 is quite effective.

do something reasonable they will lose the next elections. It is for this reason that I am against the idea that politicians are mainly responsible, the most guilty of all. No, it is we [citizens] who are the guilty ones”.⁵

As will easily be realized from the above, the turbulent history of theoretical positions on environmental issues is characterized by the systematic alternation of quite markedly different points of view and lines of action. It is a history of steps forward and steps backwards, of often apparently unmotivated swings from radical innovation to conservative retreat, as if the terms of what was at stake were not clear to everyone. The fact is that without a holistic vision of the environmental issue, capable of making us realize that the environment is not simply a question of degradation or of exhaustion of resources, and without overcoming the limitations of a scientific research that is too “sector-oriented” and too little transdisciplinary, the “new alliance” between mankind and nature – to use the ichastic expression of I. Prigogine – will never be able to be carried through.

The struggle against poverty and sustainable development

Where do we begin if we wish to go beyond what is still the most common, i.e. dichotomous, way of facing the crucial central problem of sustainable development? I would not hesitate to indicate the reduction of the welfare gap between the North and South of the world as the *primum movens* of a strategy of this kind. Let us see if we can make this clearer.

It is a well-known fact that there are three main causes of environmental degradation: the inefficient allocation of resources; the iniquitous distribution of wealth and income; the disproportion between population and capacity of the environment to sustain it. Whereas in rich countries the first of these causes is operative, poor countries are mainly afflicted by the other two causes. Through their structural characteristics, these countries tend to specialize in the production and export of goods with a high intensity of environmental degradation. Even now, 2/3 of Latin America’s exports are made up of natural resources – Africa’s percentage is even higher – resources that are imported and consumed in the countries of the North. These data, though crude, are already sufficient to have us understand why the question of sustainable development cannot be separated from the reform of the rules of international trade. When we discover that the South exports goods of a high intensity of environmental degradation, though it is not true that the

⁵ Quoted in *One World* (Monthly Magazine of the World Council of Churches), 155, May 1990, p. 16.

South disposes of higher quantities of these goods compared to the North, we may realize why commercial policies based on the Ricardian principle of comparative advantage are a serious threat to sustainability. If we then consider that most developing countries are located in the region known as the “vital zone”, characterized by highly unstable ecological equilibriums and by a marked capacity to influence the atmosphere, we realize why if we continue to force these countries to use their *natural* capital to substitute for an insufficient *physical* and *human* capital, environmental degradation will inevitably suffer a rapid acceleration.

There is still more to it than this. In a document published some years back (in 1992), the World Bank thoroughly detailed the relationship existing between some indicators of environmental quality and levels of GNP per head. A relation emerged that could be shown through a curve in the form of a U turned upside down: environmental degradation grows with the increase of average income when the latter is at low levels, whereas it decreases with the increase of average income when the latter has gone above a certain threshold. Basing their work on this rich empirical material, Grossman and Krueger (1994), through econometrics, find that the level of the critical threshold of average income, beyond which the abovementioned curve begins to decrease, stands at around \$8,000 per head income a year (dollars of 1985). The curve in question is known in the literature as the “Environmental Kuznets curve”, (EKC) from the name of the Nobel prize-winner for economics who first studied its characteristics with reference however to the relation between levels of GNP per-capita and variations of an indicator of the inequality of income within a specific population. The empirical evidence in support of the EKC is still today insufficiently robust to recommend its use for the purposes of environmental policies. It is nevertheless possible to extract from the EKC the following broad indications: some indicators of environmental degradation (emissions of CO₂; solid urban waste) increase, i.e. get worse, with the increase of pro-capita income; others (the lack of clean water; hygiene indicators) diminish, i.e. improve, with the increase in per-capita income; still others (emissions of sulfur trioxide and nitrates) first increase and then diminish with the increase in per-capita income.⁽⁶⁾

What lessons can be learned from the EKC literature? Since Northern countries are to the right of the value of the critical threshold mentioned above, whereas most Southern countries are still a long way off this goal, and

⁶ A useful critical review of the more recent literature on the subject is in S. Borghesi, 1999.

since the environmental problems that worry us the most today are the global ones, it is evident we shall have to intervene urgently on the rules of international economic activities. In particular, we must realize that in the context of an increasingly globalized economy, environmental regulation and commercial regulation have to be integrated and harmonized, exactly the opposite of what has happened up until now in the WTO (cf. Pearson, 2000).

It is well known that international trade tends to separate production from consumption. An increase in the demand for tropical wood in the North translates into a corresponding reduction in tropical forests in Amazonia. It is a fact that international trade throws a long, dark shadow over the environment. Without adequate rules and without forms of close cooperation between the agencies that concern themselves with trade and the environment, the growing volume of commercial exchanges (in itself positive and a hopeful sign for the future) will translate into increases in environmental degradation.

The second and more important message is that the problem of sustainable development, in present-day historical conditions, characterized by the phenomenon of globalization, is intrinsically linked to the problem of poverty, both absolute and relative. It would be naive to imagine we can solve the former problem separately from the second, or worse still, in opposition to it. Efforts to improve or conserve the quality of the environment in the North will be of very little use unless at the same time there is an urgent and comprehensive program of action against poverty to allow the countries of the South to get beyond the critical threshold identified by the ECK. Clearly, there will have to be a program of redistribution on a global scale, since policies on a national scale are no longer adequate for the purpose. If we stop and think for a moment, we find ourselves faced with a specific, yet remarkable case, in which the defence of justice serves also to improve efficiency (here identified with sustainable development). Let me elaborate a bit more on this issue (for an original contribution investigating the links between poverty and degradation of the local environmental – resource base and civic disconnection in poor countries, see Dasgupta, 1998).

It is certainly true that globalization is a positive sum game that increases aggregate wealth. But it is also true that it exacerbates the contrast between winners and losers. This fact is linked to the emergence of a new form of competition, unknown until recently: positional competition, according to which the “winner takes all and the loser loses everything” – the so-called “superstar effect” in the sense of Shermin Rose. Why is it that literature on the subject is so hotly divided? A credible answer comes from the recent

work by Milanovic (2011) who distinguishes between *world* and *international* inequality. The latter considers the differences in the average incomes of various countries, unweighted (“Concept 1 inequality” in Milanovic’s sense) and duly weighted to account for the size of the population (“Concept 2 inequality”). The former, on the contrary, takes into account also the inequalities in income distribution within the individual countries (“Concept 3 inequality”). It is world or global inequality which is increasing as a consequence of globalization.

In fact, in order for concept 3 inequality to diminish, two conditions should be met: i) poor and densely populated countries must grow at a faster rate than rich countries; ii) this must occur without an increase in inequality within the country. Now, while the first condition is more or less satisfied, the second condition is virtually absent. In fact, over the last quarter of a century, the growth rate of the poorest countries has been higher than that of the richest countries (4% versus 1.7%). Why should one worry about the growth of global inequality? Since it is a principal cause of conflict and ultimately of civil war. As wisely indicated by Polachek and Seiglie (2006), conflict can be defined as “trade gone awry”: if a country’s gains from trade are not as high as it thinks it should receive, this becomes a major determinant of conflict, which might in the end jeopardize peace itself. That is why the search for a socially responsible trade integration regime, capable of taking into consideration also the “pains from trade” (Verdier, 2005), is a duty that the economist cannot escape or forget about.

A related, but different, aspect is the one concerning the relationship between globalization and poverty. In the last couple of decades, poor countries have increased their participation in world trade, so much so that today they can be said to be more globalized than rich countries. Yet, there is very little evidence on that relationship and even the scanty evidence available only deals with the indirect link between globalization and poverty. A notable exception is the recent work by Harrison (2006) who provides a novel perspective on how globalization directly affects poverty in developing countries. Three general propositions deserve special attention: a) contrary to the Heckscher-Ohlin theory of international trade, the poor in countries with a lot of unskilled labour do not typically gain from trade expansion; b) globalization generates both winners and losers among the poor and this creates social instability insofar as it destroys social capital; c) the poor segments of population obtain the largest benefits from globalization when national governments endeavour to implement welfare policies aimed at improving the *capabilities* of life of their citizens, rather than their *conditions* of life.

It might be of interest to recall what Adam Smith wrote in *The Wealth of Nations* on the consequences of the discovery of America and the passage of the Cape of Good Hope – “The two greatest and most important events recorded in the history of mankind” (Smith, 1950, vol. 2, p. 141). Dealing with the consequences of these events, Smith remarked: “What benefits or what misfortunes to mankind may hereafter result from those great events, no human wisdom can foresee. By uniting, in some measure, the most distant parts of the world... their general tendency would seem to be beneficial. To the native, however, both of the East and West Indies, all the commercial benefits which can have resulted from those events have been sunk and lost in the dreadful misfortunes which they have occasioned... At the particular time when these discoveries were made, the superiority of force happened to be so great in the side of the Europeans, that they were enabled to commit with impunity every sort of injustice in those remote countries. Hereafter, perhaps, the natives of those countries may grow stronger, or those of Europe may grow weaker and the inhabitants of all the different quarters of the world may arrive at that equality of courage and force which... can alone overawe the injustice of independent nations into some sort of respect for the rights of one another. But nothing seems more likely to establish this equality of force than the mutual communication of knowledge and of all sorts of improvements which an extensive commerce from all countries to all countries naturally, or rather necessarily, carries along with it” (Ib. p. 141).

I consider this passage a remarkable and fascinating anticipation of the argument according to which nowadays we need a more balanced (and wise) approach in order to acknowledge both the gains and losses from cross-border exchange. To this regard, a cautionary word on the notion of “green growth” is in order. This is a new term that has become the focus of much interest among policy makers concerned with enhancing both nearer-term economic progress and longer-term environmental sustainability. However, green growth differs from sustainable development in a subtle but important respect (Toman, 2012). In particular, it is not always true that green growth is good for the poor and the poor should not be asked to pay the price for sustaining growth while greening the planet. (Dercon, 2011).

At this point, a question that naturally arises is: would the “happy degrowth” thesis, advanced in recent times by Serge Latouche, be the proper paradigm to tackle the sustainability question? I don’t think so, and for good reasons. The proposal of happy degrowth has an illustrious precedent: the theory of the stationary state initially developed by the great British philosopher and economist J.S. Mill halfway through the 19th century. Mill used the expression ‘stationary’ state to project a situation where the *net* growth

rate of the economy is equal to zero. Other economists and thinkers propounded analogous hypotheses in his wake. Among them I would venture to recall Nicholas Georgescu Roegen and his “bioeconomy” programme in the 1970s. Therefore, we shouldn’t be surprised if concerns over sustainability and the future of the planet every so often compel scholars of diverse cultural backgrounds (e.g. J.S. Mill was a resolute liberal) to advance proposals like that of happy degrowth. The position of the Social Doctrine of the Church (SDC) stands aloof and differs from this degrowth hypothesis not so much in terms of diagnosis – many are the points on which there may be concurrence, and which are nowadays accepted by one and all – but rather as regards the therapy. Remaining within this medical metaphor, it would be tantamount to saying: there is a serious illness, but instead of trying to treat the root causes – certainly possible, even if difficult – people just give in to the patient’s more or less slow euthanasia.

Indeed, the SDC neither does nor could accept such an approach. Let’s see why. First of all we have to specify that the concept of development has very little in common with that of growth. Etymologically speaking, development means “liberation from constraints” which curtail the freedom of the individual and the social aggregations in which he/she expresses him/herself. This notion of development was formulated in full at the time of civil humanism in the 15th century, and decisive in that regard was the contribution of the school of Franciscan thought: seeking the ways of development means loving liberty. Three are the dimensions of human development, as are the dimensions of liberty: the quantitative-material dimension, corresponding to which is freedom *from*; the social-relational dimension, corresponding to which is freedom *to*; the spiritual dimension, corresponding to which is freedom *for*. My point is that eliminating growth (quantitative) doesn’t necessarily ensure more development (qualitative).

It is obviously true that as conditions stand today the quantitative-material dimension overrides the other two, but this by no means bestows legitimacy on the conclusion that reducing (or nullifying) growth – which regards the material dimension – would foster progress on the part of the other two dimensions. In fact, it can be demonstrated that exactly the contrary is true. This is why the Social Doctrine of the Church (and especially *Caritas in Veritate*, CV) speaks about integral human development, about development which must maintain harmony and mutual equilibrium among the three dimensions. This take place through a change in the *composition* – and not the *level* – of the basket of consumer goods: fewer material goods, more relational goods, more immaterial goods. Is this possible? Certainly it is, as the civil economy school of thought indicates.

Therefore, the antidote to the current consumeristic model is not degrowth, but rather the civil economy, a typically Italian programme of research and thought dominant throughout Europe until the end of the 18th century, and since then overclouded by the programme of political economy. Take note of the differences: while the civil economy pursues the common good, the political economy pursues the total good. While the latter considers it possible to resolve problems in the economic-social realm on the basis of the principles of the exchange of equivalents and redistribution driven by the state, the civil economy flanks these two principles with the principle of reciprocity, which is the practical precipitate of fraternity. The remarkable newness of *Caritas in Veritate* is that it restored to fraternity (cf. chapter III) that central role in the economy which had been completely wiped out by the French revolution and Bentham's utilitarianism.

Humanize the market, don't demonize it: this is the slogan that describes the challenge confronting us today. As paradoxical as this may appear, the thesis of degrowth does nothing more than add a minus sign to the standard paradigm of political economy, but in no way constitutes progress beyond or above it. This is why it cannot be considered a solution for the many and grave problems now afflicting our respective societies. If people keep on demonizing the market it really will turn into Hades. The real challenge is the humanization of the market. The Social Doctrine of the Church will never be able to accept any regression at all: those who cultivate the concept of time as *kairos*, and not merely as *chronos*, know that difficulties are surmounted by changing one's outlook towards reality – and not with operations that would wind the clock of history backwards. While comprehensible is the temptation to return “to yesteryear”, it certainly cannot be justified by those who embrace in full a person-oriented anthropology, which, while refusing individualism, cannot jump over to the opposite side of communitarianism. In both cases the final outcome would be nihilism.

Towards a World Environment Organization

S. Pastel wrote some years ago: “The world economic system seems incapable of facing up to the problem of poverty and the protection of the environment. Seeking to cure the ecological ills of the earth separately from the problems linked to situations of debt, commercial imbalances, gross inequalities in income levels and in patterns of consumption, is like trying to cure a heart disease without struggling against the obesity of the patient and his diet rich in cholesterol” (quoted in L. Brown, 1992). But to what should we ultimately impute this evident incapacity? To the fact that the nature itself of the most important environmental goods is that of global

public goods. While a single global economy does not yet exist – notwithstanding the great debate on globalization – we find ourselves having to deal with a single climatic system, with a single ozone layer, etc. These are global public goods: the use of these by one country does not diminish the amount available to other countries; on the other hand, no country can be excluded from making use of them (clearly, the emissions of polluting substances are global public “evils”).

Now, as economic theory has known for some time, public goods give rise to one irritating consequence, typical of all the situations known as “the prisoner’s dilemma”. And if the public good is global the awful consequences will be global. In 1990 the Intergovernmental Panel on Climate Change showed that the emissions of greenhouse gas led to an increase in average temperatures, with all the well known consequences. And yet very few countries acted, unilaterally, to reduce their emissions. Similarly, the European Union proposed the introduction of a carbon tax in Europe, but having seen that their example was not imitated by other countries (especially the USA) it changed its plans. It is precisely the two characteristics recalled above, of the public good, that make unilateral policies wrong as a strategy of environmental politics.

Even if negotiations eventually produced some form of agreement or international treaty, the problem of how to carry it out would still have to be solved. We only have to think of the case of the Protocol of Montreal for the regulation of the use of chemical products (the CFC) that destroy the ozone layer, and the already mentioned Kyoto Protocol on climate change. Why did the former work, producing the desired effects, whereas the latter has mainly failed, as we saw above? The answer is that the Montreal Protocol contains an incentive mechanism that encourages the active participation and adherence of all the countries that signed it, a mechanism that means it is in the interest of all countries to keep to the agreed rules. The designers of the Kyoto Protocol were incapable of finding the right mechanism to ensure its self-enforcement (cf. Barrett, 2001).

Where do these reflections lead? They suggest the urgent need to set up a World Environmental Organization (WEO) along the lines of what happened some years ago, with the setting up of the World Trade Organization (WTO). It is the lack of institutions (not bureaucracies!) at the global level that makes so many problems of our age hard to solve, especially the environmental problem. While markets get globalized, the transnational institutional landscape is still that of the immediate post-war world. But the Bretton Woods negotiators of 1944 could never have imagined what the environmental issue would become. It will be objected: aren’t there perhaps enough

international treaties, just as there are enough contracts at the domestic level to regulate relationships between individuals? The analogy is dangerously misleading, because contracts stipulated inside a country can be enforced by that country's state; but there is no transnational authority capable of enforcing treaties between states. This is why a WEO is needed. On the whole, it is hard to see how the present state of affairs can continue, while the market, in its great variety of forms, has by now become global, the governance set-up has stayed basically national or at the most international.

The legal status of such a WEO would be that of an International Governmental Organization (IGO) established by national governments (an example of an intergovernmental network of national regulators is the Basel Committee on Banking Supervision, which includes representatives of 27 national banking supervisory authorities). The fact that there is no single global and comprehensive legal order and no global government does not imply that it would be impossible to devise a global regulatory regimes made up of actors such as IGOs and NGOs (non-governmental organizations) dealing with those issues and problems that cannot be addressed or resolved by national governments alone. It is ironic that today while almost every human activity is subject to some form of global regulation, environmental control is still waiting for its own IGO (see Cassese, 2012).

History has shown that a new international order has always become established at the end of a war of hegemony. We can see the example of the Thirty Years War, the Napoleonic Wars, the Second World War. All these are events which, after destroying the old order, left behind *tabulae rasae*, on which the victorious powers were able to inscribe the rules of the new order. No such situation exists today. Firstly, there is no agreement on who actually won the Cold War (assuming that there was a winner). Secondly, there is no agreement on whether we are living in a unipolar or multipolar world, or on which countries should be counted among the great powers today (should military force or economic muscle be used as the yardstick for qualifying as a great power?).

Another major feature of this age is the number of *agents* that are seeking to play a major part in the process of building the foundations of a new international order. One might say that international affairs have become a 'participatory democracy' issue, which helps to explain why it is becoming increasingly difficult to rapidly reach agreement. Bretton Woods and the Uruguay Round are a case in point. Bretton Woods was completed in a few months by only two men (J.M. Keynes and H.D. White), while the Uruguay Round took ten years of bitter negotiations between a dozen major parties plus about 100 international governments in the background.

A third feature that is unambiguously typical of the present phase in our history is the radical change that has occurred in the international distribution of economic and military power. For over three centuries the international system had been dominated by the Western powers, with the centre of gravity in the North Atlantic. Even the Cold War was a struggle between two 'visions' belonging to the same European civilization. Today, economic power has shifted towards the Pacific and East Asia areas that are now becoming the centre of gravity of world history, for better or for worse. This means that the emerging Asian powers will increasingly demand a part in designing the international institutions. But these (take the United Nations Security Council, the World Bank, the IMF etc.) are dominated by the ideas and the interests of the Western powers who are doing nothing to redress a situation that has become untenable. As always occurs in international relations, where power and authority coincide, the emerging powers, dissatisfied with the status quo, are doing everything they can to change the situation.

The two tasks a WEO should give priority to are, in my judgement, the following. Firstly, interacting with the WTO, such an agency must seek to make the rules of free trade compatible with those set out for the protection of the environment, and it must also get them respected by all concerned. Secondly, the WEO must intervene, in a supplementary role, in all those increasingly frequent cases in which price signals are unable to anticipate irreversible environmental loss. As we know, it is by now proved that thresholds of environmental degradation exist, that to a certain extent economic activities do not block the regenerative functions of the environment, but beyond that point irreversible changes can take place due to the level of economic activity overwhelming the ecosystem's capacity to assimilate it. In situations of this kind, market mechanisms get jammed: hence the need for their support through the intervention of an *ad hoc* agency.

To sum up, the international community must not only pursue goals and undertake binding obligations to be implemented gradually. It must also acquire a tool that is essential to jointly govern global environmental issues. This is the idea behind a WEO capable of making decisions, under the aegis of the UN, and having appropriate financial resources to implement the decisions made. The international community must change its patterns and ways of thinking, inverting the increasingly strong tendency to renationalize international cooperation. Jean Monnet, one of the founding fathers of the European Union, wrote: "There is an unfathomable difference between negotiating an international agreement and facing a common issue. In the first case, each party brings its own issue to the negotiating table. In the second case, there is a single issue which is the same

for all parties, and everyone brings to the negotiating table not its own issue, but the wisdom to find a solution to the common issue”.⁽⁷⁾ The environment is such a common issue.⁽⁸⁾

In lieu of a conclusion

A question spontaneously arises: given the problems and difficulties in solving them, should we perhaps resign ourselves and let the processes occurring today go ahead according to their own internal logic? To think like this would be overwhelmingly irresponsible, because in actual fact there is no need, as some people suggest, to halt the process of growth or that of globalization. What is really needed, and urgently, is to work for the establishment of an economic and social order founded on the plurality of power centres, i.e. on polyarchy, which unlike pluralism, is not just a question of numerosness, but of diversity both of the modes of production and patterns of consumption. Above all, what is needed is to make up the sense of responsibility. It is true that the concept of responsibility finds, today, many difficulties in being accepted, let alone applied. On the one hand, globalization is increasing, in unprecedented ways, the distance between action and the ultimate consequences of the action. One thinks about the impact of processes of mergers and acquisitions on the phenomenon of “short-termism”: firms fearing takeovers tend to pay scarce attention to all that does not have a return in the short-run – including social responsibility. On the other hand, the new technologies that connote the third industrial revolution tend to reduce the sense of responsibility insofar as they tend to increase the number and typology of unpredictable consequences of actions. The notion of responsibility is strictly connected to that of accountability. Responsible is s/he who knows how to manage situations, adequately evaluating their risks and results. But the current technological changes render this exercise ever more difficult, if not impossible.

That is why we find ourselves in need of turning to ethics. But which ethical theory is adequate to the purpose? My answer is the ethic of virtues, as Adam Smith, on the heels of the line of thought inaugurated by the civil humanists in the 15th century, elaborated in his fundamental work *The Theory Moral Sentiments* (1759). The institutional structure of society – says

⁷ Cited in T. Padoa-Schioppa, *La veduta corta*, Il Mulino, Bologna, 2009, p. 90.

⁸ A different approach from the one here advocated is proposed by E. Ostrom (2009) who speaks in favour of a polycentric strategy to cope with climate change. Still another approach is the one suggested by Mattoo and Subramanian (2013).

Smith – must favour the dissemination of civic virtues among citizens. If economic agents don't already embody in their structure of preferences those values that they are supposed to respect, there isn't much to be done. For the ethic of virtues, in fact, the enforceability of the norms depends, in the first place, on the moral constitution of individuals; that is of their internal motivational structure, much before any system of exogenous enforcement. It is because there are stakeholders that have ethical preferences – that attribute, that is, value to the fact that the firm practices equity and works for the dignity of people *independently* of the material advantage that can be derived – that the ethical code could be respected *also* in the absence of the mechanism of reputation. And that there are subjects endowed with ethical preferences is, today, a fact documented by a dispassionate observation of reality, in addition to experimental research.

The point worth highlighting in particular is that the key to the ethic of virtues is in its capacity to resolve the opposition between self-interest and interest for others, between egoism and altruism, by moving beyond it. It is this opposition, child of the individualistic tradition of thought, that prevents us from grasping that which constitutes our own wellbeing. The virtuous life is the best not only for others – like the various economic theories of altruism would have it – but also for us. This is the real significance of the notion of common good, which can never be reduced to a mere sum-total of individual wellbeing. Instead, the common good is the good of being in common. That is, the good of being inserted into a structure of common action, which is exactly what is required in order to sustain nature.

Common is the action that, in order to be carried out, requires both the *intentional* coming together of many subjects (and of which all the participants are aware) and of inter-subjective relationships that lead to a certain unification of efforts. More precisely, there are three elements that distinguish a common action. The first is that it cannot be concluded without all those who take part being conscious of what they are doing. The mere coming together or meeting of many individuals is not enough. The second element is that each participant in the common action must retain title, and therefore responsibility, for what he does. It is exactly this element that differentiates common action from collective action. In the latter, in fact, the individual's identity disappears and with him also disappears the personal responsibility for what he does. The third element is the unification of the efforts on the part of the participants in the common action for the achievement of the same objective. The interaction among many subjects in a given context is not yet common activity if they follow diverse or conflicting objectives (for an elaboration, see Zamagni, 2014).

Now we can appreciate the specific value that the ethic of virtues offers, that of liberating us from the obsessive Platonic idea of good, an idea that says there is an *a priori* good from which an ethic is extracted to be used as a guide to our actions. Aristotle – the initiator of the ethic of virtues – in total disagreement with Plato, indicates for us instead that the good is something that happens, that is realized through activities. As Lutz (2003) puts it, the most serious problem with the various ethical theories stemming from the individualistic tradition of thought is that they are not capable of offering a reason for “being ethical”. If it’s not good for us to behave ethically, why do what is recommended by ethics? On the other hand, if it is good for us to “be ethical”, then why would it be necessary to offer managers incentives for doing that which is in their own interest to do? The solution to the problem of moral motivation of decision makers is not that of setting constraints (or providing incentives) for acting against their self-interest, but to offer them a more complete understanding of their own wellbeing. Only when ethics becomes part of the objective-function of the agents does moral motivation cease to be a problem, because we are authentically motivated to do that which we believe is best for ourselves. This is why cultivating civic virtues is the undeniable task not only from the point of view of citizenship – something known for a long time – but also from the point of view of sustaining nature.

The difficulties and risks inherent in the practical carrying-out of a strategy as the one here indicated are obvious to everyone. It would be ingenuous to think that the diversity of the interests involved do not mean high levels of conflict. But the task is unavoidable if we wish to overcome the affliction of a rhetoric at all costs (a rhetoric that often ends up appearing nihilistic), as well as a clear-eyed optimism of those who see in technical, scientific and economic progress a sort of triumphal march of humanity towards its fulfilment. The responsible person cannot fall victim of traps of this kind.

Economics is inextricably part of ethics because humans are not aloof islands of exchange; rather, they live, work and thrive in social settings. Humans have innate dispositions *for self*, *for others*, and *against others* that serve useful functions, yet whose claims must be internally adjudicated by a moral agent. Understanding individual and social conceptions of “right” and “wrong” is essential for the environmental problematic. There is nothing to marvel at here. When one acknowledges the looming crisis of our civilization one is practically obliged to abandon any dystopic attitude and dare to seek out new paths of thought. As T.S. Eliot once observed, you can’t build a tree; you can only plant one, tend it and wait for it to sprout in due time.

You can, however, speed up its development with proper watering. For, unlike animals, which live in time but have no time, human beings have the ability to alter their times.

Acknowledgements

I would like to express my gratitude to the members of PASS and PAS and to the Chancellor, Bishop M. Sánchez Sorondo, for the encouragement and for the unexpected intellectual stimulation.

Bibliography

- Arrow, K. Dasguspta, P. *et al.* (2010) *Sustainability and the measurement of wealth*, NBER, 1659, Dec.
- Barrett, S., *Can the environment survive globalization?*, SAISPHERE, 2001.
- Brown, L., *State of the World 1992*, Milano, Isedi, 1992.
- Borghesi, S., *The environmental Kuznets curve: a survey of the literature*, Fondazione Mattei, Milano, November 1999.
- Barro, R., "Are Government Bonds Net Wealth?", *Journal of Political Economy*, 82, 1974, pp. 1095-1117.
- Carson, R., *Silent Spring*, Boston, Houghton Mifflin, 1962.
- Cassese, S. (2012), *The global polity*, Sevilla, Global Law Press.
- Chichilnisky, G., *Global Environment and North-South Trade*, WP, Stanford University, 31, 1991.
- Daly, H.E., and J.B. Cobb, *For the Common Good. Redirecting the Economy toward Community, the Environment and a Sustainable Future*, Boston, Beacon Press, 1989.
- Dasgupta, P. (1998), "The economics of poverty in poor countries", *Scandinavian Journal of Economics*, 100.
- Dasgupta, P. (2008), "Discounting climate change", *Journal of Risk and Uncertainty*, 37, 141-169.
- Dasgupta, P. (2010), "Poverty traps. The idea of mutual causation".
- Dasgupta, P. (2012), "Inclusive national accounts. Conceptual Foundations", Sept.
- Dercon, S. (2011), "Is green growth good for the poor?", Univ. of Oxford, Oct.
- Golser, K., *Futuro della nostra terra. Responsabilità cristiana per il sociale, il lavoro, l'ambiente*, mimeo, Assisi, May 2001.
- Grossman, G.M., and A.B. Krueger, *Economic Growth and the Environment*, NBER, WP 4634, 1994.
- Hahn, R. (1989), "Economic Prescriptions for Environmental Problems", *Journal of Economic Perspectives*, 3, 2, 95-114.
- Harrison, A. (2006), *Globalization and poverty*, NBER, WP 12347, June.
- Hintermann, B. (2013), "Market power in emission permit markets: theory and evidence!", *CESifo*, 4447, Oct.
- Howarth, R., "Environmental Valuation under Sustainable Development", *American Economic Review*, 82, 2, 1992, pp. 473-477.
- Kampits, P., "Natur als Mitwelt" in O. Schats (ed.), *Was bleibt den Enkeim*, Graz, 1978.
- Keenan, M., *Care for Creation. Human Activity and the Environment*, Libreria Editrice Vaticana, Vatican City, 2000.
- Keyes, R., *Nice Guys Finish Seventh: False Phrases, Spurious Sayings and Familiar Misquotations*, New York, Harper Collins, 1992.
- Knight, F. (1924), "Some Fallacies in the Interpretation of Social Cost", *The Quarterly Journal of Economics*, 38, 4, 582-606.
- Lutz, D. (2003), "Beyond business ethics", *Oikonomia*, 2.

- Norgaard, R., *Sustainability and the Economics of Assuring Assets for Future Generations*, WPS, 832, Asia Regional Office, The World Bank, 1992.
- Norgaard, R., "The Co-evolution of Economic and Environmental Systems and the Emergence of Unsustainability in R.W. England" (ed.), *Evolutionary Concepts in Contemporary Economics*, Ann Arbor, University of Michigan Press, 1993.
- Mattoo, A. and Subramanian, A. (2013), "A Greenprint for International cooperation on climate change", *World Bank Policy*, WP, 29.
- Milanovic, B. (2011), *The haves and the have-not*, New York, Basic Books.
- Pearson, C.S., (2000), *Economics and the Global Environment*, Cambridge, CUP.
- Polachek, S. and Seiglie, C. (2006), "Trade, peace and democracy: an analysis of dyadic dispute", IZA, DP 2170, June.
- Sen, A.K., "Approaches to the Choice of Discount Rates for Social Benefit-Cost Analysis", in R.C. Lind, *Discounting for Time and Risk in Energy Policy*, Washington, Resources of the Future, 1992.
- Silvestre, J., (1994), *An Efficiency Argument for Sustainable Use*, WP, Davis, University of California.
- Smith, A. (1950), *The wealth of nations* (1776), ed. by E. Cannan, London, Methuen.
- Solow, R., "Sustainability: an economist's perspective" in R. Dorfman and N. Dorfman (eds), *Economics of the Environment*, New York, Norton, 1993.
- Stern, N. (2007), *The economics of climate change: the Stern review*, Cambridge, CUP.
- Stiglitz, J., Sen, A., Fitoussi, J.P. (2009), "Report by the Commission on the measurement of economic performance and social progress" (www.stiglitz-sen-fitoussi-fr).
- Stres, A., (2000), "Le radici antropologiche e culturali della crisi ecologica", CEI, *Notiziario*, Rome, April.
- Tomas, M. (2012), "Green growth: an exploratory review", *World Bank*, 6067, May.
- UNU/GEIC, *Global Climate Governance. Interlinkage between the Kyoto Protocol and Other Multilateral Regimes*, Tokyo, 1999.
- Verdier, T. (2004), *Socially responsible trade integration*, NBER, Oct.
- Victor, D., *The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming*, Princeton, Princeton University Press, 2001.
- Vigna, C., "Linee di un'etica dell'environment", in C.Vigna (ed.), *Introduzione all'etica*, Milano, Vita e Pensiero, 2001.
- World Bank, *World Development Report 1992: Development and the Environment*, Washington, D.C., The World Bank, 1992.
- Zamagni, S., "Global Environmental Change, Rationality and Ethics", in L. Campiglio et al. (eds.), *The Environment after Rio*, London, Graham & Trotman, 1994.
- Zamagni, S., *Common goods and the civil economy*, Bologna, mimeo, 2014.

SOCIAL INCLUSION IN GOVERNANCE AND PEACE-BUILDING IN ASIA

■ WILFRIDO V. VILLACORTA

Abstract

The first apostolic exhortation of Pope Francis, *Evangelii Gaudium*, is of timely relevance to the crises in governance and the threat of armed conflict in the world at large. The papal document relates these problems to the social exclusion of the poor and the vulnerable, which, he thinks, should be a primary concern of Christian witnessing.

Pope Francis delivers his powerful message in simple, clear and straightforward language. He offers Christ's legacy to humanity – the civilization of love – as an alternative to a global order based on greed and selfishness.

My paper examines the implications of his teachings to Asia, particularly the Association of Southeast Asian Nations (ASEAN) of which I am most familiar. Finally, the paper refers to the position of His Holiness on human trafficking as a glaring result of poverty and social exclusion across national borders, and reports on actions that have been taken by ASEAN to address this issue.

The Pontiff's Approach to Governance: Inclusion of the Poor in Society

Evangelii Gaudium highlights two issues which he considers as “fundamental at this time in history” and which he believes “will shape the future of humanity”: the inclusion of the poor in society, and peace and social dialogue.¹

His thoughts on governance are embodied in Chapter Four, Section II, “The Inclusion of the Poor in Society” and Section IV, “Social Dialogue as a Contribution to Peace”.² The following are excerpts from *Evangelii Gaudium*:

Welfare projects, which meet certain urgent needs, should be considered merely temporary responses. *As long as the problems of the poor*

¹ Pope Francis. *Apostolic Exhortation Evangelii Gaudium of the Holy Father*. “Inclusion of the Poor in Society”, Section II, Chapter Two, The Social Dimension of Evangelization. Vatican City: Libreria Editrice Vaticana, 2013. Available online: http://www.vatican.va/holy_father/francesco/apost_exhortations/documents/papa-francesco_esortazione-ap_20131124_evangelii-gaudium_en.html

² “The Economy and the Distribution of Income” in Section II: The Inclusion of the Poor in Society, Chapter Four, The Social Dimension of Evangelization, Paras 202–206.

are not radically resolved by rejecting the absolute autonomy of markets and financial speculation and by attacking the structural causes of inequality, no solution will be found for the world's problems or, for that matter, to any problems. Inequality is the root of social ills (Para. 202).

The dignity of each human person and the pursuit of the common good are concerns which ought to shape all economic policies. At times, however, they seem to be a mere addendum imported from without in order to fill out a political discourse lacking in perspectives or plans for true and integral development. How many words prove irksome to this system! It is irksome when the question of ethics is raised, when global solidarity is invoked, when the distribution of goods is mentioned, when reference is made to protecting labour and defending the dignity of the powerless, when allusion is made to a God who demands a commitment to justice. At other times these issues are exploited by a rhetoric which cheapens them. Casual indifference in the face of such questions empties our lives and our words of all meaning (Para. 203). We can no longer trust in the unseen forces and the invisible hand of the market. Growth in justice requires more than economic growth, while presupposing such growth: it requires decisions, programmes, mechanisms and processes specifically geared to a better distribution of income, the creation of sources of employment and an integral promotion of the poor which goes beyond a simple welfare mentality. I am far from proposing an irresponsible populism, but the economy can no longer turn to remedies that are a new poison, such as attempting to increase profits by reducing the work force and thereby adding to the ranks of the excluded (Para. 204).

Politics, though often denigrated, remains a lofty vocation and one of the highest forms of charity, inasmuch as it seeks the common good. We need to be convinced that charity 'is the principle not only of micro-relationships (with friends, with family members or within small groups) but also of macro-relationships (social, economic and political ones)'. I beg the Lord to grant us more politicians who are genuinely disturbed by the state of society, the people, the lives of the poor! It is vital that government leaders and financial leaders take heed and broaden their horizons, working to ensure that all citizens have dignified work, education and healthcare. Why not turn to God and ask him to inspire their plans? (Para. 205).

The Holy Father reminds every State that it is its responsibility to safeguard and promote the common good of society:

Based on the principles of subsidiarity and solidarity and fully committed to political dialogue and consensus building, it plays a fundamental role, one which cannot be delegated, in working for the

integral development of all. This role, at present, calls for profound social humility (Para. 240).

Pope Francis attributes much of current social relations to the economy of exclusion:

Today everything comes under the laws of competition and the survival of the fittest, where the powerful feed upon the powerless. As a consequence, masses of people find themselves excluded and marginalized: without work, without possibilities, without any means of escape. Human beings are themselves considered consumer goods to be used and then discarded. We have created a ‘throw away’ culture which is now spreading. It is no longer simply about exploitation and oppression, but something new. Exclusion ultimately has to do with what it means to be a part of the society in which we live; those excluded are no longer society’s underside or its fringes or its disenfranchised – they are no longer even a part of it. The excluded are not the “exploited” but the outcast, the “leftovers”.³

His Holiness criticized the trickle-down theories

which assume that economic growth, encouraged by a free market, will inevitably succeed in bringing about greater justice and inclusiveness in the world. This opinion, which has never been confirmed by the facts, expresses a crude and naïve trust in the goodness of those wielding economic power and in the sacralized workings of the prevailing economic system. Meanwhile, the excluded are still waiting. To sustain a lifestyle which excludes others, or to sustain enthusiasm for that selfish ideal, a globalization of indifference has developed. Almost without being aware of it, we end up being incapable of feeling compassion at the outcry of the poor, weeping for other people’s pain, and feeling a need to help them, as though all this were someone else’s responsibility and not our own.⁴

He regrets that we have come to accept dominion of money over ourselves and our societies:

The current financial crisis can make us overlook the fact that it originated in a profound human crisis: the denial of the primacy of the human person! We have created new idols. The worship of the ancient golden calf (cf. *Ex* 32:1-35) has returned in a new and ruthless guise in the idolatry of money and the dictatorship of an impersonal econ-

³ Para. 53, Chapter Two, “Amid the Crisis of Communal Commitment”.

