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Edited by
Joachim von Braun, Bettina Iseli,
Maximo Torero, Peter K.A. Turkson

Food and Humanitarian Crises: Science and Policies for Prevention and Mitigation

Proceedings of a Workshop held at
Casina Pio IV, Vatican City, 9-10 May 2023

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"... we can and must emerge from a crisis, but under two conditions: we cannot emerge alone from a crisis – either we emerge together or not at all, and secondly, we emerge from a crisis in order to become better, to move ever forward, to make progress."

Official speech of the Holy Father delivered on May 10, 2023 addressing this conference (see full text on page 13).

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Address to the Holy Father Pope Francis by PAS President Joachim von Braun

Dear Holy Father,

We are most grateful to You for seeing us on the occasion of this workshop on "Food and Humanitarian Crises: Science and Policies for Prevention and Mitigation". The prevalence and scale of food and humanitarian crises are a shame for humanity.

We want you to know that your Pontifical Academy of Sciences cares about the poor, and mobilizes science, practitioners, and policy makers to help overcome the problems of these crises.

Participants in this workshop present here are academics that are committed to address the humanitarian and food crises, senior policy makers, UN Agencies, especially FAO, WFP, OMI, as well as leaders in civil society who directly work in the crisis hotspots, such as Ukraine, Ethiopia, Sahelian countries, Sudan, South Sudan, Northern Nigeria, Cameroon, DR Congo, Yemen, Afghanistan, Syria, Haiti, and others. You are very familiar with the problems and have visited several of these countries.

Many of the crises come about because governments fail. That must be addressed. When governments fail to serve their people, we need to form alliances of civil society, religious communities and science. Faith and science cooperation to address crises is needed. A stronger UN system is essential too.

Crises are shaped by wars and armed conflicts, disrupted food supply chains, hinderance of production, climate change.

Three billion people do not have access to healthy diets, more than 800 million are undernourished, more than ever, there are millions of refugees and displaced people. And still food continues to be wasted by the wealthy.

Our main concern is about marginal population groups, including displaced and impoverished small farmers and herders, slum dwellers, refugees, and women and children in these situations, as well as Indigenous Peoples. These groups suffer the most in humanitarian crises.

We call for improving and increasing actions. The hungry poor cannot wait.

We Focus on Solutions. Key actions proposed by us include,

(1) Re-designed emergency aid interventions, based on better foresight, with due attention to nutrition during and after humanitarian and

food crises. Satellite data, digital information and new scientific analyses do help action.

(2) Participation by local populations in policies, peace building, governance strengthening is essential. Communities are the first and most important respondents in humanitarian crises. Women's empowerment must be a central part of that.

(3) A much more comprehensive engagement and welcoming culture in support of refugees and displaced people is required. We gratefully acknowledge your statements on the issue. We must also prepare for flows of people displaced by climate crisis and need increased climate adaptation investments.

Research on how to prevent and overcome humanitarian and food crises shows impacts already, and we are committed to further strengthen the role of science for that in our Pontifical Academy of Sciences and with our partners present here.

Dear Holy Father,

we are grateful for your guidance, as for instance in the encyclicals *Laudato Si'* and *Fratelli Tutti*.

We join you in prayers for the poor, and we pray for you.

Best wishes and God bless you.

Greeting of His Holiness Pope Francis to Participants in the Conference

Your Eminence,
Mr President,
Dear brothers and sisters all!

I extend to all of you a cordial welcome on the occasion of your Conference, with its theme "Food and Humanitarian Crises: Science and Policies for their Prevention and Mitigation", and I thank President von Braun for his kind greeting. Yours is indeed a timely subject, not only for academic discussion, but also one that calls for farsighted leadership and practical policies that can be enacted at different levels of society in order to relieve the sufferings of so many of our brothers and sisters who lack healthy diets and access to sufficient food. Some months ago, an expert said to me: "If, over the course of one year, we did not manufacture weapons, hunger would end in the world".

This challenge is a pressing one, as all too often situations marked by natural disasters, as well as by armed conflict – I think especially of the war in Ukraine – political or economic corruption and exploitation of the earth, our common home, hinder food production, undermine the resilience of agricultural systems and dangerously threaten the nutritional supply of entire populations. At the same time, these various crises have been worsened by the long-lasting effects of the Covid-19 pandemic. Moreover, we are witnessing the decline of fraternal solidarity – this is a fact: wars and poverty lead to the decline of fraternal solidarity – and this decline is brought about by, among other things, the selfish demands inherent in some current economic models.

In this perspective, we need to become more and more aware that everything is closely interrelated, that "today's problems call for a vision capable of taking into account every aspect of the global crisis" (Fratelli Tutti, 137). One important element of this vision is the understanding that a crisis can also become an opportunity, a chance to recognize and learn from past mistakes.

In this sense, it is my hope that your Conference will help all of us emerge better from the crises we currently face, not only by focusing on

technical solutions, but above all by recalling how essential it is to develop an attitude of universal solidarity grounded in fraternity, love, and mutual understanding. In this regard, the Church wholeheartedly supports and encourages your efforts, together with those of all who are working not only to feed others or respond to crises, but also to promote an integral human development, justice among peoples and international solidarity, thus strengthening the common good of society.

Dear friends, I express once again my gratitude for your valuable service in collaboration with the Pontifical Academy of Sciences and assure you of my prayers that your work will bear fruit in helping to address the numerous problems which result from food and other humanitarian crises. Crises and conflicts are different. Conflicts are closed in on themselves, it is difficult to emerge from a conflict in a constructive way. On the other hand, we can and must emerge from a crisis, but under two conditions: we cannot emerge alone from a crisis – either we emerge together or not at all. This is important: we cannot emerge alone; we need the community, the group, in order to emerge. Secondly, we emerge from a crisis in order to become better, to move ever forward, to make progress. I thank you for your attitude in regard to these crises: emerging together and emerging better. Upon all of you I invoke the abundant blessings of Almighty God, and I ask you, please to pray for me. Thank you!

Final Statement

Summary

Based on an international workshop by the Pontifical Academy of Sciences, that brought together scientists, practitioners from civil society, UN, and policymakers, we draw attention to the urgent need for more engagement and actions to overcome the growing number and intensity of food and humanitarian crises. The prevalence and scale of food and humanitarian crises is unacceptable and ethically reprehensible. It is imperative that we address the causes and consequences of these problems comprehensively and innovatively.

The world is facing the highest number of violent conflicts since the Second World War. These conflicts are major triggers of humanitarian and food crises, reducing access to production factors, social safety nets and trade, and causing forced displacement.

Under global climate change, extreme weather events have become a further important trigger of humanitarian and food crises worldwide. It is crucial that international support for resilience is expanded and prioritized at upcoming Climate Summits. Policy actions must be based on the understanding that the right to life and access to basic necessities such as food and water are human rights.

We also urgently need a more proactive and better-resourced response to the global refugee crises, including a welcoming culture for refugees, as called for by Pope Francis. Respect for and adherence to international law and treaties for the protection of refugees are also required.

To prevent food and humanitarian crises, we call for context-specific and appropriate international and regional engagement, local peacebuilding, and multilateral conflict resolution by the UN, G20, and regional political bodies.

The structures, governance and management of humanitarian and food crises require comprehensive reform. This includes elements of global governance, such as nested institutions that reflect rights and responsibilities at both local and global levels to address mitigation and prevention of humanitarian crises. Women's roles and leadership in these contexts must be strengthened. We need increased and more flexible financial resources at an international level, along with redesigned emergency aid interventions. Without such reforms, we will continue to deal with symptoms rather than addressing the root causes.

Science has an important role to play in addressing food and humanitarian crises, because they are problems of complexity. Sciences can help identify policy, organizational and technological innovations.

Cooperation between faith and science is critical in overcoming humanitarian crises by combining ethics with innovation.

Food and Humanitarian Crises: Science and Policies for Prevention and Mitigation

1. **The prevalence and scale of food and humanitarian crises is totally unacceptable and ethically reprehensible. It urgently requires new and comprehensive solutions.** The Pontifical Academy of Sciences has addressed food issues and armed conflicts before.[1] At this international workshop of scientists and practitioners, we call for more science-based innovations, engagement and public actions to overcome the growing food and humanitarian crises. *We urge a reassessment of the mechanisms for prevention and mitigation of these crises, including political and diplomatic processes, and commitments to actions to end crises. We highlight opportunities for innovative actions by national and international organizations and call on science communities to engage with research in crises, to systematically understand the causes of crises, and strengthen the evidence base for solutions. Current resource mobilization, scientific assessment, and political engagement for preventing and mitigating crises are inadequate.*

2. **Food and humanitarian crises are caused and shaped by a complex set of drivers, triggers and aggravating factors**. Drivers include climate change, wars, armed conflicts and violence, forced displacement, poverty, low agricultural productivity, food, water and energy insecurity, underdeveloped markets, rising prices, and environmental degradation, and the

[1] *The Pontifical Academy of Sciences (PAS) has repeatedly addressed problems of peace, poverty, inequality and injustice*. For instance, *Preventing Nuclear War and War Against Civilian Populations: Also a Task for the Sciences*. A statement by the Council of the Pontifical Academy of Sciences, The Vatican, April 8, 2022. The world food system has also previously been addressed by PAS from various angles, for example in the recent conferences on *Science and Innovations for a Sustainable Food System – Preparing for the UN Food Systems Summit*, 21-22 April 2021; and *Reduction of Food Loss and Waste*, 11-12 November 2019. Moreover, PAS climate- and biodiversity-related conferences, as well as conferences addressing innovations in bio-sciences, have also included attention to food systems and food security. The findings from these conferences and the related statements and publications form important backdrops to the concept of this workshop.

Note: Data sources mentioned in this statement are in the papers presented at the workshop.

presence of rebel groups. Triggers include extreme weather events such as cyclones, droughts and floods, and pandemics and other disease outbreaks. Lack of basic services and infrastructures and lack of social assistance aggravate the situation. At times, hunger is even used as a weapon or a negotiating tool in conflicts. The recent global food crisis of 2020 to 2023, triggered by the COVID-19 pandemic and fueled by extreme weather events and the Russian Federation's military aggression against Ukraine, has led to a doubling of food prices. Economic slowdowns and downturns, exchange rate devaluation, market volatility and job losses have increased vulnerability. As a result, many more people go hungry and live without rights. About 1.5 billion people live in fragile and conflict-affected settings; more than 800 million are undernourished and about 3 billion are too poor to afford a healthy diet; over 100 million are forcibly displaced.

3. **The world is facing the highest number of violent conflicts since the Second World War.** So-called internationalized intrastate conflicts almost tripled between 2012 and 2020. These conflicts trigger humanitarian and food crises by reducing access to production factors, social safety nets, and trade, and causing refugee flows and internal displacements. We need a better understanding of why they occur in each context, and concerted international action to reduce their impacts on the poorest populations. In general, local populations, not just warring factions, must be respected more in efforts preventing and overcoming armed conflicts. *We call for context-specific international and regional engagement, local peacebuilding, and multilateral conflict resolution by the UN, G20, and regional political bodies. Unless addressed, these confounding factors will result in growing humanitarian aid needs.*

4. **Under global climate change, extreme weather events are a major trigger of humanitarian and food crises, and their frequency will increase.** The number of climate-related disasters has tripled in the last 30 years. Heatwaves, droughts, floods, typhoons and hurricanes cause mass destruction around the world. Ninety percent of disasters are now classed as weather- and climate-related. Adapting to climate change and coping with climate-related damages will be more and more expensive for low- and middle-income countries. It is already unaffordable for them. They have contributed little to greenhouse gas emissions. Indigenous Peoples are under particular pressure from climate crises in view of their fragile living environments, where they safeguard a large share of the world's biodiversity. While some weather shocks appear suddenly, others like droughts

build slowly. Related preparedness and adaptive capacities are inadequate, especially by national authorities in countries and regions most vulnerable to climate shocks. *Expanding international support for resilience must have high priority in upcoming Climate Summits*.

5. **Food and humanitarian crises are problems of complexity that require integrated, new approaches by sciences.** Crises dynamics are hard to predict due to their inter-connectedness with multiple actor groups and uncertainties. A set of determinants and triggers can happen simultaneously and adversely build on each other. For example, external shocks like severe weather events such as storms or droughts, earthquakes, or food price inflation and trade disruptions can be exacerbated by internal factors like violent conflicts and local crop shortfalls. Fiscal and foreign exchange constraints, and corruption in political systems, drain buffering capacities. The "Triple Nexus" concept, which integrates humanitarian, development and peace activities (HDP), is a coherent framework but needs populating with research-based facts and concrete options for action. Short-term actions are often taken under conditions of limited information, low predictability of emerging crises, and constrained resources for comprehensive responses. Together, the natural and the social sciences need to explore opportunities to contribute to short-term life-saving actions in acute crises, and to connect short-term action with sustainable development. *We call on sciences for more engagement in crises, to strengthen the evidence base for initiatives and investments. Scientific research on crisis prevention and on appropriate short-term actions is lacking and needs to build on experiences gained from hotspots of current humanitarian crises, as reviewed at the workshop: Afghanistan, Cameroon, Chad, DR Congo, Ethiopia, Haiti, Nigeria, Somalia, Sudan, South Sudan, Syria, Ukraine, Yemen, and others*.

6. **To support effective actions, sciences need to be based on foresight, data and analytics and need to consider indigenous and local knowledge.** Adequate diagnosis of crises is important for decision-makers to engage appropriately. New, more disaggregated data, modelling, and analytical approaches, including early warning systems with predictive power and adequate diagnosis of crises, are important. Artificial intelligence can help understand risks and prepare for responses. Progress has been made in data systems innovations for these challenges, such as predicting El Niño-related droughts and early warnings of large storms. *Combining indigenous and local knowledge with science can contribute to resilience. Investment in information has high benefits, but must consider information asymmetries between funders, implementers,*

and affected populations, including data sovereignty. Innovative data systems can help reduce these asymmetries. Analytical approaches must consider the dynamic nature of crises and the inter-temporal linkages of drivers and components of complex crises.

