Food insecurity, hunger and malnutrition: necessary policy and technology changes

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Ending food insecurity, hunger and malnutrition is a pressing global ethical priority. Despite differences in food production systems, cultural values and economic conditions, hunger is not acceptable under any ethical principles. Yet, progress in combating hunger and malnutrition in developing countries has been discouraging, even as overall global prosperity has increased in past decades. A growing number of people are deprived of the fundamental right to food, which is essential for all other rights as well as for human existence itself. The food and nutrition crisis has deepened in recent years, as increased food price volatility and global recession affected the poor. In a strategic agenda, it will be necessary to promote pro-poor agricultural growth, reduce extreme market volatility and expand social protection and child nutrition action.

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Ending hunger as a global priority

The current global architecture for governing food, nutrition and agriculture has not been able to adequately address the challenges the system now faces and ensure progress toward food security. Even when general ethical principles are understood and agreed upon, actors in the system do not take needed actions since they lack the right incentives for doing so [1,2]. A comprehensive new approach, founded upon strong ethical principles and right incentives, is needed to address persisting hunger and the rising challenges in the agri-food system. To realize the potential of technology and economic policies in reducing hunger and food insecurity, this approach should also give adequate attention to the role of institutions, including religious institutions.

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The attention of the Catholic Church to poverty reduction and related actions has a long history. As stated in the Encyclical of Pope Leo XIII on capital and labor in 1891, the desire of the Church is that the poor should rise above poverty and wretchedness, and better their condition in life; and for this she makes a strong endeavor [3]. Fighting hunger seems to be one of the most obvious islands of consensus in world religions, and religious institutions, such as the Catholic Church, have an important role to play in advancing food security around the world. However, none of the global religious congregations can effectively address the hunger problem alone, and synchronized actions are needed on this issue.

Three different approaches have been developed for addressing food security and hunger. The *development* approach draws on economic, technological, and institutional strategies and innova-

1871-6784/$ - see front matter doi:10.1016/j.nbt.2010.08.006

tions for hunger reduction. The *charity* approach emphasizes both private and public giving to the people in need, and the role of religious institutions is very strong. The *rights-based approach* focuses on prioritizing actions – including legal actions and advocacy – that enhance basic human rights, such as access to adequate food. All three approaches have an ethical base, and they all are intrinsically linked. Weaknesses in the development approach to hunger reduction, for example, undermine the rights-based approach in a way which cannot be easily compensated for by charitable actions. Technological innovations in food and agriculture are cutting across these different approaches for combating hunger. In the past, technological breakthroughs adopted on a large scale have had high positive social pay-offs – they have been a critical component in preventing Malthusian predictions of population growth outpacing agricultural production, and in instigating the Green Revolution in Asia in the 1960s and 1970s. New high-impact technologies such as biotechnology, biofortification and nanotechnology now offer further opportunities for boosting agricultural productivity and enhancing food quality and nutritional value. Science and technology alone, however, cannot eliminate hunger and malnutrition, and the power of agricultural technology is strengthened through related policies and institutions. At the same time, if agricultural innovations are blocked, development is also blocked, and hunger and poverty will be perpetuated.

The food and nutrition crisis expands and deepens

Global progress in combating malnutrition has been slow in past decades, with dramatic differences among countries and regions. The 2008 Global Hunger Index (GHI) score fell to 15.2 compared to 18.7 in 1990, indicating a slight improvement in the overall hunger situation [4]. (The GHI is a combined measure of three equally weighted components: (i) the proportion of undernourished as a percentage of the population, (ii) the prevalence of underweight in children under the age of five and (iii) the under-five mortality rate. The 2008 GHI is based on data until 2006 – the last year with data available at the time of publication.) But the absolute number of undernourished people in developing countries actually increased from 823 million in 1990 to 848 million in 2002–2005, and an estimated one billion in 2009 [5]. Even before the food price crisis in 2007–2008 hit the poor, roughly 160 million people were living in ultra poverty, on less than 50 cents a day [6]. In a worrying trend, the most severe deprivation is increasingly concentrated in Sub-Saharan Africa, which has experienced a significant increase in the number of the ultra poor since 1990 and is currently home to three-quarters of the world's ultra poor [6].