⁴ Para. 54.

omy lacking a truly human purpose. ... man is reduced to one of his needs alone: consumption.⁵

“Money must serve, not rule!” is his admonition. His Holiness was unsparing in condemning institutions and attitudes that perpetuate social inclusion and inequality.

While the earnings of a minority are growing exponentially, so too is the gap separating the majority from the prosperity enjoyed by those happy few. This imbalance is the result of ideologies which defend the absolute autonomy of the marketplace and financial speculation. Consequently, they reject the right of states, charged with vigilance for the common good, to exercise any form of control. A new tyranny is thus born, invisible and often virtual, which unilaterally and relentlessly imposes its own laws and rules. Debt and the accumulation of interest also make it difficult for countries to realize the potential of their own economies and keep citizens from enjoying their real purchasing power. To all this, we can add widespread corruption and self-serving tax evasion, which have taken on worldwide dimensions. The thirst for power and possessions knows no limits. In this system, which tends to devour everything which stands in the way of increased profits, whatever is fragile, like the environment, is defenceless before the interests of a deified market, which become the only rule.⁶

The Pope exhorts the people to practice generous solidarity and to return “economics and finance to an ethical approach which favours human beings”.⁷ He says that this entails

working to eliminate the structural causes of poverty and to promote the integral development of the poor, as well as small daily acts of solidarity in meeting the real needs which we encounter.

He reminds us that although the word “solidarity” is

a little worn and at times poorly understood ... it refers to something more than a few sporadic acts of generosity. It presumes the creation of a new mindset which thinks in terms of community and the priority of the life of all over the appropriation of goods by a few.⁸

The viewpoint of His Holiness with respect to inequality as the root of social ills is corroborated by the Executive Secretary of the UN Economic

⁵ Para. 55.

⁶ Para. 56.

⁷ Para. 58.

⁸ Para. 188.

and Social Council for Asia and The Pacific (ESCAP), Ms. Noeleen Heyzer. She said that

inequality not only threatens social cohesion, but is also a challenge to sustaining the region's economic dynamism. ESCAP findings show that higher income inequality adversely affects domestic demand and contributes to balance-of-payments deficits as well as higher household debts.⁹

The Pontiff's Perspective on Peace and Social Dialogue

The events at the start of this year have further shaken the world and have had an impact on the Church: the worsening crises in Syria, Ukraine, Venezuela and Egypt, ensuing challenges to peace and security in the Asia-Pacific region brought about by conflicting territorial claims in Northeast and Southeast Asia, the danger of renewed conflict in the Korean peninsula, and the continuing difficulties faced by the economies of Europe, the United States and Japan.

Our part of the world – Southeast Asia – is on the brink of war. This is the result of the increasingly aggressive behaviour of China, whose objective is to corner the resources and strategic supply lanes of the South China Sea and its surrounding waters. Its actions are also motivated by its desire to compensate for the century of humiliation and exploitation at the hands of West and Japan. Because it is not yet capable to take on these big powers, its easy targets are its small neighbours, which do not have the strength and wherewithal to effectively defend their maritime territory and exclusive economic zone. In this day and age, the international jungle is still governed not by the rule of law but by the principle of “might is right”. Imperial ambitions and forcible annexation of territories of small countries still hold sway.

In the face of these distressing conditions, the Church has an essential responsibility in helping restore trust, ethics and justice in international relations. In *Evangelii Gaudium*, His Holiness observes that

our world is being torn apart by wars and violence, and wounded by a widespread individualism which divides human beings, setting them against one another as they pursue their own well-being. In various countries, conflicts and old divisions from the past are re-emerging. I especially ask Christians in communities throughout the world to offer a radiant and attractive witness of fraternal communion. Let

⁹ UN News Centre, 19 December 2013. <http://www.un.org/apps/news/story.asp?NewsID=46785&Cr=escap&Cr1=#.U6guKahCU7A>

everyone admire how you care for one another, and how you encourage and accompany one another.¹⁰

Pope Francis warns of inequality among nations that marginalizes the peripheral economies and exacerbates poverty at the local level:

If we really want to achieve a healthy world economy, what is needed at this juncture of history is a more efficient way of interacting which, with due regard for the sovereignty of each nation, ensures the economic well-being of all countries, not just of a few.¹¹

Indeed, our Church under the Pontificate of Pope Francis has the indisputable moral ascendancy to exhort its members to set the example for building a better world. True to his humble character, he explains that

this Exhortation is not a social document, and for reflection on those different themes we have a most suitable tool in the *Compendium of the Doctrine of the Church*,¹² whose use and study I heartily recommend.¹³

Enhancing Social Inclusion in Asia

The Holy Father stresses that “conceptual tools exist to heighten contact with the realities they seek to explain, not to distance us from them”.¹⁴ At this juncture, we should examine the relevance of *Evangelii Gaudium* to the plight of peoples in Asia and the Pacific.

Despite the fact that it is the fastest growing economic region in the world, Asia and the Pacific is still home to about two-thirds of the world’s poor. Approximately 700 million live on less than US\$1 a day, 400 million of them in urban areas.¹⁵ There are about 1.7 billion who are living on less than \$2 a day.¹⁶

About half of the region’s poor live in rural areas. They include the poorest of the poor, often indigenous people or vulnerable groups with little economic opportunities. The Asian Development Bank reports that the majority of rural poor live in marginal dryland and wetland areas and their numbers are likely to increase with global warming.¹⁷

¹⁰ Para. 99.

¹¹ Para. 206.

¹² Pontifical Council for Justice and Peace. 2004. *Compendium of the Social Doctrine of the Church*, Vatican City: Libreria Editrice Vaticana.

¹³ *Evangelii Gaudium*, Para. 184.

¹⁴ Para. 194.

¹⁵ Asian Development Bank. 2013. *Overview – Poverty reduction: Promoting inclusive pro-poor growth*. <http://www.adb.org/themes/poverty/overview>

¹⁶ *Ibid.*

¹⁷ *Ibid.*

In response to this predicament, many countries in Asia have adopted inclusive growth as a priority in development policy. Alan Winters of the Asian Development Bank Institute uses the following definition of inclusive growth in the *Asian Development Outlook 2012*: “growth coupled with equality of opportunity”. It is accompanied by three policy pillars:

sustained growth to create productive jobs for a wide section of the population; social inclusion to equalize access to opportunity; and social safety nets to mitigate vulnerability and risks and prevent extreme poverty.¹⁸

The ASEAN Contribution

The next task of this paper is to review the efforts of the Association of Southeast Asian Nations (ASEAN) in promoting social inclusion. I was affiliated with ASEAN for a total of five years, first as Deputy Secretary-General of the organization and more recently, as Philippine Ambassador and Permanent Representative to ASEAN.

Founded in 1967, it is composed of ten member-countries: Brunei Darussalam, Cambodia, Indonesia, Lao People’s Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam. It is economically diverse: the richest are Brunei and Singapore, the middle income are Indonesia, Malaysia, Philippines and Thailand (the founding countries, along with Singapore), and the ones who joined in the nineties are Cambodia, Laos, Myanmar and Viet Nam (or referred to as “CLMV”). Cambodia was a socialist country. Laos and Viet Nam are still socialist. Myanmar used to be ruled by a military junta. Among the CLMV countries, it is Viet Nam that is the best performing in terms of economic growth and liberalization.

In pursuing its goal of building an ASEAN Community by 2015, the organization is committed to developing itself into a more people-centric organization. The envisaged regional community has three pillars: ASEAN Political-Security Community (APSC), ASEAN Economic Community (AEC), and ASEAN Socio-Cultural Community (ASCC).

Each pillar has adopted a blueprint, which is a framework for action structured into strategic-level development and cooperation outcomes and

¹⁸ L. Alan Winters, *Globalization, Infrastructure, and Inclusive Growth*. ADBI Working Paper Series, No. 464. Tokyo: ADB Institute, 2014.

<http://www.adbi.org/files/2014.02.24.wp464.globalization.infrastructure.inclusive.growth.pdf>

impacts toward regional community-building. The inclusion of an ASEAN Socio-Cultural Community, which was championed by the Philippines, reinforces the organization's mission of addressing the needs not only of our member-governments but also those of civil society.

Recently, the ASEAN Secretariat, in cooperation with the member-states, has completed the Midterm Review of the ASCC Blueprint implementation.¹⁹ The findings, which were generally positive, are summarized as follows:

- 90% of all the action lines have been addressed through the conduct of various activities by ASCC sectoral bodies. There have been many challenges in the course of implementing the Blueprint at the national and regional levels. But there are continuing efforts to improve and fast track meeting the 2015 targets and prepare for post-2015 challenges.
- The implementation of the Human Development component is positively progressing towards realizing its goal to enhance the well-being and livelihood of the peoples of ASEAN by providing them with equitable access to human development opportunities. This is confirmed by statistics showing the average number of school years completed by the adult population increased from 7.5 years for ASEAN-6 and 4.6 years for CLMV in 2005 to eight years and five years respectively in 2010. The literacy rate of the youth population across ASEAN-6 countries inched closer to 100 per cent while the CLMV (Cambodia, Laos, Myanmar, Viet Nam) countries have significantly improved their literacy rate from around 81 per cent in 2009 to 92 per cent in 2010.
- As a result of strong economic growth, the extent of absolute poverty (proportion of population living on less than \$1.25 a day in purchasing power parity terms) in ASEAN declined significantly between 2000 and 2010, from around 45 to 16 per cent in CLMV countries and from around 29 to 15 per cent in ASEAN-6.
- In the social justice and rights component, overall implementation is steady with 21 out of 28 actions (~79%) having been addressed. This characteristic focuses on rights for the vulnerable and marginalized in

¹⁹ Mid-Term Review of the ASEAN Socio-Cultural Community Blueprint (2009-2015): Regional Assessment. Adopted by the ASEAN Leaders at the 23rd ASEAN Summit. 2013. Jakarta: ASEAN Secretariat, 2014. This author is grateful to Deputy Secretary-General for ASEAN Socio-Cultural Community Alicia Bala for her kind assistance in sharing a copy of the MTR Report and for her permission to cite its highlights.

ASEAN – particularly women, children, persons with disabilities, older people and migrant workers. Institutional mechanisms to facilitate co-operation to promote social justice and rights of vulnerable groups have been strengthened with the establishment of the ASEAN Commission on the Promotion and Protection of the Rights of Women and Children (ACWC), and the ongoing development of an ASEAN instrument for the protection and promotion of the rights of migrant workers.

ASEAN is striving to meet the expectations of the ASCC Blueprint by 2015, particularly in improving the quality of life of its people. Given the diversity of ideologies, religions, cultures, and political and economic systems of ten member-countries, achieving this ideal is not an easy task. However, reforms and joint efforts have gained momentum. A major incentive for success is the common desire of member-countries to enhance their collective voice in the international arena.

Human Trafficking: Product of Poverty

The Holy Father states that there are new forms of poverty and vulnerability ... the homeless, the addicted, refugees, indigenous peoples, the elderly who are increasingly isolated and abandoned, and many others. Migrants present a particular challenge for me, since I am the pastor of a Church without frontiers, a Church which considers herself mother to all.²⁰

He laments that

I have always been distressed at the lot of those who are victims of various kinds of human trafficking. How I wish that all of us would hear God's cry: "Where is your brother?" (*Gen 4:9*). Where is your brother or sister who is enslaved? Where is the brother and sister whom you are killing each day in clandestine warehouses, in rings of prostitution, in children used for begging, in exploiting undocumented labour? Let us not look the other way. There is greater complicity than we think. The issue involves everyone! This infamous network of crime is now well established in our cities, and many people have blood on their hands as a result of their comfortable and silent complicity.²¹

²⁰ Para. 210.

²¹ Para. 211.

ASEAN Responses to Human Trafficking and Rights of Migrant Workers

The ASEAN has adopted three declarations that protect women, victims of human trafficking, and migrant workers: the *ASEAN Declaration on the Elimination of Violence Against Women in the ASEAN Region (2004)*, the *ASEAN Declaration Against Trafficking in Persons Particularly Women and Children (2004)*, and the *ASEAN Declaration on the Protection and Promotion of the Rights of Migrant Workers (2007)*.

The mandate of the *ASEAN Declaration on the Elimination of Violence Against Women in the ASEAN Region*²² is “to promote an integrated and holistic approach to eliminate violence against women by formulating mechanisms focusing on the four areas of concerns of violence against women, namely, providing services to fulfil the needs of survivors, formulating and taking appropriate responses to offenders and perpetrators, understanding the nature and causes of violence against women and changing societal attitudes and behaviour”. ASEAN member-states have enacted domestic legislation to prevent violence against women and re-victimization of women and girls subjected to any form of violence, whether in the home, the workplace, the community or society or in custody.

Among the measures taken under the *Declaration Against Trafficking in Persons Particularly Women and Children*²³ are

to identify the countries of origin and nationalities of such victims and thereafter ensure that such victims are treated humanely and provided with such essential medical and other forms of assistance deemed appropriate by the respective receiving/recipient country, including prompt repatriation to their respective countries of origin; and to strengthen regional and international cooperation to prevent and combat trafficking in persons.

The *ASEAN Declaration on the Protection and Promotion of the Rights of Migrant Workers*²⁴ provides that

the receiving states and the sending states shall take into account the fundamental rights and dignity of migrant workers and family mem-

²² *ASEAN Declaration on the Elimination of Violence Against Women in the ASEAN Region*, 2004. <http://www.asean.org/communities/asean-political-security-community/item/declaration-on-the-elimination-of-violence-against-women-in-the-asean-region-4>

²³ *ASEAN Declaration Against Trafficking in Persons Particularly Women and Children*, 2004 <http://www.asean.org/news/item/asean-declaration-against-trafficking-in-persons-particularly-women-and-children-3>

²⁴ *ASEAN Declaration on the Protection and Promotion of the Rights of Migrant Workers*, 2007. <http://www.asean.org/communities/asean-political-security-community/item/asean-declaration-on-the-protection-and-promotion-of-the-rights-of-migrant-workers-3>

bers already residing with them without undermining the application by the receiving states of their laws, regulations and policies, as well as

intensify efforts to protect the fundamental human rights of migrant workers, facilitate access to justice and social welfare services as appropriate, promote fair and appropriate employment protection, payment of wages, and adequate access to decent working and living conditions for migrant workers, and facilitate the exercise of consular functions to consular or diplomatic authorities of states of origin when a migrant worker is arrested or committed to prison or custody or detained in any other manner, under the laws and regulations of the receiving state and in accordance with the Vienna Convention on Consular Relations”.

...and let the skies rain down righteousness (Isaiah 45:8)

The experience of ASEAN bears out the analyses and conclusions of Pope Francis. In his Apostolic Exhortation, he stressed the necessity of translating advocacies into actual practice, as

ideas disconnected from realities give rise to ineffectual forms of idealism and nominalism, capable at most of classifying and defining, but certainly not calling to action. ... Not to put the word into practice, not to make it reality, is to build on sand, to remain in the realm of pure ideas and to end up in a lifeless and unfruitful self-centredness and gnosticism.²⁵

The Church has an essential and urgent role to play in restoring trust, ethics, justice and peace in contemporary relations among peoples and nations. It has the ascendancy to set the example for building bridges and a new world order.

After only one year of his Papacy, Pope Francis’ personal example and his genuine concern for the poor and the excluded have already resonated with peoples of different faiths and cultures.

We rest our hope in the moral and spiritual leadership of His Holiness in spreading Christ’s legacy to humanity – the civilization of love. It is the alternative to a global order based on alienation, greed and selfishness. In the 21st Century, we still witness the vicious rivalry among hegemonic powers whose realpolitik concept of peace is confined to the balance of terror.

²⁵ Para. 233.

Pope Francis exemplifies the primacy of Love that is enshrined in our Christian faith. The social doctrine of the Church states that

“love must thus enliven every sector of human life and extend to the international order. Only a humanity in which there reigns the ‘civilization of love’ will be able to enjoy authentic and lasting peace.”²⁶

Like Saint John XXIII, who prevented a nuclear war during the Cuban missile crisis, and like Saint John Paul II, who was instrumental in ending totalitarian rule in Eastern Europe, Pope Francis can lead us towards to this new world order based on justice and love for humanity.

²⁶ *Compendium of the Social Doctrine of the Church, op. cit.*, Para. 582.

INTERGENERATIONAL SOLIDARITY: OLD AND NEW SCENARIOS, CHALLENGES AND PROSPECTS

■ PIERPAOLO DONATI

1. The issue of intergenerational solidarity: a representation of the situation at the turn of the year 2000

This contribution is about solidarity between generations, and not equality between them. The two topics are quite often conflated in the public discourse, so it is useful to underline the specific focus adopted here.

The topic of equality (usually meant as equality of opportunities in the access to physical and non-physical resources, in particular educational, economic and social opportunities) is not the same as the topic of solidarity. The former is a typical expression of the ideology of opportunities within a political lib/lab configuration of society, while the latter refers to exchanges, attitudes, expectations, engagements, relations, transactions between the different generations as such. Of course, solidarity implies opportunities in the access to goods, but it is a different matter: it is about the ways in which each generation relates to the others, both synchronically and diachronically.

In this conference, many scholars have referred to the distribution of goods as physical entities (water, air, forests, climate and so on), while I am interested in *social* goods, which consist in social relations or depend on social relations, in particular those that are called 'relational goods'. As a social scientist, I am looking at what I could call 'society warming', which, in a sense, parallels what is commonly called 'global warming' in the physical environment.

The study of intergenerational solidarity has been a priority since the initial intentions of the PASS. At the end of 2000 it was decided to open a program which should have been extended over several years. In particular three topics were identified. a) The need to delineate the contours of the family problems which PASS ought to tackle within the new program. b) A number of aspects which definitely belong to the field of intergenerational solidarity and to which social scientists might usefully contribute: the role of families in the education of children and teenagers, in the support of parents and old-age members, in the provision of a better safety net than may be publicly provided, and last but not least, in contributing to building the cultural environment in which future generations will live. c) The problems posed by the crisis and reform of the welfare state to intergenerational issues. The results of the academic works de-

voted to these issues were intended to contribute to the advancement of the social doctrine of the Church.

In the first Plenary Meeting on Intergenerational Solidarity (PASS 2002, editor Edmond Malinvaud), the Academicians were like explorers slowly making our way into a new territory, clearing away obstacles, and charting the main features of the terrain. Building on our earlier, preliminary expeditions, we chose to concentrate in this phase of our project on the implications of changes in inter-generational relations for 'welfare' (broadly understood as encompassing all the networks and institutions upon which the very young, the frail elderly, the sick, and the incapacitated depend for support and security). The speakers and commentators confirmed the existence of a sobering array of challenges for social science, social policy and the Church's social teaching.

Two papers served as a starting reference framework: *Intergenerational solidarity: a sociological and social policy issue*, and *Equity between generations: a new social norm*. The contributions were focused primarily on the increasing strain that changing relations between generations, during the last decades, had placed on every society's capacity to provide for the needs of the very young, the frail elderly, and the severely ill or disabled.

The analyses cast light on the economic transitions and the demographic earthquakes that have shaken all of the four pillars upon which most individuals rely for support, security and social standing: the family, market work, governmental assistance, and the broad array of associations that are known collectively in Catholic social thought as the mediating structures of civil society. The participants underlined the repercussions of the huge changes in the socio-demographic trends (birth rates, longevity, marriage behaviour, etc.), in women's roles, geographic mobility, traditional cultures of reciprocity and filial piety (and in many other factors) on the 'load-bearing capacity' of each of these pillars to sustain viable and sound relations between generations. These changes have affected affluent and developing nations alike, in differing ways, and to varying degrees. They have jeopardized the wellbeing of the very young, the frail elderly, and other dependents, both in welfare states and in countries where government's role in providing social services is minimal or non-existent. No society has been unaffected, and no society has fully faced up to the unprecedented challenges posed by these changes in a world where dependency remains a stubborn fact of human existence.

The second step of this endeavour has been to put the intergenerational issues within the 'human ecology' framework (PASS 2004, editor Mary Ann Glendon). Five topics were given particular attention: the socio-demo-

graphic changes, the dependency welfare crisis, the breakdown in social norms, the new 'woman question', and blind spots in social policy and the social sciences.

1. *The socio-demographic changes*

One point upon which all participants agreed is that the latter 20th century was a time of extraordinary upheavals in generational relations. The speakers and commentators at the Academy's 2004 Plenary Session presented a sobering picture of the demographic upheavals – the aging of populations, changes in sexual and family behaviour, the migrations of peoples – that have transformed and are transforming the social landscape. The participants pondered the implications of these changes, both for the most vulnerable members of the human family and for the institutions to which people turn in times of need. There was some speculation about whether economic, political and cultural causes led to changes in generational relations or the other way around. But discussion of that question remained inconclusive, for economies, politics, cultures, and family structures are mutually conditioning systems whose effects on one another are hard to isolate. Although there were divergences about the analysis of the causal chains, the speakers were in accord on the seriousness of their consequences. If one asks what those upheavals have meant and are likely to mean for the world's dependent population, probably the most striking fact is that, with declining birth rates and improved longevity, that population now includes a much smaller proportion of children and a much larger proportion of disabled and elderly persons than it did a century ago. This is so even in developing countries where dependent children still outnumber the dependent elderly, but where the relatively high birth rates are declining. The changes were widespread, profound, and sudden: widespread, because all developed nations were affected to varying degrees; profound, because the changes involved increases or decreases of more than fifty per cent; and sudden, because the changes took place in less than twenty years. Perhaps not sufficiently explored in our discussions was the fact that those changes in family behaviour were both driving and driven by less quantifiable but equally momentous *shifts in attitudes*, that is, in the *meanings* that men and women attribute to sex and procreation, marriage, gender, parenthood, and relations among the generations. The tremors of the demographic earthquake subsided, but the social landscape of the developed countries was irrevocably changed. The full extent of the damage, however, was not immediately apparent because, for a time, it was widely accepted as a kind of liberal dogma that actions and decisions in the highly personal areas of sex and marriage

were of no concern to anyone other than the 'consenting adults' involved. It took time and sad experience for the understanding to sink in: that individual actions *in the aggregate* exert a profound influence on what kind of society we are bringing into being. When large numbers of people begin acting with regard primarily to self-fulfilment, the entire culture is transformed. We can now see that the cumulative effects of the changes in family behaviour that took rise in the 1960s have been especially detrimental to children and thus have cast a cloud over the futures of the societies involved. The modern freedom of divorce and of unmarried parentage have increased the scope of expression for parents without necessarily recognizing the implications for the welfare of children.

2. *The dependency welfare crisis*

The demographic upheavals of the late twentieth century have impaired the carrying capacity of all of the social systems upon which individuals depend for support and security, producing the growing dependency-welfare crisis. By human dependency, it was meant not only the composition of the dependent population at any given time, but the dependency that is an inescapable fact of the human condition for all men and women at various stages of their lives, including the dependency of the human race on its natural and social environments. Today, as the dependent elderly population expands and the cohort of active workers contracts, all welfare states are coming under severe strain. Overly ambitious welfare states have contributed to dependency and fostered a certain loss of individual initiative and responsibility. Even modest proposals to relieve pressures on welfare systems through limiting benefits or raising the age of retirement, have thus far proved politically divisive. It was noted a 'free rider' problem: childless individuals (who as a group enjoy a higher standard of living than child-raising persons as a group) expect to be cared for in old age through benefits financed by a labour force to which they did not contribute. If political deliberation continues within a framework based on the idea of competition for scarce resources, the outlook for children and child-raising families is troubling. With the declining birth rate, children are less visible in many societies: adults are less likely to be living with children; and neighbourhoods less likely to contain children. As the proportion of childless households grows, many societies are becoming ever more adult-centred, and the general level of societal concern for children declines. Families in subsistence economies are acutely aware of the importance of the human capital represented by children, while modern welfare states typically favour the elderly over the young where social spending is concerned.

Needless to say, most people consider it one of the blessings of modern social security and health care systems that they have made elders more independent, relieving families of much of the burden of eldercare. At the same time, however, the bulk of the poverty population in modern welfare states, as in the rest of the world, is composed of mothers and children. Thus, no small part of the impending dependency-welfare crisis is the prospect of divisive competition for resources, and of conflict rather than solidarity among generations. Many of the deficiencies of the welfare state have derived from an inadequate comprehension of its competencies, limits and duties, most concretely the forgetting of the principle of subsidiarity, which requires supporting the competence of those the state aids, wherever possible, rather than reducing them to passivity.

Concerns have been expressed about attempts to address work-force deficits through the importation of workers from other countries, since this can be a factor of impoverishment of the countries of origin.

3. The breakdown in social norms supporting solidarity between generations

The tendency among 20th century social planners to treat society as a collection of individuals in competition with one another for scarce resources, and, if they focus on the family at all, to regard it as an instrument to remedy failures of state and market, has produced negative outcomes. That tendency to treat the individual as the basic social unit has both obscured and aggravated the underlying problem of intergenerational solidarity: the breakdown of social norms upon which healthy economies, republics, and socially conscious states all ultimately depend. This conference has considered the implications for dependents, especially children, of the dramatic changes in social norms that took place in the affluent countries of Europe and North America in the late 20th century. The consequences for children, upon whom the human future depends, have been drastic: millions of children have been lost to abortion, and an unprecedented proportion of children are spending all or part of their childhoods in fatherless homes, often in poverty. Female-headed families created by divorce, desertion, or single parenthood now constitute the bulk of the world's poverty population. As for intact child-raising families, their standard of living is generally lower than that of childless households, especially if the mother stays home to care for the children.

The conclusion is inescapable that the affluent western nations have been engaged in a massive social experiment – an experiment that has opened many new opportunities and freedoms to adults, but one that has been con-

ducted at the expense of children and future generations.¹ Further, and more radical, experiments, moreover, are already underway in these countries via advances in biotechnology. The haunting question is: what will it mean for the relations between generations if children come to be seen as products of design and manufacture? In sum, the drastic declines in birth and marriage rates that have taken place in the developed nations, together with sharp rises in fatherless households, have cast a cloud over the economic and political futures of those societies. In places where the state once ambitiously took over many roles that formerly belonged to the family, governments are less and less capable of fulfilling their commitments, while the family has lost much of its capacity to care for its own members.

4. The new position of women within generational relations and their rights

The provision of care across any generation has been an almost exclusively female preserve and continues to be so. Perhaps no single development, apart from fatherlessness, has had more impact on the environment of childhood, the care of dependents, or the health of the mediating institutions of civil society than the increased labour force participation by women, including mothers of young children. It is a mark of great progress, and something to celebrate, that we now live in a world where women have more freedoms and opportunities than ever before in history. No society, however, has yet figured out how to assure satisfactory conditions for child-raising when both parents of young children work outside the home. And no society has yet found a substitute for the loss of other types of caregiving labour previously performed mainly by women. For many women, moreover, the picture of progress is ambiguous. Though birth rates are declining, the majority of women still become mothers. When mothers of young children enter the labour force, whether because of necessity or desire, they tend to seek work that is compatible with family roles. That often means jobs with lower pay, fewer benefits, and fewer opportunities for advancement than those available to persons without family responsibilities. Thus, ironically, the more a woman foregoes advancement in the workplace for the sake of caring for her own children, the more she and her children are at risk if the marriage ends in divorce. On the other hand, the more she invests in her work, the greater the likelihood her children will have care that is less than optimal.

¹That is why, contrary to what some scholars have theorized (for instance Parfit 1982, 1984, 1990), we have to be definitely interested in the next generations even if they are not yet born.

It is not surprising therefore that women in developed countries are hedging against these risks in two ways: by having fewer children than women did in the past, and by seeking types of labour force participation that are compatible with parenting. In so doing, they often sacrifice *both* their child-raising preferences and their chances to have remunerative, satisfying, and secure employment.

Women in developing countries face even heavier burdens. As working age men increasingly commute to jobs in the modern sector or migrate to distant places in search of work, rural life no longer takes the form of the family production community. Today, in addition to performing the traditional tasks of childcare, food preparation, and gathering wood and water, women are increasingly left to take over responsibility for cash-crop farming.

Thus, while enormous economic advances have been made by women without children, mothers face new versions of an old problem: Caregiving, one of the most important forms of human work, receives little respect and reward, whether performed in the family, or in the labour market.

Despite these risks, most women still become mothers. In marriage, they accept primary responsibility for childcare, thereby incurring disadvantages in the labour force. If divorce or separation occurs, they seek and accept primary responsibility for the care of children even when they are not well equipped financially to do so. Indeed, if women did not continue to shoulder these risks and burdens, it is hard to see how any social institution could make up for the services they now provide.

The main solutions proposed by the feminism of the 1970s were the socialization of care-giving and equal childcare responsibilities for fathers and mothers. But those ideas have not had broad appeal. They ignore that for many women, caring for family members is central to identity; sustaining the relationships that make life meaningful. *Who* people are derives from their ultimate concerns which are expressive of their identities and therefore are *not* a means to some further end.

Cost-benefit analysis does, however, expose some peculiarities of social policy in the wake of the demographic revolutions. Despite the fact that those who perform care-taking roles within the family confer important benefits on the whole society, a mother who is left destitute when a family breaks up is often treated by welfare law as a social parasite and by divorce law as a burden to her ex-husband.

5. Blind spots in social policies and the social sciences

A number of blind spots in contemporary thinking about welfare and dependency, as related to intergenerational solidarity, have been identified.

Several speakers pointed to certain flaws in prevailing modes of social, economic, political and legal thought that contribute to many oversights: incomplete concepts of personhood and society, together with a tendency to focus on the individual, the market, and the state to the neglect of families and the mediating structures of civil society. The concepts of the human person that are prominent in social science and social policy both over-emphasize individual self-sufficiency and under-rate individual human agency. The image of the free, self-determining individual exerts such powerful attraction for Western culture that human dependency – which is central to children and elderly people within the context of generational relations – is relegated to the margins of consciousness. It is still a fact that circumstances can catapult anyone at least temporarily from a secure to a dependent position. It is still a fact that almost all persons spend much of their lives either as dependents, or caring for dependents, or financially responsible for dependents. It is still a fact that we all depend on the earth for the resources that make life possible. Every human being depends on common needs and common goods that are served by networks of giving and receiving between generations and by the virtues both of independence and of acknowledged dependence. In order to flourish people need both those virtues that enable them to function as independent and accountable practical reasoners and those virtues that enable them to acknowledge the nature and extent of their dependence on others. Both the acquisition and the exercise of those virtues are possible only insofar as people participate in social relationships of giving and receiving between generations. The over-emphasis on self-sufficiency in contemporary social thought co-exists with an approach to welfare that underrates human capacities. Social policy has been influenced by mind-sets that treat human beings as passive subjects or instrumental rationalists rather than as acting persons whose decisions are influenced not only by calculation of self-interest but by strongly held values in taking part to the production and enjoyment of relational goods. Surely social policy and social science would benefit from more attention to the fact that human beings are *both* able and dependent, with variations over one's life span. Society is not just a collection of individual competitors for scarce resources; it is a fabric of relationships, to a certain extent ambivalent and conflictual, in need of solidarity. There was wide agreement that a number of conceptual adjustments will be needed if policy-makers are to move beyond unpromising proposals based on conflictual models of human relations.

Here perhaps is where Catholic social thought could enter into a mutually beneficial dialogue with the social sciences. Catholic social teachings have long promoted a vision of society where the dignity of the human

person is the highest value; where the family has priority over the state; where all legitimate types of work, paid or unpaid, are respected; and where families, local communities and the mediating structures enjoy an appropriate autonomy. It has long presented a vision of human personhood in which each man and woman is understood as uniquely individual yet inescapably social; as a creature of unruly passions who nevertheless possesses a certain ability to transcend and even transform the passions; as a knower and a chooser who constitutes himself or herself, for better or worse, through his knowing and his choosing. It has elaborated a concept of solidarity, not as a mask for collectivism, but as a moral and social attitude, a virtue based on recognition of the interdependence of the members of the human family (SRS, 38). It has offered the fertile concept of subsidiarity in which an important role for the state is to help set conditions for personal, social and economic flourishing. Subsidiarity, however, is not a mechanical formula or a dogma, but rather a principle whose application depends on the ever-changing relations among state, market, civil society, families and individuals in each society. Whether and how policy-makers in modern states might accommodate a more capacious concept of personhood, an approach to gender equality that makes room for different individual vocations and roles, a deeper appreciation of the dignity of all legitimate human work, or an understanding of the cultural importance of families and the mediating structures upon which they depend have been recognized as fateful questions in need for new answers. In this meeting, PASS did not reach the stage of confident answers, but it was agreed that the first step of asking the right questions was achieved.

The third meeting concerned with intergenerational solidarity was explicitly devoted to the human condition of young people in the new demographic, economic, cultural and political scenario (PASS 2006, editors Mary Ann Glendon and Pierpaolo Donati). Its main contents are here reported within the next section.

2. What PASS has learned and proposed

The most significant achievements of the three aforementioned conferences can be summarized in three topics: the analysis of the worldwide situation, the basic issues to be dealt with, and the first recommendations and proposals.

1. The analysis of the worldwide situation

The participants agreed that, within the modernizing and globalizing processes, youth is fading and quite literally vanishing due to rapidly falling birth rates in the developed world, and extremely high mortality rates

among the young in some parts of the developing world. At the same time, all too many children are being deprived of their youth by being forced to grow up too quickly. One of the most successful features of this conference were the regional reports, each one organized around a single set of guidelines to facilitate comparisons. The analyses showed that, in countries suffering from poverty and disease, the childhood of some is cruelly curtailed by having to take on the responsibilities of adults, while in richer countries, many are pressured to adopt the lifestyles and preoccupations of adults without support or preparation. In the language of economists, children in poor countries are both 'consumption' and 'capital' goods, whereas in rich countries they are mainly regarded as 'consumption' goods (of course, in both types of countries, children are also 'merit goods', but the real extent of this recognition depends very much on each culture and country. This historical trend should be questioned, since a society which considers the child as a mere consumption good (and/or a purely instrumental merit good) is bound to become more and more alienated from its own future.

We should therefore rethink what can be called the 'culture of childhood'. Such an endeavour will be more fruitful if it will be put in relation to the social ethics of reciprocity between generations, in the light of the following considerations: 1) there is a 'natural' obligation in the parent-child relation, which is automatically recognized by the parent; 2) the action of giving birth to a child creates an obligation, since otherwise the child wouldn't exist (this is different from point 1); 3) society has the right (and perhaps the obligation) to enforce the parental obligation, though usually enforcement will be unnecessary; 4) the parental obligation implies also power to the parents, not only for the sake of efficiency in discharging the obligation, but also as a reward to the parents. We should develop new social policies in favour of children by relying upon a deeper consideration of the above mentioned four points in order to go beyond the strictures of utilitarianism and contractarian views. The concept of 'obligation' is not widely spread in ethical and economic discourse about social arrangements and should be made a subject of a new focus. Mainstream economics talks about the achievement of happiness or, as we frequently say, 'utility', or even, as with A. Sen, 'functionings and capabilities'. Another language talks of 'rights'. We should recognize that there is a category of 'obligations', which cannot easily be reduced to either utilities or rights. There is a need to enforce the trusteeship obligations of parents. A question was posed: 'Who is subject to the law of intergenerationality?', and the answer was: everybody, as a human being, irrespective of his/her age, sex, ethnicity, nationality, religion, culture, social status. But parents should be seen as primary agents.

The topic of solidarity is intertwined with the issue of generational equity in terms of the struggle against the huge social debt that impinges upon the new generations. This debt has two dimensions. In the *intra-generational* dimension, it is the solidarity debt that some have with fellow contemporaneous countrymen. Rulers and political, economic and social leaders, as well as those who are better off, are the carriers of a social debt with those unprotected in their same generation. To this debt another one is added, the *intergenerational debt*, i.e. the debt of the generation in a productive age with the several generations in an unproductive age: the elderly, minors and those still to be born. In many countries (in particular Latin America) public debt is so vast, so demanding, that great efforts are needed to reduce it in order to give more chances to the next generations.

On the basis of the analyses provided in regional Reports, several important issues emerged regarding the situation of children and young people vis-à-vis the other generations on our planet. In particular, the serious breakdown of the current efforts of Catholics to transmit their faith to their children in many countries was underlined.

2. Basic issues to be dealt with

In terms of general trends, the most basic challenges concerning the new generations were depicted as follows. From the socio-demographic point of view: ratios of infant mortality still too high in many countries, the regressions in life expectancies, the gender inequalities in life expectancies, a certain refusal of the future in the countries afflicted by the ‘demographic winter’, the increasing importance of one-child families, the abnormality of gender-specific demographic indicators, and the fact that a decreasing number of children are benefiting from a two-parent family. From the cultural point of view: excesses of culture that make nature vanish in the name of ephemeral cultural fashions and global narratives of development that simultaneously put all relations to nature and society at risk. All the speakers stressed the fact that the flourishing of children and youth is severely threatened by the weakening of the family almost everywhere. In conclusion, it was agreed that it is time for civil society to do its own, to assume its human ecological responsibility. As all other ecological problems it demands from us to raise the view from the short term toward the medium and long term.