7. **Our main concern is marginalized population groups**, including displaced and impoverished small farmers, herders and fishers, slum dwellers, people affected by forced migration, people in fragile and conflict-affected settings. In particular, women and children in these contexts, as well as Indigenous Peoples, require special attention. Psychosocial distress and malnutrition can lead to permanent trauma and morbidity in children who suffer from displacement and are forced to live in unhealthy or inhospitable environments.
Women and children are particularly at risk of violence and deprivation during displacement. Children's cognitive development is impacted for the long term by malnutrition and lack of schooling. Children of women who grew up during a food crisis or violent conflict are more likely to die in early childhood, or to be stunted or underweight and have reduced educational attainment, transmitting poor health and lower contribution to national development over generations. This requires particular attention in refugee camps and in refugee settlement areas. Women and girls are at risk of physical and sexual violence, kidnapping, early and forced marriages, and domestic violence both during displacement and in refugee camps.
Indigenous Peoples whose livelihoods and traditions are tied to their ancestral homes are particularly affected by conflict-induced displacement. They lose their income and livelihood opportunities first, and suffer the most from water and food insecurities. During humanitarian and food crises all these groups are at increased risk of exploitation, human trafficking and modern forms of slavery.
The livelihoods and food security of **smallholder farmers and herders** are particularly affected by climate- and conflict-induced crises. Nevertheless, the potential capacities of marginalized groups to self-organize must not be underestimated. *Anticipatory and early action targeted to those most affected is urgently required. Short-term food crises can lead to permanent adverse health impacts, especially in pregnancy and in early childhood. Among the many health, social, and economic harms of malnutrition, we call attention to the fact that acute malnutrition or wasting of children (i.e., being dangerously thin for their height), and stunting (i.e., being short for their age), poses a great threat for them. Solutions for prevention and treatment of wasting and stunting (e.g., with lipid-based nutrient supplements and ready-to-use therapeutic foods) need to be scaled up, as well as engaging communities*

in screening, cash support and infection control. Moreover, families and communities should better understand the priority for feeding mothers and infants within the family hierarchy, breaking the "women eat last" syndrome.

8. **Policy actions need to be based on the Universal Declaration of Human Rights, which states that "everyone has the right to life, liberty and security of person"**[2] **and that access to food, water and other basic necessities are human rights**.[3] Governments have the primary responsibility to pursue preventive policies and take emergency measures to secure food access for all their populations. If a government lacks the capacity to prevent or mitigate a food crisis, it must allow and facilitate relief operations in accordance with humanitarian principles and international law. Any government or warring faction that prohibits access to food and other basic necessities must be sanctioned under international criminal law. *The actions of warring factions violating people's rights must be internationally monitored, including in relation to emergency food and other relief assistance. The legal research community is called upon to engage more deeply in the institutional aspects of humanitarian and food crises and the right to life, food and water.*

9. **The direct and indirect effects of the growing refugee, displaced populations and migration crises resulting from food and humanitarian crises must be addressed with compassion, adherence to laws, and better science.** The climate crisis will lead to a lot more displacement of vulnerable population groups. The indirect effects of humanitarian and food crises for vulnerable people, such as exploitation, human trafficking and modern forms of slavery, must also receive more attention. *We need a more proactive, and better-resourced response in support of refugees and displaced people, with an emphasis on supporting women's leadership in programs that aid refugees and displaced people inside and outside of camps in acute crises. We must also prepare for the flows of people who will be displaced by future climate crises. A welcoming culture for refugees, as called for by Pope Francis, respect for international law and treaties, and adherence to them are essential.*

10. **Policy, technological, and institutional innovations are needed. K*ey actions include*:**

a. **Redesigned emergency aid interventions:** *Much stronger, social protection systems endowed with flexible resources are needed to facilitate crisis prevention and mitigation.* Humanitarian interventions should help build more sus-

[2] Preamble, art. 3.
[3] Preamble, art. 25.

tainable programs and make more use of forecast- and anticipatory-based humanitarian actions. Attention should be paid to children's nutrition overall and the treatment of acute malnutrition before, during and after humanitarian and food crises, based on tested operational models. Combining young children's nutrition with cognitive programs is important.

b. **Explicit integration of affected local populations** in creating transformative policies, peace building, governance strengthening for food security is crucial, because individuals and local communities are the first and most important respondents in humanitarian crises. *Women's empowerment in local and national contexts, and listening to and engaging with indigenous peoples' concepts and resilience approaches is essential*.

c. **Comprehensive reform of structures, governance and management of humanitarian and food crises.** Effective governance, expressed by voice, accountability, rule of law and control of corruption, is closely correlated with risks of crises occurrence and outcomes. Efforts to improve governance and reduce power inequities should be part of any crisis prevention and mitigation effort. International, donor, and government structures should change toward active engagement in crisis prevention and more effective disbursement of emergency aid. Donors should be accountable for increasing anticipatory action efforts. *The establishment and strengthening of regional and international integrated "information and action platforms" should be considered. These platforms would bring together strengthened UN and civil society actors at national and regional levels, as dictated by context and humanitarian principles. They would combine data on early warning for humanitarian crises to advance anticipatory action in fragile and conflict-affected settings*.

11. **Science and research on the root causes and determinants of humanitarian and food crises and their prevention and mitigation must be strengthened.** This requires a strong commitment from scientists and science organizations, including Academies of Sciences, to engage across disciplinary boundaries with rigor and compassion. *Science communities need to engage with new theoretical and empirical approaches and interact with practitioners in acute crises to identify promising solutions. Important research areas include*:

a. **Research on the whole architecture of food and humanitarian crises prevention and mitigation.** *Implementation research on anticipatory humanitarian action, related global financial support, and evaluation research on*

what works to build resilience and effective delivery solutions in fragile contexts are important.

b. **Research on *ex-ante* and real-time modelling of complex humanitarian and food crises and response options**, including trade-offs of actions for de-risking agrifood systems and for social protection. *Related research areas include digital innovations, bioscience for resilience, new and healthy foods, and food storage and processing innovations for reduction of loss and waste*.

c. **Research on institutional and organizational change and innovations to address food and humanitarian crises**. Developing innovative tools to increase resilience in countries and population groups at risk can help prevent and absorb shocks. *Early identification of attempts to ruthlessly obtain political gain or create ethnic grievances is also important. Studying the impacts of military interventions on food markets, and household and community resilience during and after humanitarian crises, can provide valuable insights for early action*.

12. **Faith and science cooperation.** The high and growing prevalence and scale of food and humanitarian crises are a shame for humanity. They indicate a global and national failure of suitable engagement to help the poor and vulnerable. The root causes of these crises must be addressed through improved global governance and the evolution of nested institutions that reflect local and global rights and responsibilities, mitigation and prevention of humanitarian crises. Otherwise we will continue to deal with related symptoms. *We call on the international political system, national governments, civil society and the private sector to increase investments and rapidly scale delivery of tested solutions. UN agencies must provide clear and timely guidance, while governments hold primary responsibility. We need a strengthened and more integrated UN system to overcome these food and humanitarian crises. When government weakness or failure is a cause, other options, such as alliances of civil society, religious communities, and science must be used. Cooperation between faith and science is critical in overcoming humanitarian crises and protecting human dignity by combining ethics with innovation*.

1. THE SCALE, CONSEQUENCES, AND CAUSES OF FOOD AND HUMANITARIAN CRISES

Addressing Food and Humanitarian Crises – Introduction and Overview

Joachim von Braun
President of Pontifical Academy of Sciences

The challenges of humanitarian crises

The prevalence and scale of food and humanitarian crises is unacceptable and ethically reprehensible. It is imperative that we address the causes and consequences of these problems comprehensively and innovatively.

The world is facing the highest number of violent conflicts since the Second World War. These conflicts are major triggers of humanitarian and food crises, reducing access to production factors, social safety nets and trade, and causing forced displacement.

Under global climate change, extreme weather events have become a further important trigger of humanitarian and food crises worldwide. It is crucial that international support for resilience is expanded and prioritized at upcoming Climate Summits. Policy actions must be based on the understanding that the right to life and access to basic necessities such as food and water are human rights.

The Pontifical Academy of Sciences (PAS) has repeatedly addressed problems of the world food system in the past from various angles, and issued statements for action and research.[1] The findings from these conferences and the related statements and publications form important backdrops to the concept of this workshop.

Systematically addressing multi-dimensional crises

Food systems are impacted by a complex set of multidimensional problems including,

1. Wars and armed conflicts, which add to risks and uncertainty, disrupt food supply chains, and hinder production (e.g., access to inputs, such as

[1] Recently this included conferences on *Science and Innovations for a Sustainable Food System – Preparing for the UN Food Systems Summit*, 21-22 April 2021, and *Reduction of Food Loss and Waste*, 11-12 November 2019. Moreover, PAS climate-related conferences and biodiversity-related conferences, as well as conferences addressing innovations in bio-sciences also included attention to food systems and food security.

fertilizers) and food trade. The workshop will give strong attention to these related issues;

2. Climate change and water stress, which undermine Agrifood systems' resilience;
3. Covid-19 and other disease-related disruptions of food value chains;
4. Economic slowdowns and downturns, accelerated inflation, exchange rate devaluation, market volatility, and income and job losses.

These problems are interconnected and reinforce one another, and result in humanitarian crises and food access problems, 3.1 billion people with no access to healthy diets, and with accumulated debts, curtailing finance of social protection and nutrition programs. Moreover, there is regional diversity in the set of determinants of agrifood systems' crises, as well as diversity in capacities to respond.

While the above-mentioned earlier PAS conferences offered important insights and solutions mainly for the medium- to long-term, this workshop has a focus mainly on acute food insecurity and nutrition crises and related short-term actions. The 2021 UN World Food Systems Summit too mainly had a focus on medium- to long-term actions. Follow-up to the Summit will need to have a stronger focus on acute crises. Addressing acute food crises effectively in the short-term also requires more attention because new research findings point to significant human impacts in terms of child underdevelopment (stunting) and mortality due to even short-term price and income shocks. Effective action for protecting the poor in crises cannot wait. Trade-offs and synergies between short-term and long-term actions and investments also need to be on the policy agenda and will be addressed by this workshop.

Concepts and approaches

A concept that may shape the agenda before us is the "Triple Nexus" approach, which postulates integration of the interlinkages between the humanitarian, development and peace sectors (HDP). It specifically refers to attempts in these fields to work together to more effectively meet peoples' needs, mitigate risks and vulnerabilities, and move toward sustainable peace. Sciences, i.e. natural sciences and social sciences, need to explore opportunities to contribute to short-term lifesaving actions in acute food crises. Noting that there are significant practical experiences with such

actions, sciences have not paid much attention to short-term food crises mitigation and prevention. Theoretically, short-term actions need to be based on foresight, information about risks and consideration of uncertainties, and the need to make decisions while there is a high degree of information deficiency. New data, modelling, and analytical approaches, including application of artificial intelligence, may be helpful to explore to narrow risks and uncertainty and for effective actions. Political economy aspects, governance, and power need consideration. Short-term actions are often taken under conditions of lack of information, missing predictability of emerging crises, and lacking resources for comprehensive responses. There are also hard choices between the short and long term, i.e. to address the challenge of systems' transformation toward sustainability, while also addressing the acute food crisis with urgency. And it must be noted that issues, initially considered as short-term, can have very long-lasting consequences, such as populations in refugee status in the Levant Region, Afghans in Pakistan, Darfur, etc.

Moral and ethical Issues

The focus of the workshop is on marginal population groups, including smallholder producers, slum dwellers, migrants, women, children, as well as indigenous peoples. Direct and indirect effects on vulnerable people in food crises situations shall be considered prominently, such as exploitation, human trafficking and modern forms of slavery. The short long-term choices raise moral and ethical issues that will be considered in the workshop. A focus on science related to helpful short-term actions is justified for at least three reasons: first, because lives at risk in crises must be saved, and second, it is likely, that complex crises of Agrifood systems triggered by the set of causes mentioned above may occur more frequently in the future, and third, there is a lack of scientific insights into appropriate short-term actions, as indicated by many ad hoc initiatives in food crises, and lack of science involvement.

Innovative solutions and recommendations for action

At the center of solutions to the challenges are innovations, namely, policy-, technological-, and organizational innovations. These must be guided by science, be context specific, and some must be international. They include finding ways to promote local agency in acute food crises, because individuals, households/families, and communities are invariably the first

and most important respondents in crises. Expanding the choices available to them in real time may be vital – i.e., in addition to getting external support to them.

The great diversity of contexts of humanitarian crises must be considered when concrete actions are planned. The important country and regional chapters are testimony to that. A set of key actions and innovations are considered in the chapters, mapped into relevant contexts and regions. They include actions such as emergency aid interventions including forecast-based actions and investments, modelling agrifood systems shocks and trade-offs of actions/including over time, explicit integration of transformative policies, peace building, governance strengthening for food security, digital innovations, bio-science, new foods, processing, technology innovations for de-risking the agrifood systems, and organizational innovations, to identify best operational/institutional models to alleviate malnutrition and speed up humanitarian work during and post-conflicts.