At their peaks in the second quarter of 2008, world prices of wheat and maize were three times higher than at the beginning of 2003, and the price of rice was five times higher. In response to high food prices, poor households had to limit their food consumption, shift to even less-balanced diets, and spend less on other goods and services that are essential for their health and welfare, such as clean water, sanitation, education and health care [7]. Food price hikes have also worsened micronutrient deficiencies, with negative consequences for people's nutrition and health, such as impaired cognitive development, lower resistance to disease and increased risks during childbirth for both mothers and children. Since children's nutrition is crucial for their physical and cognitive development and for their productivity and earnings as adults, the health and economic consequences of insufficient food and poor diets are lifelong – for the individuals as well as for society. A 2008 Lancet article shows that men who benefited from a randomized nutrition intervention when they were young children earned wages that were 50% higher than those of nonparticipants three decades later [8]. Thus, it must be assumed that even when a multiyear price shock ends, the adverse consequences for the poor and food insecure continue for decades.

The global financial crisis and recession are now adding to the burden on the poor as wages are lost, many small farmers find themselves unable to pay off their debts and capital for agriculture is further limited. With food and general costs of living on the rise, people in more than 60 countries turned to the streets in protest in 2007 and 2008. IFPRI estimates that recession and reduced investment in agriculture could raise international grain prices by 30% and push 16 million more children into malnutrition in 2020 compared with continued high economic growth and maintained investments [7]. At a global scale, the decline in investments leading to cuts in agricultural supply seems to be stronger than the demand decline due to the recession. These trends might soon put again strong upward pressure on food prices combined with increased price volatility.

The challenge of feeding the world has greatly increased. The recent hikes in food prices are not exceptionally high from a historical perspective but they have greatly increased the challenge of feeding the world's growing population [7]. Since the time of notoriously high food prices in the 1870s, world population has increased more than five times reaching 6.7 billion today and it is expected to reach 9 billion by 2050. To overcome existing hunger, feed an additional 2 billion people and accommodate rising demand from income growth, food production would have to be doubled by 2050.

Science and technology for hunger and poverty reduction

Existing land and water constraints, as well as further challenges for natural resources such as climate change, make the task of doubling food production in the next four decades additionally challenging. There is only about 12% or less of available arable land which is not presently forested or subject to erosion and desertification. The area of land in farm production could in principle be doubled, but only by massive destruction of forests and loss of biodiversity and carbon sequestration capacity. The other consequence of doubling food production this way is significant increases in the marginal costs of investment, which would translate in increased food prices.

Numerous studies have shown that spending on agricultural research and development (R&D) is among the most effective types of investment for promoting growth and reducing poverty. For example, for every 1 million rupees spent on agricultural R&D in India in the 1990s, 323 poor people were lifted above the poverty line [9]. Plant-breeding programs, in which the centers of the Consultative Group on International Agricultural Research (CGIAR) play a leading role, have developed more than 8000 improved crop varieties in the past 40 years.

The opportunities offered by agricultural science for the future are also wide. In an assessment of the key technological innovations needed for advancement by 2020, 9 of the 16 technological innovations relate to agriculture and rural development, such as genetically modified crops and rural wireless communications [10]. Biofortification – the breeding of new varieties of staple crops that are rich in micronutrients – allows the poor to receive the necessary amounts of vitamin A, zinc and iron via their regular staple-food diets. Biofortification provides a means of reaching malnourished populations in relatively remote rural areas and delivering naturally fortified foods to people with limited access to commercially marketed fortified foods or supplements. New high-impact technologies such as nanotechnology and its applications, might allow people to eat foods without absorbing harmful allergens and cholesterol, and modify food taste and nutritional value. For such technologies, however, research efforts should be devoted to carefully studying both benefits and hazards early on in the application process.

Genetic modification has been successful in creating beneficial traits such as disease resistance, higher nutritional value and increased yields – traits which can be difficult to achieve through traditional breeding techniques. Biotechnology can increase small farmer productivity and equity in poor communities threatened by extreme weather, crop pests and different types of malnutrition. In addition, it can ameliorate environmental degradation by developing high-yield varieties, which require less use of chemical pesticides and do not require mechanical tilling. Since 1996, biotechnology has decreased the environmental impact associated with herbicides, and insecticide use has significantly reduced pesticide spraying. As a result, it has decreased the environmental impact associated with herbicide and insecticide use on these crops [11]. For consumers, biotechnology can improve health outcomes and reduce food and health expenditures.

Even though genetically modified foods currently available on the international market have passed risk assessments and are not likely to present risks for human health [12] opposition against genetically modified crops persists and has provoked wide attention and debate. On the surface, it appears as if interest group activism against genetically modified foods is motivated by precaution. However, a deeper look into the issue reveals that it is predominantly an issue of preferences. Therefore, the constructive solution would not be to enter into an exchange of dogmas, but an examination of the rationality of consumer preferences and improved information for customers.