3. First recommendations and proposals

The utilitarian and contractarian perspectives that have dominated the issue of intergenerational equity so far have proved to be misleading. In examining our values, and thus our lives, we need to ask if the destruction of

an entire species-habitat for some immediate gratification is something we can live with comfortably. The mistake is to see procreation and ecological preservation as matters of personal and political morality. It is at least as much a matter of personal and political ethics. Perhaps the time has come to realise that children are capital and merit goods not only in poor countries, but also in rich countries, although in different ways. We must extend – rather than reduce – welfare state practices to include the reduction of ill health generated not only by the self-contaminating products and hazards of global industrialism, but also by its dereliction of civic well-being. This is the broader framework of any adequate concept of well-being with respect to the world's children and their families. It is possible that this global framework of risk may induce a certain solidarity between adults, children, and youth. For whereas in class terms *some* are never afflicted by the risks of poverty, *no one* escapes the afflictions of globalized risks to our air, water, food chain, forests, and heavens. We still have to rework our cognitive and moral maps to rethink civic sustainability rather than continue to rely upon scarcity-thinking to ration out the unequal risks of the emerging global economy of industrialized hazards. We are obliged to *globalize our moral map* since it is increasingly impossible to set up national and class walls to protect privileged moral environments. It follows that the moral environment of children can no longer be isolated. We can no longer imagine childhood as a pre-political or pre-economic realm safe from the hazards of the adult world without indulging a fantasy of child-immunity that is constantly violated through the intrusions of generation, class, race, and nation. But we must be aware that the welfare state should be understood and managed according to the principle of subsidiarity in order to promote the active citizenship of all intermediary bodies of civil society, first of all the family, as actors (producers) of intergenerational solidarity.

If it is true that many children, in many countries, nowadays are the children of fragmented and individualized families, then the *intergenerational family* may serve as a regulative notion in the derivation of social policies whose task is to sustain families in difficulties of one kind or another, but for which we need some benchmark of viability. The increase in life expectancies means a remarkable rise of many intergenerational families where the great-grandparents are present and active. In order to appreciate the value of multigenerational families it is important to maintain the implicit institutional concerns inscribed in the term *pro-*(on behalf of)*creation*, which cannot be substituted by the word *re-*(again)*production* which refers to the pure biological sense of sexual reproduction. If we undermine the distinction between the sociocultural responsibility for life and the biological re-

production of life, we lose the civic assurance that goes with childhood and youth as intergenerational passages. We must re-shape the world narrative, if we wish to give room to the new generations.

Five recommendations were stated: 1) the need to improve the measuring of demographic realities keeping in mind their great geographical diversity, 2) the need to promote a better understanding of the educational mission of society vis-à-vis the new generations, 3) the need to give priority to sanitary progress and the fight against poverty, 4) the need to improve equity between genders, particularly from the point of view of health and educational policies and 5) the need to adapt family policies to reality, keeping in mind, specially, the consideration of parents as their children's educators. Policy makers and professionals have the potential to have a comprehensive understanding of the issue of 'vanishing or flourishing youth' and should be able to form their values and organizing principles of life, train themselves in skills/arts, and processes of caring for the survival of intergenerational solidarity.

We should think of the future society as a function of the youth of today, their attributes, attitudes, knowledge, preferences and ultimately their capacities, abilities and commitment to this mission. We must recognize the preoccupation of youth that moves them towards the highest ideals. We must accept their lack of conformity with injustice, with ineffectiveness and with phariseisms and we must direct all that energy so that they can satisfy their legitimate aspirations and achieve a better society through social reform. We cannot be amongst those who disappoint. Instead, we must be amongst those who accept the preoccupation and have the strength to act. John Paul II expressed his thoughts on this matter in the following terms: 'It is the nature of human beings, and especially youth, to seek the Absolute, the meaning and fullness of life'. This is the true understanding of youth and its potential. Our solidarity must be aimed in this direction. It must be a solidarity that awakens and not one that anaesthetises. It should open the path to knowledge of what is substantial. It should focus on the distinction between what is permanent and what is transitory, what is material and what is spiritual. It should be a solidarity that gives youth security in its ideals and hope with respect to the final result of its aspirations. The Church is in need of expressing new programs to evangelize the young and, in the process, to aid in the revitalization of the faith of adult Catholics.

In dealing with the issue of children's rights, an assessment of what has been achieved so far in international charters is needed. Although the UNO *Convention* of 1989 on the Rights of the Child can be considered a milestone, since it is no longer a mere exhortation but binds signatory States

and compels them to introduce all the legal measures required in order to enforce it, many deficiencies and shortcomings can be noticed. For example, the Convention is silent on the subject of the rights of parents, the definition of family, and the protection of prenatal life; and vague on the concept of the best interests of the child. As it stands, the Convention's emphasis on the individual rights of children can come into conflict with, and be detrimental to, the rights of parents and more generally the rights of the child's family. It is worthwhile noticing that this conflict does not appear in other international charters (such as the *African Charter on the Rights and Welfare of the Child*, adopted on 11 July 1990). Although the juridical perspective is in itself limited, a new cultural effort should be made in order to achieve a universal agreement on the rights of minors that can overcome these deficiencies. We must look for a sounder balance between the rights of the individual child, according to more accurate criteria of respect of the integrity of his/her personality, and the rights of the 'significant others' (primarily his/her family) in order to pursue the interests of the child within the framework of the common good.

We must always remember that, notwithstanding the international protection, in most countries children today live in a social context that experiences difficulties in relating to children and understanding their needs and rights. This is especially so when the family is unstable or missing, and when the child is subject to an accelerated process of growth. He/she is involved in the so-called 'adultization' process, by which he/she runs the risk of being deprived of the right to grow up according to the natural rhythms of life. On the other hand, the proliferation of single and fragmented rights poses the risk of loosening the connections between rights and duties. Individual and social rights of any generation should be configured in terms of the nexus between freedom and responsibility.

Neither in the UN Charters nor in the European ones is the child explicitly recalled to his/her duties towards his/her family. Without accusing the UN *Convention* of putting children against parents, one may say that it would be wise, in the future, to be more explicit on the duties that children have towards their family. In the African Charters this is stated more clearly. In the Arabic Charters the constraints of the *Sharia* provide limiting principles.

We must take a new look at the fact that the fragility of the child faces increasing difficulties in rich countries as well as in poor countries, but for different reasons.

The major worries concern the denial of rights where prenatal life is concerned: abortion, disposal of frozen embryos, experiments on embryonic stem cells. UNICEF does not mention them. It is a deafening silence, and

a worrisome one, broken only by the voices of the Churches. Yet everyone should understand that no investment in protecting prenatal life, as well as no investment in children, means no future for a country, in addition to despising humanity's most precious resources.

In the end, it is urgent to realize that that much of our contemporary youth, although cared for by nation-states and the international community, seems to vanish even before it can be born. Surely, generalizations are risky. Despite negative events, comforting news is reported every day of young people involved in their families and societies and enabled to live in a positive way the rights that the international Charters grant to them. But in order to improve the outlook everywhere, it is necessary to find a remedy for the many educational inadequacies, the commercialization of society, the socio-economic problems of the poor countries, and the alienating lifestyles of the rich countries.

Moreover, rights must be enforced by amending, if necessary, the relevant legal instruments at appropriate levels, from international to regional, national and local. The question is not just to make justiciable those rights guaranteed to children but also to better define the competence of the entities currently established. For instance, a question to be solved, once and for all, is whether it is lawful or not that a technical body devoid of any political legitimation like the Committee established for the control of the UN Convention on the Rights of the Child may by means of interpretation endanger the right to life, giving such an endangerment the same dignity as that of inviolable rights. The impact of this practice on domestic law tends to modify the correct institutional design, according to which each norm is a product of democratic consent expressed by through the bodies politically established for that purpose.

It is a duty to go on proclaiming children's rights in the international settings as well as within single States. But this is no longer enough. It is mandatory to clarify as soon as possible the ambiguities still present in matter of the right to life, parent-child relationships, the family model, and the role of the family in social life. This is primarily a political and cultural endeavour.

However, we cannot fall into the trap of a 'legalistic' perspective. We must be aware that the difficulties in caring for children and young people are much more complex than the proclamation of legal rights and therefore the solutions must be sought by going beyond the perspective of mere legal protections.

More research is needed in order to clarify the most significant difficulties 1) the extraordinary complexity of the real and normative contexts in which children live and grow up; 2) the extreme uniqueness through which that complexity in ethnic or religious communities, in social classes, in local,

regional or national units reduces itself to concrete real and normative conditions; 3) the maximum diversity and instability of the individual situations and developments which occur in spite or on account of the ethnic, religious, social, local, regional or national specifications; 4) the fractures, which may result at any time if the borders separating communities, classes, regions etc. from each other, are crossed, a fact which, however, especially comes true if children, parents, families or comparable groups cross-national borders together or separately. The growing transnationality of human life gives that aspect special topicality.

Solidarity with children and young people requires us to envisage a 'human ecology', as defined in the encyclical *Centesimus Annus*. That in turn requires a leap into a new generation of human endeavours relating to children and young people. Such endeavours can be better understood by referring to what we have come to know as *relational rights*, in particular those rights which link people through the generations. These rights (not merely legalistic) concern those relationships that meet the most basic needs of the child as a relational being who cannot develop without relying upon an adequate family and a nurturing environment surrounding him/her. The child needs, first of all, human love, and can achieve authentic human growth only through relations of reciprocity, solidarity and freedom, first of all in the context of the chain of the generations in which he/she has been generated.

In order to understand the novelty of children's needs and rights, we must see them as a new frontier, coming after the various waves of rights that have emerged in modern society. The first generation of human rights referred to civil and political rights derived from the modern liberal revolutions. The second generation of rights was concerned with rights to education and culture, to work, to social welfare, derived from the nineteenth century movements that struggled to build up the institutional national welfare state. This second generation of rights has proved to be too bureaucratic and standardized to meet the needs of young people. That is why some thinkers and activists have begun to talk about a third generation of rights, such as the so-called 'rights to differences' (in gender, ethnicity, religion, etc.). However, if we want to achieve a true intergenerational solidarity, within a framework of a sound human ecology, we must search for a further generation of rights, i.e. those rights which refer not to the individual child *qua talis*, but to his/her personal being in relation to the 'significant others' in his/her lifeworld. First of all his/her parents, and secondly his/her kin, friends, neighbours, all the people linked to him/her in the web of the local community. These are the *relational rights*.

Of course, the concept of 'relational right' has to be studied and articulated in more detail, in order to make it less vague and more operative. A possible task of the Academy could be to reflect on this issue in the future, in order to give its own contribution to the social sciences in the light of the idea that 'generational human rights' (what must be expected by every generation and who is in charge) must be understood, first of all, as norms which foster human virtues and make them feasible in concrete relational contexts.

At present in many countries, only a few (and sometimes none) of these generations of rights are really implemented. Let us think of the *favelas* in Latin America, child soldiers in sub-Saharan Africa, child prostitution in some Asian countries, poor single-parent and underclass children in North America and Europe. Our hope is that a perspective that takes relational rights into account can give professionals, educators, policy-makers a new impetus and a new direction to struggle for a better intergenerational solidarity.

It is advisable to promote a new *Pact in Favour of Youth*, but we must be very clear on the contents (ethics and goals) of such a Pact. The guidelines of a *European Pact for Youth* launched in 2005 by some countries (initially a joint initiative of France, Germany, Spain and Sweden) are strictly materialistic: the Pact has been thought of as a means for the implementation of an economic target, namely the ambition of the EU to become the most competitive and knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion (objectives set out in the Lisbon Strategy). Although these goals can be good and legitimate, it is evident that the issue of intergenerational solidarity cannot be reduced to the pursuit of a more competitive economy and higher standards of material welfare. The Intergenerational Pact, if it is to be set out, should go well beyond all that. It should imply a different view of what is most worthy to be pursued for our children and young people: i.e. a more humane society, opened to the transcendental world.

It was respectfully recommended to the Holy See that an inter-dicasterial working group be constituted with the object of integrating all the efforts of solidarity with young people in the framework of the intergenerational issues. It is clear that the issue of intergenerational solidarity concerns different dicasteries, notably, the Congregations for the Doctrine of the Faith, the Evangelization of Peoples, Catholic Education, the Institutes of Consecrated Life, etc., as well as the Pontifical Councils for the Family, the Laity, Justice and Peace, Health, the Pontifical Academy for Life, etc. In itself, such a working group would already be a witness of internal solidarity within the Church, but completely oriented toward the human community.

The Catholic Church possesses a network of agencies that is the most highly developed in the world. No public or private organization has such a worldwide network of universities, schools, youth movements and Catholic Action, new movements endowed with an emerging spirituality, family movements, charitable institutions, hospitals, means of communication, etc. Impressive directories exist. No organization possesses such a large body of members ready to freely commit themselves to projects of solidarity.

In sum, the Academy has offered many fresh data, insights and proposals to be passed on to the Church, the national and international organizations and institutions, and all the people of good will who take care of intergenerational solidarity as a relational good to be promoted. This perspective is particularly meaningful when we consider that, to the extent that the issues of intergenerational relations are coming to public attention, they are typically presented in terms of conflict, rather than solidarity, among the generations, in all continents.

In this Report, I can only mention the workshop organized by the PASS on the topic of *Trafficking in Human Beings* (November 2-3, 2013)² which touched upon many relevant issues concerning the troubles of children, women and families as victims of new forms of slavery. These issues deserve special attention and cannot be included in this report.

3. What PASS might have done better in order to focus concepts, causal chains, policy regimes, impact assessments, and cultural changes

3.1. The work done by the PASS has highlighted with accuracy the context of the problems affecting the question of intergenerational solidarity at the turn of the 21st century. Nevertheless much remain to be done not only in order to get an updated knowledge of what is happening, but above all to cope with the novelty of the rapid economic, political and cultural changes that are radically modifying the terms of the question.

Topics that deserve a new focus have to do with: (I) the fundamental concepts that we use; (II) the reading of the demographic transition from a generational standpoint; (III) the evaluation of the impact of legislation and welfare systems on the generations; (IV) how intergenerational cultural transmission is changing and the study of generations as agents of cultural change. In all of these areas there are significant implications for Catholic social doctrine.

² See the Proceedings of the working group and the subsequent *Statement* (November 2013), available online <http://www.pass.va/content/scienze-sociali/en/events/2009-13/trafficking/traffickingstatement.html>

3.2. (I) Clarifying fundamental concepts: generation, solidarity, intergenerational relations

The central concepts of the discussion need to be examined in depth and refined.

a) The first area has to do with the concept of 'generation'. This has been used mainly in the demographic sense of *cohort* (the statistical set of individuals born in a certain year or time interval). This concept is neutral from every point of view. It lacks cultural and relational contents. It is simply a statistical aggregate of those people who are of the same age.

Then there is the concept of generation as '*age group*' in the *cultural-historical sense* (derived from K. Mannheim): for example, the 'Vietnam generation', the 'generation of 1968', the 'fall of the Berlin Wall generation'. This concept has to do with the problem of intergenerational solidarity only indirectly and marginally.

Then, there is *generation as 'parental-familial lineage'*. This way of understanding the generations does not reason with the categories of 'youth, adults, old people' (cohorts), but with those of 'children, parents, grandparents, great-grandparents'. The two perspectives are substantially different.

If we continue with this line of interpretation, we arrive at the observation that 'generations' in the *real sense of the word* cannot be defined apart from the family; rather, they find in family relations (of filiation and kinship) their *distinctive criterion* as compared to the more extensive concept of generation as age group, in a demographic (cohort) or cultural-historical sense (which could also include parents and children as witnesses or actors of historical events experienced together). Nevertheless, this line of reasoning does not turn out to be completely satisfying, in my opinion. It excessively limits the concept of generation to within family lineage. With the processes of modernization, the generations are increasingly influenced by what happens in the public sphere – in particular, by technological and communicative changes and by social policies (the welfare state) – in defining what is peculiar to every age of life (Donati 2002). We need to revisit the concept of generation in light of these 'interferences'.

The need for a new (relational) definition becomes evident: *generation is familial lineage (ancestors and descendants) mediated by social relationships outside the family*. In other words: *generation becomes the totality of persons who share a relation: the one that links one's position in one's lineage in the familial-kinship sphere (that is: child, parent, grandparent, etc.) with the position defined in the societal sphere on the basis of 'social age' (that is: according to age groups: youth, adults, the elderly, etc.)*. We have to speak about young children, adult children, old children. We have to speak about young parents, adult parents, old parents. We

have to speak about young grandparents, adult grandparents, old grandparents. These are the ‘new generations’ (Donati and Colozzi 1997) that hide behind the ‘complicated intertwinement’ between the generations, which, for the first time in history, has been created by our society. Intergenerational intertwinement becomes problematical when family status connected to lineage begins to fluctuate, and, thus, also the social status attributed to individuals as members of an age group in society begins to fluctuate.

b) *The concept of solidarity* has been used in a generic way. In theory, this term can take on various meanings.

A first meaning, used in the past, is that of *organicity*. Solidarity is conceived as of a body constituted by members that exist in solidarity – that is, functionally – in a reciprocal, organic relationship. This conception can no longer be practiced in a naive and immediate way because society is no longer conceivable nor governable as an ‘organism’. A second conception of solidarity is that of benevolent action, *charity*, caring for the other. This conception also has an important aspect, but it does not get at the point. A third conception understands solidarity as the *sharing of ideals or interests*. It is particularly problematic if applied to the generations. A fourth meaning of solidarity makes it a synonym of *justice* or *equity* in the distribution of goods. It is an important concept, but is not specific to intergenerational relationships.

In the PASS Proceedings, the meaning of solidarity as ‘interdependence directed toward the common good’ appears to prevail. However, neither the concept of interdependence nor that of the common good has been analysed in depth as specifically regards intergenerational relationships.

c) *The concept of ‘intergenerational relation’* as synonym of the parent–child relation has been taken to be implicit and accepted as a matter of course, but the ‘generative’ qualities and characteristics of this relation have not been explored. A generation is a generation because it *feels that it was generated*, for good or bad, in one way or another. If this feeling is missing, a generation is something else, and the inter-generational relation takes on other connotations. It is not enough to use a generic concept of relations as the reciprocal positioning or exchange between individuals of different ages. The concept of intergenerational relation, if it is to contain the generative sense between the generator and the generated, has to be clarified in terms of its structure, dynamic, and effects over time.

In short, the traditional definitions of generation, solidarity, and intergenerational relations have to be redefined because they can no longer capture what the postmodern society of globalization is producing. The reason for these shortcomings resides in the fact that traditional definitions are deficient when it comes to exploring the changes in the relationality that

characterizes the emergence of social phenomena. It is necessary to move beyond the traditional view because hyper-modern society is in the process of developing a relationality without historical precedents, generating relations that were previously 'unknown'.

These new scenarios are such that they also overturn old stereotypes: for instance, the claim for the existence of widespread familism in Mediterranean countries, in contrast with the countries of northern Europe. Dykstra and Fokkema (2010) have refuted the traditional argument, which has dominated the literature, that family solidarity patterns are divided between an individualistic north and a familistic south. The authors have challenged this view and addressed the variability in intergenerational family solidarity within and across countries. Using multiple dimensions of intergenerational solidarity drawn from the *Survey of Health, Aging, and Retirement in Europe*, they have developed a typology of late-life families which is robust across northern, central, and southern regions. The four types are: (a) descending familism: living nearby, frequent contact, endorsement of family obligation norms, and primarily help in kind from parents to children; (b) ascending familism: living nearby, frequent contact, endorsement of family obligation norms, and primarily help in kind from children to parents; (c) supportive-at-distance: not living nearby, frequent contact, refutation of family obligation norms, and primarily financial transfers from parents to adult children; (d) autonomous: not living nearby, little contact, refutation of family obligation norms, and few support exchanges. The authors have found that these four types are common in each European country, though the distributions differ. The findings suggest that scholars should abandon the idea that a particular country can be characterized by a single dominant type of late-life family. Socio-demographic differentials in family type follow predictable patterns, underscoring the validity of the developed typology.

3.3. (II) The so-called 'demographic transition' and its causal concatenations

The statistical definition in use today of 'demographic transition' appears to be of little use in addressing the problem of intergenerational solidarity for various reasons: (a) first of all, because the comparison between birth rates and mortality rates says very little about the qualities and properties of the generations and their relations; (b) moreover, because it says little or nothing about the structure of the families upon which the characteristics of the generations depend. Behind the theory of demographic transition one finds, in reality, the presupposition of the collapse of the nuclear family (and not only of the extended family) as the most prevalent family model. Beyond variations in the relationship between birth and mortality rates, there is the fact that the

changes induced in family structures no longer generate generations, in a historical-cultural sense, which are clearly distinct from one another. Rather, they generate confused generations, which are variously intertwined with one another and where differences in identity and the rules of exchange have blurred contours, becoming uncertain and risky.

Behind the theory of demographic transition, we need to see a theory of change in intergenerational relations. The concatenations of causal factors that induce changes remain to be clarified. Moreover, the effects following from the supposed transition are not at all about ‘balancing’ populations, but consist instead in major imbalances between generations. It is thus imperative to redefine the theory of demographic transition from a generational point of view (Donati 1991).

3.4. (III) Evaluating the impact of legislation and welfare systems (or welfare regimes) on the generations and intergenerational solidarity

Social legislation and welfare systems use a certain definition of ‘generation’ and contribute to changing it. For example, provisions for supporting work among the young sometimes refer to youth in the 18–25 year cohort, sometimes in the 18–29 year cohort, and more recently, to even higher age groups (up to 35 years and beyond), meaning by this that entry into adulthood is being constantly pushed forward. The same thing is happening with regard to the elderly: until a few years ago one became ‘old’ at 58 or 60 years of age; then entry into old age was moved up to around 65 years, and today the tendency toward increasing the age for entry into the ‘old’ generation is continuing due to the increase in projected longevity.

This phenomenon indicates that social legislation continually alters the definitions of a generation. The transitions between one generation and another have become opaque – almost indeterminate, indeed. The fact is that *the correlation between age and generational position has been loosened*. Age is becoming less predictive of generational condition. One can be parents and children over a broader spectrum of ages. Variability is growing. For instance, the phenomenon of the NEET generation (not in education, employment, or training) is spreading.

Can we delineate a welfare regime typology that addresses intergenerational solidarity differently?

3.5. (IV) How intergenerational cultural transmission is changing and generations as agents of cultural change

The loss of intergenerational cultural continuity (between the different social spheres in which we live) is connected to declining continuity in

life contexts between the different generations (see Archer 2007, 2012). The loss of intergenerational contextual continuity has serious consequences for the life courses of young people, a topic that deserves considerable attention.

The most important consequence is the loss of continuity in the culture of the gift and reciprocity. Traditionally, intergenerational cultural transmission occurred based on the fact that one generation gave its cultural and material patrimony to the following one and expected that it, in turn, would do the same for the succeeding generation. This chain has been broken and no longer functions. Each generation must start its life course from square one.

But one could ask: is it really true that continuity in transmitting the culture of the gift and reciprocity from one generation to the next has broken down? There is ambiguous evidence in this regard (Komter 2005).

The protagonists of these changes are young people who remain for a longer time in educational institutions or in the training that precedes work and starting a family. At the start of the 21st century, and especially after September 2008, young people have had to cope with such negative contingencies as increased uncertainty, risks, disorientation, and the loss of opportunities enjoyed by previous generations (for example, certain welfare benefits, jobs, the security deriving from one's family of origin).

There are no significant studies on the processes that have led from the predominance of hedonistic youth cultures to the emergence of youth cultures that have to face resource restrictions and conditions of relative deprivation, from which new protest movements and lifestyles have arisen. Sociological, psychological, and anthropological research still has to explain the processes and reasons for these upheavals, which cannot be explained in terms of changes in society's productive bases and the political arrangements for the distribution of resources.

3.6. To conclude this section, we can affirm that the analysis and proposals on the topic of intergenerational solidarity require a new, relational vision of the problems facing us. We must better understand: 1) the structure (the generative character) of the relations between generations, 2) the dynamic of the relations (how the reasons for exchange are changing, the symbolic meanings of belonging to one generation or another, what it means to be, respectively, children, parents, grandparents, great-grandparents, what it means to be a multi-generational family, and so on), 3) the effects of changes, and, finally, 4) how to assess all of this in relationship to Catholic social doctrine, which can no longer make reference to the society of the past or to a purely abstract idea of society.

Two questions deserve particular attention. (a) Modernizing culture glorifies individualism and the call for ever more individual freedoms, but, on the other hand, these pressures produce a growing precariousness in the lives of all the generations: the contradiction between one's need for individual self-realization and, then, finding oneself in conditions of loneliness and poverty with few or no exchanges between generations must be addressed and the question asked: where does this contradiction lead us? (b) Do these processes produce only the hollowing out of the meaning of relations of intergenerational interdependence, or do they also generate a new meaning for such interdependences?

4. What needs to be done in the near future: coping with the challenges of a radically changing scenario

4.1. The tendency that is gaining ground in the most modernized societies and is influencing every continent is that of distancing the generations from one another, treating them separately with specific measures aimed at each.

Certainly, everyone today underscores the precariousness of youth and the conflicts in the distribution of resources (work, welfare, and pensions) among youth and the elderly. But, overall, the topic of solidarity is sidelined and pushed underground for a variety of reasons that we can synthesize as follows: (i) the spread of new ICTs is creating new gaps between generations in that ICTs socialize the young while bypassing the mediating functions of both the family and school systems; (ii) market globalization is increasing social and geographic mobility and incentivizing migratory processes, tearing young people away from their families of origin and local contexts; (iii) the welfare state is experiencing growing difficulties and is unable to effectuate compensation and solidarity between the generations.

These tendencies are due to the new scenario of social morphogenesis (Archer ed. 2013), which redefines the context in which the generations define themselves and requires more highly differentiated interventions for each of them. On the other hand, however, the tendency to functionally differentiate and specialize ways of addressing the needs of youth as opposed to the other generations entails huge problems of social integration. Let us now consider which are the principal causes of these phenomena, what remains to be clarified, and which initiatives could be undertaken.

(i) The increasing cultural generation gap

Until the beginning of the 21st century, most empirical studies showed that young people's cultural values were not very different from those of

their parents. But in recent years it has become evident that the processes of modernization are increasing the generation gap, understood as differences of opinions, tastes, beliefs, and other social and cultural norms that exist between older and younger age groups. We are dealing with a veritable *fracture générationnelle*, defined as an absence of transmission between the older generations and their descendants.

The phenomenon that has radically changed the situation has been the advent of the new ICTs, which have transformed the *cultural gap* into the *digital divide*. It is still not clear how ICTs are influencing solidarity between generations. This is an area of research that deserves to be explored with some urgency.

For example, while some investigations underscore that ICTs are creating new social networks of acquaintances and friendships, other studies highlight the isolation produced among young people who use social networks (Turkle 2011). All of this creates new challenges for the processes of raising and socializing the young.

In particular, as regards the Catholic Church, colossal problems arise in assessing the use of new technologies aimed at evangelization and religious education. Religious education requires a culture based on the conversation between past and present generations (Laslett 1979). The need for a *new human ecology* (Bronfenbrenner 1991, 1996, 2004) requires a transcendent inspiration vis-à-vis a globalizing world.

(ii) The new economic scenario

The globalization of markets is causing a rupture in the continuity between generations in the family, distancing them and leading to fewer exchanges of solidarity. At the same time, it is accentuating migration, with family members separating from one another in order to find work and survive. Once again, we see here the fact that economic, political, and cultural systems are pushing toward an increasingly strong individualism, which acts to the detriment of solidarity between the generations.

(iv) The crisis States are facing regarding intergenerational policies

The welfare state's social policies are experiencing great difficulties in redefining the criteria for the intergenerational distribution of resources. In recent years many places have seen the growth of an *objective* conflict (even if external manifestations are lacking) between the 'gray power' (*pouvoir gris*) of the older generations, who hold power and resources,

and the relative deprivation of the young, especially as regards the lack of work, places to live, and adequate life opportunities in general.³

Although the UN's official reports deny this conflict and predict substantial continuity in intergenerational solidarity,⁴ the economic and social facts of recent years seem to be moving in the opposite direction, not so much as a reduction of micro solidarity (on the family level) as on the level of national and supranational economic and political macro-systems. For example, UNICEF reports underscore the growth of child poverty in many parts of the world (Ortiz, Moreira Daniels, and Engilbertsdóttir 2012).

Scholars have insisted for a long time on the need for the State to increase its efforts to guarantee equity and collective solidarity *in opposition to* intergenerational familial solidarity (see, for example, the approach by Sgritta 1997). Recently, authors such as Blome, Keck, and Alber (2009) continue to assert that social policies have the goal of supporting each generation's *autonomy from family solidarity*. Today we must recognize that the welfare state has shown major failures in this area. Indeed, we can say that welfare policies have not operated from an intergenerational perspective and have not activated new circuits of reciprocity between the generations, so that one could make the argument that the welfare state has eroded solidarity between generations rather than increase it. In other words, the welfare state has completely ignored the criteria of subsidiarity and, thus, has also undermined the principle of solidarity (Archer and Donati 2008).

In Europe this tendency has taken the name of *de-familiarization*, which consists in making social policies that aim to make the family irrelevant to the effects of young people's life courses. This tendency, far from realizing equality of opportunity for the young, has instead often had the effect of leaving the problem of intergenerational solidarity in the private sphere of families.

We must recognize that the State is not able to produce more generational equity for the very reason that it opposes the logic of solidarity and

³ An analysis conducted by Bradshaw and Holmes (2013) recently raised doubts on this tendency, showing that in the 1980-2007 period, the shift of resources toward the elderly took place to a lesser degree in some countries (such as the Scandinavian countries and Italy) but not in others (the US and the UK). Nevertheless, the analysis of these authors is not convincing.

⁴ For example, Bengtson and Oyama (2007) argue that 'on the basis of the evidence reviewed, it does *not* appear that there will be marked generational conflict in the future, and it is likely that intergenerational solidarity and altruism will remain present at high levels'.

compensation inside the family. On the contrary, we need: i) balance between direct reciprocity (in the family and kinship network) and indirect reciprocity (mediated by the State and by other social systems outside the family) between the generations; ii) a personalization of interventions directed at the generations, that is, addressing their needs in a way that is consistent with the requirements of each life cycle phase, which has a decisive variable in the structure of the family in which one lives (owing to the number of family members and their characteristics).

In the past, a great many scholars and politicians proposed a new social intergenerational contract (Bengtson and Achenbaum 1993; Etzioni and Brodbeck 1995; Williamson *et al.* 1999; Barry 2000). Yet, these proposals always failed, in part because they did not identify the sociological premises and conditions necessary for a social pact of such scope; for example, the idea of a company contract that allowed for the passage of an occupation from parent to child never worked.

The fact is that our society is based on 'institutionalized individualism' that makes intergenerational contractual solutions impossible (Beck and Beck-Gernsheim 2002). At the bottom of processes that work against solidarity between the generations is a culture of so-called 'emancipatory individualism' (Dumont, 1983; Corcuff, Ion and De Singly 2006; de Singly 2000), which erodes social bonds and 'de-socializes' the relations between generations (Fforde 2000). Primary agents are not able to oppose these tendencies, which can be situated in what has been called unbound morphogenesis (Archer ed. 2013). It is unlikely that individualism can create social bonds, not to mention solidarity, even if it is precisely individualism that is causing the emergence of new needs for sociality.

To address these processes, it becomes necessary to configure new social institutions and new corporate actors that work to oppose the separation and conflicts between young and old and to build new, positive (co-operative) solutions for both (*win-win solutions*: Ostrom, Gardner, and Walker 1994). In this connection, the role of family associations needs to be explored (Donati 1992/93) and, more generally, that of Third Sector non-profit organizations that work on intergenerational relations. In effect, both in scientific research and in economic and political programs, the role played by these organizations, both formal and informal, is almost always overlooked, given that social studies and policies usually privilege only three actors: families, the market, and the State (an example of an investigation that ignores the role of civil associations and organizations in influencing intergenerational relationships is the paper by Van Bavel *et al.* (2010).

All the social actors, from families to intermediate communities to the State, must recognize that intergenerational solidarity is a (relational) good that only emerges through the exercise of a personal and relational reflexivity in a context of structures and institutions that nourish the common good.

4.3. Can the future that awaits us do without a vision of society that takes into account the generations and deals with the problem of their solidarity?

Notwithstanding the official proclamations of international and supranational organisms that claim to support intergenerational solidarity, social, economic, and political realities are moving in the opposite direction. An example can be found in reports of the OECD, which define the family as a simple aggregate of individuals that will be determined by technologies and economic market conditions (OECD 2012) and whose well-being should be evaluated with methodologies that are inspired by individualism. In fact, an OECD report⁵ proposes a formula for calculating families' well-being that excludes intergenerational transfers, even if it admits that these could exist. This small detail reveals that the OECD reasons *as if* the relations of intergenerational exchange could become irrelevant and rendered null and void.

Some years ago the EU launched several programs for intergenerational solidarity. In the first report (EC Commission 1999) and then in a series of studies and documents (Moor and Komter 2008), the EU forced itself to support ideas and programs of intergenerational solidarity, but little was done and little accomplished due to the lack of an appropriate relational approach: governments do not support relations between generations, but concern themselves with meeting the needs of each generation. The EU is lacking in relational thinking. In order to manage the effects of the demographic transfer, it is not enough to create a 'pact between the generations' merely understood as age groups that confront one another in the public sphere over the distribution of resources (for example, work or pensions) in the present and near future. It is necessary to define with which criteria, with which coordinates, we are connecting the *relations* between the age groups, in the present and immediate future, not only within society, but

⁵ *Inter-generational wealth transfers*. The formula given above assumes that no wealth transfer occurs between generations, i.e. none of the wealth of the household remains at the end of the period. This does not imply that no wealth transfer between generations will occur in reality, as the measure proposed is a notional concept developed to better indicate economic resources currently available to a household. For some analyses, the formula could be amended to assume that some wealth does remain at the end of the annuity period' (OECD 2013: 182-183).

also within the family and through it. The EU cannot do this because it is contemporaneously pursuing policies of defamiliarization.

This condition, or pre-contractual framework, of the intergenerational pact is called *alliance between the family and society*: that is, the full recognition of one vis-à-vis the other that values reciprocal specificity in terms of spheres, organizational modalities, and forms of intertwining between generations. Precisely when, in society, generations seem to be differentiating themselves to the point that their connections are breaking down, there emerges the necessity to respond to the time frames and lifecycles specific to each generation by means of a conceptual and operative framework that defines generation, every generation, as the connection between family and society. A relational point of view is called for. In the end, recognizing generations means observing society as a 'society of families', and not only as a 'society of individuals'.

From this perspective, it is important to underscore the need to move beyond the model of the 'patriarchal family', which was used as the best exemplar for governance in past centuries.

5. Some suggestions from the social sciences for Catholic social doctrine

The analysis presented here shows that the problem of intergenerational solidarity is becoming increasingly more acute and consists in the growing lack of a relational vision of the relationships between generations inside the new family structures and in society at large. This lack is cultural (a weakening of the gift culture and of reciprocity), social (the fragmentation of primary social networks and the family's diminished mediatory role), economic (the globalization of market economies excluding intergenerational exchanges), and political (the crisis of the welfare state entailing new inequalities in the distribution of resources to the generations, poverty traps, and a reduced role of compensation in transfers of welfare benefits to the different generations).

Catholic social doctrine could address these topics with a precise objective: to oppose the tendency to solve the problems of the relationships between the young generations and other generations (the elderly, in particular) as if they were social subjects that are independent from one another. Since the relations connecting the various generations are not visible, economic, political, and cultural systems sometimes address youth, sometimes adults, and sometimes the elderly as if they were separate social collectivities, increasingly isolated and independent from one another. This also leads to pitting the generations against one another. In this way, the problems of resource distribution are reduced to a zero sum game (what is given to some is taken from others), while what are needed are games that add up

to more than zero (where all generations gain advantages from their exchanges and can create relational goods, for instance job sharing between generations, programs to exchange houses between families at different stages of their life course, etc.). In order to achieve new solidarity between generations we need new principles and new strategies that meet the following demands:

1) on a *micro* level: how can the family be supported as a social citizen-subject [I mean: as a subject of citizenship endowed with its own rights and obligations that are added – not subtracted – to the complex of rights and duties pertaining fully to individual persons] that mediates the relations between the generations;

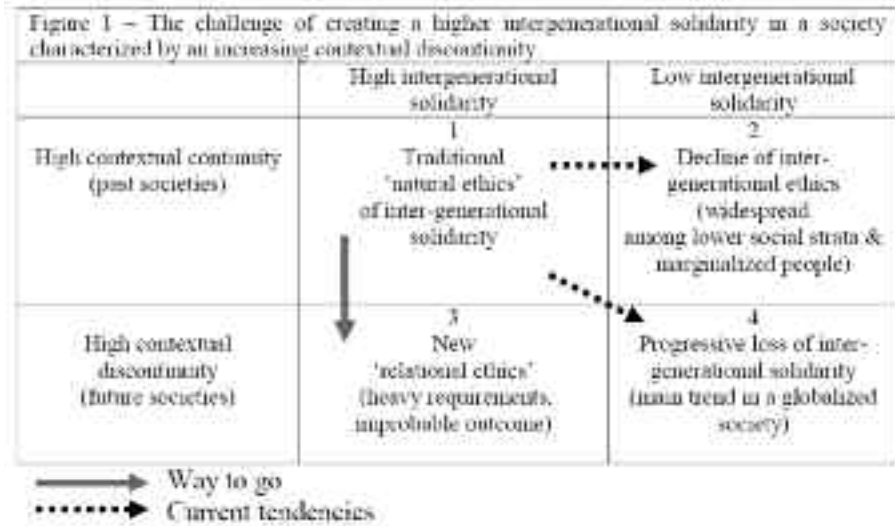
2) on a *meso* level: how can institutions and organizations of civil society – those in intermediate positions between families and the political system and which care for intergenerational relations – be promoted;

3) on a *macro* level: how can the role of political-administrative systems (States and supranational political systems) be redefined so that they support relations of solidarity between the different generations when distributing public resources, regulate economic and social exchanges when they create inequities between one generation and another, and determine entitlement to social rights on the part of, respectively, the young and the elderly?