The recommendations are summarized in the statement issued by the workshop participants forming the final chapter of this volume. Key points include,

- To prevent food and humanitarian crises, we call for context-specific and appropriate international and regional engagement, local peacebuilding, and multilateral conflict resolution by the UN, G20, and regional political bodies.
- The urgent need for more proactive and better-resourced response to the global refugee crises, including a welcoming culture for refugees, as called for by Pope Francis. Respect for and adherence to international law and treaties for the protection of refugees is also required.
- The structures, governance and management of humanitarian and food crises require comprehensive reform. This includes elements of global governance, such as nested institutions that reflect rights and responsibilities at both local and global levels to address mitigation and prevention of humanitarian crises.
- We need increased and more flexible financial resources at an international level, along with redesigned emergency aid interventions. Without such reforms, we will continue to deal with symptoms rather than addressing the root causes.
- Women's roles and leadership in these contexts must be strengthened.

- Science has an important role to play in addressing food and humanitarian crises, because they are problems of complexity. Sciences can and must help identify policy, organizational and technological innovations.
- Cooperation between faith and science is critical in overcoming humanitarian crises by combining ethics with innovation.

Statement to the Pontifical Academy of Sciences

Cindy McCain
The UN World Food Programme Executive Director

Eminence. Excellencies. Your Honors. Members of the Diplomatic Corps. Distinguished Academicians. Ladies and Gentlemen.

Thank you for having me here today, and thank you for inviting me to be part of your important conversation about solutions to food insecurity.

This event could not be more timely. We are facing an unparalleled global hunger crisis, fueled by conflict, climate change, Covid-19's economic aftershocks, and rising inflation.

Most recently, the war in Ukraine has sparked a fresh wave of hunger that has swept across many lower-income countries.

Global food prices are 40 percent higher than before the pandemic, despite falling back from the peaks seen last year. This has driven up food import costs and slashed governments' purchasing power on international commodity markets.

Declining currencies and rising national debts are deepening the pain in many regions of the world. The cost of food has risen at least 15 percent in over 70 countries in the past year.

As a result, many governments simply do not have the financial firepower to support their most vulnerable citizens.

At the World Food Programme, we are seeing the impact of this global crisis everywhere we work. The number of hungry people is soaring – but the resources we need to feed them are running dangerously low.

Up to 828 million people do not know when – or if – they will eat again. And 43 million people in 51 countries are right on the brink of famine. This is unconscionable in a world that produces enough food to feed everyone on our planet.

Last year, WFP reached nearly 160 million people with life-saving food. But unless we raise new funding, we will have to cut – or even stop - rations for millions of hungry people in the coming months. If we do, the impact will be truly devastating.

Excellencies: now more than ever, we all need to collaborate to overcome this crisis. We must work together on short-term and long-term solu-

tions to hunger – solutions which address the immediate crisis, but also tackle its root causes.

Building long-term resilience against hunger is vital, so vulnerable communities are better able to cope with food security shocks.

In particular, we need to help agricultural communities adapt to climate change. Many regions of the world are seeing more frequent droughts and floods, which often destroy smallholder farmers' crops and livestock, and leave their families hungry.

In the Sahel region of West Africa, WFP and our partners have been working since 2018 to reduce hunger and build resilience against these threats.

In addition to providing food assistance in Burkina Faso, Chad, Mali, Mauritania and Niger, we are teaching irrigation and land rehabilitation, so communities can grow food despite the changing climate.

We also support smallholder farmers to sell crops to earn a sustainable living, and run school meals programs to encourage the poorest families keep their children in education.

So far, we have reached nearly 3 million people in more than 2,700 villages, and we aim to support 5 million people in the next 5 years.

This has to be the way forward: combining life-saving assistance with longer-term solutions to hunger to achieve lasting impact.

But to succeed, we all need to work more closely together. The UN's three Rome-Based Agencies – WFP, FAO and IFAD – are all strongly committed to stepping up our collaboration.

And we need everyone else to come on board as well – scientists, academics, donors, NGOs and, critically, the private sector.

There must be more innovation and partnerships across sectors, and more collaboration with companies to develop new technologies which can help end hunger.

Excellencies: the challenges we face are daunting, and none of us can do this alone. The global food crisis is simply too severe. But if we unite, as one, to end hunger and save lives, I believe we can and we will succeed.

Thank you, and I look forward to working with all of you in the coming months and years.

Rising Global Food Insecurity: Combinations of Crisis Drivers and their Impacts on Food Security and Nutrition and Access to Healthy Diets[1]

Maximo Torero Cullen
Chief Economist, Food and Agriculture Organization of the United Nations – FAO

At the beginning of 2022 global food security was already in a state of deterioration as a result of the measures adopted to contain the COVID-19 pandemic, new or pre-existing conflicts, weather shocks and global economic slowdown. Around 735 million people were hungry in 2022 (Figure 1, left panel). The number of people affected by chronic hunger had grown by about 122 million since the outbreak of the COVID-19 pandemic. After remaining relatively unchanged since 2015, the prevalence of undernourishment in the world jumped from 8.0 in 2019 to 9.3 percent in 2021 and slightly decline in 2022 to 9.2 percent.[2]

An estimated 29.6 percent of the global population – 2.4 billion people – were moderately or severely[3] food insecure in 2022, meaning they did not have access to adequate food. This is still 391 million more people than in 2019, before the pandemic, and 745 million more compared to 2015 when the 2030 Sustainable Development Agenda was launched. The prevalence of moderate or severe food insecurity rose slightly in Africa, Northern America and Europe, and decreased non-significantly in Asia from 2021 to 2022. The only region showing encouraging progress is Latin America and the Caribbean, (where moderate or severe food insecurity decreased from 40.3 percent in 2021 to 37.5 percent in 2022, the equivalent of 16.5 million fewer people in one year), mainly in South America.

[1] This chapter was prepared by the Chief Economist Office of the Food and Agriculture Organization of the United Nations – FAO.

[2] FAO, IFAD, UNICEF, WFP & WHO. 2023. *The State of Food Security and Nutrition in the World 2023. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome, FAO.

[3] Definitions and indicators related to hunger and food insecurity are provided in Box 1.

More than one-third of people facing moderate or severe food insecurity in the world in 2022 – over 900 million – were severely food insecure, indicating that they had run out of food at times during the year and, at worst, gone an entire day or more without eating. The prevalence of severe food insecurity based on the FIES provides additional evidence on the extent of hunger to complement the prevalence of undernourishment, although the indicators are based on very different methodologies and sources of data. Both indicators point to rising levels of severe food insecurity in the Caribbean, Western Asia, and almost all subregions of Africa from 2021 to 2022 (Figure 1, right panel). The estimates also suggest that 3.1 billion people globally could not afford a healthy diet in 2021, an increase of 112 million more people than in 2019.[4] Projections suggest that nearly 590 million people globally, equating to 8 percent of the world population, would still be undernourished in 2030, placing the world off track to achieve the Sustainable Development Goal 2 of Zero Hunger. Moreover, the disparity between men's and women's food security is 8.4 times as great as it was in 2018 and will likely increase with the compounding effects of the global food security crisis.[5] The fact that severe food insecurity rose across all regions should prompt a reflection on national policy priorities, as well as on the global responses. Rising hunger has reverberations upon other dimensions of malnutrition, including micronutrients deficiency, and impacts peoples' ability to engage productively in the broader economy.

At the same time, a confluence of factors led to increasing food prices in 2020 and 2021. As demand started to recover in mid-2020 from the dramatic decrease in economic activity at the beginning of the pandemic, agricultural commodity prices rebounded from a 10-year low in May 2020. Increasing fuel and transportation costs added momentum to the surge in food prices. On the supply side, weather-related production shortfalls and logistics bottlenecks also contributed, though less significantly than the demand-side drivers.[6,7]

[4] *Ibid*.

[5] *Ibid*.

[6] FAO. 2022. Information Note: The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. 5 December 2022 update. Rome.

[7] Vos, R.; Glauber, J.; Hernandez, M., & Laborde, D. 2021. COVID-19 and Rising Global Food Prices: What's Really Happening? IFPRI. Washington, DC.

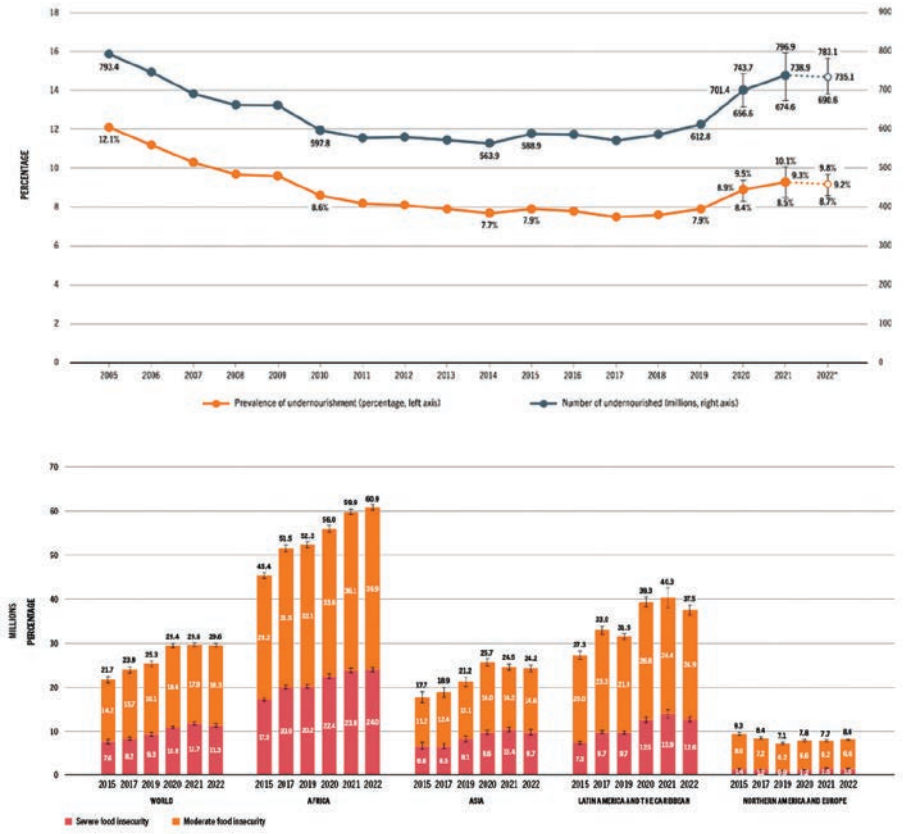


Figure 1. Global hunger has been on the rise since 2019 (left) and severe food insecurity increased in every region in the world in 2021 (right). Source: FAO, IFAD, UNICEF, WFP & WHO. 2023.

Export restrictions contributed to increased price volatility and higher price levels in the early pandemic period.[8,9] Fears of supply chain disruptions and production shortfalls because of pandemic-related restrictions led some countries to impose restrictions on exports of staple foods. However, compared to the 2007-08 global food price crisis, export restrictions af-

[8] FAO. 2022. Information Note: The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. 5 December 2022 update. Rome.

[9] WTO. 2020. COVID-19 and Agriculture: A Story of Resilience. WTO Information Note, 26 August 2020. Geneva.

fected a smaller share of world food trade as fewer countries had imposed restrictions and for shorter durations.[10]

Just as global economic conditions appeared to be recovering from the pandemic slowdown, the outbreak of the war in Ukraine in February 2022 sent another shock through global food and agricultural markets. The Russian Federation and Ukraine are among the most important producers and exporters of agricultural commodities in the world.[11,12] In 2021, either the Russian Federation or Ukraine (or both) ranked among the top three global exporters of wheat, maize, rapeseed, sunflower seeds, and sunflower oil (Figure 2). In the same year, the Russian Federation also stood as a prominent exporter of fertilizers (see Section 6).[13]

Ukraine and the Russian Federation are key suppliers to many countries that are highly dependent on imported foodstuffs and fertilizers.[14,15] Wheat imports of many countries situated in North Africa and Western and Central Asia are highly concentrated towards supplies from the Russian Federation and Ukraine due to geographical proximity. Overall, more than 30 net importers of wheat have been dependent on both countries for over 30 percent of their wheat import needs (Figure 3). Many of these countries fall into the Least Developed Country (LDC) group, while many others belong to the group of Low-Income Food-Deficit Countries (LIFDCs).

The immediate impacts of the war were spikes in the world food and fertilizer prices and a sharp reduction in grain exports by the Ukraine and the Russian Federation as Black Sea trade routes were disrupted, affecting also the procurement of crucial food supplies for humanitarian assistance (Figure 4). Nevertheless, recent WTO analysis suggests that throughout 2022

[10] Laborde, D. & Mamun, A. 2022. Food & Fertilizer Export Restrictions Tracker, IFPRI.

[11] FAO. 2022. Information Note: The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. 5 December 2022 update. Rome.

[12] WTO. 2022. The Crisis in Ukraine: Implications of the War for Global Trade and Development. WTO Secretariat Note, April 2022. Geneva.

[13] FAO & WTO. 2022. *Global Fertilizer Markets and Policies: A Joint FAO/WTO Mapping Exercise*. Rome and Geneva.

[14] FAO. 2022. Information Note: The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. 5 December 2022 update. Rome.

[15] WTO. 2023. *One year of war in Ukraine: Assessing the impact on global trade and development*. Geneva.

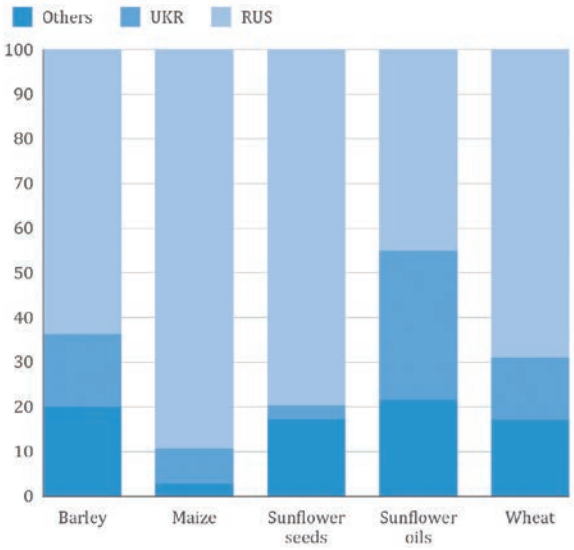


Figure 2. Shares in global production of selected crops (2021, percent). Source: FAO. 2022. The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine.