From an ethical standpoint, the risks of growing genetically modified crops should be weighed against the risks of nonadoption. Rejection of genetically modified crops leads to negative externalities that hurt the poor. To sustainably save human lives without biotechnology investments, two options exist: use more environmental capital and undermine sustainability, and invest more in safety nets and direct social programs.

Both are very high-cost alternatives which are not sustainable.

Despite the benefits and the associated opportunity costs, agricultural growth in many developing countries continues to be hampered by lack of appropriate agricultural technologies. While in 2008, about 12.3 million farmers in 15 developing countries were growing biotech crops [13] these farmers still represent a small fraction of those working on the 400 million small farms globally. Dissemination of technology in agriculture requires much more upfront investment in the foundations of effective technology utilization, such as rural education, infrastructure and extension services.

However, public R&D investments have been stagnating since the mid-1990s, and the gap between rich and poor nations in generating new technology remains [14]. From 1992 to 2006, funding for the CGIAR, which is a major contributor to agricultural innovation in partnership with national research systems, increased by only 2% per year [15]. The current resources are hardly enough to work at the frontiers of new science, and the recent financial crunch further constrains the availability of capital for agriculture science in the developing world.

Strategic agenda for science and policy

At the global level, a science and technology initiative is needed to respond to risks such as rising food prices, economic recession, increased competition for natural resources and climate change. Its agenda should focus on increasing agricultural productivity, but also include increasing small farm incomes, sustainability of agricultural practices, natural resources management, international competitiveness, and food quality and health. Priorities should be set with a clear focus on the poor and food insecurity. For example, in the areas of agriculture, health and nutrition, focus should be placed on increasing lives saved and livelihoods improved, as well as economic productivity, growth and returns on investment. In addition, the proposed science and technology initiative would need to increase investments in R&D, explore new technologies, including biotechnology, and strengthen partnerships.

The renewed focus on agriculture, food and nutrition should be supported by three sets of complementary policy actions:

Promote pro-poor agricultural growth. To enhance agricultural productivity, investments should be scaled up in the areas of R&D, rural infrastructure, rural institutions, and information monitoring and sharing. Doubling investments in public agricultural research from US$5 to US$10 billion from 2008 to 2013 would significantly increase agricultural output and millions of people would emerge from poverty. If these R&D investments are targeted at the poor regions of the world – Sub-Saharan Africa and South Asia – overall agricultural output growth would increase by 1.1 percentage points a year and lift about 282 million people out of poverty by 2020 [15]. On a global scale, an evidence-based functional system is needed to ensure biosafety.

Reduce extreme market volatility. To prevent extreme volatility, it is essential to ensure open trade. In addition, two global collective actions for food security are needed: first, a small, independent physical reserve should be established exclusively for emergency response and humanitarian assistance. Second, a virtual reserve and intervention mechanism should be created to help avoid the next price spikes. The organizational design of the virtual reserve would include a high-level technical commission that would intervene in future markets and a global intelligence unit that would signal when prices head toward a spike [16].

Expand social protection and child nutrition action. To protect the basic nutrition of the most vulnerable and improve food security, agricultural growth and reducing market volatility must be accompanied by social protection and nutrition actions. Protective actions are needed to mitigate short-term risks (incl. conditional cash transfers, pension systems and employment programs), and preventive actions are needed to avoid long-term negative consequences (including preventive health and nutrition interventions such as school feeding and programs for improved early childhood nutrition and strengthened and expanded to ensure universal coverage). In the formulation of global policy and technology promotion strategies, the different innovation needs and (risk) preferences of poor and rich need to be reconciled. To achieve this, first, innovation must not be compartmentalized as a need of a specific group, country or region, since such categorizations stop innovation in its tracks. Second, survival and basic needs should be acknowledged and treated as absolute, and must not be weighed against relative preferences. Third, solutions to overcome conflict must be found in the interest of the poor in terms of access to technology, which is implicit in the right to food, active development of pro-poor technology and access to product benefits.

Given that prioritization, sequencing, transparency and accountability are crucial for successful implementation, policy and governance practices in many developing countries must be strengthened. To achieve maximum effectiveness of policy and technology strategies, it is essential to close information gaps of credible and up-to-date data on the impacts of food and nutrition insecurity and the effects of policy responses. Technology, including biotechnology, for agricultural productivity growth is necessary for food and nutrition security. Making biotechnology available for developing countries' farmers is called for from all three approaches that ethically underpin the fight against hunger – development, charity and rights-based approach.

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