The traditional ethics of intergenerational solidarity, entrusted for the most part to the family and primary social networks, is no longer sufficient in that it is in decline, and its dwindling importance is inevitable. On the other hand, intergenerational solidarity can no longer be entrusted solely to the welfare state and to transfers from the administrative-political system either. New ethical, political, and economic criteria are needed on a societal level and within the framework of globalization processes. The novelty of an ethics of intergenerational solidarity must be two-fold: a) it must invest all spheres of society; b) it must be elaborated taking into account the fact that networking characterizes the emerging society: in other words, it must be an ethics of relations in a social context marked by increasing morphogenesis of relations between the generations.

The challenge is how to avoid the deterioration of the traditional ethics of intergenerational solidarity in those contexts that conserve a strong socializing continuity (which are increasingly marginalized), as well as in contexts of market globalization. Social doctrine is called upon to rethink the ethics of intergenerational relations in contexts that are highly discordant with one another as regards the socialization of young people and the life courses of people (figure 1). The challenge is to elaborate a new 'relational ethics' (cell 3) which, confronted with the crisis of natural ethics (cell 1),

can avoid the tendencies towards the decline or the loss of intergenerational solidarity (cells 2 and 4). This new relational ethics should combine high intergenerational solidarity with the high contextual discontinuities of our future society.



In conclusion, what I am suggesting is to endorse an *all-generations approach* to public policy that does the following:⁶

- helps counter the negative impacts of the insular ‘silo’ approach to policy making,⁷ and works to attract wider public support for policies and programs addressing needs across the life course.
- views the increasing older population as a resource to be enlisted on behalf of the common good, not as a problem that will divide the nation along generational lines.
- stresses intergenerational sharing of opportunities and responsibilities in the families, educational system, labour market, and welfare services.

⁶ On this track see Cornman, Kingson, and Butts (2009).

⁷ That is, an insular management system incapable of reciprocal operation with other, related information systems, lacking collaboration between units, which reduces efficiency and can be a contributing factor to a failing corporate culture.

- encourages those who design, evaluate, and implement social policies and programs to seek and strengthen links among a range of institutions, departments, and programs to develop new collaborations between generations.
- calls for policies and programmes that engage and affect more than one generation through the building of social contexts endowed with a high level of sociability (or ‘social capital’ defined in terms of relations of trust, cooperation, reciprocity).

It is essential, when following this path, to combine the objective of inter-generational solidarity with the pursuit of family mainstreaming policies, which have been heavily penalized in almost all countries in favour of ideologies inspired by ‘institutionalized individualism’. In my opinion (Donati 2013), it is a matter of replacing the principle of individualism with a principle of relationality. The current debate in the US about the rising American generation, the so-called ‘millennials’,⁸ postpatriotic, postfamilial, disaffiliated, indicates the great challenge in front of us.

⁸ ‘In the future, it seems, there will be only one ‘ism’ – Individualism – and its rule will never end. As for religion, it shall decline; as for marriage, it shall be postponed; as for ideologies, they shall be rejected; as for patriotism, it shall be abandoned; as for strangers, they shall be distrusted. Only pot, selfies and Facebook will abide – and the greatest of these will probably be Facebook. That’s the implication, at least, of what the polling industry keeps telling us about the rising American generation, the so-called millennials. A new Pew survey, the latest dispatch from the land of young adulthood, describes a generation that’s socially liberal on issues like immigration and marijuana and same-sex marriage, proudly independent of either political party, less likely to be married and religious than earlier generations, less likely to identify as patriotic and less likely – by a striking margin – to say that one’s fellow human beings can be trusted. (...) The common denominator is individualism, not left-wing politics: it explains both the personal optimism and the social mistrust, the passion about causes like gay marriage and the declining interest in collective-action crusades like environmentalism, even the fact that religious affiliation has declined but personal belief is still widespread. So the really interesting question about the millennials (is) whether this level of individualism – postpatriotic, postfamilial, disaffiliated – is actually sustainable across the life cycle, and whether it can become a culture’s dominant way of life’. (Douthat 2014).

References

- Archer, M.S. (2007). *Making Our Way Through the World: Human Reflexivity and Social Mobility*, Cambridge University Press, Cambridge.
- Archer, M.S. (2012). *The Reflexive Imperative in Late Modernity*, Cambridge University Press, Cambridge.
- Archer, M.S. (ed.) (2013). *Social Morphogenesis*. Springer, New York.
- Archer, M.S. and Donati, P. (eds.) (2008). *Pursuing the Common Good: How Solidarity and Subsidiarity Can Work Together*, Proceedings of the XIV Plenary Session of the Pontifical Academy of Social Sciences, Vatican Press, Vatican City. Available online <http://www.pass.va/content/scienze-sociali/en/publications/acta/common-good.html>
- Barry, B. (2000). Sustainability and Intergenerational Justice. In A. Dobson (ed.), *Fairness and Futurity. Essays on Environmental Sustainability and Social Justice*, Oxford: Oxford University Press: 93-117.
- Beck, U. and Beck-Gernsheim, E. (2002). *Individualization. Institutionalized Individualism and its Social and Political Consequences*. London, Sage.
- Bengtson, V.L. and Achenbaum, W.A. (eds.) (1993). *The changing contract across generations*, New York: Aldine de Gruyter.
- Bengtson, V.L. and Oyama, P.S. (2007). Intergenerational Solidarity and Conflict. In V.L. Bengtson and P.S. Oyama (eds). *Intergenerational Solidarity: Strengthening Economic and Social Ties*, Expert Group Meeting, Department of Economic and Social Affairs, UNO, New York.
- Blome, A., Keck, W. and Alber, J. (2009). *Family and the welfare state in Europe. Intergenerational relations in ageing societies*. Edward Elgar, Cheltenham.
- Bradshaw, J. and Holmes, J. (2013). An Analysis of Equity in Redistribution to the Retired and Children over Recent Decades in the OECD and UK. *Journal of Social Policy*, 42: 39-56.
- Bronfenbrenner, U. (1991). *Intergenerational Relationships and Cross-National Development: An Ecological Perspective*. Konstanz: University of Konstanz.
- Bronfenbrenner, U. (1996). *The State of Americans: This Generation and the Next*. New York: Free Press.
- Bronfenbrenner, U. (2004). *Making Human Beings Human: Bioecological Perspectives on Human Development*. New York: Sage.
- Corcuff, Ph., Ion J. and de Singly, F. (2006). *Politiques de l'individualisme entre sociologie et philosophie*. Ed. Textuel, Paris.
- Cornman J.M., Kingdon E.R., Butts D.M. (2009). Time for an All-Generations. Approach to Public Policy. *Generation*, 33, 3: 86-88.
- Donati, P. (1991). Equità generazionale: un nuovo confronto sulla qualità familiare. In: P. Donati (ed.), *Secondo Rapporto sulla famiglia in Italia*, Milano: Edizione Paoline: 31-108
- Donati, P. (1992/93). Family Movements and Social Policy in Europe Today: The Issue of Intergenerational Equity. *The Annals of the International Institute of Sociology*. New Series vol. 3: 205-220.
- Donati, P. (2002). *Inter-generational solidarity: a sociological and social policy issue*. In: E. Malinvaud (ed.), *Intergenerational Solidarity*, The Pontifical Academy of Social Sciences, Vatican City: 57-81. Available online <http://www.pass.va/content/scienze-sociali/en/publications/acta/intergenerationalsolidarity.html>
- Donati, P. (2013). *Sociologia relazionale. Come cambia la società*, Editrice La Scuola, Brescia.
- Donati, P. and Colozzi I. (eds.) (1997). *Giovani e generazioni. Quando si cresce in una società eticamente neutra*. il Mulino, Bologna.
- Douthat, R. (2014). 'The Age of Individualism', *The New York Times*, March 16, p. sr12.
- Dumont, L. (1983). *Essais sur l'individualisme. Un perspective anthropologique sur l'idéologie*

- moderne*. Seuil, Paris.
- Dykstra, P.A. and Fokkema, T. (2010). Relationships between parents and their adult children: a West European typology of late-life families. *Ageing and Society*, 2: 1-25.
- Etzioni, A. and Brodbeck, L. (1995). *The Intergenerational Covenant: Rights and Responsibilities*. Washington, D.C.: The Communitarian Network.
- EC Commission (1999), *Towards a Europe for All Ages. Promoting Prosperity and Intergenerational Solidarity*, Communication from the Commission of the European Communities, Brussels, COM (1999) 221, May 21.
- Fforde M. (2000). *Desocialization the crisis of the post-modern*. Aracne, Roma.
- Izuhara, M. (2012). *Ageing and intergenerational relations: Family reciprocity from a global perspective*, Policy Press Scholarship Online: March (DOI: 10.1332/policy-press/9781847422057.001.0001)
- Jong Gierveld, J. de (1998). Intergenerational Relationships and Solidarity Within the Family. In K. Matthijs (ed.), *The Family. Contemporary Perspectives and Challenges*, Leuven University Press, Leuven.
- Komter, A.E. (2005). *Social Solidarity and the Gift*. Cambridge University Press, Cambridge.
- Laslett, P. (1979). The Conversation Between Generations. In P. Laslett, J. Fishkin (eds.), *Philosophy, Politics and Society*, New Haven CT: Yale University Press: 36-56.
- Moor, N. and Komter, A. (2008). *Demographic changes, intergenerational solidarity and well-being in Europe: a comparative approach*. Multilinks position paper, April.
- OECD (2012), *The Future of Families to 2030*, OECD Publishing, Paris.
- OECD (2013), *OECD Framework for Statistics on the Distribution of Household Income, Consumption and Wealth*, OECD Publishing, Paris.
- Ortiz I., Moreira Daniels L., Engilbertsdóttir S. (eds) (2012). *Child Poverty and Inequality: New Perspectives*. United Nations Children's Fund (UNICEF), Division of Policy and Practice, New York.
- Ostrom, E., Gardner, R. and Walker, J. (1994). *Rules, games, and common-pool resources*. Ann Arbor: University of Michigan Press.
- Parfit, D. (1982). Future Generations: Further Problems. *Philosophy and Public Affairs*. vol. 11 (2): 113-172.
- Parfit, D. (1984). *Reasons and Persons*. Oxford, Oxford, University Press.
- Parfit, D. (1990). Overpopulation and the Quality of Life. In J. Glover (ed.), *Utilitarianism and its Critics*, London, Macmillan.
- PASS (2002). *Intergenerational Solidarity*. Editor E. Malinvaud, The Proceedings of the Eighth Plenary Session of the Pontifical Academy of Social Sciences (8-13 April 2002), Acta 8, Vatican City. Available online <http://www.pass.va/content/scienze-sociali/en/publications/acta/intergenerational-solidarity.html>
- PASS (2004). *Intergenerational Solidarity, Welfare and Human Ecology*. Editor Mary Ann Glendon, The Proceedings of the Tenth Plenary Session of the Pontifical Academy of Social Sciences (29 April-3 May 2003), Acta 10, Vatican City. Available online <http://www.pass.va/content/scienze-sociali/en/publications/acta/solidarity.html>
- PASS (2006). *Vanishing Youth? Solidarity with Children and Young People in an Age of Turbulence*. Editors Mary Ann Glendon and Pierpaolo Donati, The Proceedings of the Twelfth Plenary Session of the Pontifical Academy of Social Sciences (28 April-2 May 2006), Acta 12, Vatican City. Available online <http://www.pass.va/content/scienze-sociali/en/publications/acta/vanishingyouth.html>
- Sgritta, G.B. (1997). The Generation Question: State Solidarity versus Family Solidarity. In J. Commaille and F. de Singly (eds.), *The European Family*, The Netherlands: Kluwer Academic Publishers: 151-166.

- Singly, F. de (2000). *Libres ensembles. L'individualisme dans la vie commune*. Nathan, Paris.
- Turkle, S. (2011). *Alone Together. Why we expect more from technology and less from each other*. New York: Basic Books.
- Van Bavel, J., Dykstra, P.A., Wijckmans, B. and Liefbroer, A.C. (2010). *Demographic change and family obligations*, Multilinks deliverable 4.2, March (<http://www.vub.ac.be/SOCO/demo/papersonline/ID-WP2010-1.pdf>).
- Williamson, J.B., Watts-Roy, D.M. and Kingson, E.R. (eds.) (1999). *The Generational Equity Debate*. New York: Columbia University Press.

► X. CLOSING SESSION: MOTIVATING SOCIETIES

WHAT ROLE FOR SCIENTISTS?

■ NAOMI ORESKES,* DALE JAMIESON,** MICHAEL OPPENHEIMER***

I. Introduction

Scientists in the contemporary world have increasingly become “sentinels”,¹ alerting the world to matters – such as stratospheric ozone depletion, anthropogenic climate change, and biodiversity loss – that threaten both human well-being and the continued existence of the diverse life with which we share our planet. Although these threats are not purely matters of natural science – being rich with social, political, economic and moral dimensions – they were first identified by natural scientists, and they cannot be solved without a robust scientific understanding of their causes, character, and extent. Thus, scientists, it might seem, have an obvious role in discussing both the problems and their solutions.

Yet most contemporary scientists shy away from becoming involved in articulating solutions, fearing to trespass into territory that seems to belong to others. In some cases, scientists hesitate even to explain the implications of their work in human terms – hesitating, for example, to explain why a 2-degree climate change *matters* – insofar as that might also lead into non-scientific territory.

A major location where this tension expresses itself is in scientific assessments for policy. In an on-going research study of such assessments, we have found that participating scientists believe strongly in the existence and importance of a clear and distinct boundary between “science” and “policy.” In interviews with participants, the question of the relationship between science and policy persistently arises, and is viewed as an extremely important matter.²

* Professor, Department of the History of Science. Affiliated Professor, Department of Earth and Planetary Sciences. Harvard University.

** Professor of Environmental Studies and Philosophy. Director, Animal Studies Initiative. New York University.

*** Albert G. Milbank Professor of Geosciences and International Affairs. Princeton University

¹ Oreskes, Naomi, 2013. “The Scientist as Sentinel”, *Limn* 3: 69-71.

² This paper draws on research done as part of the project, “Assessing Assessments”, funded by the U.S. National Science Foundation, and to be presented in greater detail in a forthcoming book by the same title. Acknowledgements to Jessica O’Reilly, Keynyn Brysse, Milena Wazeck and Matthew Shindell for contributing to research discussed in this paper.

Scientists often claim that it is essential for them to honor the boundary between science and policy because their credibility as neutral, objective experts depends upon it. In making this argument, they are implicitly making an argument about *politics* – that they should not become involved in them. Politics, they say or suggest, is not a matter of objective knowledge and therefore a realm where scientists do not belong. Scientific facts, they argue, should inform political decision-making, but scientists, *qua* scientists, should not stray into politics. In formal interviews and informal conversations, many scientists involved in assessment work stress the imperative of preventing the “infiltration” of political considerations into their technical reports, insisting that it is essential that their work remain firmly on the “science” side of the science-policy border. If asked why it is essential, a common response is that the credibility of the assessment depends upon it.

Yet, at the same time, there are considerable differences of opinion among scientists as to where the posited boundary sits. Assessments exist for the purpose of providing scientific information to support potential policy decisions, a dimension that distinguishes them from “ordinary” scientific work, but in the practice (as opposed to the theory) of assessment, there is no absolute (or even consistent relative) standard for the relationship between “the science” and “the policy”. Some issues that may look to an outsider as policy matters may be considered by scientists to be amenable to technical analysis. Conversely, matters that some scientists wish to avoid as “political” might seem to a layperson to be highly technical. Moreover, many scholars in the social sciences would argue that the very act of making an assessment for a political purpose necessarily makes the assessment itself an instrument of politics.³

If we step back from current discussions, we find that scientists’ views on this matter have not been stable over time, but have changed considerably over the course of the 20th century. In theory – and from the perspective of expertise (as well as democracy) – an observer might agree that it makes sense for scientific experts to focus on science, leaving the social, political, and economic dimensions to other experts, to governments, and the public. In practice, this proves to be shifting, contested, and murky ground.

³ Sheila Jasanoff, *Science and Public Reason* (2013); idem. *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton, 2011); idem., editor. *States of Knowledge: The Co-Production of Science and the Social Order* (Routledge, 2004); Bruno Latour, *Politics of Nature: How to Bring the Sciences into Democracy* (Harvard, 2004); idem., *We Have Never Been Modern* (Cambridge: Harvard, 1993); Clark A. Miller and Paul Edwards, editors, *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (Cambridge: The MIT Press, 2001).

Some scientists believe that making policy recommendations *is* appropriate. In the U.S. National Acid Precipitation Assessment Program (NAPAP), for example, many participants suggested that the assessment would be incomplete without recommendations as to how much acid rain should be controlled. This meant calculating the degree of emissions reduction needed to protect lakes and forests. Other NAPAP scientists argued the opposite: that as scientists they should stand steadfastly in the domain of “science” and not tread in policy waters. Similar arguments were made about ozone depletion, and scientists assessing ozone in the 1970s and early 1980s similarly divided on the issue. Early assessments included discussions of how much and how rapidly chlorinated fluorocarbons – the chemicals that were causing ozone depletion – needed to be controlled. Over time, however, leaders in the ozone research community retreated from that position, as they came to believe it necessary to demarcate technical findings from policy recommendations, developing the rubric that an assessment should offer “policy-relevant but not policy-prescriptive” information. In hindsight most scientists who were involved in ozone now argue strongly against making policy recommendations. Scientists involved in climate change assessment generally take the same view, which is officially endorsed by the IPCC. In its statement of principles and procedures, the Intergovernmental Panel on Climate Change explicitly states that its role is to provide “policy-relevant but not policy-prescriptive information” (IPCC 2010).⁴

Scientists active in the IPCC argue that it is important, even essential, for them to stay on the “science” side of the science-policy divide, holding (sometimes with great force) that scientists should tell the government what obtains in the world, but not presume to tell the governments what they should do. (Or, to paraphrase Galileo, to tell how the heavens go but not how to go to heaven).⁵ To put it in David Hume and Max Weber’s famous *is/ought* terms, they should describe what is, but not presume to say what ought to be done about it.⁶ But it was not always this way; scientists’ views of their appropriate role in addressing policy questions have been neither uniform nor static.

⁴ <http://www.ipcc.ch/pdf/press/ipcc-statement-principles-procedures-02-2010.pdf>

⁵ Galileo Galileo: Letter to the Grand Duchess Christina of Tuscany, 1615, on line at *Modern History Sourcebook*, www.fordham.edu/halsall/mod/galileo-tuscany.asp

⁶ Robert Proctor, *Value-free Science? Purity and Power in Modern Knowledge* (Harvard, 1991).

II. Science and Policy: A Historical Trajectory

If we step back from recent assessments and the views of scientists now living, we can discern significant differences in approaches to this issue. Indeed, we can recognize a trajectory from a period immediately after World War II, when many physicists considered it not only appropriate but urgent that they speak out on political matters related to their science, through an intermediate period during the Cold War when scientists gave policy advice but in a more measured way, to our current situation wherein scientists insist that what they do is policy-relevant, but not political. In short, we can discern a trajectory of retreat from the political.

The Scientist as Wise Man and Public Intellectual

Consider Neils Bohr's famous interventions in the matter of nuclear arms control. Both during World War II and the years immediately following it, Bohr spoke passionately and publicly to the urgent need, created by nuclear weapons, for international cooperation to control their spread. But Bohr's intervention was not uniformly welcomed.⁷ After his meeting with U.S. President Franklin Roosevelt in 1944, the U.S. government questioned Bohr's loyalties, limited his participation in the Manhattan project, and placed him under FBI surveillance. It was not until 1995 that the U.S. government officially cleared Bohr – along with Robert Oppenheimer, Leo Szilard, and Enrico Fermi – of accusations that he had acted as agents for the Soviet Union. The FBI stated that their decision was based on their own “classified information” – in other words, files that the FBI (and perhaps the CIA) had collected on Bohr and the others, having at the time viewed scientists – particularly, but not only foreign-born ones – as uncertain allies.⁸

Bohr was joined by Albert Einstein, who spoke out strongly during the war against the Nazi threat, after the war for arms control, and in later years as an advocate for Zionism, pacifism, socialism, and civil rights. During the Cold War, Einstein also spoke strongly against McCarthyism in the United States. Both Bohr and Einstein can be seen as embracing the role of public intellectual, speaking on diverse cultural and political questions, some related to their expertise in matters nuclear but many others not.

⁷ Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1995).

⁸ http://articles.latimes.com/1995-05-02/news/mn-61373_1_atomic-bomb On scientists as uncertain allies, see also Oreskes, Naomi and Ronald Rainger, 2000. “Science and security before the atomic bomb: The loyalty case of Harald U. Sverdrup”, *Studies in the History and Philosophy of Modern Physics* 31B: 309-369.

Einstein and Bohr spoke as individuals, but as individuals whose views were taken to be of more than ordinary value in light of their exceptional brilliance and insights into the workings of nature. They were also taken, in some unarticulated but still evident way, to reflect the insights and wisdom of science. Einstein spoke as Einstein, but many viewed his as a voice of science and therefore as a voice of *reason*.⁹

The environment of their interventions was of course unique: the looming existential threat created by nuclear weapons. The atomic bomb owed its existence in part to the intervention of scientists, including Einstein, who signed (although did not actually write) the letter that first alerted U.S. President Franklin Roosevelt to the possibility that an atomic bomb could be built. Other scientists, notably Americans Vannevar Bush and James Conant, played a critical role in persuading the President that it should be built.¹⁰ Thus one might argue that, to a significant degree, the atomic bomb existed because scientists had waded into political (and military) waters. Given this, it was not entirely surprising that, having done so once, they would do so again.

Once the Manhattan project was underway, most American scientists who knew about it supported it, but as the war in Europe came to a close, the prospect loomed that the bomb would be used in a manner that scientists had not anticipated and did not necessarily support. Leo Szilard, the Hungarian-born scientist who actually wrote the famous “Einstein letter”, began a petition drive at Los Alamos to collect signatures against the use of the bomb against Japan.¹¹ Scientists at the University of Chicago, led by physicist James Franck, also began to organize opposition, advocating at least for a test demonstration before any possible use.¹²

Oppenheimer opposed the Szilard petition, discouraging scientists at Los Alamos from signing on grounds that the bomb’s use was outside their domain of expertise. Yet after the war, he spoke to many issues outside the narrowly

⁹ Silvan S. Schweber, *In the Shadow of the Bomb: Oppenheimer, Bethe, and the Moral Responsibility of the Scientist* (Princeton: Princeton University Press, 2013).

¹⁰ Stanley Goldberg, “Creating a climate of opinion: Vannevar Bush and the Decision to Build the Bomb”, 83: 429-452, 1992.

¹¹ Rhodes, *Atomic Bomb*, 697, 749-750, Charles Thorpe, *Oppenheimer: The Tragic Intellect* (Chicago: The University of Chicago Press, 2008), 7, 123, 156. See also Martin Sherwin, *A World Destroyed: The Atomic Bomb and the Grand Alliance* (New York: Vintage Books, 1977), 217-219; Gus Alperovits, *The Decision to Use the Atomic Bomb* (New York: Random House, 1995) 190, 604-607.

¹² Rhodes, *Atomic Bomb*, Sherwin *World Destroyed*, Alperovits, *Decision*.

technical, including, famously, arguing that physicists, having built the bomb, now knew “sin”. Later he would claim that the sin he referred to was the sin of pride, but that was not how most people interpreted it at the time. Most saw it as suggesting that scientists bore some responsibility for what they had done, and thus for thinking as well about its future and control.¹³

President Harry Truman, along with his military and political advisors, ignored the scientific opposition and used the atomic bomb against civilian targets in Hiroshima and Nagasaki. But the fact that their interventions were not necessarily welcomed (much less heeded) did not prevent men like Franck and Szilard from believing they were justified in taking the positions they did. Franck in particular argued that scientists’ intimate involvement in the question of atomic weaponry, including their “prolonged preoccupation with its world-wide political implications”, not only justified but indeed imposed upon them the obligation to offer their views.¹⁴

While at Los Alamos, Robert Oppenheimer disagreed, suggesting that scientists had no special competency in the social, political or military aspects of atomic weapons. A young Robert Feynman went further, claiming to practice “active irresponsibility” as a matter of principle.¹⁵ But soon after the war, many scientists began to argue something closer to Szilard and Franck’s position: in building the bomb they might not have sinned, but they did have an active responsibility to engage in discussions of its future use by virtue not only of their role in building it, but also by virtue of their intimate knowledge of and proximity to the problem. The so-called Scientists’ Movement – initially an informal assortment of voices but later organized into the Federation of Atomic Scientists and then re-named the Federation of American Scientists – stressed the point earlier made by Franck that their familiarity with atomic weapons gave them a particular, specific, and immediate responsibility to engage in public discussion of them. After the war, Oppenheimer allowed that it was “true that we are among the few citizens who have had occasion to give thoughtful consideration to these problems...”¹⁶

Oppenheimer was inconsistent – perhaps conflicted – on this point. During the war he argued against the scientists’ role in the decision on how or whether to use the bomb, but soon after it he argued for the imperative

¹³ Thorpe, *Tragic Intellect*, 191, 286.

¹⁴ Zuoyue Wang, *In Sputnik’s Shadow*. (New Brunswick: Rutgers University Press, 2009) 19–20.

¹⁵ Wang *In Sputnik’s Shadow*, 22.

¹⁶ Wang, *In Sputnik’s Shadow*, 20.

of policies to control it.¹⁷ In 1946, Oppenheimer would be a co-author, along with other Manhattan Project luminaries such as Hans Bethe, Arthur Compton, Walter Alvarez, and Glenn Seaborg, of the Report on the International Control of Atomic Weapons – known as the Acheson-Lilienthal report for the chairs of the committee – which advocated international control of fissile materials.¹⁸ The justification that these men offered for their foray beyond the technical and into the political was the same one Szilard and Franck had offered – that their intimate scientific knowledge of nuclear weapons gave them a particular – even unique – appreciation of the political and existential threat that they represented. Scientists also understood acutely that the notion of a “secret of the atomic bomb” was a fantasy; Soviet scientists would soon catch up if they had not done so already.¹⁹

When the time came just a few years later to discuss the hydrogen bomb, Oppenheimer and his colleagues dove deeply into a deep that was not merely, or even centrally, about its technical aspects. As historians Barton Bernstein and Peter Galison have shown, leading physicists initially opposed the H-bomb on moral grounds. Asked in 1949 whether the H-bomb should be built, a majority of the General Advisory Committee said no. The magnitude of the destruction it would wreak meant that the H-bomb could not be directed solely at military targets, but would necessarily kill civilians in copious numbers. A minority of the committee – including Enrico Fermi – went further, arguing that, as a weapon of mass destruction – a genocide weapon – it was “necessarily evil in any light”.²⁰ After the American decision to build the bomb was made – and Robert Oppenheimer humiliated, stripped of his security clearance in part because of his initial hesitation – prominent scientists, including Einstein and Bohr, nevertheless continued to speak against it, intermittently joined by others including Hans Bethe, Frederic Joliot-Curie, George and (later) Vera Kistiakowsky.²¹

¹⁷ Wang, *In Sputnik's Shadow*, 26.

¹⁸ <https://history.state.gov/milestones/1945-1952/baruch-plans>

¹⁹ Richard G. Hewlett and Francis Duncan, *Atomic Shield: 1947-1952*, Volume II of *A History of the U.S. Atomic Energy Commission* (Washington DC: US Department of Energy 1970); Herbert York, *The Advisors: Oppenheimer, Teller and the Superbomb* (Palo Alto: Stanford University press, 1989); Zuoyue Wang, 2014, Scientists and Arms Control: The U.S.-China Case and Comparisons with Climate Change, paper presented at “Arms Control and Climate Change Conference”, UT Austin, January 16-17, 2014.

²⁰ Barton Bernstein and Peter Galison, In any light: Scientists and the decision to build the superbomb, 1952-1954, *Historical Studies in the Physical Sciences* 19(267-347).

²¹ On the role of the Joliot-Curies in France, see Spencer Weart, *Scientists in Power*: (Cambridge: Harvard University Press, 1979). On Hans Bethe, see Silvan S. Schweber,

What role did Oppenheimer's initial opposition to the H-bomb play in his loss of his security clearance? Historians do not agree on the answer to that question, but we do know that the hearing board that took that action cited, as one justification, the fact that Oppenheimer had inappropriately strayed beyond the technical and into the moral and political realm.²² While most leading scientists – including the conservative stalwart Vannevar Bush – defended Oppenheimer, for scientists unsure of where the ship of science ended and the ship of state began, this was a clear shot across the bow. Oppenheimer's "candor" had seemingly contributed to his downfall. Historians Martin Sherwin and Kai Bird suggest that American scientists took this to heart, and now believed that they could serve the state "only as experts on narrow scientific issues".²³ That is an overstatement, but certainly scientists saw that reticence on policy questions was a safer strategy.

The rise of elite committees

Oppenheimer's downfall, and the broader context of the governments' need of scientific advice on diverse technical questions related to the prosecution of the Cold War, including, especially, Sputnik, led policy-makers increasingly to recognize science advice as a formal problem, and scientists to press for a formal mechanism to supply it. The need was answered by the creation of new institutional structures, most notably in the United States the President's Science Advisory Committee (PSAC, created in 1957), and the JASONs (established in 1960), a group of reclusive scientists, originally all physicists, who advised the U.S. Department of Defense and the Atomic Energy Commission (later the Department of Energy) throughout the Cold War (and continue to do so today, albeit with a more diverse disciplinary and gender distribution).

Despite Oppenheimer's downfall, the scientists involved in these committees defined their role expansively. Historian Zuoyue Wang has described how PSAC members were mindful of the need not to over-step their authority – the famous question of whether scientists should be "on top" or "on tap" – particularly as their remit was explicitly to advise the President of the United States. Yet the argument was also made – most notably by a President,

Nuclear Forces: The Making of the Physicist Hans Bethe (Cambridge: Harvard University Press, 2012) and idem.

²² Wang, *In Sputnik's Shadow*, 46.

²³ Kai Bird and Martin Sherwin, *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (New York: Vintage Press, 2005) on p. 549.

Dwight Eisenhower – that the distinction between science and policy was too crudely wrought. Eisenhower argued that there was an *expertise-policy continuum* from technical considerations through policy evaluations and into political decision-making. Scientists, Eisenhower felt, would be more useful if they could “liberate themselves from their “exact” mind-set to see beyond the logic of technological determinism, and to take the broader political factors into considerations in the policy realm. This did not mean that he would want political considerations to distort technical evaluations, but it did mean that the technical arguments should be balanced with those derived from other justified sources”.²⁴ Many did: one sees in PSAC analyses considerations of diverse issues, from arms control to DDT, in which social, economic, and environmental aspects are not ignored. (PSAC under George Kistiakowsky also wanted to examine birth control, but Eisenhower rejected the topic as too divisive).²⁵

PSAC served as persuasive advocates for civilian control of the U.S. space program – and not only on technical grounds – despite pressure from the Pentagon to control it, and for the Limited Test Ban Treaty. They also served as persuasive critics of misguided military projects such as aircraft nuclear propulsion, and gave extensive advice about weapons systems, especially missile systems and the infamous “missile gap”. In all these areas, PSAC scientists argued that the technical and political considerations were closely linked, if not inseparable. Discussing a review of the 1961 DOD budget, for example, PSAC wrote “We have not found it possible to limit our review to purely technical considerations in view of the complex interaction between weapons technology and non-technical factors”.²⁶ Meanwhile, scientists like Herbert York, first Director of Defense Research and Engineering at the Pentagon, joined with PSAC in arguing against “technological palliatives to cover over serious persistent underlying political and social problems”.²⁷ York was not alone in becoming an advocate for arms control in light of the futility of trying to solve the problems posed by nuclear weapons by building more of them. And the President, according to Wang, consistently supported this approach.

While PSAC scientists may have restrained from overt political statements and were mindful of honoring the prerogatives of the President they served, PSAC in its day made many recommendations that, by the standards of our

²⁴ Wang, *In Sputnik’s Shadow*, 64.

²⁵ Wang *In Sputnik’s Shadow*, 107.

²⁶ Quoted in Wang, *In Sputniks’ Shadow*, 110.

²⁷ Quoted in Wang, *In Sputnik’s Shadow*, 104.

contemporary informants, would be viewed as over-stepping. Wang concludes that the overarching philosophy of PSAC in the Eisenhower administration was that experts needed to consider technical issues in their full context, that “technical issues could never be neatly and completely separated from social, economic, and political factors, and what was technically feasible was not always desirable”.²⁸ More than that, PSAC’s impact derived from this recognition and the willingness that followed from it *not* to restrict their analyses to the narrowly technical. “Crucially” Wang concludes, “Eisenhower agreed with PSAC on the need for science advising to integrate technical evaluations and policy considerations”.²⁹

PSAC scientists played a major role in supporting arms control because they believed it obvious that an uncontrolled arms race would decrease national security, no matter how sophisticated those arms were. What they brought to these discussions, Wang suggests, was a form of “technological rationality” that applied equally to the technical and the political.³⁰ In the words of the nation’s first Science Advisor, James Killian, the “scientific” issues they addressed “involve political, ethical, and scientific considerations in a way that ... cannot be wholly disentangled”.³¹ In short, Wang argues, PSAC scientists “wanted to exercise their social responsibility and [to consider how] their technical investigations fit into the broader social and political context”, and President Eisenhower encouraged them to do so. This overall philosophy continued into the Johnson administration, which, although more focused on domestic policy than its predecessors, wanted “scientists to help make life better for ‘grandma’”.³²

This is not to say that PSAC scientists never attempted to draw lines between science and policy – or, more specifically, between the scientific and the political – at times they clearly did. But it is to point out that in various ways these scientific advisors understood their role to be both technical and political. They believed that artificial distinctions between these realms would lead to flawed analyses and costly errors. And they rejected instrumental rationality by insisting instead that the ends of scientific and technological programs were as important to consider as the means.³³

²⁸ Wang, *In Sputnik’s Shadow*, 2.

²⁹ Wang, *In Sputnik’s Shadow*, 3.

³⁰ Wang, *In Sputnik’s Shadow*, 5.

³¹ Quoted in Wang *In Sputnik’s Shadow* 14.

³² Wang *In Sputnik’s Shadow*, 244.

³³ Wang *In Sputnik’s Shadow*, 9.

The same point may be made about the JASONs. The original JASONs were all physicists, but that did not stop them giving advice when asked in the 1960s and '70s about military policy in Vietnam, the desirability of building the SST or negotiating an anti-ballistic missile treaty, and whether climate change was something to worry about.³⁴ In the Vietnam case, scientists argued against carpet bombing on *moral* grounds, something which our current IPCC members would find at least discomfiting if not inappropriately over-stepping.³⁵

Before long PSAC *would* be accused of overstepping, as members of PSAC publicly opposed President Richard Nixon on the deployment of anti-ballistic missile defense.³⁶ PSAC had also opposed ABM under Johnson – on political as well as technical grounds – a position that was adamantly rejected by Johnson's Joint Chiefs of Staff, but supported by Defense Secretary Robert McNamara. Johnson did not have strong views on ABM, but President Nixon did, and the public stance against it taken by some PSAC members, as well as their publicly expressed opposition to the Vietnam War, deeply angered the President. His anger was compounded when PSAC member Richard Garwin testified in Congress against the super-sonic transport program, which Nixon also strongly favored and shortly after his re-election, Nixon dissolved PSAC.³⁷

Despite the demise of PSAC, scientists continued to play a role in diverse domains where the technical and political met. Throughout the 1960s, '70s, and '80s scientists such as Barry Commoner and Paul Ehrlich spoke publicly about environmental threats; Roger Revelle advocated actively for population control; and Frederick Seitz, a former President of the U.S. National Academy of Sciences, became a public advocate against tobacco control.³⁸ Physicists

³⁴ Wang, *In Sputnik's Shadow*, 259–260, Ann Finkbeiner, *The Jasons: The Secret History of Science's Post-war Elite* (New York: Penguin, 2006); Marvin ("Murph") Goldberger, personal communications.

³⁵ Finkbeiner, *The Jasons*, 63–71, 76–78, 87–89, 103–117; Goldberger, pers. comm.

³⁶ PSAC members, including science advisor Donald Hornig, had opposed President Johnson on the war in Vietnam (and before that President Kennedy on manned space flight) but this opposition had mostly occurred in private. See discussions in Wang, *In Sputnik's Shadow*.

³⁷ Wang suggests that Johnson's decision to develop the Sentinel "thin ABM" system over scientists' opposition, and particularly Robert McNamara's false suggestions in public that scientists had endorsed this approach, led PSAC scientists for the first time to begin to dissent publicly. Thus the ABM "split" began in the Johnson years, but culminated under Nixon. Wang, *In Sputnik's Shadow*, 280.

³⁸ Barry Commoner, *The Closing Circle: Nature, Man and Technology* (New York: Bantam Books, 1974); Paul Ehrlich, *The Population Bomb* (New York: Sierra Club–Ballantine

also continued to advocate for and even participate in arms control negotiations and agreements. Turning again to Wang, he has documented how in the late 1980s, Wolfgang Panofsky, Director Emeritus of the Stanford Linear Accelerator Center and member of the U.S. National Academy of Sciences Committee on International Security and Arms Control, helped to open a back channel to the Chinese government through his contacts in the Chinese physics community.³⁹ Personal connections seem to have played an important role in building relations in trust in the fraught domain of arms control; elsewhere however, elite committees and informal personal approaches were being overshadowed by the rise of organized assessments of science for policy.

From Elite Committees to Organized Assessments

The history of PSAC illustrates an intrinsic tension between objectivity and loyalty that may arise when scientists serve as advisors inside government. Members of PSAC served at the discretion of the President who appointed them, and the same is true of scientists who have served the US (or other) governments on the various panels that predated and post-dated PSAC. In hindsight, moreover, one might also agree at least in part with critics who noted that PSAC and JASON scientists commented on many areas well beyond their formal training and expertise.