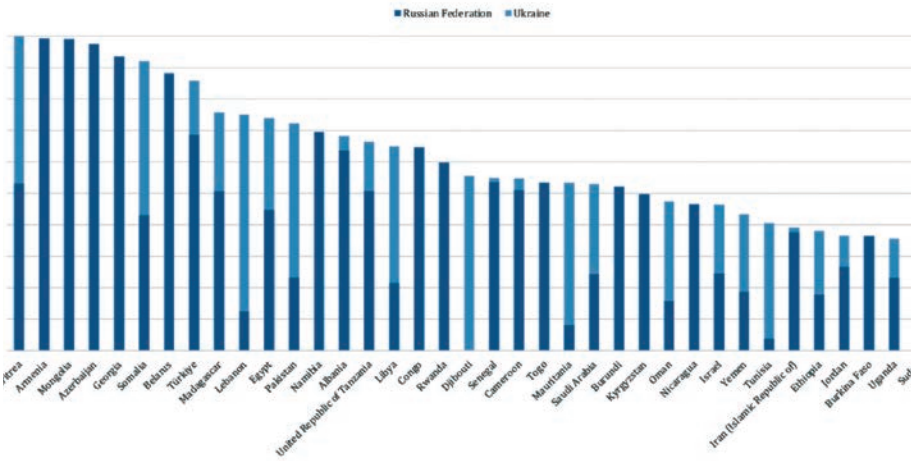


Figure 3. Wheat import dependency: Share of wheat imports from the Russian Federation and Ukraine in total wheat purchases by net importers (2021, percent). Source: FAO. 2022. The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine.

Box 1: Levels of Food Insecurity

Chronic hunger: is defined as the long-term or persistent inability to meet minimum food consumption requirements and is measured by the Prevalence of Undernourishment (PoU).

Hunger: Hunger is an uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy.

Prevalence of undernourishment (PoU): an estimate of the proportion of the population that lacks enough dietary energy for a healthy, active life. It is FAO's traditional indicator used to monitor hunger at the global and regional level, as well as SDG Indicator 2.1.1.

Severe food insecurity: is the level of severity of food insecurity at which people have likely run out of food, experienced hunger and, at the most extreme, have gone for days without eating, putting their health and well-being at grave risk, based on the Food Insecurity Experience Scale (FIES).

Moderate food insecurity: refers to the level of severity of food insecurity, based on the FIES, at which people face uncertainties about their ability to obtain food and have been forced to reduce, at times during the year, the quality and/or quantity of food they consume due to lack of money or other resources. It thus refers to a lack of consistent access to food, which diminishes dietary quality, disrupts normal eating patterns, and can have negative consequences for nutrition, health and well-being.

Food Insecurity Experience Scale (FIES): is the experience-based food security scale used to produce a measure of access to food at different levels of severity that can be compared across contexts. It relies on data obtained by asking people, directly in surveys, about the occurrence of conditions and behaviours that are known to reflect constrained access to food. FIES is the indicator used to monitor hunger for SDG Indicator 2.1.2.

Acute food insecurity: food insecurity found in a specified area at a specific point in time and of a severity that threatens lives or livelihoods, or both, regardless of the causes, context or duration. These acute states are highly susceptible to change and can manifest in a population within a short amount of time, as a result of sudden changes or shocks that negatively impact on the determinants of food insecurity and malnutrition. Transitory food insecurity is a short-term or temporary inability to meet food consumption requirements related to sporadic crises, indicating a capacity to recover (for more definitions on acute food insecurity, see Box 2).

FAO, IFAD, UNICEF, WFP and WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome, FAO.

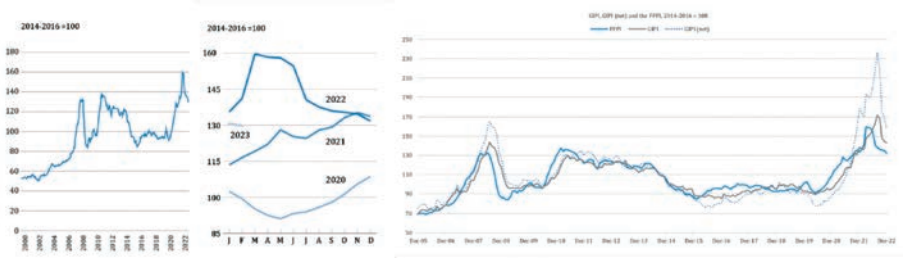


Figure 4. FAO Global Food Price Index (left and center panel) and FAO Global Input Price Index (GIPI) (right panel). Source: FAO. 2023.

many countries were able to diversify their sources of food imports to some extent, thereby partly cushioning the impact of the shock and mitigating the consequences for food security.[16] Many of the countries hardest hit by this new shock were already suffering from previous conflict, climate, and economic shocks.

An early assessment of the impacts of the war in Ukraine and other developments on global food security in 2022 pointed to an additional increase of 10.7 million people facing chronic hunger compared with the pre-war baseline.[17] Millions of people that had slid into extreme poverty due to the economic slowdown caused by COVID-19 were further affected by the increase in food prices that followed the war in Ukraine. This shock hit them just as the post-pandemic economic recovery process had begun, with a potential impact on their nutrition and serious long-term implications for their health and longer-term wellbeing. This is particularly the case for the nutrition of women, young children and older people, as well as those who are disabled, with both immediate and long-term consequences particularly for poorer social groups in all nations.

The UN Secretary-General established the Global Crisis Response Group on Food, Energy and Finance (GCRG) in March 2022 to help decision-makers find global and systemic solutions to an unprecedented three-dimensional food, energy and finance crisis.[18] The GCRG estimated

[16] WTO. 2023. *One year of war in Ukraine: Assessing the impact on global trade and development*. Geneva.

[17] This initial analysis was conducted using the Aglink-Cosimo modeling system developed by OECD and FAO. Updated estimates will be released in July 2023.

[18] See: https://news.un.org/pages/global-crisis-response-group/

that 1.2 billion people live in countries affected by all three dimensions of the current crisis – finance, food, and energy – simultaneously, and issued three briefs with recommendations. These highlight the pathways through which rising food, fertilizer, and energy prices, higher interest rates, and increasing debt burdens are affecting vulnerable economies and people.[19,20] One recommendation being implemented is the reintegration of Ukrainian and Russian food and fertilizer supplies into world markets through the Istanbul Agreements, namely the Black Sea Grain Initiative, signed by the Russian Federation, Türkiye, Ukraine and the United Nations Secretariat on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports, and the Memorandum of Understanding between the Russian Federation and the Secretariat of the United Nations on promoting Russian food products and fertilizers to the world markets.[21]

As alarming as the rise in the FAO Global Food Price Index was in 2022, it understated the economic pain inflicted upon the most vulnerable people and countries. Even though world price levels have decreased in recent months, net food importing developing countries continue to face affordability difficulties to meet their import needs. This is connected to the broader effects of both the pandemic and the war on global markets and macroeconomic conditions. The pandemic-induced economic downturn lowered the fiscal space available to many low-income countries to meet higher food and fuel import bills or to alleviate the impacts of higher costs on consumers through social programmes (Table 1).[22,23] It was in response to this constraint that FAO put forward a proposal for the development of a Global Food Import Financing Facility (FIFF) to help countries pay for their import bills

[19] United Nations. 2022. Global Impact of war in Ukraine on food, energy and finance systems – Brief NO.1. New York.

[20] See: https://news.un.org/pages/global-crisis-response-group/#briefs

[21] For the Black Sea Grain Initiative, see: https://www.un.org/en/black-sea-grain-initiative. For the Memorandum of Understanding between the Russian Federation and the Secretariat of the United Nations, see: https://news.un.org/pages/wp-content/uploads/2022/09/MOU_21_July_UN-Secretariat86.pdf

[22] FAO. 2022. Information Note: The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. 5 December 2022 update. Rome.

[23] FAO. 2022. Global food import bill set to increase at a slower pace in 2022, nevertheless to another record level In: Food Outlook – Biannual Report on Global Food Markets. Food Outlook, November 2022. Rome.

	World				LDCs				NFIDCs				SSA			
	2019	2020	2021	2022*	2019	2020	2021	2022*	2019	2020	2021	2022*	2019	2020	2021	2022*
Animal and vegetable oils, fats	91.5	103.0	150.1	176.5	5.0	5.8	8.1	8.4	10.8	12.6	18.8	21.3	4.9	6.1	8.0	9.7
Beverages	119.7	113.3	133.8	140.1	1.6	1.7	1.7	2.0	3.3	3.1	4.0	4.8	3.0	2.1	2.8	3.0
Cereals and cereal preparations	195.1	207.2	255.5	296.4	12.1	13.1	16.8	20.0	32.2	35.0	41.2	53.7	16.1	17.0	19.5	21.7
Coffee tea cocoa spices and products	109.9	112.5	125.5	137.4	1.4	1.2	1.5	1.8	5.4	4.8	5.4	6.1	1.5	1.5	1.7	1.8
Dairy products and eggs	94.9	95.7	107.9	120.2	1.5	1.6	1.9	2.0	5.5	5.6	6.1	7.1	2.4	2.3	2.6	2.7
Fish, crustaceans, and molluscs	164.5	151.9	175.9	194.7	1.4	1.1	1.4	1.5	5.4	5.0	5.2	5.6	4.3	3.7	4.5	4.6
Meat and meat preparations	154.7	159.7	177.0	190.9	1.5	1.6	2.3	2.7	7.6	6.6	6.6	8.3	3.2	2.7	3.2	3.4
Miscellaneous food	98.5	103.9	115.3	121.3	3.0	3.5	4.0	4.0	7.2	7.7	8.8	9.2	4.2	4.2	4.9	4.8
Oilseeds and oleaginous fruits	92.4	102.5	134.0	156.1	0.7	0.6	1.8	2.3	7.0	7.5	10.2	10.8	0.2	0.2	0.3	0.3
Sugar, honey and preparations	45.3	49.5	56.8	62.7	3.2	3.6	4.3	4.0	6.2	6.5	8.0	8.9	4.2	3.7	4.3	4.2
Fruits and vegetables	284.0	294.9	323.2	339.1	4.3	4.0	4.4	4.5	10.3	11.0	11.9	12.3	2.9	2.9	3.1	3.4
Total	1 450.6	1 494.1	1 755.0	1 935.6	35.7	37.9	48.3	53.2	100.9	105.4	126.4	148.1	47.0	46.4	54.9	59.6
	HICs				UMICs				LMICs				LICs			
	2019	2020	2021	2022*	2019	2020	2021	2022*	2019	2020	2021	2022*	2019	2020	2021	2022*
Animal and vegetable oils, fats	45.1	50.8	69.7	89.0	21.2	24.8	35.6	36.4	23.3	25.2	41.3	47.6	2.0	2.2	3.5	3.6
Beverages	94.4	91.7	106.6	110.8	18.8	16.2	20.3	21.5	5.6	4.7	6.0	6.7	0.9	0.6	0.9	1.1
Cereals and cereal preparations	99.7	104.0	118.9	142.2	40.0	45.6	67.0	68.1	49.1	51.0	60.9	77.0	6.3	6.7	8.7	9.1
Coffee, tea, cocoa, spices and products	84.0	86.4	95.0	106.0	15.4	16.0	18.8	18.7	9.6	9.4	10.9	11.9	0.9	0.6	0.8	0.8
Dairy products and eggs	65.4	65.3	72.2	82.2	19.5	20.4	24.2	24.9	9.1	9.2	10.5	12.2	0.8	0.8	1.0	1.0
Fish, crustaceans and molluscs	123.1	115.9	134.6	146.1	31.7	27.2	31.0	37.8	8.8	8.0	9.3	9.7	1.0	0.8	1.0	1.1
Meat and meat preparations	110.5	106.4	117.2	129.1	33.7	44.4	49.0	48.9	9.7	8.1	9.6	11.7	0.8	0.9	1.1	1.2
Miscellaneous food	62.4	65.4	72.4	76.5	24.1	25.8	27.9	29.4	10.5	10.9	12.6	13.3	1.6	1.9	2.4	2.1
Oilseeds and oleaginous fruits	28.4	31.0	38.9	49.5	51.2	58.0	77.1	86.7	12.8	13.4	17.8	19.7	0.0	0.0	0.2	0.2
Sugar, honey and preparations	26.3	27.0	30.6	34.2	7.7	9.2	10.6	11.9	9.5	11.7	13.1	15.2	1.8	1.6	2.4	1.5
Fruits and vegetables	208.6	217.3	232.7	237.2	48.3	49.7	58.3	66.9	25.3	26.2	30.3	33.0	1.9	1.6	1.9	2.0
Total	947.8	961.2	1 088.9	1 202.6	311.7	337.4	420.0	451.1	173.1	177.9	222.3	258.1	18.0	17.6	23.9	23.7

Table 1. Import bills of total and food products by region (USD billion). Source: FAO. 2022. Food Outlook.

and meet their food import needs.[24] Spillover effects of monetary policies in developed economies, namely raising interest rates, put pressure on the currencies of vulnerable food importing countries to depreciate. Although food prices in world markets have decreased since their peak in the spring of 2022, the transmission of lower international prices to the domestic markets of many low-income countries is incomplete, and local food prices remain high and continue to severely hinder access to food.[25] While the global market situation may have improved over the past year, the economic situation of most low-income countries has not. The World Bank's Food Price Inflation Dashboard shows that domestic food price inflation remains high across countries, and exceeds overall inflation in many.[26]

[24] FAO. 2022. A Global Food Import Financing Facility (FIFF): Responding to soaring food import costs and addressing the needs of the most exposed – Updated June 10th 2022. Rome.

[25] FAO. 2023. Crop Prospects and Food Situation – Quarterly Global Report No. 1, March 2023. Rome. https://doi.org/10.4060/cc4665en

[26] World Bank. 2023. Food Security Update, 12 January 2023.

Food Security Assistance

As of March 2023, food security funding requirements are estimated at USD 18.8 billion, with 58.5 percent of funding requirements met, amounting to just under USD 11 billion.[27] Acute food insecurity continued to escalate in 2022, affecting up to 222 million people in IPC Phase 3 or above across 53 countries and territories, as of September 2022.[28,29] Among those, around 45 million people in 37 countries were projected to have so little to eat that they would be severely malnourished, at risk of death, or already facing starvation and death (IPC Phase 4 and above).[30] This was a new peak from 2021, when the number of people suffering from acute food insecurity had already surpassed all previous records, affecting close to 193 million people in IPC Phase 3 and above in 53 countries and territories.

Many of the countries experiencing the highest levels of food insecurity have suffered multiple compounding shocks. Out of 53 countries/territories affected by acute food insecurity, conflict is identified as the primary driver in 24 of these, economic shocks as the primary driver in 21, and weather extremes in 8 countries.[31]

In 2022, the number of people in acute food insecurity (IPC level 3+) in 55 countries is expected to rise by 24% if compared with the one presented in 2021. Nine countries faced important increases in the population in Crisis or worse (IPC level 3+): Nigeria, Pakistan, Somalia, Kenya, Sudan, Niger, Yemen, Malawi and Cameroon. Populations facing Catastrophe (IPC Phase 5) can be found in Afghanistan, Burkina Faso, Haiti, Nigeria, Somalia, South Sudan and Yemen. Risks of Famine were raised in 2022 in Somalia and Yemen.

As of March 2023, prospects of persisting drought in East Africa have raised serious concerns about levels of acute food insecurity, with some

[27] Food Security Cluster Dashboard. Accessed 15 March 2023.

[28] GNAFC & FSIN. 2022. *Global Report on Food Crises 2022: Mid-Year Update*. Rome. The 2023 edition of the Global Report on Food Crises is currently under preparation and expected to be published within end of April 2023 including the final 2022 AFI figures.

[29] WFP & FAO. 2022. *Hunger Hotspots: FAO-WFP early warnings on acute food insecurity. October 2022 to January 2023 Outlook*. Rome.

[30] The Integrated Food Security Phase Classification (IPC) and the Cadre Harmonisé provide transparent findings on current and projected acute food insecurity. See: https://www.ipcinfo.org/ipcinfo-website/ipc-dashboard/

[31] GNAFC & FSIN. 2022. *Report on Global Food Crises 2022: joint analysis for better decisions*. Rome.

Box 2: Acute Food Insecurity Levels

The IPC Acute Food Insecurity (IPC AFI) classification provides information to enable short-term actions by policy makers to prevent, mitigate or decrease severe food insecurity that threatens lives or livelihoods. The IPC Acute Food Insecurity classification differentiates between levels of severity of acute food insecurity, comprising five phases. **Phase 1** indicates minimal to none acute food insecurity in a population; **Phase 2** indicates stressed, **Phase 3** indicates crisis level; **Phase 4** indicates emergency levels; and **Phase 5** indicates catastrophe or famine levels. The populations that require urgent action to meet their food needs are those in Crisis (IPC Phase 3), Emergency (IPC Phase 4) and Catastrophe (IPC Phase 5). Each phase has different characteristics and requires distinct interventions. In Crisis (IPC Phase 3), households are already facing food consumption gaps which are reflected in high or above normal acute malnutrition, or are only able to minimally meet their food needs by depleting essential livelihood assets or engage in crisis-level coping. People in Emergency (IPC Phase 4) face high levels of acute malnutrition and excess mortality due to lack of food, or resort to emergency coping strategies to mitigate large food consumption gaps. For populations in Catastrophe (IPC Phase 5), households have exhausted all coping strategies and face destitution, very high malnutrition, starvation and death. For more information on the IPC classifications, see https://www.ipcinfo.org/

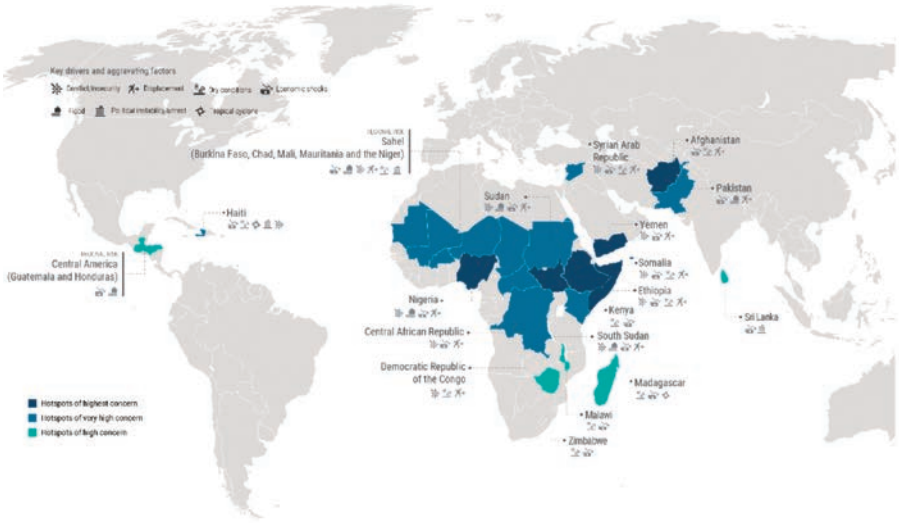
IPC Global Partners. 2021. *Integrated Food Security Phase Classification Technical Manual Version 3.1. Evidence and Standards for Better Food Security and Nutrition Decisions*. Rome.

areas of Somalia facing a risk of famine.[32] Very early, analyses show a probability that an El Niño event may materialize in the second half of 2023, with potential huge negative impacts worldwide, including dry spells during critical agricultural seasons in Southern Africa, West Africa, and Central America's Dry Corridor, and flooding in the Horn of Africa.[33] Map 1 illustrates early warning hunger hotspots across the world.[34] This suggests that the needs will keep climbing in 2023.

[32] Somalia IPC Technical Working Group. 2023. Multi Partner Technical Release on Somalia 2022 Post Deyr Assessment and IPC Analysis Results. 28 February. https://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/Somalia-Multi-Partner-Technical-Release-on-Somalia-2022-Post-Deyr-Assessment-and-IPC-Analysis-Results-28-Feb-2023.pdf

[33] According to the World Meteorological Organization, the likelihood of a return of the El Niño phenomenon increases as the year progresses, with a probability around of 55 percent from June 2023. WMO. 2023. WMO Update: El Niño may return. Press Release Number: 01032023, 1 March 2023.

[34] An update of the Hunger Hotspots report is due to be published in May 2023.



Map 1. Global Hunger Hotspots. Source: WFP & FAO. 2022. Hunger Hotspots: FAO-WFP early warnings on acute food insecurity. October 2022 to January 2023 Outlook. Rome.

Moreover the 2023 Global Report on Food crises indicates that there are 258 million people in acute food insecurity requiring urgent food, nutrition and livelihood assistance (IPC/CH 3 or above) in 58 countries. Of the 41 countries with IPC/CH analysis 0.38 million are in catastrophe (IPC/CH Phase 5), 35 million in emergency (IPC/CH phase 4) and 143.7 million in crises (IPC/CH Phase 3).

Gaps in Food and Livelihoods Support

While record levels of food assistance suggest a strong response to the humanitarian impacts of rising hunger, further analysis is needed to assess the amount and effectiveness of humanitarian assistance resources in offsetting the impacts of the food-energy-finance crisis.

The annual increase in the number of people facing acute food insecurity indicates a growing gap between humanitarian assistance needs and resources available. In 2021, 83 percent of humanitarian assistance to food sectors went to food crises driven by conflict and insecurity, an increase of more

than 35 percent compared to the previous year. Allocations to countries primarily affected by economic and weather shocks went down significantly.[35]

The unabated increases from 2016 to 2021 in the same countries as assessed by the Global Report on Food Crises 2022 – Mid-Year Update indicate a failure to adequately address the underlying causes of food insecurity.[36] This results in an expanding humanitarian crisis, which in turn leads to an ever-increasing share of resources being devoted to humanitarian assistance. Fragile contexts receive insufficient levels of development assistance, and less than 11 percent is devoted to the food sectors in food crisis contexts, reflecting development actors' reluctance to step up action in these contexts.[37]

The analysis of causal factors and the related financing flows is complicated by the fact that many countries are affected by multiple shocks that are mutually reinforcing, including conflicts and extreme weather conditions with direct impacts often (but not always) tending to be more localized and aggravating conditions at the local level.

Nevertheless, given the increasing share of resources devoted to conflict situations, it is reasonable to question whether the humanitarian assistance system is adequately prepared to address a future in which overlapping economic and weather shocks are more probable. The availability of adequate financial resources is a major consideration, but not the only one. Economic and weather shocks may be shorter-lived than the impacts of conflicts but reducing the susceptibility of vulnerable populations to economic and weather shocks would reduce the need for emergency assistance in response to future shocks.

The ability of the IPC to provide timely, consensus-based and context-specific information has never been more important than in the context of the current global food and nutrition crisis, driven by persistent conflict, natural disasters and high food prices. With global acute food insecurity and malnutrition on the rise, IPC is renewing its strategy and undergoing a transformation process to expand its geographic coverage and, at the same time, maintain the high quality of information that decision makers require for planning interventions in response to food and nutrition

[35] GNAFC. 2022. 2022 Financing Flows and Food Crises Report – Analysis of humanitarian and development financing flows to food sectors in food crisis countries. Rome.

[36] An update to the report is forthcoming in May 2023.

[37] GNAFC. 2022. 2022 Financing Flows and Food Crises Report – Analysis of humanitarian and development financing flows to food sectors in food crisis countries. Rome.

crises. To meet the unprecedented demand for actionable information for decision support to counter food insecurity and malnutrition, the IPC requires USD 48.6 million between 2023 and 2026, currently funded at only 26 percent. The USD 35.6 million required funding will allow the IPC to expand its reach, assure continued quality and improve processes of acute food insecurity and malnutrition analyses.[38] The third IPC Global Strategic Programme (2023-2026) aims at addressing critical gaps in the coverage of food and nutrition crises and envisions a substantial geographic expansion of the IPC, borne of global demand for the IPC in every region that has also been discussed within the GCRG.[39]

Financial Needs

One of the most urgent needs arising from the limited fiscal space many countries have for responding to food price shocks is additional support for vulnerable populations. The World Bank reports a fourfold increase in the number of social protection measures announced or implemented across 170 countries in response to food price inflation since April 2022.[40] An IMF analysis of 48 countries highly exposed to food insecurity revealed that the use of cash transfers is relatively rare despite evidence showing that social protection programmes are more effective at mitigating the impacts of price shocks on the poor than subsidies.[41]

There is need to act now to minimize the likelihood and consequences of households reducing the cost of food purchases by skipping meals or shifting consumption from highly nutritious to less nutritious foods as a way of coping with increased prices. People living in poverty need access to universal social protection and primary health-care services, which include nutritional support programmes that focus on both the prevention of acute malnutrition and its treatment. Improved access to targeted gen-

[38] IPC. 2023. The IPC Renews its Strategy to Meet Global Demand for Actionable Information on Acute Food Insecurity and Malnutrition, Calls for Increased Funding. March.

[39] IPC. 2023. IPC Global Strategic Programme 2023-2026.

[40] Gentilini, U.; Almenfi, M.; Iyengar, H.; Valleriani, G.; Okamura, Y.; Urteaga, E. & Aziz, S. 2022. Tracking Global Social Protection Responses to Inflation. Living paper v.4, World Bank, Washington, DC.

[41] Rother, B.; Sosa, S.; Kohler, L.; Pierre, G. Kato, N.; Debbich, M.; Castrovillari, C.; Sharifzoda, K.; Van Heuvelen; E.; Machado, F.; Thevenot, C.; Mitra, P. & Fayad, D. 2022. Tackling the Global Food Crisis: Impact, Policy Response, and the Role of the IMF. IMF Note 2022/004. International Monetary Fund, Washington, DC.

der-responsive and nutrition-sensitive social protection is needed, particularly for women and children, including through safety nets in the form of cash and, if necessary, nutritious food.[42]

Yet the rapid acceleration of this crisis has challenged the capacity of the international community to respond. The UN Global Crisis Response Group raised concerns that the financial commitments to the World Bank and the IMF are inadequate to allow these institutions to fully utilize their rapid response capabilities. The IMF Food Shock Window provides transitory relief to countries experiencing balance-of-payments needs as a result of shocks related to the food crisis. It was envisioned as a third line of defense after increased donor funding and concessionary lending. The Food Shock Window was conceived to meet the needs of countries whose situation does not warrant an upper credit tranche (UCT)-quality programme due to the transitory nature of the shock, the urgency of needs, or because a country is not able to develop/implement a full programme. To date, six countries have been approved for programmes under the Food Shock Window. While others are in the pipeline, the number of beneficiaries is likely to be constrained by debt burden requirements and other considerations.