It is therefore not surprising to find that one reason given by scientific participants for the need for international assessments was that they came to believe that international assessments would be viewed as more objective and therefore carry more authority than assessments tied to the policy aims of national governments.⁴⁰ One might conclude, in parallel, that national assessments might be viewed as more objective than the advice of individual scientists serving at the discretion of a particular President. Strikingly, the rise of formalized assessments does not quite coincide with the fall of PSAC, but it comes close: NAPAP was authorized by the U.S. Congress in 1980; the International Ozone Trends Panel issued its first report in 1981; the IPCC was created in 1988.

While scientific panels and committees within governments persist, and celebrated individuals at times still offer their opinions on diverse subjects,

Books, 1970); see also, Paul Sabin, *The Bet: Paul Ehrlich, Julian Simon, and Our Gamble over Earth's Future* (New Haven: Yale University press, 2013) and Naomi Oreskes and Erik M. Conway, 2010. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York: Bloomsbury Press).

³⁹ Wang, 2014.

⁴⁰ Keynyn Brysse, *Assessing Ozone*, forthcoming in *Assessing Assessments*.

since the late 1970s scientific advice has been increasingly sought by governments and offered by scientists in the form of large, formal assessments. Unlike the elite advisory committees that prevailed in the Cold War, these assessments are made by large groups (hundreds or even thousands) of scientists, few of whom are known to the public and most of whom may be fairly described as “rank and file” scientists. That is to say, whereas scientific advice for policy was previously offered by famous individuals, and then for a time by select committees of hand-picked mostly famous men, today it is offered by diverse scientists (many of whom are not particularly famous and certainly not known to the general public), often working in international contexts, and speaking in a collective voice.

III. Criticism, Pushback, and Shifting Epistemologies

For historians, it is hardly surprising to find that “science” and “policy” are not fixed categories, nor that the perceived relation between them has been involved shifting standards. However, many scientists *do* find it surprising, and, surprising or not, these observations lead to two questions: What drove the trajectory from individuals freely making policy recommendations, to smaller groups continuing to do so but in a more circumspect manner, to our current situation where the IPCC formalizes the concept of a high wall of separation? And if scientists have not always thought it wrong to make policy recommendations, why do so many of them think so now?

One obvious answer is political pushback. FDR’s response to Bohr is one illustration of the obvious fact that advice is not always wanted or heeded. Bohr was correct in his prediction that nuclear arms without arms control would lead to an arms race, but that did not make his inventions welcome in the political domain. One might argue that, almost inevitably, scientific interventions in the public sphere are going to be critical ones, insofar as scientists who agree with their nation’s policies or the general state of world affairs are unlikely to feel the need to speak out about them. Yet, by and large World War II and the early Cold war were periods when scientific advice was often heeded, and during which scientists were generally held in high cultural regard.⁴¹

But, as scholars have noted, the cultural heyday of science as a general model for knowledge and of scientists as the embodiment of epistemic au-

⁴¹ Daniel J. Kevles, *The Physicists: The History of a Scientific Community in America*, (Cambridge: Harvard University Press, 1995); Paul Boyer, *By the Bomb’s Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Rayleigh-Durham: The University of North Carolina Press, 1994); Wang, *In Sputnik’s Shadow*.

thority had a relatively short half-life after World War II. One might place the beginning of the end in 1960, when *Time* magazine chose “U.S. Scientists” for its man (sic) of the year. From the apogee, the cultural status of science began to drift downward, first as the political left began to doubt that we could expect “better living through chemistry”, and later as the political right became dis-enamored with a science that seemed to be challenging its core values and presumptions.⁴²

These larger cultural trends may help to explain the change in how scientists viewed their role. As the cultural position of science became less secure, scientists’ became less confident about offering advice to a world that was not so keen to take it, and began to retreat into the more circumscribed technical realm that PSAC, in the 1950s, had so consciously rejected. As society became more skeptical – and at times even hostile – to science, scientists further retreated to the safety of technical territory. Some went further, rhetorically draping themselves in institutional finery of “pure science”, treading carefully so as not to tear the fabric and insisting that they only intended to wear their own clothes and no one else’s. In short, when society was welcoming to scientists’ views on diverse subjects, scientists were happy to offer them and only occasionally doubted that they should. But when society became more critical of science, scientists increasingly hesitated to offer their opinions, and began to develop arguments to justify their hesitation.

This interplay between scientific attitudes towards cultural engagement and the cultural attitude towards science suggests that to a significant extent, what scientists think they *should* do depends on both the perception and the reality of what they actually *can* do, given the prevailing political and social context. The history recounted here suggests that, when it comes to the relation between science and policy, scientists have transformed necessity into virtue, and transmogrified political reality into epistemology.

Some evidence to support this interpretation may be found in the history of attempts to analyze the threat of stratospheric ozone depletion.

IV. Failed Boundary Work: The 1979 Ozone Assessment

Sociologist Thomas Gieryn has long argued that scientists do “boundary work” to preserve and protect their authority against those who might usurp

⁴² Oreskes and Conway, *Merchants of Doubt*. See also Peter J. Jacques and Riley E. Dunlap, *The Organisation of Denial: Conservative think tanks and environmental skepticism*, *Environmental Politics*, 17(3): 349-385, 2008; Thomas Medvetz, *Think tanks in America* (Chicago: The University of Chicago Press, 2012).

or undermine it.⁴³ His classic paper on this subject gave a sociological gloss to a problem that philosophers had previously defined as epistemic: the problem of demarcating science from non-science. Gieryn held that by establishing social borders between scientific research and other activities, scientists helped to establish and maintain the epistemic (and thus cultural) authority of their work. It follows that scientists who feel themselves to be in an insecure position may strive to establish clear and firm boundaries around it. And it also follows that as the cultural position of science became less secure in the 1960s and 70s than it had been in the period immediately following World War II, scientists would increasingly engage in boundary work.

In the early history of ozone assessment we observe this manifested in scientists' attempts to define and honor a boundary between scientific findings and policy recommendations.

In 1979, scientists at the U.S. National Research Council (NRC), the research arm of the U.S. National Academy of Sciences, were asked to assess the threat of stratospheric ozone depletion. Attempting to separate the "science" from the "policy", they wrote two separate reports, one that dealt with technical matters – the science or "is" part of the problem – and one that considered whether the manufacture and use of ozone-depleting chemicals should be restricted – the policy or "ought" part. However, they ran into troubled waters, and were criticized both at the time and by some later commentators for making policy recommendations.

In the most detailed account of the history of ozone science and policy, UCLA Law Professor Edward Parson criticizes the NRC scientists for wading into policy waters. Parson judges the scientists harshly for attempting to make policy recommendations, arguing that the reports "established a harmful model for scientific assessments and weakened the credibility of subsequent Academy reports on the issue", because, he argues, scientists were perceived as taking sides. He concludes that the reports did more harm than good in the international arena, where "those [governments] who were initially skeptical [of the need for regulation] viewed the Academy reports simply as scientific supporting documents for the US government position".⁴⁴

One might conclude that the scientists involved made a mistake by wading into the waters of policy, and indeed, influential scientists drew that

⁴³ Gieryn, Thomas F. (1983). "Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists". *American Sociological Review* 48(6): 781-795. doi:10.2307/2095325.

⁴⁴ Parson, Edward A. 2003. *Protecting the Ozone Layer: Science and Strategy*. Oxford: Oxford University Press, on 41.

conclusion. International ozone experts Robert Watson and Dan Albritton developed the rubric of “policy-relevant but not policy-prescriptive”, later instantiated at the IPCC, in light of their experiences of ozone assessments.

But Parson neglects to ask a key question: *why* did the scientists do what they did? The answer is: In response to a *request* from the White House. The charge for the report came from the White House Office of Science and Technology Policy, and it specifically asked for *both* a technical analysis of the problem and a set of recommendation as to what should be done in light of that analysis.

The National Academy of Sciences and the National Research Council were created to answer questions posed to them by the U.S. government. By definition, this means questions of policy import, so policy is always implicit in the issues being address. (As already suggested, the act of commissioning an assessment is a political act). But the Academy is not an arm of the government, so it necessarily faces the matter of how to give advice judiciously. Nowadays the NRC generally negotiates with its sponsoring agencies, and frequently works to adjust or alter questions that it finds to be poorly posed, but rarely does decline an offer to proffer advice. It is certainly difficult to imagine the NRC refusing or even seriously questioning a request from the White House.

This raises a further question: if the issues at stake were a question of desirable policy (rather than of technical information) and outside the realm of scientific expertise, then why did the White House ask the scientific community for its views? Without further research in Executive Office archives, we cannot answer this question definitively, but, as already noted, during the 1950s, 1960s, and even into the 1970s, it was common for the President, his staff, or other Executive Branch officials to ask the President’s Science Advisory Committee for their views on diverse issues, such as the use of pesticides, the prosecution of the war in Vietnam, or the appropriate response to the Santa Barbara oil spill.⁴⁵ There is no intrinsic reason why the White House should not ask any highly educated and intelligent expert or group of experts for their views on any matter. In this context, it seems unsurprising that the White House in the 1970s would have asked the NRC not just about the facts of ozone depletion, but also for advice about what to do about it.

Yet, just as the NRC scientists in 1979 were grappling with the questions placed in front of them, the relationships between scientific experts and the U.S. federal government were changing. The fact that we view the matter

⁴⁵ Wang, *In Sputnik’s Shadow*; Goldberger, personal communications.

differently now – that it now seems unproblematic to criticize scientists for doing what they were asked to do – clearly reflects changes in the character of science–society relations. One way to view this history is to suggest that the scientists involved got caught in shifting societal standards and expectations. Another is to suggest that the terms “science” and “policy” are too blunt to adequately capture the subtleties of the issues at stake.

The policy question that the NRC scientists were asked to answer – whether the probable extent of ozone reduction warranted restrictions on the use of CFCs – was a matter of assessing the *severity* of the problem, and to do this required specialized technical expertise. In this sense, they were being asked to address the necessity of a proposed policy goal, and they responded to a request to judge the extent of what appeared to be a serious problem but whose exact degree of severity was impossible for a layperson to judge. It was neither unreasonable that they were asked the question, nor that they answered it. *At that juncture, they were the only people in a position to answer.*

The scientists recognized the challenge that they faced, and tried, as we have seen, to maintain a clear distinction between the two questions by writing two separate reports. But their attempt at demarcation was not entirely successful, in part because although the questions may have been distinct the people involved were not. Essentially the same group of people who had summarized the technical information in the first report – the “is” question – were responsible for answering the “ought” in the second (perhaps affirming the point that no one else was really capable of doing so).

One way to read this episode, then, is as illustrating the difficulty that scientists have in finding (or building) and navigating (or patrolling) a clear boundary between science and policy/politics. If one wanted to criticize scientists for wading into policy waters, the fact that essentially the same group was involved in both reports certainly invited such criticism. But if no one else was able to answer the question posed, then what was the alternative? Scientists were asked the question of what should be done because their expertise placed them in a position to answer.

There is also a larger historical point that the scientists involved understood: that no matter what they did, they would almost certainly be criticized. As committee member Harold Schiff put it, they were not unaware that they were “fooling with a fairly major industry”.⁴⁶ In the highly contested domain of ozone depletion, where the financial, political, human, and environmental

⁴⁶ Quoted in Sharon Roan, *Ozone Crisis: The 15-year Evolution of a Sudden Global Emergency* (New York, Wiley: 1990), 80.

stakes were high, the idea that scientists could protect themselves from criticism through boundary work was probably unrealistic. At that time, the industry was still committed to defending its product, and therefore to challenging evidence that indicated its potential for harm. Sticking to the facts would not have shielded scientists from attempts to undermine those facts.⁴⁷

Scientists were striving to demonstrate their objectivity and avoid accusations of bias or inappropriate excursions into policy domains, but the reality was that many groups were standing ready to attack, no matter what the scientists had done. Given the stakes, as well as the hovering industrial sector to which Schiff refers, it seems reasonable to suppose that no matter what the scientists had recommended, and no matter how carefully those recommendations had been framed, they would have been criticized by those who did not like the results. Because ozone depletion had serious consequences – because it was a *problem* – the technical and the social – the *is* and the *ought* – overlapped.⁴⁸

Consider another example. In the 1975 Climate Impacts Assessment Program (CIAP), sponsored by the U.S. Department of Transportation, scientists came to the conclusion that the exhaust produced by a proposed large fleet of super-sonic transport planes (SST) would pose a serious threat to the ozone layer. This had the obvious policy implication that the proposed fleet should not be built. But bureaucrats in the sponsoring agency (whose leadership supported the SST) altered the scientists' message, writing an Executive Summary that dwelled mostly on the effects of a small and near-term projected SST fleet (30 or so aircraft), which were essentially negligible, and downplaying the possible effects that scientists predicted of the large long-term projected fleet (200 or so aircraft – although this number was not mentioned in the Executive Summary). In addition, any potential adverse effects were cast as preventable through future, unspecified and as yet undeveloped, technology. The overall effect of the tone and wording of the Executive Summary was to suggest that the scientists had dismissed, rather than confirmed, the worry that the SST could damage ozone. This suggestion that was erroneous. As Parson notes, “a wire service report of the press conference made this misinterpretation explicit and was widely repeated, in some cases with scathing attacks on the scientists who had raised the alarm”.⁴⁹ When scientists realized what had happened, they tried but found themselves

⁴⁷ Oreskes and Conway, *Merchants of Doubt*, Chapter 4.

⁴⁸ Oreskes and Conway, *Merchants of Doubt*, see also Wagner and McGarity, *Bending Science*; Michaels, *Doubt is their Product*; Proctor, *Golden Holocaust*; Brandt, *Cigarette Century*.

⁴⁹ Parson, *Ozone*, 28–29.

unable to undo the impact of the Department's intervention.⁵⁰ Why did the Department of Transportation misrepresent the scientists' conclusions? Presumably because they did not like their policy implications. Whether or not those implications were stated explicitly or were left implicit mattered not to the officials who wrote the misleading summary.

These episodes, and others in the histories we have documented, suggest that much as scientists may strive to define and respect a boundary between science and policy – and as much as they may strive to be fair, neutral, and objective – the intrinsically political character of assessments makes it almost inevitable that there will be pushback against scientific results from those who dislike their implications. It may have also be predictable – if not inevitable – that such pushback would cause at least some scientists to want to retreat from the contested borderlands into safer territory. One might conclude that that is what subsequently occurred.

The lesson that ozone scientists took from their experiences was that they needed to articulate a bright line between science and policy and “never to be prescriptive”. Dan Albritton expressed pride in the formulation he developed with Bob Watson, citing the example of the finding that “Unless there is a 100% elimination... of all long-lived chlorine- and bromine-containing compounds... the Antarctic ozone hole will be with us forever”. This, he argues, was not a prescription because it did not tell the governments what to do: “it was totally non-prescriptive”.⁵¹ Perhaps. But as Erik Conway and I have documented in our book, *Merchants of Doubt*, that did not stop opponents of regulation from criticizing them, nor has a comparable strategy protected climate scientists.

Moreover, albeit unstated, the policy implication of Albritton's statement is by no means unclear: it suggests that society should move towards 100% elimination of all long-lived chlorine- and bromine-containing compounds. Semantics matter, and Albritton may be correct that governments prefer an implicit approach, perhaps because it seems less arrogant and more respectful of governmental authority and prerogatives. The implicit rather than explicit approach may be a useful and defensible *rhetorical* strategy. It may even be understood as a form of good manners. But epistemologically, the policy implication was certainly clear to the industries who opposed the finding, framed prescriptively or not, which is, of course, why they objected to it.

⁵⁰ A similar story is told about an Acid Rain peer review panel, in 1983, see Oreskes and Conway, *Merchants of Doubt*, Chapter 3.

⁵¹ Brysse, *Assessing Ozone*.

To avoid both prescription and the pushback they believed it provoked – to make it clear that they were “rendering unto Caesar...” – ozone scientists moved into the mode of “scenario development”, a model that is now extensively used in climate assessments. By this they meant outlining what-if (or what-if-not) options. But, as several of our informants have noted, this still implicates them in choices that are not purely technical. When climate scientist Jonathan Shanklin suggested in an interview the benefits of letting politicians “chose from a menu” of policy options, his colleague Michael MacIntyre revised that to say that scientists should *not* present policy options, they should rather say, “if you do this, then we think the range of possible [outcomes] is that”.⁵² Yet, whether it is a menu of options or a set of scenarios, scientists decide what is on the menu and which set of scenarios is reasonable and appropriate to analyze and offer.

Albritton’s “choices” for policy-makers and Shanklin’s “menu of policy options” also introduce an intriguing ambiguity. On the one hand, ozone assessors now generally agree that it is not their place to make explicit policy recommendations; the international ozone assessments since the Montreal Protocol have adhered to this ideal. On the other hand, ozone assessors also agree that the assessments should present a clear set of options, menu selections, or choices. This would seem, in general, to be sending the message that policy action is needed, and this is one reason why assessments come under attack as “politicized” by those who think that doing nothing is not only acceptable but preferable. The very fact of having an assessment suggests that the issue being assessed is at minimum at potential problem about which something (at least probably) needs to be done. (The IPCC “business as usual” scenario is not presented as a reasonable choice, but as a mean to demonstrate the adverse implications of continuing to act as we have been acting). In principle, business as usual may be one of the options, but in practice there is an implicit message that it would be highly undesirable, if not unconscionable.

Assessors are not telling policy-makers what choices to make, but they are deciding what choices to *present* and guiding policy-makers to interpret those choices in certain ways. Watson credits the fact that the ozone assessments did just this with a large measure of their success: “most critically, we had developed a set of plausible futures that highlighted the implications of inaction as well as the implications of different policy actions”.⁵³

⁵² Brysse, *Assessing Ozone*.

⁵³ Watson 2005, 476.

How do assessment authors decide which scenarios should or should not be included in an assessment? Should this process of inclusion/exclusion be viewed as a political decision? Interestingly, few of our informants raised this issue. While Watson argues that scientists should not tell policy-makers what to do (i.e., which policy option to choose), he still argues that that ozone assessments *should* present them with a selection of clear policy options among which to choose; many of his colleagues agree. One could argue that this weakens the wall of separation that Watson and others have worked hard to build. After all, what does it matter if the Antarctic ozone hole lasts forever, if you are not suggesting that that is a bad thing? Scientists speak of doing the thing that is “least worst”, but this is least worst is from their perspective, and that may be different from that of stakeholders outside the scientific community. As Albritton notes, you are not presenting every option under the sun, you are presenting a set of options that seem reasonable to you. Scientists routinely leave out options that others might consider reasonable – prayer, for example. So while the conceptual virtue of scenarios is clear, the strategy does not expunge judgment, and perhaps in part for that reason it has not succeeded in expunging political pushback, either.

Both NAPAP and early ozone assessments included both science and policy. In some cases this was by design: scientists were asked to make policy recommendations relevant to the question of urgency, something which they, as experts, were in a position to understand. In other cases it was by desire: scientists felt themselves qualified to make recommendations of a certain sort. But scientists were criticized – by industry representatives, by government officials, and by later commentators, and even explicitly blamed for delaying regulatory action by blurring the boundary between science and policy. Parson, perhaps the most well informed of the critics, argues that the incursions into policy in the UK ozone reports of the late 1970s undermined their scientific contribution.

Although these reports [i.e., UK DoE 1976 and 1979] provided cogent reviews of scientific knowledge and recent results, the attempt to combine objective scientific review and partisan advocacy in one volume rendered their credibility suspect and their purpose obscure. ... The substantial scientific effort that went into these assessments was wasted as contribution to international policy debate, because the resultant report was tainted by its association with the UK government position.⁵⁴

⁵⁴ Parson, *Ozone*, 97-98.

Parson is arguing that scientific credibility rests on its objectivity and objectivity rests on neutrality. If scientists are seen as aligned with their government's stated or desired policies, their contributions may be suspect. Many scientists would agree. But Parson provides scant concrete evidence to support the claim of "taint" – and leaves it unclear as to who considered the report tainted. Many parties had reason to want to delay regulatory action on ozone, and it seems reasonable to suppose they would have found reasons to justify that position whether or not the UK reports had cleanly and clearly separated the "science" from the "policy". After all, the US NRC had done what Parson suggests the UK scientists should have done – separated the science and the policy into separate volumes – but both industry and Parson criticized them as well.

What does seem to be the case is that scientists took from these episodes the lesson that Parson suggests they should have taken: to build and keep a high wall of separation between science and policy. Another response to this was to make the assessments international, so that they could not be accused of representing the views of any particular national government. Yet a third was to make them larger.

V. Institutional Expansion and Standpoint Epistemology

By making their ozone assessments international, Bob Watson and colleagues tried to address the complaint that they were biased in favor of their own governments' views. They also began to expand the size of their assessments, to include as many relevant experts as possible. In essence, they adopted a standpoint epistemology, attempting to demonstrate and achieve objectivity by including the broadest possible range of perspectives. This is the approach that prevails in the IPCC today, where inclusivity is a guiding principle: it is a matter of course that chapter authors must encompass men and women, include representatives from many countries, and not be dominated by scientists from the US or Western Europe. It is also now viewed as important that, to the degree possible, anyone who has significant expertise should be included in the process, if not as a lead author, then as a contributing author or at least a peer reviewer. Objectivity is constructed as a group accomplishment; accusations of bias are remedied through inclusionary processes. The intellectual presumption is that so long as sufficient diverse voices are heard, no one bias could prevail.

The expansion of the IPCC to be as inclusive as possible may be viewed as a defensive measure to protect the organization from accusations of bias. It may also be viewed as reflecting a contemporary vision of objectivity as a group achievement: it appears that scientists have come to the conclusion

that to achieve credibility and influence, assessments must demonstrate objectivity through inclusivity. (One may note the irony that scientists are embracing a version of objectivity that only a few years ago was considered radical, and a threat).⁵⁵ In this context, it is important to note that the impetus for the creation of the IPCC came from scientists, and scientists have largely presided over its growth. Scientists have not been forced to participate in assessments nor to make them as large as possible; they have done this by their own volition.⁵⁶ The “scientific voice” is no longer the voice of the sage individual, or small group of sages, but the collective voice of the essentially the entire community of relevant experts. The growth of the institutionalized assessment both reflects and reinforces this view.

Consensus then emerges as an important element, because it signals agreement and permits scientists to speak with a collective voice. The consensus of the scientific community marks the recommendations of the assessment as not merely the views – the *opinion* – of a man or even a group of men and women. It marks the results as scientific *knowledge*. Through the assessment, expert opinion is transmuted into knowledge.

This contrasts markedly with earlier traditions, and with the epistemologies that prevailed in early modern science generally, wherein the reliability of the scientific knowledge was assumed to arise from the stature and reliability of the individual or individuals involved. As Steven Shapin and others have emphasized, early modern traditions placed the source of epistemic credibility in the virtues of the individual scientist.⁵⁷ This view persisted into the 1960s, as small groups of “wise men” were called upon to offer up expertise on diverse subjects ranging far from their disciplinary expertise. The intellectual presumption seems to have been that if the correct experts were chosen – men of both relevant knowledge and good reputation – then correct answers could be expected to follow.

The modern assessment both reflects and creates a different epistemological standard, one that implies that no matter how “good” any particular expert, he or she may be accused of bias. Thus, we see a practice we may label “bal-

⁵⁵ Cf. Sandra Harding, *The Science Question in Feminism*, Ithaca: Cornell University Press, 1986 and idem., editor, *The Feminist Standpoint Theory Reader: Intellectual and Political Controversies* (Routledge, 2003); Helen E. Longino, *Science as Social Knowledge* (Princeton: Princeton University Press, 1990).

⁵⁶ Bert Bolin, *A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2008).

⁵⁷ Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth Century England* (Chicago: The University of Chicago Press, 1995).

ancing of bias” – that of including as many voices as possible in the belief that this ensures that any possible biases are cancelled out.⁵⁸ Objectivity is not achieved by finding the right (unbiased) individuals, but by finding a capacious and comprehensive mix of differently biased ones. Bias is viewed as a form of error that may be cancelled by opposing error. This is an epistemic shift from locating the source of scientific objectivity and reliability in the individual to the institution.

The balancing bias approach gives the scientific community an argument with which to respond to accusations of bias; whether or not it actually produces an epistemically robust result is another matter. Whether it helps to prevent political stalling is also unclear. Recent experience suggests that those who wish to delay action will find ways to do so irrespective of how scientists present the evidence that might warrant such action. Over the course of the 20th century, we have seen a shift from assessments that were primarily nation-based to assessments that are predominantly international, a shift to more clearly delineate and separate technical from political considerations, and a shift to larger numbers of included experts. Yet these changes have not led to speedier political response.

Moreover, despite the evident shift in prevailing epistemology within the scientific community, it appears that important cultural strands, at least in the US and Europe, still cling to the older model. Thus opponents of action on climate change have embarked on significant efforts to discredit particular individuals whose work has played a major role in IPCC conclusions. After the IPCC concluded in its Second Assessment Report that the “balance of evidence suggests a discernible human impact” on global climate, the co-lead author of the key chapter on attribution was the target of a sustained and hostile attack on his virtue, accused of doctoring the conclusions and making unauthorized changes in the report (claims that were later shown to be unsubstantiated). In the wake of the Third Assessment, climate scientist Michael Mann, a co-author of the “hockey stick graph” documenting the rapid uptick of global mean temperatures as measured by instrumental records and proxies, was also the target of personal attacks and Congressional investigations suggesting personal misbehavior. And after the IPCC released its Fourth Assessment and shortly before the 2009 Copenhagen COP 15

⁵⁸ On “balance as bias” in the media, see Maxwell T. Boykoff and Jules M. Boykoff, *Balance as Bias: Global Warming and the U.S.* (Prestige Press, 2004), 125-136; idem., *Climate Change and Journalistic Norms: A case-study of US mass-media coverage*, *Geoforum*, 38: 1190-1204, 2007.

meeting, the personal emails of British climate scientists Phil Jones, evidently stolen some time before, were released to the public and the media, accompanied by allegations that Jones and his colleagues had attempted to fudge the data and to distort the peer review process.

If the IPCC strategy of objectivity and reliability through scale and diversity had been effective, these attacks on individual scientists would have lacked resonance. Observers might have simply argued that, even if an individual had done something inappropriate, it would have been detected and corrected by the others involved. Indeed, some defenders of Santer did make exactly that point – that Santer could not have done what he was accused of doing without others noticing.⁵⁹ Defenders of Phil Jones similarly argued that he was just a human being, and any dark thoughts he may have expressed in private was irrelevant to the larger (public) IPCC process. But arguments of these sorts had little impact on the media or in the blogosphere, which were greatly take with the idea that individual malfeasance was a major story.⁶⁰

In short, scientists have adjusted their practices to vest reliability, credibility, and authority in the organizational structure of the assessment, rather than in the virtues of the individuals involved, but if the motivation for doing so is to persuade larger publics of their virtue, or to address the concerns raised by critics and accelerate the uptake of scientific conclusions into policy making, a critical observer might conclude that those efforts have not had the desired effect. The same may be said about the strenuous efforts that have been made to segregate scientific conclusions from policy recommendations.

VI. Conclusion: Normative Considerations and the Role of Consensus

Let us return to Neils Bohr. As historian Paul Boyer has noted, Bohr was not only criticized by government officials who suspected his motives, but also by civilian commentators who questioned his authority to expound on matters of international diplomacy. Was Bohr not speaking out of court, some asked, when he attempted to tell world leaders how they should pursue their affairs? Arms control was not, after all, a *scientific* matter; it was a *social and political* one. And was it not ironic, even hypocritical, for the scientists who made weapons of mass destruction possible now to instruct the world on the necessity of peace?⁶¹

⁵⁹ <http://connection.ebscohost.com/c/articles/9703113538/open-letter-ben-santer> see also <http://www.ucar.edu/communications/quarterly/summer96/insert.html>

⁶⁰ Boykoff and Boykoff, *Balance as Bias*.

⁶¹ Boyer, *Bomb's Early Light*.

These were reasonable questions in 1950 and they remain reasonable today. What right do scientists have to speak on social and political solutions beyond the domain of their technical expertise? If they do, what obligations do they incur? Certainly scientists have the same right as ordinary citizens to speak up on issues of import. Beyond that, scientists have the right – and some would say the obligation – to speak out, to alert the world to threats, challenges, and opportunities of which they, by virtue of their scientific expertise, are especially or even uniquely aware. Is it possible to make sense of these competing considerations and make a normative recommendation? Is there a recognizable line between useful interventions and unhelpful stepping out of bounds?

Policies and Instruments

One way to begin to answer these questions is by differentiating between policies and instruments. While scientists like Watson and Albritton came to an unequivocal conclusion that they should not make policy recommendations, others came to a different conclusion. Sherwood Rowland, who first recognized the threat that CFCs represented to stratospheric ozone (and later won the chemistry Nobel Prize for it) thought it was important that ozone scientists speak out because they understood the character of the problem in a way that no non-expert could. In fact, because they (alone) understood the threat that ozone depletion represented, they had an obligation to speak out. That obligation went beyond simply describing the problem to becoming advocates for action to prevent further irreversible damage to life on Earth.

The key point here is that their expertise put them in a unique position: no politician, no layperson, and not even a scientist who was not an ozone expert could accurately articulate the threat. But it went further than this. One could argue that ozone scientists were right to raise the alarm, but still should have left the policy decisions to the government – in effect what Parsons does argue. This is also what Hans Bethe argued in the wake of Hiroshima and Nagasaki: that scientist should speak up, yes, about the threat of atomic weapons, but they would refrain from advocating a means of arms control – such as world government – lest they lose prestige by speaking too far outside their realm of expertise, prestige they might need in the future when their expertise was again needed.⁶² Bethe's argument reminds one of the most recent arguments of climate scientists, stressing that honoring

⁶² Wang, *In Sputnik's Shadow*, 24.

the science/ policy divide preserves their credibility. Yet, the boundary where technical expertise ends and politics begins is not so easy to draw.

Returning to ozone, it took a certain level of expertise to understand *what* level of reduction in the use of CFCs would protect the ozone layer, and how soon that level of reduction needed to be achieved. These were technical matters, yes, but they were also matters of policy as well. How much and how fast were questions that were both scientific and technical. Therefore, it was not only appropriate but necessary for experts to be heard, not just on the fact of ozone depletion, but also on the degree of action needed to prevent it.

In effect, what Rowland was saying was that “policy” is too capacious a word to address what needed to be done. One aspect of policy was the demand for the rapid decrease or phase out in the use of CFCs. Was it enough to reduce them a little? Or did they need to be phased out entirely? And how rapidly did that need to occur? These were policy issues, but they could only be answered through technical expertise. In essence, they were questions about *what to do*. In the case of both acid rain and ozone the answer was: reduce emissions of the pollutants that were the driving forces of the problem. This was a policy question, but it was also a scientific question, because it was a matter of science to identify the driving forces. Once you knew what the driving forces were, it was a logical – indeed a deductive – consequence that they had to be controlled, and it took a scientist to determine what levels and rates of reductions were needed. A second aspect of policy was the choice of instruments to achieve that control. Those questions required different sorts of expertise. We could call this the second sense of policy the *how to do it*: with taxes, treaties, emissions trading regimes, or other policy instruments. Ozone was controlled through an International convention, acid rain through an emissions trading regime. It took other forms of expertise to answer the question of the choice of instruments to do the job. (Although as we have already noted, some nuclear physicists became advocates for the particular instrument of international control of atomic weapons).

Rowland’s position implicated him in an implied value premise: the value of life on Earth as we know it. If one wanted to protect life on Earth, then it was necessary to prevent ozone depletion. For Rowland, the value of life was so obvious as not to need stating, so the implication – that ozone needed to be protected – was equally obvious. And no one, in fact, ever seriously argued otherwise. Yet, many of his colleagues did feel that he went too far, and some felt for that reason that he would not be an asset in the assessment process, and should not be asked to serve on ozone assessments. But how and where did scientists make that judgment? Why was it acceptable to imply – even extremely strongly – that ozone-depleting chemicals needed

to be controlled but not acceptable to say so explicitly?

For our purposes here, the significant question is how and why certain kinds of claims that go beyond the “purely scientific” are judged to be appropriately included in “scientific” judgments. Parson attributes the qualities of “modesty” and “common-sense” to the conclusion offered by some scientists that if CFC production continued unabated, stratospheric ozone would be substantially reduced. But one man’s common sense is another man’s gauntlet; today most climate scientists would say the same thing about anthropogenic climate change: that if greenhouse gas production continues unabated, dangerous anthropogenic climate change will accelerate. They might also say that given the harmful impacts of increased greenhouse gases in the atmosphere, it is common sense that greenhouse gas emissions need to be curtailed. The argument is logically parallel to the claim about CFCs, but that has not led to general acceptance or prevented attempts to challenge the epistemic authority of the IPCC.

Science/Policy v Facts/ Values

The scientific effort to distinguish between science and policy closely mirrors the traditional demarcation between facts and values. Scientists striving to remain on the “science side” of science/policy divide are striving to remain on the “fact” side of the facts/values divide. While there has been an enormous amount of ink spilled over the facts/values distinction, particularly on the matter whether or not it exists, most scientists have no doubt that it does and they believe that it is part of their job is to keep their science clear of values. Whether this is an ideal towards which one should rightly strive or a fantasy that obscures the intrinsic subjectivity of scientific work is not the question here. Rather, the questions here is to understand why scientists have taken the position they have.

It seems clear, on historical analysis, that under the increasing external political pressure of the mid-late 20th century, scientists concluded that their best way to protect themselves from criticism and attack would be to retreat from policy, and therefore, implicitly, politics. This meant developing both rhetorical and epistemic strategies that articulate and reinforce the presumed boundary that they promised not to transgress. This accounts for the observed historical trajectory from a period in which leading scientists, secure in their cultural position, spoke freely as to what they believed society needed to do, to the current situation in which scientists, insecure in their cultural position, insist that they do not and must not tell anyone what to do.

This historical trajectory mirrors Pierre Bourdieu’s distinction between the total intellectual and the specific expert. Bourdieu criticized what he

called intellectual prophet, or “total intellectual, the man (usually a man) who, by virtue of his position, may comment on any aspect of intellectual, political, or social life”.⁶³ His type case was Jean-Paul Sartre, but we might argue that Bohr and Einstein fit that role as well, speaking broadly on diverse issues far from the expertise that originally warranted their fame and presumably undergirded their credibility.

When scientists attempt to build demarcating boundaries, they are rejecting the ideal of the total intellectual preferring to be a specific expert, a man (or now a woman) who hews to his (or her) specific knowledge. Thus for example, when interviewed by the *New York Times* on the occasion of the release of the IPCC Fourth Assessment Report, an IPCC leader reiterated the IPCC conclusion that “warming was unequivocal”, but when asked what we should do about it, replied, “It’s not my role to try to communicate what should be done”.⁶⁴ When asked about this comment, former IPCC chair Robert Watson summarized the tension felt by many in the scientific community, saying on the one hand that, “Ducking the question of what is needed did weaken the impact of the report to many observers”, but on the other that one “could argue that her neutrality on the policy question provides her greater credibility as an unbiased scientist and chair”.⁶⁵

There are obvious reasons why specific experts should not stray beyond their specificity. Outside their domain of expertise, scientists often know little more than lay people and sometimes knowing less, as a consequence of their long years of specialized training and acutely focused work. (A thrust of my work with Erik Conway on the history of doubt-mongering and the construction of Potemkin science is to suggest that we should be troubled when scientists speak assertively on questions outside their specific expertise, as when a physicist makes claims about tobacco control or a climate modeler recommends nuclear energy policy).⁶⁶ When the IPCC leader declined to

⁶³ David Swartz, From critical sociology to public intellectual: Pierre Bourdieu and politics, *Theory and Society*, 32: 791–823, 2003. Swartz notes the irony that Bourdieu himself became a public intellectual, arguably of the sort he had earlier criticized.

⁶⁴ http://www.nytimes.com/2007/02/06/science/earth/06profile.html?module=Search&mabReward=relbias%3Ar%2C%5B%22RI%3A11%22%2C%22RI%3A14%22%5D&_r=0

⁶⁵ Disinterestedness here is interpreted as policy-neutrality. Before World War II it was largely interpreted as having no financial interest; see Wang, In Sputnik’s Shadow, 24.

⁶⁶ See Oreskes *Room for Debate* <http://www.nytimes.com/roomfordebate/2013/11/14/is-nuclear-power-the-answer-to-climate-change/we-need-a-new-manhattan-project-to-deal-with-climate-change>.

comment on the policy dimensions of global warming, she pre-empted (or attempted to pre-empt) the claim that her science might be biased by her political preferences, an understandable choice in the context in which climate scientists operate.

Yet our discussion should also make clear the limits of the specific expert, particularly insofar as the challenge of climate change – and many pressing issues of our day – cannot be solved by specific expertise alone. As diverse actors from Dwight Eisenhower to Bob Watson have noted, policy choices involve a good deal more than technical considerations, and the technical and the political are not always easily, or even appropriately, separated. Scientists' recommendations on such matters are not necessarily *inappropriate*, but they are often – one might even argue almost inevitably – incomplete. And some scientists, notably including those of the earlier generation who *did* give policy advice, felt that that the IPCC leader was too reticent. To give one example: former Caltech President Murph Goldberger, member of PSAC during the 1960s, and long-time member of the JASONs, felt that the IPCC had missed an important opportunity.⁶⁷

Proximate Expertise

From Neils Bohr to Sherry Rowland, scientists who defended taking a position on policy matters did so from a position we may label “epistemic proximity”, or “proximate expertise”. They argued that their particular, intimate knowledge of a problem – like nuclear weaponry or ozone depletion – qualified them to speak to the issue in a way that justified a public, cultural, intervention. This argument, I argue, gives us a basis for thinking about what the right role for scientists may be.

I wish to argue that scientists *should* generally refrain from making recommendations in areas far from their expertise, but they should not refrain from commenting on areas within their proximate expertise. In these domains, scientists, by virtue of their knowledge, are among those qualified to judge, and sometimes the most qualified to judge, what actions may be called for. Consider once again Sherry Rowland.

Sherwood Rowland was criticized by some colleagues for publicly stating that CFCs needed to be controlled. Rowland did not advocate a specific policy instrument, but some colleagues nevertheless felt that by calling for any action Rowland was over-stepping the science/policy divide. But

⁶⁷ Murph Goldberger, Discussion in SIO 286, February 6, 2007, Scripps Institution of Oceanography, University of California, San Diego.

consider this thought experiment. Imagine that Rowland and his colleagues had published their research demonstrating that chlorinated fluorocarbons (CFCs) had the potential to destroy stratospheric ozone. Imagine as well, that they had published this work as articles in peer-reviewed journals, but that like most scientific work it had been largely ignored. 30, 40 or 50 years later, dermatologists and oncologists began to notice an apparent but unexplained increase in rates of skin cancer. Epidemiologists analyzed the available data, and concluded that there was in fact an epidemic of skin cancers around the globe, especially severe in Australia, southern Chile, and among white Africans. Meanwhile, plant pathologists noticed increased UV-damage in agricultural crops; veterinarians noted increased rates of cataracts in farm animals. Scientists would have begun to search for an explanation for this strange association of human, animal, and plant pathology, and, in time, someone would have come across Rowland's work, connected the dots, and understood what was happening. Programs would then have been quickly put in place to measure stratospheric ozone, which would have demonstrated that the ozone layer had been massively depleted. But by that point, it would have been too late to do anything about it.

This scenario, while counter-factual, is not fantastic. It is essentially what did occur with asbestos and tobacco; it could easily have been the case with CFCs. Rowland and his colleagues had to be the ones to alert the world to the threat of ozone depletion – they had to be the sentinels – because there was no one else who could, for the simple reason that *there was no one else with the specific knowledge to understand the general threat*. By virtue of their epistemic proximity to the problem, these scientists were the only ones who could see it and explain it. They were the only ones who could sound an alarm. And they were the only ones who could accurately judge how urgent the problem was, and therefore how quickly society needed to adopt a solution. Their expertise was specific, but they needed to speak in a general way. By virtue of their epistemic proximity, they became the relevant public intellectuals. Perhaps we could call them “specific public intellectuals”.

One might argue that it is one thing to say, “CFCs can destroy the ozone layer that protects life on Earth from damaging UV light” (a statement of scientific fact) and “Therefore we must take steps to control CFCs” (a policy recommendation). This demarcation would fit the IPCC's current notion of policy relevant (this can happen) and policy-prescriptive (we need to control CFCs). But the fact is, the second statement is a direct consequence of the scientific information, a consequence that requires scientific understanding to deduce. Drawing on the traditional deductive-nomological model, we might say that the need to control CFCs is a deductive consequence

of the general conclusion that CFCs destroy ozone. We might put it this way: CFCs destroy ozone. Ozone protects us. Therefore, if we want to continue to benefit from the protection ozone offers us, we must control CFCs. This, of course is what Rowland did say. So we might go further: If we know the rate at which CFCs destroy ozone, then we might also say that CFCs need to be controlled within a certain time frame. This is what the NRC committees and the ozone trends panels were grappling with. They were using their scientific expertise to understand causes and consequences – and the rates at which those causes operate – something that scientists do every day. It is something that is very much part of science as traditionally understood.

One might draw a line between conclusions from the science versus recommendations as to how to achieve social and political goals. This is not a question of value-neutrality; any claim that the ozone layer should be protected – or that dangerous climate change should be stopped – is inherently value-based. It is rather a question of epistemic proximity: that scientists are epistemically proximate to certain questions and by virtue of that proximity in a position to judge the consequences of certain forms of actions or inaction. It does not mean that their views are necessarily correct, nor that they have adequately understood, much less incorporated, the complex social, political, economic, ethical, religious or aesthetic considerations that may be involved. But it does mean that their views are relevant, and it is not necessarily wrong for them to be articulated.

To return to the IPCC leader, here is what a group of graduate students, having discussed the issue in class, concluded that she might have said that day to *The New York Times*:

Well, I'm a scientist, so it's not for me to recommend specific policy instruments. But I can tell you this. We know what is causing global warming: it's increased greenhouse gases in the atmosphere. So whatever we do, we need to control greenhouse gases. And that's not just my opinion, it's the conclusion of the IPCC.⁶⁸

This final point brings us back to the question of consensus. U.S. National Research Council assessments of scientific evidence are called “consensus” reports, and consensus is an implied (if not explicit) goal of most (if not virtually all) assessments. The reason for this is now evident. Articulating conclusions as the consensus of an inclusive community of experts marks

⁶⁸ Graduate students in SIO 286, February 6, 2007, Scripps Institution of Oceanography, University of California, San Diego.

those conclusions as knowledge, rather than opinion. Bohr and Einstein spoke as men, the IPCC speaks for science.⁶⁹

But speaking for science necessarily also means that the moral and ethical considerations of the issue at stake have been expunged. It remains a challenge for scientists to find an appropriate way to communicate the moral implications of their technical work.

⁶⁹ And if consensus cannot be reached, it means that the science is not settled and we don't yet quite know what is going on, and more research really is needed.

EXISTENTIAL RISKS

■ MARTIN REES

In 1902, the young H.G. Wells gave a celebrated lecture at the Royal Institution in London. He spoke mainly in visionary mode. “Humanity”, he said, “has come some way, and the distance we have travelled gives us some earnest of the way we have to go. All the past is but the beginning of a beginning; all that the human mind has accomplished is but the dream before the awakening”. His rather purple prose still resonates more than a hundred years later – he realised that we humans aren’t the culmination of emergent life.

But Wells wasn’t an optimist. He also highlighted the risk of global disaster: “It is impossible to show why certain things should not utterly destroy and end the human story ... and make all our efforts vain ... something from space, or pestilence, or some great disease of the atmosphere, some trailing cometary poison, some great emanation of vapour from the interior of the Earth, or new animals to prey on us, or some drug or wrecking madness in the mind of man”.

The concept of devastating threats to human survival is certainly not new. Millennialism is perhaps as old as civilisation itself, and a scientific awareness of cataclysmic natural risk – from volcanoes and asteroid impact – dates back many decades. Were Wells writing today, he would have been elated by the amazing advances of science, but even more anxious about its ‘downside’. Revolutionary new technologies might lead – perhaps accidentally, and perhaps very rapidly, once a certain point is reached – to a catastrophe. Some of the risks that have been envisaged may indeed be science fiction; but others may be disquietingly real. In future decades, events with low probability but catastrophic consequences may loom high on the political agenda.

Over nearly all of Earth’s history, the greatest threats to humanity have come from nature – disease, earthquakes, floods, asteroids and so forth. But now our perspective is very different. More worrying by far are hazards that we ourselves engender – those caused by a rising population of humans, all empowered by advancing technology and more demanding of resources. Humans now utilise 40 percent of the world’s biomass; we are collectively affecting the world’s climate and ravaging the biosphere. The Earth has existed for 45 million centuries, but this is the first when one species – ours – has the planet’s future in its hands. We’re deep into Paul Crutzen’s ‘anthropocene era’.

Technological global hazards

Many speakers at this conference have addressed the threats stemming from the collective impact of the world's growing population on the biosphere and climate. I shall therefore focus on a different category of threats: those that could be caused by rather few individuals via misuse – by error or by design – of ever more powerful technologies.

At any time in the Cold War era – when armament levels escalated beyond all reason – the superpowers could have stumbled towards Armageddon through muddle and miscalculation. During the days of the Cuba crisis I and my fellow-students participated anxiously in vigils and demonstrations. But we would have been even more scared had we then realised just how close we were to catastrophe. Kennedy was later quoted as saying that during the Cuba crisis the probability of war was “between one in three and evens”. And only when he was long retired did Kennedy's defence secretary, Robert McNamara, state frankly that “[w]e came within a hairbreadth of nuclear war without realizing it. It's no credit to us that we escaped – Khrushchev and Kennedy were lucky as well as wise”. Be that as it may, we were surely at far greater hazard from nuclear catastrophe than from anything nature could do. Europe and North America would have been devastated; and the rest of the world would have suffered a ‘nuclear winter’. We'd likely have a million years' grace before suffering a *natural* disaster – a giant asteroid impact or volcano supereruption – that was as disastrous.

The threat of global devastation involving tens of thousands of H-bombs is thankfully in abeyance; there is, though, now more reason to worry that smaller nuclear arsenals might be used in a regional context, or even by terrorists. But we can't rule out, later in the century, a geopolitical realignment leading to a standoff between new superpowers. So a new generation may face its own ‘Cuba’ – and one that could be handled less well or less luckily than the 1962 crisis was.

But the thermonuclear threat is not the only one – and maybe now not the most serious one – that humans confront as a downside of advancing technology. The H-bomb stemmed from 20th century science. But we should now be even more anxious about the powerful 21st century technologies on which our civilisation increasingly depends.

There are benefits from living in an interconnected world. But in consequence we are increasingly dependent on elaborate networks: electric-power grids, air traffic control, international finance, just-in-time delivery, globally-dispersed manufacturing, and so forth. Unless these globalised networks are highly resilient, their manifest benefits could be outweighed by catastrophic (albeit rare) breakdowns – real-world analogues of what hap-

pened in 2008 to the financial system. Our great cities would be quickly paralysed without electricity. Supermarket shelves would be empty within a couple of days if supply chains were disrupted. Air travel can spread a pandemic worldwide within days, causing the gravest havoc in the shambolic but burgeoning megacities of the developing world. And social media can spread panic and rumour, and psychic and economic contagion, literally at the speed of light.

Because technology gives powerful leverage to small groups, or even individuals, we're vulnerable not just to accidental malfunctions that cascade globally, but to maliciously-triggered events that could have catastrophic consequences. IT and biotech have a dark side: they will present new threats more diverse and more intractable than nuclear weapons did.

The techniques and expertise for cyber attacks are becoming accessible to millions – they don't require large special purpose facilities like nuclear weapons. Cyber-sabotage efforts like 'Stuxnet', and frequent hacking of financial institutions, have already pushed these concerns up the political agenda. A recent report from the Pentagon's Science Board claimed that the impact of the most sophisticated (state-engineered) cyber-attack could be catastrophic enough to justify a nuclear response.

And, before too long, millions will have the capability and resources to misuse biotech, just as they can misuse cybertech today. Advances in synthetic biology offer huge potential for medicine and agriculture – but they amplify the risk of bioerror or bioterror. Just last year some researchers who'd shown that it was surprisingly easy to make an influenza virus both virulent and transmissible were pressured to redact some details of their publication. The concern here was partly that it would be aiding terrorists, but partly also that if such experiments weren't conducted everywhere to the very highest safety and containment standards, there would be a risk of bioerror.

In the 1970s, in the early days of recombinant DNA research, a group of biologists led by Paul Berg formulated the 'Asilomar Declaration', advocating a moratorium on certain types of experiments. In retrospect, this move was perhaps over-cautious, but it seemed an encouraging precedent. However, it is surely far less likely that similar self-regulation could be achieved today. The research community is far larger, far more broadly international, and far more influenced by commercial pressures. One fears that, whatever regulatory regime is established on prudential or ethical grounds, anything that can be done will be done, somewhere (cf. the failure to enforce drug laws).

The physicist Freeman Dyson foresees a time when children will be able to design and create new organisms just as routinely as his generation played

with chemistry sets. I think this prospect is comfortably beyond the ‘SF fringe’, but were even part of this scenario to come about, our ecology (and even our species) surely would not long survive unscathed. (The consequences are so unpredictable and potentially widespread that it is unlikely that a bioterror event would be triggered by extremist groups with well-defined political aims. But such concerns would not give pause to an eco-fanatic who believed that ‘Gaia’ was being threatened by the presence of too many humans in the world. Most devastating would be a potentially fatal virus that was readily transmissible and had a long latency period).

Those of us with cushioned lives in the developed world fret too much about minor hazards: improbable air crashes, carcinogens in food, low radiation doses, and so forth. But we are less secure than we think. We (and our political masters) are in denial about catastrophic scenarios. These could be triggered as suddenly as the 2008 financial crisis; or they could develop insidiously. The worst have thankfully not yet happened – indeed they probably won’t. But if an event is potentially catastrophic, it is worth paying a substantial premium to safeguard or insure against even if it is unlikely – just as we take out fire insurance on our house. Society could be dealt shattering blows by misapplication of technology that exists already, or that we can confidently expect within the next 20 years. It is, however, unrealistic to expect that we can ever be fully secure against bioerror and bioterror: risks would remain that cannot be eliminated except by measures that are themselves unpalatable, such as intrusive universal surveillance.

Looking forward to mid-century

But it’s the trends in coming decades that should make us even more anxious. So I’ll venture a word about these – but a tentative word, because scientists have a rotten record as forecasters. Lord Rutherford, the greatest nuclear physicist of his time, said in the 1930s that nuclear energy was ‘moonshine’. One of my predecessors as Astronomer Royal said, as late as the 1950s, that space travel was ‘utter bilge’. My own crystal ball is very cloudy.

We can predict confidently that in the latter part of the 21st century the world will be warmer and more crowded. But we can’t predict how our lives might then have been changed by novel technologies. After all, the rapid societal transformation brought about by the smartphone, the Internet and their ancillaries would have seemed magic even 20 years ago. So, looking several decades ahead we must keep our minds open, or at least ajar, to prospects that may now seem in the realm of science fiction.

My own expertise is in astronomy and space technology. Colleagues may therefore think I worry specially about asteroid impacts. I don’t. Indeed the

threat from asteroids is one of the few that we can quantify: we know roughly how many objects are on Earth-crossing orbits; and we know what the consequences would be from impacts of bodies with different sizes. Every few million years, there would be impact of a body a few kilometres across, causing global catastrophe – we have about one chance in 100000 that this will happen in our lifetime. But there is of course a higher chance of smaller impacts that would cause regional or local devastation. A body (say) 300 metres across, if it fell into the Atlantic, would produce huge tsunamis that would devastate the East Coast of the US, as well as much of Europe. An impact in Siberia in 1908 released energy equivalent to 5 megatons; a widely-reported impact last year was only a few times less powerful and such events happen, somewhere on Earth, about once a year.

Can we be forewarned of these impacts? The answer is already yes for the really big and rare ones – those triggered by bodies more than a kilometre across. However, only 1 percent of asteroids between 50 and 100 meters across have so far been detected. That is why I support the B612 project, spearheaded by former astronaut Ed Lu. The aim of this project is to put an infrared telescope in solar orbit to catalogue a million asteroids and monitor their orbits. With a few years' forewarning of where on Earth the impact would occur, action could be taken to mitigate its consequences on human populations by evacuating the most vulnerable areas. But what is even better news is that during this century we could develop the technology to protect us from impacts. A 'nudge', imparted a few years before the threatened impact, would only need to change an asteroid's velocity by a millimetre per second in order to deflect its path away from the Earth.

By 2100, groups of pioneers may have established bases independent from the Earth – on Mars, or maybe on asteroids. Whatever ethical constraints we impose here on the ground, we should surely wish these adventurers good luck in genetically modifying their progeny to adapt to alien environments. This might be the first step towards divergence into a new species: the beginning of the post-human era. And it would also ensure that advanced life would survive, even if the worst conceivable catastrophe befell our planet. But don't ever expect mass emigration from Earth. Nowhere in our Solar system offers an environment even as clement as the Antarctic or the top of Everest. Space doesn't offer an escape from Earth's problems.

The scope of biotechnology, and its consequent risks, will surely become more acute with each decade. But what about another fast-advancing technology: robotics and machine intelligence? Computers will surely vastly enhance our logical or mathematical skills, and perhaps even our creativity. We may be able to 'plug in' extra memory, or acquire language skills by di-

rect input into the brain (which would lead to a specially disquieting new form of inequality if such mental augmentations were available only to a privileged few). Even back in the 1990s IBM's 'Deep Blue' beat Kasparov, the world chess champion. More recently the Watson computer won a TV gameshow. Advances in software and sensors have been slower than in number-crunching capacity. Computers still can't match the facility of even a three-year-old child in telling a dog from a cat, or moving the pieces on a real chessboard. They can't tie your shoelaces or cut your toenails. But machine learning is advancing apace.

Once computers can observe and interpret their environment as adeptly as we do through our eyes and other sense organs, their far faster 'thoughts' and reactions could give them an advantage over us. [This will incidentally raise challenging ethical issues. We generally accept an obligation to ensure that other human beings (and indeed at least some animal species) can fulfil their 'natural' potential. Will we have the same duty to sophisticated robots, our own creations? Should we feel guilty about exploiting them, or if they are underemployed, frustrated, or bored?]

Moreover, we may need really to confront some science fiction scenarios – dumb autonomous robots 'going rogue', a 'supercomputer' with analytical powers offering its controller dominance of international finance, or a network that could develop a mind of its own and threaten us all. Be that as it may, by the end of this century, our society and its economy will be deeply changed by autonomous robots, but we should hope that this remain as 'idiot savants' rather than displaying full human capabilities. But can we be confident that machines will remain so limited? As early as the 1960s the British mathematician I.J. Good pointed out that a superintelligent robot (were it sufficiently versatile) could be the last invention that humans need ever make. Once machines have surpassed human capabilities, they could themselves design and assemble a new generation of even more intelligent ones, as well as an array of robotic fabricators that could transform the world physically.

Environmental threats and technological solutions

It is clear from other contributions to this conference that humanity's collective 'footprint' is threatening our finite planet's ecology. We should worry about the burgeoning environmental impact of a growing population needing food and energy – aggravated because, hopefully those in the developing world will close the consumption gap with the more fortunate among us. These pressures will be heightened because the world will also be warmer – though we can't forecast by how much, and how threatening

climate change will by then be. 'Ecological shocks' could irreversibly degrade our biosphere.

Doom-laden predictions of environmental catastrophe made in the 1970s proved wide off the mark. Unsurprisingly, such memories engender scepticism about the worst-case climatic and environmental projections. But the hazards may merely have been postponed. Climate change could plainly be devastating if the more pessimistic projections are borne out. Straightforward physics tells us that the anthropogenic rise in atmospheric CO₂ (which is itself uncontroversial) will itself induce a long-term greenhouse warming: a rise of just over one degree Centigrade if CO₂ doubles. This is superimposed on all the other complicated effects that make climate fluctuate. One degree may not seem much, but the direct 'greenhouse' effect of steadily-rising CO₂ is thought to be amplified by consequent changes in water vapour and other greenhouse gases. These effects, and the consequences of changing cloud cover, aren't so well understood. The 5th IPCC report presents a spread of projections, depending on how much this 'carbon sensitivity factor' enhances the blanketing by CO₂. The mean temperature rise is just an index for a warming that's very non-uniform, and which induces complex changes in weather patterns. And the worst consequences entail long time lags – it takes decades for the oceans to adjust to a new equilibrium, and centuries for ice-sheets to melt completely. The most compelling argument for prioritising mitigation, in my view, is the small risk of a runaway 'worst case' (as discussed, for instance, by Peter Wadhams) rather than the consequences of the median IPCC projections.

These 'sustainability' issues are familiar – so is the inaction in dealing with them and moving towards a lower-carbon economy. The inaction stems from the tendency in all democracies for the urgent to trump the long-term, and the parochial to trump the global.

It's uncertain how rapidly the climate will change and what 'insurance premium' we should be willing to pay to avoid the worst-case scenarios. My pessimistic guess is political efforts to decarbonise energy production will continue to be torpid rather than effective, and that the CO₂ concentration in the atmosphere will rise at an accelerating rate throughout the next 20 years. But by then, we'll know with far more confidence – perhaps from advanced computer modelling, but also from how much global temperatures have actually risen by then – just how strongly the feedback from water vapour and clouds amplifies the effect of CO₂ itself in creating a 'greenhouse effect'. If the effect is strong, and the world consequently seems on a rapidly-warming trajectory into dangerous territory, there may be a pressure for 'panic measures'. These would have to involve a 'plan B' – being

fatalistic about continuing dependence on fossil fuels, but combating its effects by some form of geoengineering.

The ‘greenhouse warming’ could be counteracted by (for instance) putting reflecting aerosols in the upper atmosphere, or even vast sunshades in space. The political problems of such geoengineering may be overwhelming. There could be unintended side-effects. Moreover, the warming would return with a vengeance if the countermeasures were ever discontinued; and other consequences of rising CO₂ (especially the deleterious effects of ocean acidification) would be unchecked.

An alternative strategy would involve direct extraction of carbon from the atmosphere. This approach would be politically more acceptable – we’d essentially just be undoing the unwitting geoengineering we’ve done by burning fossil fuels. But it currently seems less practicable.

It seems right at least to study geoengineering – to clarify which options make sense and perhaps damp down undue optimism about a technical ‘quick fix’ of our climate. However, it already seems clear that it would be feasible and affordable to throw enough material into the stratosphere to change the world’s climate – indeed what is scary is that this capacity might be within the resources of a single nation, or even a single corporation or individual. Geoengineering would be an utter political nightmare: not all nations would want to adjust the thermostat the same way. Very elaborate climatic modelling would be needed in order to calculate the regional impacts of such an intervention. It would be prudent to sort out the complex governance issues raised by ‘Solar Radiation Management’ – and to do this well before urgent pressures for action might build up.

Are there genuinely ‘existential’ threats?

The events I’ve described could present serious, even catastrophic, setbacks to our civilization, but wouldn’t wipe us all out. They’re extreme, but strictly speaking not ‘existential’. Are there conceivable events that could threaten the *entire* Earth, and snuff out all life? Promethean concerns of this kind were raised by scientists working on the atomic bomb project during the Second World War. Could we be absolutely sure that a nuclear explosion wouldn’t ignite all the world’s atmosphere or oceans? Before the first bomb test in New Mexico, Hans Bethe and two colleagues addressed this issue; they convinced themselves that there was a large safety factor. We now know for certain that a single nuclear weapons, devastating though it is, can’t trigger a nuclear chain reaction that would utterly destroy the Earth or its atmosphere.

But what about even more extreme experiments? Physicists were (in my view quite rightly) pressured by the media to address the speculative

‘existential risks’ that could be triggered by powerful accelerators that generate unprecedented concentrations of energy. Could physicists unwittingly convert the entire Earth into particles called ‘strangelets’ – or, even worse, trigger a ‘phase transition’ that would rip apart the fabric of space itself? Fortunately, reassurance could be offered: it was pointed out that cosmic ray collisions of much higher energies occur frequently in the Galaxy, but haven’t ripped space apart. And cosmic rays have penetrated white dwarf and neutron stars without triggering their conversion into ‘strangelets’.

But physicists should surely be circumspect and precautionary about carrying out experiments that generate conditions with no precedent even in the cosmos – just as biologists should avoid release of potentially-devastating genetically-modified pathogens.

So how risk-averse should we be? Some would argue that odds of 10 million to one against a global disaster would be good enough, because that is below the chance that, within the next year, an asteroid large enough to cause global devastation will hit the Earth. (This is like arguing that the extra carcinogenic effect of artificial radiation is acceptable if it doesn’t so much as double the risk from natural radiation). But to some, even this limit may not seem stringent enough. We may become resigned to a natural risk (like asteroids or natural pollutants) that we can’t do much about, but that doesn’t mean that we should acquiesce in an extra avoidable risk of the same magnitude. Designers of nuclear power-stations have to convince regulators that the probability of a meltdown is less than one in a million per year. Applying the same standards, if there were a threat to the entire Earth, the public might properly demand assurance that the probability is below one in a billion – even one in a trillion – before sanctioning such an experiment. We may offer these odds against the Sun not rising tomorrow, or against a fair die giving 100 sixes in a row; but a scientist might seem over-presumptuous to place such extreme confidence in any theories about what happens when atoms are smashed together with unprecedented energy. If a congressional committee asked: ‘Are you really claiming that there’s less than one chance in a billion chance that you’re wrong?’ I’d feel uncomfortable saying yes.

But on the other hand, if you ask: “Could such an experiment reveal a transformative discovery that – for instance – provided a new source of energy for the world?” I’d again offer high odds against it. The issue is then the relative probability of these two unlikely event – one hugely beneficial, the other catastrophic. Innovation is always risky, but if we don’t take these risks we may forgo disproportionate benefits. Undiluted application of the ‘precautionary principle’ has a manifest downside. As Freeman Dyson argued in an eloquent essay, there is ‘the hidden cost of saying no’.

And, by the way, the priority that we should assign to avoiding truly existential disasters, even when their probability seems infinitesimal, depends on an ethical question posed by the philosopher Derek Parfitt, which is this. Consider two scenarios: scenario A wipes out 90 percent of humanity; scenario B wipes out 100 percent. How much worse is B than A? Some would say 10 percent worse: the body count is 10 percent higher. But others would say B was *incomparably* worse, because human extinction forecloses the existence of billions, even trillions, of future people – and indeed an open-ended post-human future.

And especially if you accept the latter viewpoint, you'll agree that existential catastrophes – even if you'd bet a billion to one against them – deserve more attention than they're getting, in order that we can guard against them. That's why some of us in Cambridge – both natural and social scientists – plan to inaugurate a research programme to compile a more complete register of these 'existential' risks, and to assess how to enhance resilience against the more credible ones.

Moreover, we shouldn't be complacent that all such probabilities are so miniscule. We've no grounds for assuming that human-induced threats worse than those on our current risk register are improbable: they are newly emergent, so we have a limited timebase for exposure to them and can't be sanguine that we would survive them for long. And we have zero grounds for confidence that we can survive the worst that future technologies could bring in their wake. Some scenarios that have been envisaged may indeed be science fiction; but others may be disquietingly real.

Technology bring with it great hopes, but also great fears. We mustn't forget an important maxim: the unfamiliar is not the same as the improbable.

The role of scientists and their academies

More should be done to assess, and then minimize, the extreme risks I've addressed in this paper. But though we live under their shadow, we can nonetheless surely be technological optimists. There seems no scientific impediment to achieving (with very high probability) a sustainable world, where all enjoy a lifestyle better than those in the 'west' do today. But I'm a political pessimist. The intractable politics and sociology – the gap between potentialities and what actually happens – engenders pessimism. Politicians look to their own voters – and the next election. Stockholders expect a pay-off in the short run. We downplay what's happening even now in far-away countries. And we discount too heavily the problems we'll leave for new generations. Without a broader perspective, the public will never be adequately motivated to stem the risk of environmental degradation; to pri-

oritise clean energy, and sustainable agriculture; and to handle the challenge posed by ever more powerful technology.

Now that the impact of their researches can be so much greater, scientists surely have a still deeper responsibility to engage with governments and society. Politicians need the best ‘in house’ scientific advice. But, more than that, choices on how technology is applied require wide public debate, and such debate must be leveraged by ‘scientific citizens’ – engaging, from all political perspectives, with the media, and with a public attuned to the scope and limit of science. They can do this via campaigning groups, via blogging and journalism, or through political activity and thereby catalyse a debate that is better-informed. And there is a role for international academies. (Indeed I recall with admiration the efforts of the PAS, under the leadership of Profs Chagas, Weisskopf, Perutz and others in the 1980s, to urge on heads of state the importance of reducing nuclear arsenals).

We need to realise that we’re all on this crowded world together. We are stewards of a precious ‘pale blue dot’ in a vast cosmos – a planet with a future measured in billions of years, whose fate depends on humanity’s collective actions. We must urge greater priority for long-term global issues on the political agenda. And our institutions must prioritise projects that are long-term in a political perspective, even if a mere instant in the history of our planet. We need to broaden our sympathies in both space and time and perceive ourselves as part of a long heritage, and stewards for an immense future. We must be guided by the best science – both natural science and social science – but also by values that science itself can never provide.

I started by quoting H.G. Wells. I’ll finish with a quote from another scientific sage, the biologist Peter Medawar:

“The bells that toll for mankind are ... like the bells of Alpine cattle. They are attached to our own necks, and it must be our fault if they do not make a tuneful and melodious sound”.

HUMANITY'S RESPONSIBILITY TOWARD NATURE

■ ENRICO BERTI

As a philosopher, I have tried to find those arguments in contemporary philosophy that can justify humanity's responsibility towards nature, and I think I have found a few valid ones in Hans Jonas' book *The Imperative of Responsibility: In Search of an Ethics for the Technological Age* (original German edition: *Das Prinzip Verantwortung*, Frankfurt a. M. 1979; English translation: Chicago University Press, 1984). Born in Germany in 1903, Jonas was Heidegger's philosophy student and Bultmann's theology student at Marburg. There he met Hannah Arendt, with whom he remained in touch his whole life. Being Jewish, he left Germany in 1933 for England, where he enlisted in the Jewish Brigade of the British army and took part in the Second World War; he then went to Palestine, where he took part in the 1948 Israeli War of Independence. Finally, he moved to Canada but took up residence in the United States, where he died in 1993.

Like other German philosophers who studied under Heidegger (Hans-Georg Gadamer, Joachim Ritter, Hannah Arendt), Jonas was inspired by Aristotle. However, unlike them, he did not focus on practical philosophy (ethics and politics), but on ontology and metaphysics, intended essentially as teleological ontology, which is different from the one cultivated by the Thomists, for example, because it is not interested in determining the ultimate foundation of reality. In Aristotelian terms we should speak of physics or philosophy of nature rather than metaphysics intended as a search for first causes, that is as theology, though of a rational nature. This is undoubtedly an original aspect of Jonas' book, which makes it stand out from all the other treatises on philosophical ethics circulating today.

Thanks to the competence Jonas acquired during his previous biology studies, his book, whose title controversially contrasts with the one by Marxist Ernst Bloch, *Das Prinzip Hoffnung* (The Principle of Hope), focuses primarily on the fact that progress in science and technology has made each individual interdependent on all others, so that humanity's behaviour today will have enormous consequences even for future humanity. For these reasons, Jonas points to the current insufficiency of a purely individualistic ethics, which only addresses the analysis of individual behaviour, as did most traditional ethics, and Kant's in particular. He states the need for an "ethics of the future",

based on rational principles and therefore capable of being demonstrated to everyone. The only possible foundation of this new ethics is – according to Jonas – the existence of finalism in nature, both at the human and at the infra-human level, i.e. of a living world in general, from which it follows that the actions of individuals are indeed oriented to a finality.

In general, this finality is the preservation of life, that is, the protection of the species. According to Jonas, this is also a value, it is good, because being is preferable to nothingness (since the latter can't be assessed), and for this reason is an "ought to be", i.e. a compelling norm also from the moral point of view. Thus we are in the presence of a passage from "is" to "ought", which however does not violate "Hume's law", because "ought" is implicitly accepted in the premises of reasoning and therefore immediately justifies the normative nature of the conclusions. At first glance, this may seem like a re-edition of the traditional demonstration, which dates back to scholastic philosophy, that *ens et bonum convertuntur*, but in actual fact Jonas uses some very effective considerations, such as when he writes, «For when asked for a single instance [...] where the coincidence of "is" and "ought" occurs, we can point at the most familiar sight. The newborn, whose mere breathing uncontradictably addresses an "ought" to the world around, namely, to take care of him» (p. 131 of the English translation).

Of course, the proposal of a metaphysical foundation of ethics is destined to meet with, and in fact already has, the preconditional reservations of those who consider any form of finalism the expression of an ingenuous anthropomorphism, exchanging, as it had already happened to Descartes and Spinoza, the intrinsic finalism inspired by Aristotle with the extrinsic finalism inspired by the Stoics or by Christianity, and by those who consider any kind of metaphysics unacceptable, dreading possible theological, authoritarian and intolerant consequences. In my opinion, however, this shows the importance of Jonas' book, which demonstrates that environmental and bioethical problems can be solved only by an ethics based on metaphysics (intended as ontology), which is a sort of demonstration a posteriori, i.e. starting from the ethical consequences, of the need for a metaphysics.

To this end, it is worth noting a few particular arguments developed by the author, such as the one according to which the negation of metaphysics presupposes the absolutisation of scientific knowledge, which is, in turn, a metaphysical conception (from bad metaphysics) of knowledge, or the one according to which the exclusion of each passage from "is" to "ought" presupposes a neutralization and a reduction of the concept of being, which is every bit as metaphysical. Moreover, worthy of note is Jonas' refusal to turn to religious faith as a foundation of ethics, a refusal motivated by the fact

that «Faith is not there on command [...] metaphysics on the other hand has always been a business of reason, and reason can be set to work upon demand». Therefore, «the worldly philosopher struggling for an ethics, must first of all hypothetically allow the *possibility* of a rational metaphysics, despite Kant's contrary verdict, if the rational is not pre-emptively determined by the standards of positive science» (p. 45 of the English translation). This seems to me a good example of layman's ethics.

Another reason that makes Jonas' book interesting is the fact that, as well as being a meta-ethics book, it is also a treatise of applied ethics, as most moral philosophy books tend to be now that the tragic practical problems posed by the new technologies have given back to philosophers the role of counsellors that scientists and politicians listen to and sometimes consult. Indeed, the compulsory conservation of life is placed by Jonas on the grounds of an ethics of responsibility, which goes beyond (to use the well-known distinction introduced by Max Weber) any ethics of simple conviction, considered by Jonas as purely individualistic, formalistic and, all things considered, egoistic.

According to Jonas, present humanity is obliged to respond to the above-mentioned obligation especially vis-à-vis future generations, whose possibility of survival it can endanger through science and technology (destruction of the environment and genetic engineering). In actual fact, responsibility is elevated to a new ethical principle, called "Principle of Responsibility", analogous to Bloch's "Principle of Hope". Jonas, however, believes that the former is more valid than the latter, because the Principle of Hope, in the intent of ensuring future humanity's happiness, leads to the sacrifice of present humanity, as is proper of all revolutionary utopias, whereas the Principle of Responsibility, which is content to guarantee the physical survival both of present and of future humanity, does not favour any moment of history over others, i.e. it envisages not only the "not yet" but also the "already always".

Although these theses might seem akin to political conservatism – as it was pointed out several times – what Jonas really wants to preserve is not a specific political or economic and social structure, but, to put it simply, life itself. And although controversy against Bloch and utopism in general may now seem dated, especially after what happened in 1989 (even though the fall of the Soviet Empire contradicted "real" socialism rather than Bloch's utopistic socialism), there is no doubt that only an ethics of responsibility, such as Jonas', can justify "caring" (a term which clearly originates with Heidegger) for future generations. Indeed, on the basis of a utilitarian ethics, only inspired by the criterion of reciprocity, what is the point of worrying about future generations? On the basis of a similar ethics, does it make sense

to ask – as comedian Groucho Marx apparently did – “what have future generations done for me?” But also on the basis of a Kantian ethics, how can future generations aspire today to the dignity of “people”, that is, of rational subjects that one has to answer for?

However, Jonas’ reference to the responsibility of parents as an emblematic example of the Responsibility Principle, instead of being paternalistic, as it may seem, suits the problem of future generations perfectly. Indeed, for those of us who are still young, future generations are made up of our children (who exist already, and therefore are people) and, in any case, by our children’s children. The reference to the responsibility of politicians is also appropriate. Let us hope that the principle of *dum fiat iustitia, pereat mundus* (as long as one acts fairly, the world can go to ruin) that Kant referred to, without fully approving it, has no value for them. This is a typical expression of an individualist ethics, of which Kant himself can be taken as an example, as a celibate university professor and “private citizen”, i.e. without family, social or political responsibilities.

Jonas’ book, however, also has its limits, which are clearly identified and probably derive from his education under Heidegger, i.e. essentially late Romantic, pessimistic, naturalistic, aesthetic, inclined to “let the being be”, not to intervene, not to transform, not to try and improve things for fear of making them worse. The signs of this tendency can be recognised clearly in the fact that he reduces the goal of nature and of man to pure survival, intended in an almost exclusively biological sense. In this case, however, Jonas is not at all Aristotelian, because Aristotle considered that the goal of man and of the *polis* (which is the “perfect society”), is not just “living”, that is, surviving (which is the goal of the family and of the village, i.e. of imperfect communities), but it is “living well”, which is what nowadays we would call a good quality of life. For Aristotle, this consists in the fulfilment of oneself and of one’s own full capabilities, first of all the most specifically human ones (taking for granted, however, health, sufficient financial means, good looks, a good family and good friends, i.e. conditions for survival).

Those who accuse Jonas of biologism, naturalism and conservatism thus have it easy, although pacifists at all costs should not have the right to do so, because they place the conservation of life above any other value, and neither should the advocates of a “thin” theory of ethics, for example the ethics of simple justice (by John Rawls), who consider it the only task of politics to guarantee purely negative conditions, such as a minimum wage (survival) and freedom, leaving each person to choose what his or her happiness should consist in (without considering that those who ignore their capabilities cannot even wish to achieve them).

From this point of view an economist such as Amartya K. Sen is certainly more progressive and “Aristotelian” when he suggests a “thicker” theory of ethics, that is not just an ethics of justice or survival, but an ethics of “good”, where “good” is meant as the complete achievement of all of man’s capabilities, his complete “fulfilment”. This of course implies the willingness to transform the existing (not only letting him be), a political commitment in favour of emancipation (not only of conservation), a certain dose of optimism and, perhaps, also of utopia (without which history cannot be made). In this sense, even the Constitution of the United States of America is Aristotelian when it lists “the pursuit of happiness” among the rights of man that must be guaranteed by the political society. This concept, in fact, derives from Aristotle’s *Politics* and reached Thomas Jefferson through his correspondence with Joseph Priestley, a “Unitarian” philosopher who had received it by the Sozzini brothers, “Unitarians” who lived in Poland in the XVI century, who in turn had learned it from the Aristotelian masters of Padua University.¹

¹ Cfr. A. Stella, *Influssi dell’aristolismo veneto nella genesi del socinianesimo*, in L. Olivieri (ed.), *Aristotelismo veneto e scienza moderna*, Padova, Antenore, 1983, pp. 993-1007; Id., *Influssi sociniani nella genesi della costituzione americana: Joseph Priestley e Thomas Jefferson*, in «Accademia Nazionale dei Lincei, Rendiconti della classe di Scienze morali», s.VIII, vol. XXXVIII, nn. 5-6, maggio-giugno 1988, pp. 231-249.