FAO's proposal for a Food Import Finance Facility, which preceded the establishment of the IMF Food Shock Window, should be reconsidered given the experience with the latter. The multi-dimensional nature of this crisis has highlighted the linkages between food security and financial security. Lower international food prices are not necessarily being transmitted to local markets. Macroeconomic drivers will continue to play an important role in food security in part because of the economic implications of climate change. Further analysis is needed of whether food security considerations are adequately addressed in the existing financial rapid response mechanisms. The international community must unite forces to support all countries affected by rapidly rising hunger regardless of their development status or indebtedness levels.

Given already high debt levels in many vulnerable countries, there have been calls to consider debt relief for countries with debt that is assessed as being unsustainable. One model to consider is the temporary debt service relief provided under the G20 Debt Service Suspension Initiative (DSSI) implemented at the time of the COVID-19 pandemic. The DSSI was established in May 2020 to help countries concentrate their resources on fighting the

[42] UN GCRG. 2022. Global impact of war in Ukraine: Energy crisis.

pandemic and safeguarding the lives and livelihoods of millions of the most vulnerable people. Forty-eight out of 73 eligible countries (http://www.g20.utoronto.ca/2020/2020-g20-finance-0415.html#a2) participated in the initiative before it expired at the end of December 2021. According to the latest estimates, from May 2020 to December 2021, the initiative suspended USD12.9 billion in debt-service payments (https://www.bi.go.id/en/G20/Documents/G20-Communique.pdf) owed by participating countries to their creditors.[43,44] The DSSI did not cover debt to private creditors.

With healthy diets out of reach for 3.1 billion people and 500 million mostly poor smallholder farmers facing an uncertain future because of climate change, national policies need to support a transformation of agriculture and food systems to enable them to promote healthy lives, prosperous rural communities, and climate-resilient production.[45] The current crisis reinforces the growing call for repurposing agricultural and food policy support. Currently, most agricultural and food policy support from national governments is not effectively targeted at meeting challenges related to sustainability objectives, such as climate change and nutrition, and preparing for the future. Redirecting these resources to ignite the sustainability transition can address multiple challenges in high- and middle-income countries. Low-income countries will need access to additional concessional resources to implement their transition. In the current context of constrained fiscal space, the countries with the most urgent need for transforming food systems have the least resources available to invest. There also remains scope for better inter-agency coordination on the ground to combine investments for scaled-up impact.

While governments are expending significant amounts of public resources to support food and agriculture, more can be achieved with these resources. The different support measures being used can distort prices, trade, production, and consumption decisions. Worldwide support to food and agriculture accounted for almost USD 630 billion per year on average over 2013-2018, and about 70 percent of this support was destined to pro-

[43] Group of 20. 2022. Finance Ministers and Central Bank Governors Meeting Communiqué, 17-18 February 2022, Jakarta, Indonesia.

[44] See: World Bank, Debt Service Suspension Initiative, https://www.worldbank.org/en/topic/debt/brief/covid-19-debt-service-suspension-initiative

[45] FAO, IFAD, UNICEF, WFP & WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO.

duction. About USD 111 billion were spent yearly by governments for the provision of general services to the sector, while food consumers received USD 72 billion on average every year. Most of the support producers get is through price incentives. This includes border measures on imports and exports (such as import tariffs, quotas, export taxes, bans or licensing, etc.) and market price controls (administered prices at which governments procure food from farmers, or minimum producer price policies).[46]

Import tariffs – taxes imposed on imported goods and services – are the most commonly used border measure, often employed to shield domestic producers from competition. Non-tariff measures (NTMs) are also widespread, while tariffs in agrifood trade have declined. Examples include export restrictions mostly targeting staple foods that are considered important for food security, such as rice, wheat, maize or pulses. Overall, support to agricultural production largely concentrates on staple foods, dairy and other animal source protein-rich foods, especially in high- and upper-middle-income countries. Rice, sugar, and meats of various types are the foods most incentivized worldwide, while producers of fruits and vegetables are less supported overall, or even penalized in some low-income countries.

FAO, in the 2022 edition of The State of Food Security and Nutrition in the World, presents evidence that if governments repurpose their current composition of food and agriculture support resources to incentivize the production, supply and consumption of nutritious foods, they will contribute to making healthy diets less costly and more affordable, equitably for all. In addition, there will also be improvements towards reducing hunger and extreme poverty.

The results suggest that with the same money countries can unambiguously improve the affordability of healthy diets. This was the case for three modelling scenarios up to 2030, where simulations in which all countries in the world (i) reallocate fiscal subsidies from producers to consumers to bridge gaps in healthy consumption patterns; (ii) reallocate fiscal subsidies among producers to bridge gaps in healthy consumption patterns; and (iii) reallocate support through border price incentives (border measures and market price controls) to bridge gaps in healthy consumption patterns.

[46] FAO, IFAD, UNICEF, WFP & WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO.

Trade-offs and negative outcomes could emerge from this repurposing in terms of GHG emissions, agricultural production levels and farm income. The magnitude and direction of the trade-offs do vary by region and income group, and therefore results and solutions will necessarily be country and context specific.[47]

Trade Measures

From the start of the war in Ukraine, the UN Secretary-General highlighted the need to restore global access to food and fertilizer supplies from Ukraine and the Russian Federation. With successful mediation by the United Nations and Türkiye, two agreements were signed in Istanbul on July 22, 2022, jointly referred to as the Istanbul Agreements. The Initiative on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports, commonly referred to as the Black Sea Grain Initiative, provided a framework for the resumption of exports of grain, other foodstuffs, and fertilizer (including ammonia) from Ukrainian ports. It allowed for the resumption of exports from three key Ukrainian Black Sea ports through a safe maritime humanitarian corridor. The agreement foresaw a duration of 120 days, renewable. In March 2023, the Black Sea Grain Initiative was further extended for an additional 60 days. Reducing uncertainty around the renewal and duration of the initiative would further contribute to market stability. To implement the Black Sea Grain Initiative, a Joint Coordination Centre (JCC – https://www.un.org/en/black-sea-grain-initiative/background) was established in Istanbul, comprising senior representatives from the Russian Federation, Türkiye, Ukraine and the United Nations.

The Memorandum of Understanding between the Russian Federation and the Secretariat of the United Nations on promoting Russian food products and fertilizers to the world markets, commonly referred to as the Memorandum of Understanding (MoU), provides assurances that the Russian Federation's exports of food and fertilizer will not be impeded by measures imposed upon the country. This has a duration of three years.

The resumption of exports of grains and other foodstuffs under the Black Sea Grain Initiative increased predictability and helped to ease global price pressures. Under the Initiative, Ukrainian grain exports recovered

[47] FAO, IFAD, UNICEF, WFP & WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO.

significantly, but Ukrainian exports for the period between January and November 2022 remained 22 percent below those seen in 2021. As of July 2023, approximately 32.9 million tonnes of grains (predominantly wheat and maize) and other foodstuffs were exported under the Initiative.[48] According to UNCTAD, about 49 percent of maize exports were destined to developing countries, while 65 percent of total wheat cargo was destined to developing countries and least developed countries.[49] In addition to benefitting Ukrainian farmers, the agreement has allowed shipments to resume to traditional importers of Ukrainian grains, including countries in the Middle East, North Africa and sub-Saharan Africa, as well as increasing the availability of grain supplies for humanitarian assistance in Yemen, the Horn of Africa, Afghanistan and other hunger hotspots. At the time of writing of this report, ammonia exports have not resumed through Ukrainian ports.

However, the latest extension of the Initiative expired on 17 July 2023, and the Russian Federation decided not to renew it. Prospects of additional renewal remain unclear despite continuing consultations and negotiations. The renewal of the Agreement and the resumption of BSGI are important for the global agrifood systems that are already under the pressure of climate shocks including but not limited to El Nino in 2023-24. Further decrease of Ukrainian agricultural products from the global market while the world is experiencing low level of stocks (e.g., grain) poses a huge risk to global food security.

In June 2022, at the 12th Ministerial Conference of the World Trade Organization (WTO), Members agreed on a Ministerial Declaration on the Emergency Response to Food Insecurity, the first Declaration on this topic in the Organization's history.50 In this, WTO Members recognized the vital role trade plays in improving food security and nutrition and resolved to make progress in promoting sustainable agriculture and food systems.51 Members also committed to take concrete steps to facilitate trade and im-

[48] FAO. 2023. FAO Brief on the interruption of the Black Sea Grain Initiative and its Potential Implications on Global Food Markets and Food Security. Available at: https://www.fao.org/3/cc7271en/cc7271en.pdf

[49] UNCTAD. 2023. A Trade Hope: The impact of the Black Sea Grain Initiative. Geneva.

[50] WTO. 2022. Ministerial Declaration on The Emergency Response to Food Insecurity. WT/MIN(22)/28; WT/L/1139. Geneva.

[51] WTO. 2022. World Trade Report 2022: Climate change and international trade. Geneva.

prove the functioning and long-term resilience of global markets for food and agriculture. Members further committed not to impose export prohibitions or restrictions in a manner inconsistent with relevant WTO provisions.

Improving market access would generally reduce the price of food and make it more accessible to poor consumers, particularly in developing countries. Likewise, the enhancement of transparency-related practices in connection with export restrictions, in conjunction with the commitment already undertaken at the 12th Ministerial Conference by WTO Members to sparingly resort to export restrictions and exempt purchases by the WFP for humanitarian purposes from such measures, would greatly enhance predictability and further improve the food security of importing countries.

Following the outbreak of the war in Ukraine, the UN, the G20, and the G7 were among the leading global voices calling for keeping international markets and trade in food and fertilizer open. They called for a resumption of exports from Ukraine and the Russian Federation and restraint in the use of export bans or restrictions that could add further volatility to markets. According to an analysis by IFPRI, export restrictions peaked in late May 2022 with measures by 23 countries covering 17 percent of global food and feed exports (on a caloric basis). By mid-July the amount of trade affected had fallen to 7.3 percent.[52] According to the WTO Secretariat, since the beginning of the war up until 14 March 2023, 100 export restrictions have been imposed on essential agricultural commodities by 29 WTO members and 6 observers. Of these, 92 applied to food and feed and 8 on fertilizer exports (Figure 5). Over the past 12 months, 29 measures have been phased out, meaning that there are currently 71 measures in force (66 on food and 5 on fertilizers) by 27 WTO members and 5 WTO observers. The export restrictions in force cover approximately USD 85 billion worth of goods.

As of 14 March 2023, the WTO had also identified 74 trade-facilitating measures by importing members in respect of food, feed, and fertilizers. Whereas 66 applied specifically to food and feed, 7 to food, feed, and fertilizers combined, and one specifically to fertilizers. These measures were introduced by 62 WTO members and 2 observers (including as members of economic/customs unions). Twenty-five of these measures have been phased out, bringing the total number of currently applied measures to 49

[52] Glauber, J.; Laborde, D. & Mamun, A. 2022. Food export restrictions have eased as the Russia-Ukraine war continues, but concerns remain for key commodities. IFPRI Blog Post, January 23, 2023.

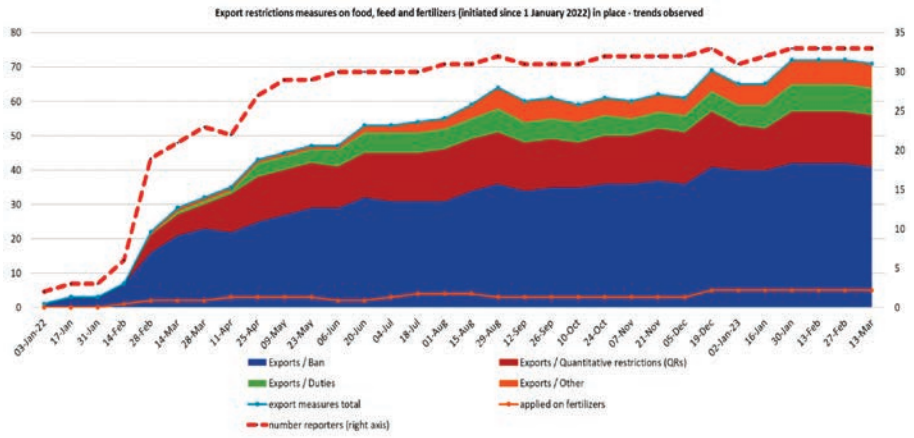


Figure 5. Export restrictions on food, feed and fertilizers in place (initiated since 1 January 2022). Source: WTO. 2023. A Year of Turbulence on Food and Fertilizers Markets. WTO Trade Monitoring Updates, 28 February 2023. Geneva.

(42 on food and feed, 6 on food, feed, and fertilizers, and 1 on fertilizers), imposed by 59 WTO members and 2 observers.

Tracking trade measures implemented in response to the war remains a challenge, in particular as the direct link to the crisis is becoming less clear and because measures often undergo minor adjustments on a very regular basis. The WTO's Trade Monitoring Exercise actively and regularly engages WTO Members in the verification of trade measures implemented so as to ensure the most up-to-date information is recorded.

Fertilizer Markets

Similar to global cereal exports, fertilizer exports originate from few countries, rendering world fertilizer markets concentrated and vulnerable to shocks (Figure 6). The Russian Federation is the largest exporter of nitrogenous fertilizers, the second largest supplier of potassic fertilizers and the third largest exporter of phosphorous fertilizers.[53] Most major exporting countries of nitrogenous fertilizers are also energy exporters, which is explained by the fact that their production is a highly energy-intensive

[53] FAO & WTO. 2022. Global Fertilizer Markets and Policies: A Joint FAO/WTO Mapping Exercise. Rome and Geneva.

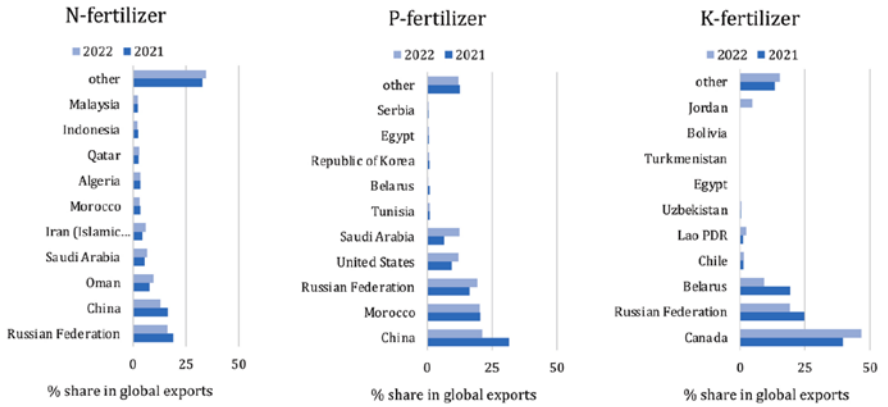


Figure 6. Global Fertilizer Supply is Concentrated in Few Countries. Source: FAO calculations based on Trade Data Monitor data.

process. While Ukraine did not feature as a key producer, it served as an important transit point, particularly for ammonia.

The outbreak of the war pushed the prices of energy and energy-intensive products sharply upwards, resulting in a severe decline in the affordability of fertilizers. To address high prices and supply shortages, FAO has developed tools to help countries navigate the complexities of fertilizer markets, enhance their ability to access scarce supplies, and ensure more efficient fertilizer use with soil nutrient maps.[54] Fertilizer prices have declined by more than 40 percent since hitting record highs in nominal terms in 2022, especially due to recent drops in natural gas prices and the reopening of fertilizer plants in Europe. Though prices remain almost twice the level of two years ago, this development is welcome news for producers.

While trade volumes from the Russian Federation remained largely unaffected in the first half of 2022, those from Belarus, a major supplier of potassic fertilizer, have shrunk notably.[55] Rather, resilient fertilizer exports

[54] FAO. 2022. Using Soil Maps to Promote Efficient Use of Fertilizers. See: https://www.fao.org/3/cb9452en/cb9452en.pdf

[55] See FAO and WTO. 2023. Global Fertilizer Markets and Policies. In this study Russia's fertilizer exports are depicted by all other countries' imports from the Russian Federation. Recourse to mirror statistics is necessary given the delay of export notifications by the Russian Federation. This mirroring may therefore underestimate the actual

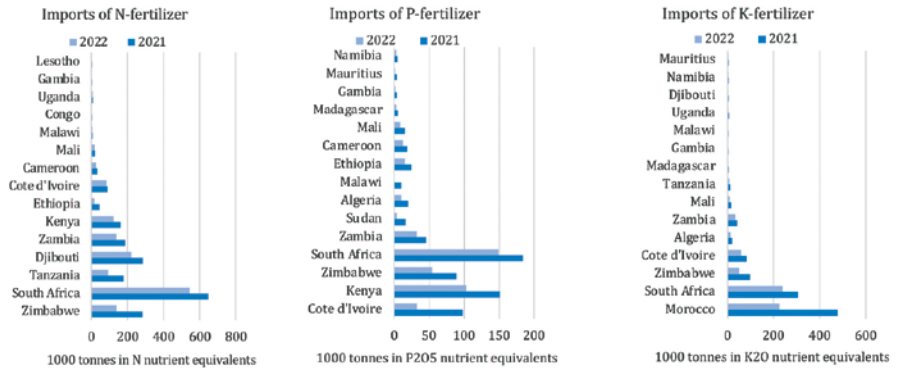


Figure 7. 2022 Fertilizer Import Deficits in Selected African Countries. Source: FAO calculations based on TDM data.

from the Russian Federation were an important factor in containing fertilizer prices in the course of 2022.[56] Exports from the Russian Federation found new destinations in 2022, with India emerging as the largest destination market.

Despite this recent decline, fertilizer prices remain elevated, albeit with notable differences between different nutrients (sharp price declines in nitrogenous fertilizers, smaller declines for potassic fertilizers). While most large food-producing countries have secured their fertilizer needs for the 2022/23 season, there remain unmet import needs in many LDCs, notably in sub-Saharan Africa (Figure 7). This includes countries with food insecurity problems already, such as Malawi, Zimbabwe, Tanzania or Kenya. Higher input prices translate into higher production costs, lowering the use of inputs, yields and/or quality, and eventually leading to higher food prices.[57]

exports by the Russian Federation in recent months as imports by some of its trading partners, notably those of Belarus, are also not available. Other estimates put the decline in fertilizer exports from the Russian Federation at around 20 percent volume terms.

[56] According to the WTO, exports of primary sector goods (which include fuels, fertilizers and cereals) by the Russian Federation had a relatively small decline in volumes, while exports of other goods have fallen sharply. See: WTO. 2023. One Year of War in Ukraine: Assessing the impact on global trade and development. Geneva.

[57] For information on fertilizer access by country see: https://www.fao.org/in-focus/remaining-fertilizer-trade-tracker/en

The Global Fertilizer Challenge was launched by the United States of America, the European Union, and Germany, among others, at the June 17 Major Economies Forum, to raise USD 100 million by COP27 to help low- and middle-income countries address the global fertilizer shortages. As of November 2022, the Challenge had raised USD 135 million in new funding for fertilizer efficiency and soil health programs to combat fertilizer shortages and food insecurity. Of this amount, USD 109 million is new public funding that will be used to expand fertilizer and soil health programs in sub-Saharan Africa and in key middle-income countries outside the continent.

In September 2022, France launched the Save Crops Operation, which aimed at facilitating fertilizer access by vulnerable countries.[58] The initiative reiterated that fertilizers were exempt from the sanctions regime and committed to addressing potential over-compliance to sanctions by the private sector through outreach and letters of comfort. It committed to provide financial and logistical support to the Africa Trade Exchange (ATEX) mechanism to facilitate the purchase of fertilizers. The initiative also launched an emergency fertilizer purchasing mechanism to ease African farmers' access to fertilizers and facilitated donations for fertilizer procurement to Africa. Within the context of the Save Crops Operation, FAO and the WTO published a joint report on global fertilizer markets and policies, which provided a global outlook on markets, export restrictions, and mapping fertilizer-related measures across broad policy categories.[59]

Further Actions Needed Across Fertilizer Markets

Fertilizer is one of the most complex stories to emerge from the Ukraine crisis. The disruptions in global fertilizer markets are severe, wide-ranging, and likely to continue long enough to impact multiple growing seasons. The sector's complicated structural dynamics defy easy or quick solutions. Short-term solutions to fertilizer shortages come with significant trade-offs. Supply constraints in global markets limit the ability to support any group of countries without affecting the availability of fertilizer for other countries.

In Africa, contractions in fertilizer use would have severe ramifications on the food security of some agriculture-dependent rural areas where food insecurity challenges are particularly pronounced. Prohibitive international

[58] For more information, see: https://www.elysee.fr/en/emmanuel-macron/2022/09/23/launch-of-the-save-crops-operation-initiative

[59] https://www.fao.org/3/cc2945en/cc2945en.pdf

prices, fast depreciation of currencies against the US dollar, appreciation of the Russian ruble (which makes Russian exports more costly), high levels of indebtedness, as well as inefficient transportation and marketing infrastructure, give rise to concerns that many African countries will not be able to afford purchasing fertilizers in international markets without external support.

Food and fertilizer exports from the Russian Federation are excluded from the sanctions that have been imposed by 33 countries following the war in Ukraine.[60,61] They are also largely excluded from associated restrictions on financial transactions and transport, though restrictions on individuals and/or companies can reverberate upon these. Despite these exclusions, overall uncertainty about the application and operation of sanctions may have had a hindering effect on fertilizer trade. The United States and the EU have attempted to counteract the uncertainty through official communications and written assurances to shippers (e.g., comfort letters) clarifying the application of sanctions.[62]

More efforts are needed to reassure the private sector on this matter and thus enable the continuation of business and, where necessary, the establishment of alternative trading hubs and routes. These efforts are particularly important for the African continent that relied on European trading hubs and routes to access food and fertilizers prior to the outbreak of the war (as seen for instance in Figure 3). Such efforts should go together with actions to support importing countries to meet higher transaction costs resulting from market disruption and fragmentation. In this context, it is important

[60] Glauber, J. & Laborde, D. 2022. How sanctions on Russia and Belarus are impacting exports of agricultural products and fertilizer. IFPRI, November 9, 2022. See also: US Department of Treasury. 2022. Office of Foreign Assets Control (OFAC) Food Security Fact Sheet: Russia Sanctions and Agricultural Trade, (https://home.treasury.gov/system/files/126/russia_fact_sheet_20220714.pdf); EU Commission. 2023. Questions and Answers: tenth package of restrictive measures against Russia (https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_1187).

[61] See also:

US Department of Treasury. 2022. Food Security Fact Sheet: Russia Sanctions and Agricultural Trade. Office of Foreign Assets Control (OFAC). https://home.treasury.gov/system/files/126/russia_fact_sheet_20220714.pdf

European Commission. 2023. Questions and Answers: tenth package of restrictive measures against Russia. https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_1187

[62] However, sanctions do affect trade in potash products from Belarus, and these sanctions predated February 2022. See: https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/729428/EPRS_ATA(2022)729428_EN.pdf

to underline that the international community is well-equipped to address food crises that emerge from affordability issues, and that food crises that derive from availability constraints must be prevented.

While the IMF's Food Shock Window eligibility criteria allows countries to draw on these resources to meet rising fertilizer import costs, at the time of writing this report only four African countries had a Food Shock Window approved. Of these, three countries had drawn on these additional funds to meet rising costs of both food and fertilizers.[63] More analysis is needed to shed light on the underlying causes for apparent low response by countries to take up these funds, their policy options and choices as well as the constraints faced by African countries and to enable them to access the agricultural inputs. The African Union is organizing the Africa Fertilizer and Soil Health Summit in June 2023. The Summit will adopt a 10-year action plan to address Africa's expanding fertilizer crisis. The action plan will focus on improved efficiency, financing, fertilizer policy, and soil health. In this regard, every effort must be made to support this dialogue and the implementation of meaningful actions.

FAO has developed a "fertilizer neediness index" to inform international efforts to support and prioritize initiatives that aim to ensure that African countries are able to access international fertilizer markets, either through the provision of financing facilities to purchase fertilizers or through outright donations.[64] This index considers a number of indicators, including the country's balance-of-payment situation, the severity of food insecurity, as well as other factors that shape the ability to purchase fertilizer at market conditions.

Urgent steps need to be taken to make fertilizer more accessible and affordable. Especially within Africa, internal trade and logistics barriers raise intra-regional trade costs of African-produced fertilizer and undermine trade efficiency within the continent.[65] Investments in trade infrastructure and trade facilitation measures will help the regional market to function more efficiently.

[63] IMF. 2023. See: https://www.imf.org/en/news/searchnews#sort=%40imfdate%20descending

[64] For more information, see: Fertilizer Allocation Methodology https://www.fao.org/3/cc2802en/cc2802en.pdf; Fertilizer Allocation for Africa https://www.fao.org/3/cc2803en/cc2803en.pdf; and Trade tracker for Nitrogen, Phosphorous and Potassium fertilizer https://www.fao.org/in-focus/remaining-fertilizer-trade-tracker/en

[65] Malpass, D. 2022 A transformed fertilizer market is needed in response to the food crisis in Africa. World Bank Blogs, December 21, 2022.

For resource-poor smallholder farmers, targeted and tailored interventions are needed to provide support in weathering the crisis and planting for upcoming seasons with enough fertilizers and other agricultural inputs, while maintaining livelihoods. However, the search for longer-term solutions should also focus on increasing soil fertility and fertilizer use efficiency and reducing the environmental impact of fertilizers. There is no single solution to all soil fertility problems, but a portfolio of options can be employed. Recycled nutrient sources are alternatives to increase soil fertility. Animal manure, urban wastes, wastewater, algal biomass, compost, and digestates, among other sources, can be recycled to the plant nutrient cycle after consumption by humans or animals, as by-products of food processing or as plant residues returned to the soil. More – and longer-term – efforts and investments are needed to develop these options into viable alternatives for farmers.

Conclusions and Recommendations

The currently fragile food security situation is one dimension of a global food, energy, and financial crisis affecting every region of the world. Our humanitarian assistance system, already overstretched by ongoing conflicts and climate-related disasters, is facing even greater demands in 2023. Financial support, while increasing, has not kept pace with the needs.

The consequences of soaring inflation and mounting debt burdens are spreading the food security crisis well beyond those countries that have been suffering from acute food insecurity for successive years. Countries that were on a positive path to achieving the food security and nutrition targets of the SDGs are seeing poverty levels rise, while their ability to provide assistance to their populations is undermined by increasing debt, falling revenues, and depreciating currencies.

The global community, including the G20, has responded to the current crisis with humanitarian assistance, new initiatives and political commitments. The global response prioritized keeping food supply chains functioning, avoiding export restrictions, re-opening Black Sea trade routes, strengthening social safety nets, and continuing to invest in building sustainable food systems. Progress has been made on all these fronts, but any additional supply shocks could turn the current food access crisis into an availability one.

The main drivers of food crises – lack of adequate investments in agri-food systems and rural areas, research and development, direct impacts from conflict and insecurity, extreme climatic events, and economic slowdowns and downturns – are all expected to persist in 2023 and beyond.

A return of global economic growth will ease the crisis, but it is not sufficient either to alleviate the current suffering or to prevent future shocks from piling additional pain on vulnerable populations. Much more needs to be done to address the root causes of hunger, food insecurity and malnutrition and to make safe, healthy diets more affordable for all.