XI. CELEBRATIONS FOR THE TWENTIETH ANNIVERSARY OF PASS

THE HISTORY OF THE PONTIFICAL ACADEMY OF SOCIAL SCIENCES*

■ HERBERT SCHAMBECK

To be the church in the world of today, the Second Vatican Council has proclaimed with the Pastoral Constitution *Gaudium et Spes* as an objective.

This joy and hope moved me as well when the Congregation for Catholic Education published the *Guidelines for the Study and Teaching of the Church's Social Doctrine in the Formation of Priests* in 1988. They clearly illustrated the order and the continuity of Catholic social doctrine in general and of the papal doctrinal statements in particular. These guidelines were also in a welcome way responsive to the pedagogical concerns of Catholic social doctrine. At this occasion in 1988, the idea came to me that it would be important for the Holy See if, besides the already existing scientific Pontifical Academies, such as the Pontifical Academy of Sciences, there would also be one for social sciences, because Catholic social doctrine is current as a social design recommendation for all parts of the world and important for the social sciences.

The timeliness of Catholic social doctrine increased after the promulgation of these guidelines still further as, after 1988, a political tum emerged in Central and Eastern Europe with the end of Communism, which created an ideological and worldview vacuum which needed, and still needs, to be addressed.

Since I knew that Fr. Johannes Schasching SJ, a long-time professor at the Pontifical Gregorian University, professor emeritus who died in Vienna at an advanced age in 2013, and whom I had already known and respected for his work in Austria for many years, had both an insight into the academic life of the Holy See as well as into the political needs of the world, I arranged a meeting with him during his holidays in Carinthia in August 1989. On this occasion, I conveyed to Fr. Schasching SJ my idea regarding the initiative for the establishment of a Pontifical Academy of Social Sciences. He also affirmed the timeliness of such an establishment, saying that it would require a Vatican initiative and, for the realization, a Committee of Proponents possibly with international figures would be needed. After the holidays, in

*(Speech held in the framework of the Special Session for the 20th Anniversary of the Pontifical Academy of Social Sciences on 4 May 2014 at the Casina Pio IV in the Vatican).

Vienna I spoke about this idea with the Viennese full professor of Catholic social doctrine, Univ. Prof. Prelate Rudolf Weiler, who also welcomed the initiative and recommended for me the Dominican scholar Prof. Fr. Arthur Fridolin Utz OP of the University of Fribourg for the Committee of Proponents. Through the literature, he had been known to me for a long time. He had published a lot on Catholic social doctrine, especially with Friar Fr. Joseph-Fulko Groner OP in three volumes under the title *The Social Sum of Pope Pius XII*.

Unfortunately, in the autumn of 1989, my wife Elisabeth was so gravely ill that she died on the celebration day of her patron saint, in November 1969. Before that, she had completed with me on the hospital bed that was to become her deathbed, the necessary preparatory work for my publication of another anthology via the Berlin publishing house Duncker & Humblot. A selection of speeches and sermons of the Cardinal Secretary of State Agostino Casaroli, translated into German. This book, entitled *Faith and Responsibility*, was to have been presented on the 75th birthday of His Eminence Casaroli in Rome on 24 November 1989.

As a result of the illness and loss of my wife, the book presentation was postponed until the end of the second week in January 1990 and was carried out in the Vatican for the Holy Father Pope John Paul II and Cardinal Casaroli.

On the occasion of the book presentation, I gave a reception in the Hotel Columbus on 12 January 1990 in honour of Cardinal Casaroli in the presence of notable figures of the Holy See in Rome, at which I submitted to Cardinal Casaroli a memorandum with the proposal of establishing such an Academy.

In the interim, after prior arrangement by phone, I also had a first meeting on 2 January 1990 with Professor Fr. Utz OP in Fribourg, informing him of my idea of founding a Pontifical Academy of Social Sciences and asking if he would like to participate in the initiative. He expressed interest in the affirmative.

In contrast to Fathers Schasching SJ and Utz OP, I am not a theologian and did not have a Chair for Social Ethics or for Catholic Social Doctrine, but rather for Public Law, namely in constitutional and administrative law, political science and legal philosophy. Considering my subjects in the legal faculties, first at the University of Vienna and later in Innsbruck and Linz, I also dealt with the legal philosophy and constitutional content of the papal doctrinal statements; from 1969, for many years I was a member of the Delegation of the Holy See to the International Atomic Energy Agency in Vienna and invited by the Pontifical Secretariat of State to comment on papal doctrinal statements. In this way, I came to know Monsignor Roland

Minnerath in the Vatican; at the time, he was an employee of Cardinal Casaroli. He later became a full professor at the University of Strasbourg and is now Archbishop of Dijon. Msgr. Minnerath, Fr. Utz OP and I met subsequently for the first time in Zürich. These meetings we continued later in Vienna. The Apostolic Nuncio to Austria, Archbishop Donato Squicciarini, supported the initiative to found a Pontifical Academy of Social Sciences in every way from the outset; he invited Fr. Utz OP and Msgr. Minnerath to a meeting with me about this Academy initiative. Later, Nuncio Squicciarini led the way for the establishment of the Academy as, together with Fr. Schasching SJ, he prepared a draft of the statutes of a possible Academy of Social Sciences.

During this meeting, in preparation for the foundation of the Pontifical Academy of Social Sciences, arose also the question of covering the costs. For this purpose, the establishment of a foundation to promote this Academy was planned. I took the liberty of naming Liechtenstein lawyer Prof. Herbert Batliner, patron of the sciences and avowed Catholic, as a desired sponsor.

Prof. Batliner has supported the Academy from the beginning in every way possible to him, especially with annual allocations and, it should be emphasized, by the constantly covering the cost of the simultaneous translation provided at our meetings, as the Chancellor of our Academy, Bishop Marcelo Sánchez Sorondo, noted in the Festschrift with gratitude to Prof. Batliner. This support contributes “substantially to our learning about and understanding each other better”.

In turn, Fr. Utz OP had called for this foundation from the circle of Catholic German entrepreneur Mr. Cornelius Fetsch and Mr. Alfonso Horten and I had suggested, on behalf of the Association of Christian Trade Unions of Austria, the former President of the Federal Council, Martin Strimitzer. The Holy See was represented in this foundation by His Excellency Squicciarini. In the many years Prof Batliner was President, and after him, the former President of the Deutsche Bundesbank, Prof. Hans Tietmeyer followed; Squicciarini was succeeded by the Bishop of Graz-Seckau, Egon Kapellari, who is also vice chairman of the Austrian Bishops’ Conference and a member of the Commission of the Bishops’ Conferences of the European Community (COMECE).

In this time of preparation for the Academy’s foundation there was an invitation to a private meeting in the library of the Pontifical Secretariat of State, with Msgr. Minnerath and Fr. Utz OP; I also attended as a representative of the Curia. On this occasion, the representative of the Pontifical Commission *Justitia et Pax*, Msgr. Diarmuid Martin, the current Archbishop of Dublin, and the representative of the Pontifical Council for Culture, Fr. Hervé

Carrier SJ, expressed concerns about the founding of such an Academy. However, later in the founding, when it came to the first Plenary Session of the Academy, Fr. Carrier SJ held a lecture and Msgr. Martin participated in cooperating with the PASS.

The Chair of the preparatory meeting in the Secretariat of State, the then-Assessor Msgr. Crescenzo Sepe, today Cardinal Archbishop of Naples, confided in a personal conversation at this meeting that Pope John Paul II was determined to establish this Academy. I came to realize that intention as, at this meeting, the then-Chancellor of the Pontifical Academy of Sciences, Msgr. Eng. Renato Dardozi, suggested that the Pontifical Academy of Social Sciences should have its seat at the existing Pontifical Academy of Sciences in the Casina Pio IV.

In 1994 came the founding of the Academy by Pope John Paul II, who received the newly appointed members in an audience on 25 November 1994.

Since the opinion forming in the Curia claimed some time after my first initiative, the proclamation and constitutionalization of the Academy did not come on the 100th anniversary of the social encyclical *Rerum Novarum* by Pope Leo XIII in 1991 as I had proposed, but only three years later in 1994.

The period of preparation was used for the appointment of Members of the Academy, selected by the Holy See to represent a global spectrum. In addition to theologians, which, to my delight, included Msgr. Minnerath and Fathers Schaching SJ and Utz OP, there were also appointed as Academy Members well-known figures in theology, Catholic social doctrine, ethics, sociology, humanities, law, social sciences, political science and economics.

I, personally, had no part in the selection of the Members of the Academy and in the drafting of its statutes. However, in the form of letters to Pope John Paul II on 28 February 1990, Cardinal Secretary of State Casaroli on 9 March 1990, and the then-Substitute and today's Cardinal Giovanni Re, I indicated the importance of the possible establishment of a Pontifical Academy of Social Sciences. It should not go unmentioned that, after the founding of the Academy, Cardinal Casaroli told me that a wish of Pope Paul VI had been fulfilled as the Pope had already suggested such an Academy to his Cardinal Secretary of State, Jean Villot. However, the financial requirements had been too difficult.

After the proclamation of the statutes and the appointment of the Members of the new Pontifical Academy, I agreed, as a personal symbolic contribution to the founding of the Academy, to assume the costs of the membership insignia chains for all founding members, who numbered 30 people at that time.

With this Academy, every year it has been possible to deal with subjects and across continents through handling current and fundamental questions

and concerns of social life in plenary sessions and workshops, as well as to inform the public in press conferences after these meetings and through its own series of publications.

Through the work of the PASS, the concerns of the first encyclical by Pope Paul VI, *Ecclesiam Suam* (1964) would be taken into consideration, as well as the encyclical *Fides et Ratio* (1998) by Pope John Paul II. There have already been many papal doctrinal statements and sign-postings such as the encyclical *Rerum Novarum* (1891) by Pope Leo XIII, *Quadragesimo Anno* (1931) by Pope Pius XI, and regarding Pope Pius XII, Fathers Utz OP and Gröner OP published *Social Sum of Pope Pius XII (Soziale Summe Papst Pius XII)* with his Christmas radio broadcasting message from 1944; furthermore, there were the encyclicals *Mater et Magistra* (1961) and *Pacem in Terris* (1963) by Pope John XXIII, *Populorum Progressio* (1967) and *Octogesima Adveniens* (1971) by Pope Paul VI as well as Pope John Paul II and his encyclicals *Laborem Exercens* (1981), *Sollicitudo Rei Socialis* (1987) and *Centesimo Annus* (1991).

Fr. Schasching SJ released these social circulars of the popes and other church documents in an anthology with a shared introduction by Fr. Oswald von Nell-Breuning SJ which was published in 1992.

On the occasion of the Academy's meetings, almost regularly, as long as it was possible regarding his health, Pope John Paul II gave an audience to the participants; in 2005 Pope Benedict XVI even came to the PASS.

Even before the start of his Pontificate in 2005, I had the ongoing opportunity to provide private reports about the activity of the PASS to Cardinal Joseph Ratzinger, as the former Nuncio in Austria, and later to Cardinal Opilio Rossi, as well as to Cardinal Alfonso Stickler, an Austrian-born librarian and archivist of the Holy See whom I had known for a long time and who, in the Curia, supported concerns of the founding of the Academy. Unfortunately, Cardinal Ratzinger was never invited to give a lecture at the PASS before he was elected as the successor of Saint Peter! In his Pontificate the encyclicals *Deus Caritas Est* (2006) and *Caritas in Veritate* (2009) provide directives which are also of importance for the PASS.

These papal doctrinal statements were continued in an encyclical started by Pope Benedict XVI and completed by Pope Francis as well as proclaimed in the 2013 encyclical *Lumen Fidei* and published also in his *Evangelii Gaudium* letter in 2013.

This teaching of the church with the social recommendations of papal doctrinal statements stand in relation to the earthly realities, as the aforementioned Pastoral Constitution on the Church in the Modern World *Gaudium et Spes* of the Second Vatican Council indicates. In the view of this Constitution, there shall be neither a profanation and secularization of

the church nor a clericalization of the world. The Council has recognized the autonomy of earthly matters. Art. 36 of the Council's Constitution emphasizes and explains, "the proper autonomy of earthly realities"; I quote: "For by the very circumstance of their having been created, all things are endowed with their own stability, truth, goodness, proper laws and order. Man must respect these as he isolates them by the appropriate methods of the individual sciences or arts. Therefore, if methodical investigation within every branch of learning is carried out in a genuinely scientific manner and in accord with moral norms, it never truly conflicts with faith, for earthly matters and the concerns of faith derive from the same God".

This Council's Constitution recognized the plurality in thinking and found: "Often enough the Christian view of things will itself suggest some specific solution in certain circumstances. Yet it happens rather frequently, and legitimately so, that with equal sincerity some of the faithful will disagree with others on a given matter". To do this, the Second Vatican Council emphasizes, it "is necessary for people to remember that no one is allowed in the aforementioned situations to appropriate the Church's authority for his opinion. They should always try to enlighten one another through honest discussion, preserving mutual charity and caring above all for the common good".

With regard to this basic attitude, the PASS 1994 *Sentire Cum Ecclesia* began with the knowledge of representatives of different areas of the social sciences from different parts of the world joined together in a bond of *scientia* and *conscientia*. The specializations in their mutual relationship were also reflected in the 1994–2004 presidency of the PASS of economist Prof. Edmund Camille Malinvaud of France, and from 2004 to 2014, by lawyer Prof. Mary Ann Glendon from the United States, as they will be in the next few years with sociologist Prof. Margaret Scotford Archer from Great Britain. Under these presidencies and accompanied by its own Council, the PASS programme was prepared and, thanks to academic cooperation, implemented in such a way that it could afterwards be recorded in the publications of the PASS.

The Chancellors of the PASS have been particularly important for these tasks and activities; at its inception there was Msgr. Eng. Renato Dardozi, who had been the Chancellor of the Pontifical Academy of Sciences and who prepared the inclusion of the PASS in the Casina Pio IV. Msgr. Dardozi was followed by Jesuit Father Joseph Pittau SJ, later Archbishop of the Curia, whom I had met during my first stay in Japan in 1979 as Rector of Sophia University in Tokyo, and afterwards and until now Msgr. Marcelo Sánchez Sorondo. Born in Sardinia, the political scientist Joseph Pittau was followed by the Buenos Aires-born philosopher Marcelo Sánchez Sorondo, who was already the Dean of the Pontifical Lateran University.

In the last two decades these statutory and organizational conditions have enabled the referral to the PASS of the basic questions and main problems of the social sciences on the basis of human equality and social inequality, the culture of work, the living conditions of the unemployed and help for them, generational problems, fundamental rights of democracy and constitutional law, migration and integration, as well as basic questions of Catholic social doctrine, such as subsidiarity, the common good and the development of the Catholic social doctrine from *Pacem in Terris* by Pope John XXIII to *Caritas in Veritate* by Pope Benedict XVI and now with the four-handed encyclical *Lumen Fidei* to *Evangelii Gaudium* by Pope Francis.

In this circular letter, Pope Francis says: “Jesus... wants us to touch human misery, to touch the suffering flesh of others” (270). In this responsibility, it is important to use the social sciences in terms of the interests and concerns of the people. Pope Francis advocates here for “dialogue between faith, reason and science” (No. 242 if.) and points out: “Faith is not fearful of reason; on the contrary, it seeks and trusts reason because ‘the light of reason and of faith both come from God’ (Thomas Aquinas, *Summa contra Gentiles*, 1, VII; cf. John Paul II, Encyclical *Fides et Ratio* (September 14 1998), 43: AAS91 (1999), 39) and therefore cannot contradict each other” (No. 242).

This connectedness of *Fides et Ratio* has accompanied the PASS within the past 20 years. It requires that people’s dignity be recognized and protected by law, which might come from the people and not to the people. Therefore, it is necessary to comply with the attunement of cultural progress, economic growth and social security, in which one can distribute only what was achieved before; in this regard, a social partnership of employer and employee is both necessary as well as, to quote Fr. Schasching SJ in his last letter to me dated February 11 1999, “the need for ecumenism of values-creating forces: the Christian religions, Judaism, the great world religions and all people of good will to impart these value bases and thus to protect a democracy before deformation”. This endeavour will continue to accompany our PASS.

Since I have worked not only in my areas of law, but also for several decades in politics as a Parliamentarian, including 22 years in presidential functions, I would finally like to emphasize that, along with the elaboration of scientific knowledge, its communication in a comprehensible way is important; it not only depends on what someone means but also on how the other one understands and receives!

In this mutual understanding, the responsibility of academics to respond is both possible and necessary. As a lawyer, I believe that this requires connectedness between legality and humanity and this order might also be

fulfilled in mercy, the necessity of which Pope Francis particularly indicated. Regarding the protection of basic rights, this requires above all the protection of life, beginning with the protection of unborn life and until the end of life. As the former Archbishop of Vienna Franz Cardinal König said, one should not die by the hand of humans but rather die accompanied by the helping hand of other humans.

With our Academy of Social Sciences, may we contribute to this compassionate responsibility: in word, in scripture and in fact, as well as deepened by worship for which we have the opportunity in our Masses in or near St. Peter's. This according to the abovementioned Pastoral Constitution *Gaudium et Spes* with joy and with hope: *ad multos annos* for our *Pontificia Accademia delle Scienze Sociali*.

SUMMARY OF THE JOINT PAS/PASS WORKSHOP ON “SUSTAINABLE HUMANITY, SUSTAINABLE NATURE: OUR RESPONSIBILITY”

■ WERNER ARBER

In May 2014 the Pontifical Academy of Sciences and the Pontifical Academy of Social Sciences held, at the Casina Pio IV, a Joint Workshop devoted to sustainable development. In the four days of the workshop, thirty-eight talks were presented by members of the two Academies and by invited experts, and half of the available time was spent on discussions. This report is on the main topics dealt with, on the identified roles of past, present and future development, and on proposed measures to be taken in order to ensure the long-term sustainability of forthcoming development in the context of the ongoing cultural evolution of mankind.

The Roots and History of Mankind

Referring to another workshop held in May 2013 at the Casina Pio IV on *Via Humanitatis*, the participants were reminded that the species *Homo* has its roots about 7 million years ago. We can date the start of mankind's cultural evolution with the start of agriculture, i.e. the domestication of some plants and of some animals. This contributed about 10,000 years ago to ensuring the nutrition of humans. At this early time, members of the species *Homo Sapiens*, driven by their intellectual capacity and curiosity, might have reflected on the possible roots of themselves and of their environment. The chapter of Genesis is a remarkable testimony to the world view of several thousand years ago, containing the results of early scientific observations complemented with religious beliefs. In the past centuries, scientific investigation has become considerably more powerful. But it is only in the last about 200 years that scientific knowledge has become enriched to a degree to allow mankind to develop applications of this knowledge to facilitate its life in its encountered environment. Today, we realise that some of these biomedical and technological applications can also have specific risks. This aspect has to be considered to ensure the sustainability of future development. Based on available astrophysical knowledge, we can assume that the cosmic evolution of our solar system together with planet Earth will persist for a few thousand million years. We can also assume that bio-

logical evolution can continue on our planet for a very long time. The sustainability of cultural developments should take this aspect into account. However, in view of the difficulties in predicting future natural developments, it is proposed that our reflections should be made with a time horizon of 10 million years, or more feasibly of 10,000 years, and not only for a few human generations.

The Science-Based Impact on the Health and Facilities of Human Beings

Statistical data reveal a remarkable increase in the past decades of human life expectancy for people living in developed countries. This is largely due to applications of available biomedical knowledge for better healthcare, including the provision of appropriate nutrition. So far these benefits have not fully reached a majority of people living in developing countries. We are aware that this still ongoing improvement of life conditions contributes to the considerable increase in the human population on our planet. An increasing number of technological applications of scientific knowledge also contribute to facilitating our daily lives. Historical examples are: the introduction of steam power, railroads, telegraphy, electrification, automotive transport, aviation, industrial chemistry, computing and now the digital revolution, biotechnologies, nanotechnologies and robotics. Those advances have reshaped the world economy into one that is increasingly urban and globally connected. However, just as humanity confronted “Revolutionary Change” (*Rerum Novarum*) in the Age of Industrialization one hundred and fifty years ago, today we have become a geological and geobiological force and this compels us to redefine the current age as the Age of the Anthropocene.

The Potential Risks of Human Innovations in the Anthropocene

Besides their envisaged benefits for humans and in some cases for the environment, science-based innovations may sometimes also have specific risks. It is in principle possible to predict some such risks by a good technology assessment before the introduction of the innovations. On the other hand, indicators for unexpected risks show up, often some time after the introduction of an innovation. The sustainability workshop paid particular attention to indicators of a climate shift due to a number of introduced technological applications, such as the use of coal and fossil oil as sources of energy. Obvious indicators in this case are a statistical increase in the average global temperature; glacier retreat both in high mountain areas and in polar regions, including the melting of sea ice and causing a sea level rise with increased flooding risks in coastal zones; and finally the melting of permafrost which in some cases is accompanied by the liberation of the

greenhouse gas methane. Other observable effects are health-threatening air pollution in densely populated areas, as well as ocean acidification. On the other hand, increased concentrations of life-supporting components with nitrogen and phosphorus, in rivers, lakes and oceans due to the intensive use of fertilisers in agriculture, contribute to changes in life diversity in the related aqueous habitats. It is to be expected that these kinds of undesirable effects will continue to strengthen without measures being taken to prevent them. Workshop participants also discussed both positive and negative impacts of people living in megacities, including in their slum areas providing shelter to socially excluded people.

Measures Proposed to Prevent and Mitigate Negative Impacts on the Sustainability of Cultural Development

First of all, the workshop participants favour active contributions to ameliorate the living conditions of poor populations, particularly in developing areas of our planet. This should be accompanied by measures anchored both in the natural sciences and in the social sciences. As an example, unhealthy daily nutrition only providing calories can be improved by a richer and more diverse daily diet including the regular provision of essential micronutrients. Genetically modified Golden Rice containing a precursor of vitamin A is an excellent example of the feasibility of this proposal and its beneficial effects.¹ Secondly, a number of measures can contribute to mitigating the role of a continued anthropogenic climate change. A good example is a possible shift to alternate sources of energy, such as solar energy and wind energy. Additional technologies are within possible reach. Thirdly, agricultural practices should be reconsidered, including those introduced by the green revolution, in order to minimise undesirable environmental impacts in the longer term. For example, nature uses biological means to fix nitrogen. This can render plant growth much less dependent on fertilizers, although with some negative effects on the yield per unit of land surface. Fourthly, the already mentioned process of science-based technology assessment should in principle be applied before any wide application of novel technological inventions. Similarly, political measures related to environmental aspects should also become submitted to science-based policy

¹ cf. Transgenic Plants for Food Security in the Context of Development, Proceedings of a Study Week of the Pontifical Academy of Sciences, Ingo Potrykus and Klaus Ammann (eds.), *New Biotechnology*, Vol. 27, Issue 5, November 2010, Elsevier, Scripta Varia 113, ISSN 1871-6784.

assessment before the introduction of the proposed measure. Fifthly, partnerships between scientists, enterprises and political leaders, rather than single individuals or enterprises, should be involved in the introduction of novel innovations. Sixthly, special efforts should be made to rapidly integrate available scientific knowledge on the laws of nature relating to life functions, including life evolution, into everybody's knowledge. This may require specifically devised educational programmes. Finally, the workshop participants considered negative impacts on sustainable life conditions by the increasing density of the human population. Appropriate goals should be set to reach quickly a more stable equilibrium that can persist without a negative impact on the highly appreciated biodiversity and diversity of habitats on our planet Earth, which has a constant size and a very long life expectancy. These defined measures can beneficially contribute to the long-term sustainability of the future evolution of life and of environmental habitats offered by Mother Nature to all living organisms.

SUMARIO DEL WORKSHOP DE LA PAS Y PASS SOBRE “HUMANIDAD Y NATURALEZA SOSTENIBLES: NUESTRA RESPONSABILIDAD”

■ WERNER ARBER

En mayo de 2014, la Pontificia Academia de las Ciencias y la Pontificia Academia de las Ciencias Sociales realizaron en la Casina Pío IV un taller conjunto dedicado al desarrollo sostenible. En las cuatro jornadas que duró dicho taller, hubo treinta y ocho disertaciones a cargo de los integrantes de ambas Academias y de algunos invitados expertos, destinándose la mitad del tiempo disponible al debate. El presente informe aborda los principales temas allí tratados; el papel que ha desempeñado, desempeña y habrá de desempeñar el desarrollo, y las medidas propuestas con el fin de garantizar, en el largo plazo, un desarrollo sostenible en el marco de la dinámica evolución cultural de la humanidad.

Las raíces y la historia de la humanidad

En referencia a otro taller organizado en la Casina Pío IV en mayo de 2013 sobre *Via Humanitatis*, los participantes recordaron que la especie Homo se originó hace alrededor de siete millones de años. Puede decirse que la evolución cultural de la humanidad se inició con el nacimiento de la agricultura, es decir, con la domesticación de algunas plantas y de algunos animales. Esto contribuyó, hace aproximadamente 10.000 años, a garantizar la nutrición de la especie humana. En esos tiempos lejanos, los miembros de la especie Homo Sapiens, impulsados por su curiosidad y por su capacidad intelectual, quizás hayan reflexionado sobre sus propios orígenes y también sobre el origen de su entorno. El capítulo del Génesis, que contiene los resultados de las primeras observaciones científicas complementados por una serie de creencias religiosas, es un notable testimonio de la cosmovisión dominante hace varios miles de años. En los siglos anteriores al nuestro, la investigación científica fue cobrando cada vez más importancia, pero recién durante los últimos 200 años el conocimiento científico se enriqueció al punto de permitir el desarrollo de aplicaciones destinadas a facilitar la vida humana en su entorno, cualquiera este sea. Hoy día nos damos cuenta de que algunas de estas aplicaciones biomédicas y tecnológicas pueden también encerrar riesgos concretos. Este aspecto debe ser tenido en cuenta si lo que se desea es garantizar un desarrollo sostenible en el futuro. Según lo revelado

por la astrofísica, podemos suponer que nuestro sistema solar, y el planeta Tierra que lo integra, seguirán evolucionando durante algunos miles de millones de años más. También podemos suponer que en nuestro planeta la evolución de la vida seguirá ocurriendo durante aun muchos años. Es fundamental tomar cuenta de esto si lo que se quiere es que nuestros avances culturales sean sostenibles. Sin embargo, en vista de lo difícil que es predecir los fenómenos naturales que nos depara el futuro, proponemos que nuestras reflexiones tengan un horizonte temporal que, en lugar de estar limitado a algunas generaciones humanas, sea de diez millones de años o, lo que es más factible, de diez mil años.

Los efectos de la ciencia en la salud y en la vida cotidiana del ser humano

Los datos arrojados por la estadística revelan que en las últimas décadas ha habido un marcado aumento de la expectativa de vida entre los habitantes de los países desarrollados. Esto se debe mayormente a las aplicaciones de los conocimientos biomédicos, que posibilitan un mejor cuidado de la salud e incluso una nutrición adecuada. Por el momento no ha sido posible extender tales beneficios a gran parte de la población de los países en desarrollo. Somos conscientes de que el progresivo mejoramiento de las condiciones de vida al que asistimos hoy día contribuye a un notable crecimiento demográfico en nuestro planeta. Una cantidad creciente de aplicaciones tecnológicas del conocimiento científico también ha contribuido a facilitar nuestra vida cotidiana. Algunos ejemplos que nos brinda la Historia son: el motor a vapor, el ferrocarril, el telégrafo, la electricidad, el automóvil, el avión, las industrias químicas, la informática y, más recientemente, la revolución digital, la robótica, las biotecnologías y las nanotecnologías. Tales avances han modificado la economía mundial haciéndola cada vez más urbana y globalmente interconectada. Sin embargo, de la misma manera en que la humanidad se enfrentó a un «cambio revolucionario» (*Rerum Novarum*) durante la Era Industrial, que tuvo lugar hace 150 años, hoy nos hemos convertido en una fuerza geológica y geobiológica, de tal suerte que nos vemos obligados a redefinir nuestra era actual como la Era del Antropoceno.

Los potenciales riesgos de la innovación humana durante el Antropoceno

Además de los beneficios que encierran para el ser humano, y en algunos casos para el medioambiente, las innovaciones que vienen de la mano de la ciencia también pueden plantear algunos riesgos. En principio es posible predecir estos últimos mediante una sólida evaluación de la tecnología propuesta antes de su introducción. Sin embargo, es cierto que los indicadores

que dan cuenta de riesgos inesperados suelen aparecer tiempo después de la puesta en uso de una innovación. El taller sobre sostenibilidad prestó particular atención a los indicadores del cambio climático producido por aplicaciones tecnológicas tales como el uso del carbón y del petróleo como fuentes de energía. En este caso algunos indicadores obvios son el aumento estadístico de la temperatura media del planeta; el retroceso de los glaciares tanto en las áreas montañosas como en las regiones polares; el concomitante proceso de deshielo de las aguas marinas, con el consiguiente aumento del nivel del mar y el mayor riesgo de inundaciones en las regiones costeras, y, por último, el derretimiento del permafrost, que en algunos casos viene acompañado de la liberación de metano, un gas de efecto invernadero. Otros efectos observables son la nociva contaminación del aire en las áreas densamente pobladas y la acidificación de los océanos. Por otra parte, la saturación de los ríos, los lagos y los mares con nitrógeno y fósforo como consecuencia del uso intensivo de fertilizantes en la agricultura tiene efectos perjudiciales en los nutrientes de los hábitats acuáticos y provoca cambios en su biodiversidad. Es de esperar que estos efectos no deseados sigan exacerbándose si no se toman medidas para prevenirlos. Los participantes del taller también analizaron los impactos tanto positivos como negativos de vivir en las megaciudades, y en particular en sus barrios más pobres, que dan refugio a los sectores excluidos socialmente.

Medidas propuestas para prevenir y mitigar los impactos negativos sobre la sostenibilidad del desarrollo cultural

En primer lugar, los participantes del taller son partidarios de la realización de aportes activos destinados a aliviar las condiciones de vida de las poblaciones más pobres de nuestro planeta, en particular de aquellas que viven en las zonas en desarrollo. Esto debe ir de la mano de medidas ancladas tanto en las ciencias naturales como en las ciencias sociales. Por ejemplo, una nutrición insalubre que solo aporta calorías puede mejorarse a través de una dieta más rica y diversa que incluya micronutrientes esenciales. La variedad genéticamente modificada de arroz dorado que contiene un precursor de la vitamina A es un excelente ejemplo de la factibilidad de esta propuesta y de sus efectos positivos.¹ En segundo lugar, algunas medidas

¹ cf. Transgenic Plants for Food Security in the Context of Development, Informe de lo tratado en la Semana de estudios de la Pontificia Academia de las Ciencias, Ingo Potrykus y Klaus Ammann (eds.), *New Biotechnology*, Vol. 27, Número 5, Noviembre de 2010, Elsevier, Scripta Varia 113, ISSN 1871-6784.

pueden ayudar a mitigar el cambio climático de origen antropogénico. Un buen ejemplo es el de las fuentes de energía alternativas, como la solar y la eólica. Hay otras tecnologías que también son viables. En tercer lugar, es preciso reconsiderar las prácticas agrícolas, incluyendo aquellas introducidas por la Revolución Verde, de modo de minimizar el daño al medioambiente en el largo plazo. Por ejemplo, la naturaleza usa mecanismos biológicos para fijar el nitrógeno. De esta manera, y pese a cierta pérdida de rendimiento por unidad de superficie cultivable, puede lograrse que una planta crezca sin depender tanto de los fertilizantes. En cuarto lugar, el ya mencionado proceso de evaluación de las tecnologías con base en la ciencia debe realizarse, en principio, antes de toda aplicación masiva de cualquier novedad en materia técnica. En forma similar, toda medida política vinculada al medioambiente debería ser objeto de una evaluación fundada en la ciencia previo a su implementación. En quinto lugar, en lugar de ser el resultado del esfuerzo solitario de un individuo o de una compañía, las innovaciones deberían llegar a la sociedad como producto de la acción mancomunada de científicos, empresas y líderes políticos. En sexto lugar, debería bogarse por integrar el conocimiento científico sobre las leyes naturales vinculadas a las funciones biológicas, incluyendo la evolución de la vida, al saber de todas las personas. Para esto puede ser necesario contar con programas educativos diseñados especialmente. Por último, los participantes del taller consideraron los impactos negativos que la creciente densidad demográfica está produciendo sobre la sostenibilidad de las condiciones de vida. Deberían fijarse objetivos adecuados para alcanzar sin más demora un equilibrio más estable, que pueda mantenerse sin provocar impactos nocivos en la valiosa diversidad biológica y de hábitats de nuestro planeta, el cual tiene, por cierto, un tamaño constante y una expectativa de vida muy prolongada. Todas estas medidas pueden contribuir a una mayor sostenibilidad a largo plazo de la evolución de la vida y de los hábitats que brinda la Madre Naturaleza a todos los organismos vivos.

STATEMENT OF THE JOINT PAS/PASS WORKSHOP ON “SUSTAINABLE HUMANITY, SUSTAINABLE NATURE: OUR RESPONSIBILITY”

Stabilizing the Climate and Giving Energy Access to All with an Inclusive Economy

Humanity has entered a new era. Our technological prowess has brought humanity to a crossroads. We are the inheritors of two centuries of remarkable waves of technological change: steam power, railroads, the telegraph, electrification, automotive transport, aviation, industrial chemistry, modern medicine, computing, and now the digital revolution, biotechnologies and nanotechnologies. These advances have reshaped the world economy into one that is increasingly urban and globally connected, but also more and more unequal.

However, just as humanity confronted “Revolutionary Change” (*Rerum Novarum*) in the Age of Industrialization in the 19th century, today we have changed our natural environment to such an extent that scientists are redefining the current period as the Age of the Anthropocene, that is to say an age when human action, through the use of fossil fuels, is having a decisive impact on the planet. If current trends continue, this century will witness unprecedented climate changes and ecosystem destruction that will severely impact us all.

Human action which is not respectful of nature becomes a boomerang for human beings that creates inequality and extends what Pope Francis has termed “the globalization of indifference” and the “economy of exclusion” (*Evangelii Gaudium*), which themselves endanger solidarity with present and future generations.

The advances in measured productivity in all sectors – agriculture, industry and services – enable us to envision the end of poverty, the sharing of prosperity, and the further extensions of life spans. However, unfair social structures (*Evangelii Gaudium*) have become obstacles to an appropriate and sustainable organization of production and a fair distribution of its fruits, which are both necessary to achieve those goals. Humanity’s relationship with nature is riddled with unaccounted for consequences of the actions each of us take for both present and future generations. Socio-environmental processes are not self-correcting. Market forces alone, bereft of ethics and collective action, cannot solve the intertwined crises of poverty, exclusion, and the environment. However, the failure of the market has been accompanied by the failure of institutions, which have not always aimed at the common good.

Problems have been exacerbated by the fact that economic activity is currently measured solely in terms of Gross Domestic Product (GDP) and therefore does not record the degradation of Earth that accompanies it nor the abject inequalities between countries and within each country. The growth in GDP has been accompanied by unacceptable gaps between the rich and the poor, who still have no access to most of the advancement of the Era. For example, about fifty-percent of available energy is accessed by just one billion people, yet the negative impacts on the environment are being felt by the three billion who have no access to that energy. Three billion have so little access to modern energy that they are forced to cook, heat and light their homes with methods dangerous to their health.

The massive fossil fuel use at the heart of the global energy system deeply disrupts the Earth's climate and acidifies the world's oceans. The warming and associated extreme weather will reach unprecedented levels in our children's life times and 40% of the world's poor, who have a minimal role in generating global pollution, are likely to suffer the most. Industrial-scale agricultural practices are transforming landscapes around the world, disrupting ecosystems and threatening the diversity and survival of species on a planetary scale. Yet even with the unprecedented scale and intensity of land use, food insecurity still stalks the planet, with one billion people suffering from chronic hunger and another billion or so suffering from the hidden hunger of micronutrient deficiencies. Tragically, a third of the produced food is wasted, which as Pope Francis said is "like stealing from the table of the poor and the hungry".

In view of the persistence of poverty, the widening of economic and social inequalities, and the continued destruction of the environment, the world's governments called for the adoption by 2015 of new universal goals, to be called Sustainable Development Goals (SDGs), to guide planetary-scale actions after 2015. To achieve these goals will require global cooperation, technological innovations that are within reach, and supportive economic and social policies at the national and regional levels, such as the taxation and regulation of environmental abuses, limits to the enormous power of transnational corporations and a fair redistribution of wealth. It has become abundantly clear that Humanity's relationship with Nature needs to be undertaken by cooperative, collective action at all levels – local, regional, and global.

The technological and operational bases for a true sustainable development are available or within reach. Extreme poverty can be ended through targeted investments in sustainable energy access, education, health, housing, social infrastructure and livelihoods for the poor. Social inequalities can be reduced through the defense of human rights, the rule of law, participatory democracy,

universal access to public services, the recognition of personal dignity, a significant improvement in the effectiveness of fiscal and social policies, an ethical finance reform, large scale decent work creation policies, integration of the informal and popular economic sectors, and national and international collaboration to eradicate the new forms of slavery such as forced labor and sexual exploitation. Energy systems can be made much more efficient and much less dependent on coal, petrol and natural gas to avoid climate change, protect the oceans, and clean the air of coal-based pollutants. Food production can be made far more fruitful and less wasteful of land and water, more respectful of peasants and indigenous people and less polluting. Food wastage can be cut significantly, with both social and ecological benefits.

Perhaps the greatest challenge lies in the sphere of human values. The main obstacles to achieving sustainability and human inclusion are inequality, unfairness, corruption and human trafficking. Our economies, our democracies, our societies and our cultures pay a high price for the growing gap between the rich and the poor within and between nations. And perhaps the most deleterious aspect of the widening income and wealth gap in so many countries is that it is deepening inequality of opportunity. Most importantly, inequality, global injustice, and corruption are undermining our ethical values, personal dignity and human rights. We need, above all, to change our convictions and attitudes, and combat the globalization of indifference with its culture of waste and idolatry of money. We should insist upon the preferential option for the poor; strengthen the family and community; and honor and protect Creation as humanity's imperative responsibility to future generations. We have the innovative and technological capability to be good stewards of Creation. Humanity needs urgently to redirect our relationship with nature by adopting the Sustainable Development Goals so as to promote a sustainable pattern of economic development and social inclusion. A human ecology that is healthy in terms of ethical virtues contributes to the achievement of sustainable nature and a balanced environment. Today we need a relationship of mutual benefit: true values should permeate the economy and respect for Creation should promote human dignity and wellbeing.

These are matters on which all religions and individuals of goodwill can agree. These are matters that today's young people around the world will embrace, as a way to shape a better world. Our message is one of urgent warning, for the dangers of the Anthropocene are real and the injustice of globalization of indifference is serious. Yet our message is also one of hope and joy. A healthier, safer, more just, more prosperous, and sustainable world is within reach. The believers among us ask the Lord to give us all our daily bread, which is food for the body and the spirit.

DECLARACIÓN FINAL DEL WORKSHOP PAS Y PASS SOBRE “HUMANIDAD Y NATURALEZA SOSTENIBLES: NUESTRA RESPONSABILIDAD”

Estabilizar el clima y brindar acceso a la energía para todos en el marco de una economía inclusiva

La humanidad ha ingresado en una nueva era en la que el poderío tecnológico nos pone en una encrucijada. Somos los herederos de dos siglos de enormes olas de cambio en materia técnica: el motor a vapor, el ferrocarril, el telégrafo, la electricidad, el automóvil, el avión, las industrias químicas, la medicina moderna, la informática y, más recientemente, la revolución digital, la robótica, las biotecnologías y las nanotecnologías. Tales avances han modificado la economía mundial haciéndola cada vez más urbana y globalmente interconectada, aunque también cada vez más desigual.

Sin embargo, de la misma manera en que la humanidad se enfrentó a un «cambio revolucionario» (*Rerum Novarum*) durante la Era Industrial iniciada en el siglo XIX, hoy hemos alterado nuestro entorno natural a tal punto que los científicos definen la época actual como la Era del Antropoceno, es decir, una época en que la mano del hombre, a través de la utilización de los combustibles fósiles, está causando un impacto decisivo en el planeta. Si la actual tendencia continúa, este siglo será testigo de cambios climáticos inauditos y de una destrucción sin precedentes de los ecosistemas, con graves consecuencias para todos nosotros.

Cuando la acción humana no es respetuosa de la naturaleza, se convierte en un búmeran que genera desigualdades y exacerba lo que el Papa Francisco ha denominado «la globalización de la indiferencia» y «la economía de la exclusión» (*Evangelii Gaudium*), fenómenos estos que hacen peligrar la solidaridad para con las generaciones tanto presentes como futuras.

Los avances en la productividad registrada en todos los sectores —la agricultura, la industria y los servicios— nos permiten vislumbrar el fin de la pobreza, la distribución equitativa de la prosperidad y una mayor extensión de la expectativa de vida. Sin embargo, las estructuras sociales injustas (*Evangelii Gaudium*) se han convertido en obstáculos contra una organización adecuada y sostenible de la producción y una distribución justa de sus frutos, ambas condiciones necesarias para alcanzar esos objetivos. La relación del hombre con la naturaleza está colmada de las consecuencias que, sin explicación alguna, producimos cada uno de nosotros con nuestras acciones en

detrimento de las generaciones tanto presentes como futuras. Los procesos socioambientales no se corrigen por sí solos. Si están reñidas con la ética y la acción colectiva, las fuerzas del mercado no son capaces de resolver por sí mismas las crisis interrelacionadas de la pobreza, la exclusión y el medioambiente. Además, el fracaso del mercado ha ido de la mano con el fracaso de las instituciones, que no siempre han tenido por objeto el bien común.

Estos problemas se han visto exacerbados por el hecho de que en la actualidad la actividad económica es medida únicamente en términos del producto bruto interno (PBI), algo que hace caso omiso de la concomitante degradación de la Tierra y de las abyectas desigualdades entre los países y dentro de cada país. El crecimiento del PBI ha venido acompañado de brechas inaceptables entre los ricos y los pobres, quienes siguen sin tener acceso a la mayor parte de los avances de la época actual. Por ejemplo, alrededor del 50% de toda la energía disponible es utilizada por tan solo mil millones de personas; sin embargo, los impactos negativos en el ambiente están afectando a los tres mil millones que carecen de acceso a dicha energía. Estos tres mil millones tienen un acceso tan limitado a la energía moderna que deben cocinar su alimento y calentar e iluminar sus hogares con métodos que son peligrosos para la salud.

La utilización masiva de los combustibles fósiles, que hace al corazón del sistema energético mundial, causa profundas perturbaciones en el clima del planeta y acidifica nuestros océanos. El calentamiento global y los extremos climáticos a él asociados habrán de alcanzar niveles inauditos cuando nuestros hijos hereden el planeta; en tanto, el 40% de los pobres del mundo, que juegan un papel ínfimo como generadores de contaminación, son los que más habrán de sufrir. Llevadas a escala industrial, las prácticas agrícolas están transformando el paisaje en todo el mundo, y el grado en el que alteran los ecosistemas y amenazan la diversidad y la supervivencia de muchas especies ha adquirido dimensiones planetarias. Sin embargo, incluso con la escala y la intensidad inusitadas que ha adquirido la utilización del suelo, la inseguridad alimentaria sigue acechando, ya que mil millones de habitantes sufren de hambre crónica y un número similar es víctima del hambre oculta que provocan las deficiencias de micronutrientes. Es una tragedia que se desperdicie un tercio de los alimentos producidos para el consumo humano, lo que en palabras del Papa Francisco «es como robar de la mesa de quienes son pobres y tienen hambre».

En vista de la persistencia de la pobreza, de las crecientes desigualdades sociales y económicas y de la incesante destrucción del medioambiente, los gobiernos del mundo han hecho un llamado a adoptar los Objetivos de

Desarrollo Sostenible (ODS), una serie de nuevas metas universales destinadas a guiar las medidas que habrán de tomarse a nivel planetario a partir de 2015. Para cumplir tales objetivos será necesaria la cooperación a nivel mundial, además de innovaciones tecnológicas accesibles y el respaldo de las políticas socioeconómicas a nivel nacional y regional, siendo algunos ejemplos la aplicación de impuestos, la legislación contra los abusos ambientales, la imposición de límites al enorme poderío de las transnacionales y una redistribución justa de la riqueza. No cabe la menor duda de que la relación del Hombre con la naturaleza debe ser abordada mediante la acción solidaria y colectiva a nivel local, regional y global.

Lejos de ser inalcanzables, las bases tecnológicas y operativas de un genuino desarrollo sostenible ya están disponibles o bien son de fácil acceso. Es posible poner fin a la pobreza extrema a través de inversiones específicas en educación, salud, vivienda e infraestructura social, así como en el acceso a energías sostenibles y el fomento del sustento entre los más pobres. Las desigualdades sociales pueden reducirse mediante la protección de los derechos humanos, el Estado de derecho, la democracia participativa, el acceso universal a los servicios públicos, el reconocimiento de la dignidad personal, la optimización de la eficacia de las políticas sociales y fiscales, las reformas financieras basadas en la ética, las políticas de creación de empleo digno a gran escala, la integración de los sectores económicos informales y populares, y la colaboración a nivel nacional e internacional con miras a erradicar las nuevas formas de esclavitud, como lo son el trabajo forzado y la explotación sexual. Los sistemas energéticos pueden volverse mucho más eficientes y menos dependientes del carbón, el petróleo y el gas natural: así se evitaría el cambio climático, se protegerían los océanos y se limpiaría el aire, liberándolo de las sustancias contaminantes producidas por el uso del carbón. Podemos hacer que el sector alimentario se torne mucho más productivo y eficiente en la utilización del suelo y del agua, y sea menos contaminante y más respetuoso de los campesinos y de los pueblos indígenas. El despilfarro de comida puede reducirse notablemente, lo que se traduciría en beneficios tanto sociales como ecológicos.

Quizás el mayor desafío resida en el terreno de los valores humanos. Los principales obstáculos a la sostenibilidad y la inclusión son la desigualdad, la injusticia, la corrupción y el tráfico de personas. Nuestras economías, nuestras democracias, nuestras sociedades y nuestras culturas pagan un precio muy alto por esta creciente brecha que se está abriendo entre los ricos y los pobres en el seno de las naciones y entre ellas. Y tal vez el aspecto más nocivo del creciente abismo en materia de ingresos y riqueza que se observa en tantos países es que está profundizando la desigualdad de oportunidades. Es más, la

desigualdad, la injusticia a nivel global y la corrupción están socavando nuestros valores éticos, nuestra dignidad como personas y nuestros derechos humanos. Necesitamos, ante todo, cambiar nuestras convicciones y nuestras actitudes, y combatir la globalización de la indiferencia y su cultura del despilfarro y la idolatría del dinero. Debemos insistir en la opción preferencial por los pobres; fortalecer la familia y la comunidad; y honrar y proteger a la Creación como responsabilidad imperativa de la humanidad ante las generaciones futuras. Contamos con la capacidad tecnológica y de innovación necesarias para ser buenos custodios de la Creación. La humanidad necesita con suma urgencia corregir el rumbo en su relación con la naturaleza mediante la adopción de los Objetivos de Desarrollo Sostenible, los que permitirán promover un patrón sustentable de desarrollo económico e inclusión social. Una ecología humana sana en materia de virtudes éticas contribuye a la concreción de una naturaleza sostenible y un medioambiente en equilibrio. Hoy día necesitamos construir un vínculo que encierre beneficios mutuos: los valores genuinos deberían impregnar la economía, y el respeto por la Creación debería promover la dignidad y el bienestar humanos.

Estos son temas en torno a los cuales se puede esperar un consenso entre todas las religiones y las personas de buena voluntad. Son cuestiones que los jóvenes de todo el mundo harán suyas, pues constituyen una manera de construir un mundo mejor. Nuestro mensaje encierra una advertencia urgente, ya que los peligros del Antropoceno son reales, y la injusticia de la globalización de la indiferencia es grave. Sin embargo, nuestro mensaje es también un mensaje de esperanza y de alegría. Un mundo más sano, más seguro, más justo, más próspero y más sostenible está a nuestro alcance. Quienes somos creyentes pidamos al Señor que nos dé a todos nuestro pan de cada día, que es alimento para el cuerpo y el espíritu.

STATEMENT FINALE DEL WORKSHOP PAS E PASS SU “UMANITÀ SOSTENIBILE, NATURA SOSTENIBILE: LA NOSTRA RESPONSABILITÀ”

Stabilizzare il clima e dare accesso a tutti all'energia con un'economia inclusiva

L'umanità ha varcato la soglia di una nuova era. La nostra abilità in campo tecnologico ha condotto l'umanità a un bivio. Siamo gli eredi di due secoli di cambiamenti tecnologici considerevoli: la macchina a vapore, la ferrovia, il telegrafo, l'elettrificazione, il trasporto su strada, l'aviazione, la chimica industriale, la medicina moderna, l'informatica e ora la rivoluzione digitale, la robotica, le biotecnologie e le nanotecnologie. Questi progressi hanno ridisegnato l'economia mondiale rendendola sempre più urbana e interconnessa a livello globale, ma anche sempre più disuguale.

Tuttavia, proprio come l'umanità ha affrontato “un cambiamento rivoluzionario” (*Rerum Novarum*) nel XIX secolo all'epoca dell'Industrializzazione, oggi abbiamo modificato a tal punto l'ambiente naturale che gli scienziati tendono a definire la nostra era come Età dell'Antropocene, vale a dire un periodo in cui l'azione umana, attraverso l'uso di combustibili fossili, ha un impatto decisivo sul pianeta. Se continuano le tendenze attuali, questo secolo sarà testimone di cambiamenti climatici senza precedenti e della distruzione dell'ecosistema, con conseguenze drammatiche per noi tutti.

L'azione umana che non rispetta la natura diventa un boomerang per gli esseri umani, creando disuguaglianza ed estendendo quelle che Papa Francesco ha definito “la globalizzazione dell'indifferenza” e l’”economia dell'esclusione” (*Evangelii Gaudium*), che mettono a repentaglio la solidarietà con le generazioni presenti e future.

I progressi nella produttività misurata in tutti i settori – agricoltura, industria e servizi – ci permettono di immaginare la fine della povertà, la condivisione della prosperità, e un aumento ulteriore dell'aspettativa di vita. Tuttavia, le strutture sociali ingiuste (*Evangelii Gaudium*) sono diventate un ostacolo all'organizzazione appropriata e sostenibile della produzione e all'equa distribuzione dei suoi frutti, che sono entrambi necessari per raggiungere tali obiettivi. Il rapporto dell'umanità con la natura è pervaso da conseguenze imprevedute delle azioni compiute da ognuno di noi a scapito delle generazioni presenti e future. I processi socio-ambientali non sono autocorrettivi. Le sole forze di mercato, prive di etica e di azione collettiva,

non possono risolvere le crisi interdipendenti di povertà, esclusione e ambiente. Tuttavia, il fallimento del mercato è andato di pari passo con quello delle istituzioni, che non hanno sempre puntato al bene comune.

I problemi sono stati esacerbati dal fatto che, attualmente, l'attività economica è misurata solo in termini di prodotto interno lordo (PIL) e non tiene conto del degrado della Terra che ne consegue, né delle disuguaglianze ingiuste tra paesi e all'interno di ciascun paese. La crescita del PIL è stata accompagnata da divari inaccettabili tra ricchi e poveri. Questi ultimi, infatti, non hanno ancora accesso alla maggior parte dei progressi avvenuti nella nostra epoca. Ad esempio, il cinquanta per cento circa dell'energia disponibile è fruibile da un miliardo scarso di persone, mentre gli impatti negativi sull'ambiente colpiscono i tre miliardi di persone che non ne hanno accesso. Questi tre miliardi, infatti, hanno così scarso accesso all'energia moderna da essere costrette a cucinare, riscaldarsi e illuminare le proprie case usando metodi dannosi per la loro salute.

Il massiccio uso di combustibili fossili su cui è incentrato il sistema energetico globale sconvolge profondamente il clima della Terra e provoca l'acidificazione degli oceani del globo. Il riscaldamento e le condizioni meteorologiche estreme che esso comporta raggiungeranno livelli senza precedenti durante la vita dei nostri figli e il 40% dei poveri del mondo, il cui ruolo nell'inquinamento mondiale è minimo, rischiano di soffrirne di più. Le pratiche agricole su scala industriale stanno trasformando il territorio in tutto il mondo, distruggendo ecosistemi e minacciando la diversità e la sopravvivenza delle specie su scala planetaria. Eppure, nonostante la portata e l'intensità di questo sfruttamento del suolo senza precedenti, l'insicurezza alimentare è ancora una minaccia globale. Infatti, un miliardo di persone soffre di fame cronica e un altro miliardo circa soffre della fame cosiddetta nascosta, causata dalla carenza di micronutrienti. Questo è ancora più tragico se si considera che un terzo del cibo prodotto nel mondo viene sprecato, il che, come ha detto Papa Francesco, equivale a "rubare dalla tavola dei poveri e degli affamati".

In considerazione della povertà persistente, dell'ampliamento delle disuguaglianze economiche e sociali, e della distruzione continuativa dell'ambiente, i governi del mondo hanno chiesto l'adozione, entro il 2015, di nuovi obiettivi universali, denominati Obiettivi di Sviluppo Sostenibile (OSS), che servano a guidare le azioni su scala planetaria dopo il 2015. Il raggiungimento di questi obiettivi richiederà una cooperazione a livello globale, innovazioni tecnologiche (la maggior parte delle quali già esistenti) e, a livello nazionale e regionale, politiche economiche e sociali di sostegno, quali la tassazione e la regolamentazione degli abusi ambientali, l'imposi-

zione di vincoli all'enorme potere delle imprese transnazionali e un'equa redistribuzione della ricchezza. È ormai più che evidente che il rapporto dell'Umanità con la Natura debba essere gestito tramite azioni di cooperazione collettiva a tutti i livelli – locale, regionale e globale.

Le basi tecnologiche e operative per ottenere un vero sviluppo sostenibile sono già disponibili o alla nostra portata. Si può mettere fine alla povertà estrema con investimenti mirati a favorire l'accesso all'energia sostenibile, all'istruzione, alla sanità, agli alloggi, alle infrastrutture sociali e ai mezzi di sostentamento per i poveri. Le disuguaglianze sociali possono essere ridotte grazie a misure volte a difendere i diritti umani, lo stato di diritto, la democrazia partecipativa, l'accesso universale ai servizi pubblici, il riconoscimento della dignità personale, il miglioramento significativo dell'efficacia delle politiche fiscali e sociali, una riforma etica della finanza, politiche di creazione di lavoro dignitoso su vasta scala, l'integrazione dei settori economici informali e popolari, e una collaborazione nazionale e internazionale per debellare le nuove forme di schiavitù quali il lavoro forzato e lo sfruttamento sessuale. I sistemi energetici possono essere resi molto più efficienti e molto meno dipendenti dal carbone, dal petrolio e dal gas naturale, in modo da evitare cambiamenti climatici, proteggere gli oceani, ed eliminare dall'aria le sostanze inquinanti generate dal carbone. La produzione alimentare può essere resa molto più proficua e meno dispendiosa in termini di consumo di acqua e di suolo, più rispettosa dei contadini e delle popolazioni indigene e meno inquinante. Lo spreco di alimenti può essere drasticamente ridotto, con vantaggi sia sociali che ecologici.

La sfida più grande risiede forse nella sfera dei valori umani. I principali ostacoli al raggiungimento della sostenibilità e dell'inclusione umana sono la disuguaglianza, l'ingiustizia, la corruzione e la tratta di esseri umani. Le nostre economie, democrazie, società e culture pagano un prezzo elevato per il divario crescente tra ricchi e poveri all'interno di ciascuna nazione e tra di esse. E forse l'aspetto più deleterio dell'ampliamento del divario tra reddito e ricchezza in così tanti paesi è l'aggravarsi della disparità di opportunità. Anzi, quel che è ancora più importante è che la disuguaglianza, l'ingiustizia globale, e la corruzione stanno minando i nostri valori etici, la dignità personale e i diritti umani. Vi è una forte necessità, innanzitutto, di cambiare convinzioni e atteggiamenti, e di combattere la globalizzazione dell'indifferenza con la sua cultura dello scarto e l'idolatria del denaro. Dobbiamo insistere sull'opzione preferenziale per i poveri; rafforzare la famiglia e la comunità; e onorare e proteggere il Creato come responsabilità fondamentale dell'umanità nei confronti delle generazioni future. L'umanità ha urgente bisogno di correggere il proprio rapporto con la natura, adottando

gli Obiettivi di Sviluppo sopraindicati in modo da promuovere un modello sostenibile di sviluppo economico e di inclusione sociale. Un'ecologia umana sana in termini di virtù etiche contribuisce al raggiungimento della sostenibilità naturale e di un ambiente equilibrato. Occorre oggi instaurare un rapporto di reciproco beneficio: l'economia ha necessità di essere permeata dai veri valori, mentre il rispetto per il Creato dovrebbe promuovere la dignità umana e il benessere.

Su questi temi tutte le religioni e tutti gli individui di buona volontà possono essere d'accordo. I giovani di oggi li abbracceranno per creare un mondo migliore. Il nostro messaggio è un avvertimento urgente, perché i pericoli dell'Antropocene sono reali e l'ingiustizia della globalizzazione dell'indifferenza è una questione seria. Eppure, il nostro messaggio è anche di speranza e di gioia. Un mondo più sano, più sicuro, più giusto, più prospero e più sostenibile è alla nostra portata. I credenti tra noi chiedono al Signore di darci il nostro pane quotidiano, in quanto cibo per il corpo e per lo spirito.

DÉCLARATION FINALE DE LA RÉUNION SUR “HUMANITÉ DURABLE, NATURE DURABLE: NOTRE RESPONSABILITÉ”

Stabiliser le climat et donner accès à l'énergie à tous avec une économie inclusive

L'humanité est entrée dans une nouvelle ère. Notre prouesse technologique a conduit l'humanité à un tournant. Nous sommes les héritiers de deux siècles de vagues remarquables de changement technologique: la puissance de la vapeur, les chemins de fer, le télégraphe, l'électrification, le transport automobile, l'aviation, la chimie industrielle, la médecine moderne, l'informatique, et maintenant la révolution numérique, les biotechnologies et les nanotechnologies. De telles avancées ont transformé l'économie mondiale en la rendant de plus en plus urbaine et interconnectée au niveau mondial, mais aussi de plus en plus inégale.

Cependant, tout comme l'humanité a été confrontée à un “changement révolutionnaire” (*Rerum Novarum*) à l'époque de l'industrialisation au XIX siècle, aujourd'hui, nous avons changé notre environnement naturel, à tel point que les scientifiques sont en train de redéfinir la période actuelle comme l'âge de l'anthropocène, c'est-à-dire une époque où l'action humaine, par l'utilisation de combustibles fossiles, a un impact décisif sur la planète. Si ces tendances actuelles continuent, ce siècle assistera à des changements de climat sans précédent et de destruction de l'écosystème qui aura des conséquences sévères pour nous tous.

L'action humaine qui ne respecte pas la nature se transforme en boomerang pour les êtres humains; elle crée de l'inégalité et favorise ce que le pape François a appelé «la globalisation de l'indifférence» et «l'économie d'exclusion» (*Evangelii Gaudium*) qui mettent en danger la solidarité des générations actuelles et futures.

Les progrès de la productivité observés dans tous les secteurs – agriculture, industries et services – nous permettent d'envisager la diminution de la pauvreté, le partage de la prospérité, et l'augmentation ultérieure de l'espérance de vie. Cependant, les structures sociales injustes (*Evangelii Gaudium*) sont devenues des obstacles à l'organisation appropriée et durable de la production ainsi qu'à la distribution équitable de ses fruits; toutes deux sont nécessaires pour atteindre de tels objectifs. La relation qu'entretient l'humanité avec la nature a de nombreuses conséquences imprévues ; cha-

cun d'entre nous prend part à des activités qui se font au détriment des générations présentes et futures. L'action de l'homme sur son environnement ne fait pas l'objet de mesures correctives. Les seules forces du marché, dénuées d'éthique et de responsabilité collective, ne peuvent pas résoudre les crises interdépendantes de pauvreté, d'exclusion et d'environnement. Toutefois, les insuffisances du marché n'ont pas été compensées par le rôle des institutions qui n'ont pas toujours visé le bien commun.

Les problèmes ont été exacerbés par le fait qu'actuellement l'activité économique est mesurée seulement en termes de produit intérieur brut (PIB); par conséquent elle ne tient pas compte de la dégradation de l'environnement qui en résulte ni des inégalités injustes entre pays et au sein de chaque pays. La croissance du PIB a été accompagnée d'écarts inacceptables entre riches et pauvres. Ces derniers, en effet, n'ont pas encore accès à la plupart des progrès de notre époque. Par exemple, environ cinquante pour cent de l'énergie disponible est accessible à seulement un milliard de personnes alors que les impacts négatifs sur l'environnement touchent trois milliards de personnes qui n'ont pas accès à cette énergie. Ces trois milliards de personnes ont si peu accès à l'énergie moderne qu'ils sont forcés de cuisiner, chauffer et éclairer leurs maisons avec des méthodes dangereuses pour leur santé.

L'utilisation massive de combustibles fossiles au cœur du système énergétique mondial perturbe profondément le climat de la Terre et acidifie les océans de la planète. Le réchauffement et les conditions météorologiques extrêmes associées, atteindront des niveaux sans précédent durant la vie de nos enfants et 40% des pauvres dans le monde qui ont un rôle minime dans la pollution mondiale sont susceptibles d'en souffrir le plus. Les pratiques agricoles à l'échelle industrielle transforment les paysages, détruisent les écosystèmes, menacent la diversité et la survie des espèces à l'échelle planétaire. Cependant, malgré l'étendue et l'intensité de cette exploitation du sol sans précédent, l'insécurité alimentaire reste une menace mondiale. En effet, un milliard de personnes souffre de faim chronique et un autre milliard de faim appelée cachée en raison de carences en micronutriments. Ce constat est encore plus tragique si on considère qu'un tiers de la nourriture produite dans le monde est gaspillée, ce qui revient, comme le dit le pape François, à «pillier la table des pauvres et des affamés».

Compte tenu de la persistance de la pauvreté, de l'accroissement des inégalités économiques et sociales, de la destruction continue de l'environnement, les gouvernements ont demandé l'adoption d'ici 2015 de nouveaux objectifs universels, appelés Objectifs de Développement Durable (ODD), afin d'orienter les activités humaines après 2015. Pour atteindre ces objectifs,

il faudra développer la coopération au niveau mondial, maîtriser les innovations technologiques qui sont à portée de main, définir des politiques économiques et sociales adaptées aux niveaux national et régional (par exemple la fiscalité et la réglementation des atteintes à l'environnement), limiter le pouvoir exorbitant des sociétés multinationales et organiser une redistribution équitable de la richesse. La relation qu'entretient l'humanité avec la nature a besoin désormais de faire l'objet d'actions de coopération collective à tous les niveaux – local, régional, et mondial.

Les bases technologiques et opérationnelles pour un véritable développement durable sont déjà disponibles ou à notre portée. La pauvreté extrême peut être combattue par des investissements appropriés dans l'accès à l'énergie durable, l'éducation, la santé, le logement, les infrastructures sociales et les moyens de subsistance pour les plus pauvres. Les inégalités sociales peuvent être réduites grâce à la défense des droits de l'homme, la primauté du droit, la démocratie participative, l'accès universel aux services publics. Elles peuvent l'être également par la reconnaissance de la dignité de la personne, une amélioration significative de l'efficacité des politiques fiscales et sociales, une réforme éthique de la finance. Enfin, des politiques ambitieuses de création d'emploi décent, l'intégration des secteurs économiques à haute et basse valeur ajoutée, des coopérations nationales ou internationales permettront d'éradiquer les nouvelles formes d'esclavage comme le travail forcé et l'exploitation sexuelle. Les systèmes de production d'énergie peuvent être rendus beaucoup plus efficaces et bien moins dépendants du charbon, du pétrole et du gaz naturel afin d'atténuer les changements climatiques, protéger les océans et nettoyer l'air des polluants à base de charbon. La production alimentaire peut être beaucoup plus fructueuse et moins dispendieuse en termes de consommation d'eau et d'épuisement des sols. Elle peut être aussi plus respectueuse des paysans et des populations indigènes tout en étant moins polluante. Le gaspillage alimentaire peut être réduit de manière significative par des incitations d'ordre social ou écologique.

Le plus grand défi réside peut-être dans la sphère des valeurs humaines. Les principaux obstacles à lever pour donner un caractère durable et l'accès du plus grand nombre aux activités humaines sont l'inégalité, l'injustice, la corruption et la traite des êtres humains. Nos économies, nos démocraties, nos sociétés et nos cultures paient un prix élevé pour l'écart grandissant entre riches et pauvres au sein des nations mais aussi entre elles. La conséquence la plus néfaste de l'écart grandissant de revenu et de richesse dans de nombreux pays est peut-être l'aggravation de l'inégalité des chances. Il est encore plus important de prendre conscience que l'inégalité, l'injustice

généralisée et la corruption ébranlent nos valeurs éthiques, la dignité de la personne et les droits de l'homme. Nous avons besoin, avant tout, de changer nos convictions et nos attitudes, de lutter contre la mondialisation de l'indifférence avec sa culture de laissés-pour-compte et l'idolâtrie de l'argent. Nous devons nous préoccuper en priorité des pauvres, renforcer la famille et la communauté, honorer et protéger la Création car c'est une responsabilité fondamentale de l'humanité envers les générations futures. L'humanité a un besoin urgent de réorienter son rapport avec la nature en adoptant les ODD, afin de promouvoir un modèle durable de développement économique au profit du plus grand nombre. Une écologie humaine saine en termes de valeurs éthiques, contribue à la réalisation d'une nature durable et d'un environnement équilibré. Aujourd'hui il faut instaurer un rapport de bénéfice mutuel: l'économie a besoin d'être imprégnée de vraies valeurs tandis que le respect de la Création devrait promouvoir la dignité humaine et le bien-être.

Sur ces questions, toutes les religions et tous les individus de bonne volonté peuvent partager les mêmes orientations. Ce sont des questions que les jeunes d'aujourd'hui et à travers le monde embrasseront pour façonner un monde meilleur. Notre message est un avertissement urgent car les dangers de l'anthropocène sont réels et l'injustice de la mondialisation de l'indifférence est une question sérieuse. Cependant notre message est aussi un message d'espoir et de joie. Un monde plus sain, plus sûr, plus juste, plus prospère et plus durable est à portée de main. Nous, croyants, demandons au Seigneur de donner à tous le pain quotidien qui est la nourriture du corps et de l'esprit.

人類與自然的永續存在：我們的責任 宗座科學院／宗座社會科學院 聯合研討會聲明

穩定氣候、全民經濟與普及能源

人類已經進入新的紀元，科技實力帶領我們來到選擇的交叉路口。我們承襲了兩世紀以來，如滾雪球般席捲而來的日新月異的工藝技術，如蒸氣動力、鐵路、電報、電力、汽車運輸、航空、工業化學、現代醫學、電腦，以及現在的數位革命、生物科技和奈米科技。這些科技的進展使得世界經濟的型態逐漸轉變為都市化與全球連結的經濟，也成為越來越不平等的經濟。

然而，如同人類在十九世紀工業時期面對「革命性改變」那樣，如今人類也處成自然環境的巨大變遷。科學家因此將現今時期重新界定為「人類紀」時代，這也說明人類因使用化石燃料為地球帶來決定性的影響。如果目前的趨勢繼續不變，我們在本世紀將會看到前所未有的氣候變遷與生態環境，全球人類也會受到嚴重衝擊。

對自然缺少尊重的行為就像回力槌那樣反擊人類，不但造成不平等，也擴大戰爭方遑各所稱的「冷感的全球化」與「排斥弱勢的經濟」^[2]。這兩者已經威脅到現在與未來兩個世代之間的團結。

原本期望農業、工業及服務業各部門生產力的進步可以結結實實，共享繁榮，同時延長人類的壽命。不過不公平的社會結構與已經阻礙生產組織的合理化與永續化，其成果也因此未能獲得公平分配；而生產組織的合理化與永續化卻正是達到上述無雙所不可或缺的。由於我們對個人的活動所帶給現在或未來世代的後果缺少深思熟慮，人類與自然的關係因此充滿矛盾，社會環境的進程也未能自我修正。假如沒有倫理規範和集體行動，單靠市場機制是無法解決相互糾結的貧窮、弱勢及環境的危機的。所幸不以大眾利益為優先考量的機構也因其市場機制的失敗而功效垂危。

目前完全以國內生產毛額 (GDP) 來衡量的經濟活動並未考慮到地球所遭到的消耗，也未考量國家內部或國際間令人擔憂的不平等現象，問題因而更形複雜。伴隨 GDP 的成長而來的是令人無法忍受的貧富差距，窮人並未因時代的進步而受益。舉例來說，地球百分之五十的能源僅由十個人所使用，但是對環境所造成的負面影響卻涉及三十億用不到能源的人。三十億人幾乎享用不到現代的能源，我們必須利用有審慎的方法來審查、取締和規管。

以大量化石燃料為核心的全球能源系統已經嚴重影響地球的氣候，海洋也開始酸化。我們的下一代將經歷空前的全球暖化及其引發的惡劣氣候災情。而世界上百分之四十的窮人在全球污染上扮演極小的角色，卻可能成為最大的受害者。以企業規模經營的農業正在大幅度改變全球的糧食、影響生態系統，甚至威脅很多生物的多樣性和存活。然而，儘管人類以前所未見規模不斷開墾與利用土地，很多地方卻依然糧食不足。至少有十億人體受長期飢餓，另外約有十億人因缺乏最低的營養素而處於慢性飢餓狀態。可悲的是，人類生產的糧食卻有三分之一被浪費了，教宗方濟各將將此形容為「從貧窮和飢餓的餐桌上偷飯食」。

有鑑於貧困無法改善、經濟和社會不平等繼續擴大，以及環境不斷受到破壞，各國政府將於2015年通過新的全球目標——「永續發展目標」(Sustainable Development Goals, SDGs)，作為2015年之後全球性行動方案的依據。為達到這個目標，人類有必要加強全球合作，創新科技，支持國家和區域層面的經濟社會進程（例如對糧食所需的抽稅與管理），展現跨國大企業的巨大潛力，以及重新公平地分配財富。無疑，我們必須由地方、區域和全球各層面彼此合作，並集思廣益重建人類和自然的關係。

真正永續發展所需要的技術條件基礎其實已經存在，而且唾手可得。透過有目標的投資，給予窮人永續的能源、教育、衛生、住宅、社會基礎建設與生計，可以將極度貧窮的現象，透過維護人權，注重法治，強化民主參與，全面普及公共服務，重視個人尊嚴，大幅改善對稅務社會政策的效能，推動合乎治理的財政改革，大規模提升適當工作機會的政策，整合非正式與部門的經濟部門，

促進國內和國際合作以根除強制勞動和性別平等的奴隸制度，就可以降低社會的不公平。建設更有效率的能源系統，大幅減少對煤炭、石油和天然氣的依賴，可以避免氣候變遷，保護海洋，同時淨化受煤煙污染的空氣。糧食生產可以更有成效，減少土地和水源的浪費，更尊重農民和原住民，降低環境污染。大量減少糧食的浪費可以再造社會和生態。

巨大的挑戰也新在於人類的價值觀：達成永續發展和人類彼此存活的互惠關係就是不公平、貪婪及人口販賣。日益擴大的國內與國際的貧富差距已經使我們的經濟、民主、社會及文化付出極高的代價。在很多國家，所得與財富差距的擴大帶來的最大傷害就是讓社會不均繼續惡化。更重要的是，不平等、全球性的不公不義和貪婪正在侵蝕我們的倫理價值、個人尊嚴及人權。我們必須改變我們的信念與態度，對抗冷硬的全球化，以及此全球化所造成的虛假文化和資金開支。我們應堅持優先照顧窮人，強化家庭和社區關係，尊重和保護萬物，這是我們對後代無可推卸的責任。我們有足夠的創新和科技能力，可以成為萬物的守護者。人類迫切需要達成「永續發展目標」(SDG) 以改變我們與自然的關係，促進永續型的經濟發展與社會包容。從倫理覺悟的角度看來屬於健康的人類生態系統是有助於自然的永續發展與環境的平衡的，我們必須建立互利共生的關係；真正的價值應該滲入經濟活動之中，而對萬物的尊重應該增進人類的尊嚴與福祉。

所有善良的宗教和哲人都應該贊同這些議題。這些議題也是全球年輕人所願意認同的，他們要以這些議題來塑造一個更為美好的世界。我們的訊息其實是個急迫的警告，因為「人類紀」的危機是千真萬確的，而冷硬的全球化所造成的不公不義已經非常嚴重。然而，我們的訊息也帶著希望和喜樂。一個更健康、更安全、更公正、更簡單而且能夠永續發展的世界已經近在咫尺。我們當中的教友們祈求天主賜給我們日用的食糧，我們的肉身和心靈的食糧。

引用文獻

- [1] 《新事物》(Baran Novizam)
 - [2] 《福音的喜樂》(Evangelii Gaudium)
- (王雪琪、陳建仁譯)

Signatories to the Statement

PASS President Prof. Margaret Archer
Prof. Vanderlei S. Bagnato
Prof. Antonio M. Battro
Dr. Lorenzo Borghese
Prof. María Verónica Brasesco
Prof. Joachim von Braun
Prof. Edith Brown Weiss
Dr. Pablo Canziani
Marco Casazza
Prof. Yves Coppens
Prof. Paul Crutzen
Dr. Michael Czerny S.J.
Aisha Dasgupta
Prof. Sir Partha Dasgupta
Prof. Gretchen Daily
Prof. Pierpaolo Donati
Prof. Gérard-François Dumont
Prof. Ombretta Fumagalli Carulli
Juan Grabois
Prof. Allen Hertzke
Prof. Vittorio Hösle
Prof. Daniel Kammen
Emily Kelly
Prof. Charles Kennel
Dr. Anil Kulkarni
Prof. Nicole Le Douarin
Prof. Yuan T. Lee
Prof. Pierre Léna
Prof. M. Ramón Llamas

Prof. Karl-Göran Mäler
Dr. Marcia McNutt
Prof. Dr. Jürgen Mittelstrass
Prof. Walter Munk
Prof. Naomi Oreskes
Alicia Peressutti
Dr. Janice Perlman
Prof. Vittorio Possenti
Prof. Ingo Potrykus
Prof. V. Ramanathan
Prof. Sir Martin J. Rees
Dr. Daniel Richter
Prof. Ignacio Rodríguez-Iturbe
Dr. Courtney Ross
Prof. Louis Sabourin
Prof. Jeffrey Sachs
Msgr. Marcelo Sánchez Sorondo
Prof. John Schellnhuber
Prof. Bob Scholes
Matthew Siegfried
Prof. Hanna Suchocka
Prof. Govind Swarup
Msgr. Mario Toso
Card. Peter K.A. Turkson
Prof. Rafael Vicuña
Prof. Wilfrido Villacorta
Prof. Peter Wadhams
Prof. Dr. Hans F. Zacher
Prof. Stefano Zamagni