The current multi-dimensional crisis underscores the potential for global macroeconomic conditions to undermine food security and nutrition goals and the need for a swift and coordinated global financial and policy response. It is important to move beyond a sector-specific discussion of food security and consider how the development finance architecture can be improved to support investments that will address the underlying causes of food insecurity, promote sustainable and inclusive economic growth in rural areas and reduce the potential for financial stress to lead to increased hunger and food insecurity.

Recommendations

1. *Emergency humanitarian assistance*: Funding must keep pace with the needs. More funds are needed for emergency food and livelihood operations and for other emergency measures that preserve livelihoods and reduce future short-term needs.

2. *Social safety net programmes*: An integrated, people-centered policy approach is needed, which must include food-related policies. The countries with the greatest needs have the fewest resources and the smallest capacity to protect vulnerable households. Social safety net programmes need to be improved and expanded to contribute towards the realization of the right to food, facilitate access to food for the poor and vulnerable, alleviate hardship and promote well-being.

3. *Increasing resilience*: Key to building the shock-absorptive capacity of an agrifood system is diversity in food sources, diversity in actors in food supply chains, including small and medium agrifood enterprises, efficient transport networks, effective early warning systems, early action plans and social protection, and affordability of a healthy diet for all households, particularly the poorest and most vulnerable.

4. *Fertilizer*: Urgent action is needed to facilitate access to fertilizers for farmers in vulnerable areas, while also increasing investment in long-term solutions. Efforts must also be deployed to improve fertilizer use efficiency, for instance by investing in and using soil nutrient maps, and

reduce dependency on mineral fertilizers. The Africa Fertilizer and Soil Health Summit will be key to set priority actions for the continent, and its outcomes should be supported with concrete actions.

5. *Finance*: Countries need to be provided with fiscal space to protect their populations from the impacts of the soaring food price inflation. Donor funding, concessional loans, and emergency relief through the IMF Food Shock Window are critical. A broader food import financing facility, such as that proposed by FAO, which will expand the IMF Food Shock Window, will ease the immediate food import financing burden of vulnerable countries and help them mitigate long-lasting impacts on their agrifood systems, reducing future needs for emergency assistance. While recommendations on debt relief and restructuring are beyond the scope of this report, there is no question that such actions would provide more fiscal space to offset the impact of elevated food, fuel and fertilizer prices on poor households.

6. *Markets and trade*: Governments must take concrete steps to improve the functioning and long-term resilience of global markets for food and agriculture, including by reducing distortions, improving competition and food safety standards, and – in the longer term – ensuring that the true costs of food and farmed goods are reflected when traded internationally. This also means strengthening the provision of public goods, for example by improving the availability of extension and advisory services, investing in research & development, promoting access to technologies and innovation, and improving infrastructure in rural areas. In the immediate future, AMIS should be provided with adequate support to enable it to monitor world fertilizer markets and assess global supply chain logistical constraints. Regional efforts should improve market data and analysis of commodities that contribute to the affordability of healthy diets. Governments should also enhance transparency on trade policies and measures affecting markets, exercise restraint in the use of export restrictions, and revitalize the WTO ongoing agriculture negotiations to address both short- and long-term food security challenges, while new financial tools to give policy-makers viable alternatives are also needed.

7. *Agrifood systems transformation*: We must address the underlying causes of hunger, food insecurity and malnutrition. The right investments now in transforming food systems to be more climate-resilient and less resource intensive will help to overcome the current crisis and build resilience to

future crises – while responding to climate change challenges. To meet the targets of SDG 2 by 2030, agrifood systems must be transformed in ways that they deliver lower cost and safe nutritious foods that make healthy diets more affordable for all. To continue to drive poverty reduction and protect incomes and livelihoods in the face of future shocks, agrifood systems need to be more diverse, more climate-resilient and less resource intensive. Repurposing agricultural support would provide leverage to implement policies that will prompt the transformation of agrifood systems to become more sustainable and resilient and make healthy diets more affordable for all.

Global Food Crisis and Implications for Actions in the Context of War and Pandemic Shocks

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1 Introduction[1]

After years of encouraging progress made toward reducing the number of undernourished people globally, in 2015 this trend began to stagnate and by 2018, undernourishment numbers began to rise. This trend was reinforced by the global COVID-19 pandemic, which led to an increase in hunger by 150 million since the outbreak of the pandemic. Supply shortages in international grain and vegetable oil markets, as a direct consequence of the Russian invasion and Ukraine's inability to export, as well as high international food prices in the first half of 2022, have worsened the global food situation and likely contributed to global hunger increases.

With the onset of the Covid-19 pandemic, international food prices rose sharply. The FAO Cereal Price Index has increased from 96 in 2019 to a record high of 141 in January 2022, while global prices for vegetable oil tripled over the same period (FAO 2023). A similar trend is observed for local food prices in low and middle-income countries (LMICs). Food price inflation has increased sharply in many regions since 2020. In Africa, average price changes for all food groups were over 10% in 2020. In 2021, price increases for most food items were slightly lower. In Asia, food price changes were slightly higher than in Africa, averaging about 50% for some products compared to 2019. The average price changes illustrate that local price spikes are not just exceptions but a general trend. However, the averages cover up extreme values. For example, cereal and tuber prices quadrupled between 2019 and 2021 in several markets in Syria and Lebanon. In several

[1] The paper draws on Kornher, L. and J. von Braun. 2022. Higher and more volatile food prices – Complex implications of the Ukraine war and the Covid-19-pandemic (ZEF Policy Brief 38) and Kornher, L. and J. von Braun. 2023. The global food crisis will not be over when international prices are back to normal (ZEF Policy Brief 42).

markets in Zambia, Sudan, South Sudan, and Ghana, prices for maize, cassava, or rice doubled (WFP 2023).

The escalation of the armed conflict between Russia and Ukraine drove international wheat and maize prices up. Considering that Russia and Ukraine together account for about 20% of global maize exports and 30% of global wheat exports, effects are large. Additionally, the World Food Program typically stocks half of its grain reserves from Ukraine. Russia and its ally Belarus are also the top two exporters of fertilizer products. The importance of Ukraine and Russia for international commodity markets is reflected by this year's movements of international wheat and maize prices (Fig. 1) which were strongly linked to changes in expectations about the future grain supply. For instance, within a few days after the outbreak of the war, the price of wheat rose from U$214/ton to about U$400/ton, the price of rice from U$441/ton climbed to about U$550/ton, and the price of maize rose from about U$150/ton to over U$300/ton at some point in 2021, as compared to pre-COVID levels (IGC 2023).

In the second half of 2022, international grain prices returned to the levels seen at the beginning of the year. This development was caused by the relaxation of international supply shortages through Ukrainian exports as part of the Black Sea Initiative and overland as well as the constant Russian

Figure 1. The evolution of the global food crisis in 2022. Data source: Authors' illustration based on International Grains Council (IGC).

export outflows. However, domestic food price inflation is still on the rise. Therefore, the global food crisis is far from over. The causes of international and domestic food price changes are complex and influenced by several interlinked factors. This study discusses the causes of rising and volatile food prices since the beginning of the Covid-19 pandemic, including the period of the Ukraine war, maps vulnerabilities, identifies development policies to prevent renewed price spikes and outlines support measures for LMICs to reduce the negative impact of high and volatile prices through economic and social policies.

2 Causes of post-Covid food price developments

Food markets cannot be analyzed in isolation. Interlinkages of agricultural markets with financial and energy markets as well as input markets continue to increase and contribute significantly to food price dynamics. This is further amplified by climate shocks. International food trade linkages have both negative and positive impacts on food security. On the one hand, trade reduces dependence on local weather patterns and plays an important role in improving global food security. However, the linkages also create potentially new vulnerabilities because different actors around the world, that are active in food markets, influence food prices through their trade and marketing decisions.

Generally, there exist different categories of causes for food price changes. The root causes are short-term and long-term changes in demand and supply. Due to the low price elasticity of demand for food products, supply changes often fully transmit into higher consumer prices. With the ongoing climate crisis, supply shocks due to extreme weather events become more frequent. Market conditions, such as the concentration of production and exports in a few countries and the lack of information and transparency about global food stocks, are the reason that individual supply shocks can destabilize the global food system. Often these shocks are amplified by internal causes such as discretionary trade policy measures (e.g., the export stops) or excessive speculation in agricultural commodity futures markets.

The increase in food, fertilizer, and energy prices began before the Russian invasion of Ukraine (Fig. 2). Price expectations and economic sanctions on Russia and its ally Belarus have created additional shortages in global fertilizer markets. Therefore, in assessing the effects of food price inflation, it is also important to consider macroeconomic developments during the Coronavirus period. Globally, economic growth rates were far below the fore-

casts. The Indian economy for instance shrank by 6% in 2020/2021 and in December 2021 employment was 2.9 million below the level in 2019/2020. Lower employment mainly affects women (Dev 2022). Given low or shrinking economic growth and reduced employment, which are also seen in other regions of the world, price increases in basic foodstuffs have even more serious effects on the socio-economic well-being of the population.

Supply chain disruptions contributed to the rise of input and output prices. Although global food trade appeared resilient during the Covid-19 pandemic (Engemann and Jafari 2022), market closures and restrictions on mobility under the Coronavirus protection measures caused additional costs for traders and the food-processing industry which contributed to price increases (Dietrich et al. 2021; Andriantomanga et al. 2023). In addition, unclear regulations and coordination failures between neighboring countries at the onset of the pandemic led to supply shortages due to long waiting times for customs clearance. Disruptions were not limited to output markets but also affected labor input and fertilizer availability. In India, where lockdown measures during the pandemic have been particularly severe, agricultural labor shortages, higher transportation costs, and the tem-

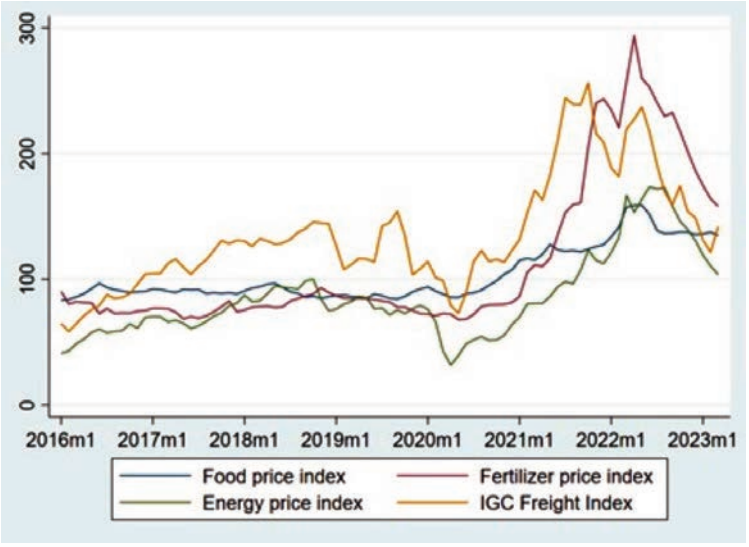

Figure 2. Input price and transport costs trends. Source: The World Bank Commodity Price Data (pink sheet) and International Grains Council (IGC).

porary closure of key wholesale markets hampered the smooth functioning of agricultural supply chains (Raijkhowa and Kornher 2022).

Increases in input and energy prices have led to increases in production costs and higher transportation costs (Fig. 2), which in turn have affected food prices. Since January 2021, prices of NPK (nitrogen, phosphorus, and potassium), potassium, and phosphate rock have more than doubled, whereas prices of DAP (di-ammonium phosphate) and TSP (triple super-phosphate) have increased by 58% and 74%, respectively. The natural resources of all chemical fertilizer products are geographically concentrated. Russia, its ally Belarus, and China account for a significant share of global fertilizer exports (i.e., 50% of potassium and 30% of nitrogen). The potassium market is the most concentrated with over 60% of the reserve located in three countries in the northern hemisphere (Russia, Belarus, and Canada) (FAOSTAT 2023). The increase in fertilizer prices can be attributed to a combination of factors: Disruptions in the agricultural input supply chain, China's restriction on the export of fertilizers up to and during 2022 (Laborde et al. 2022), as well as rising energy prices and the subsequent cuts in ammonia production. Labor shortages due to mobility restrictions as part of Covid-19 measures also contributed to the increase in production costs. All this led to an increase in the costs of global food supplies and thus higher prices. Russia and its ally Belarus also account for a significant share of global fertilizer exports. Supply chain disruption as a result of the military conflict in combination with export sanctions against Russia put additional pressure on energy and fertilizer prices (Glauber and Laborde, 2022).

Climate change and conflicts are the two other main drivers of domestic inflation. In 2022, extreme weather events destroyed harvests and livelihoods in several LMICs. Most notable in terms of the number of affected people and causalities were floods in Pakistan, Guatemala, Bangladesh, and Nigeria, as well as droughts in Ethiopia, Niger, and China (Guha-Sapir et al.). In East Africa, the desert locust infestation in 2020 and very low precipitation in the past rainy season caused local food shortages. Conflicts, which are strongly linked to climate change and economic opportunities, break supply chains and reduce the availability of inputs and income. Additionally, migration flows stress receiving countries that are often food insecure and constrained. Therefore, stable international food prices will reduce the pressure on import-dependent countries, but bringing down domestic inflation requires a more comprehensive food systems approach.

Food system geopolitics make the global food system less predictable. Unlike during the global food crises of 2007/2008 and 2011, global food supplies have been stable over the past two years. Global grain inventories were around 24% of total supply at the start of 2020, significantly higher than before the 2008 price crisis (18%), which means that short-term production shortfalls can, in principle, be absorbed unless political restrictions take effect. The ownership of these stocks has, however, shifted since 2008. Today, China is the largest food importer in the world and alone holds more than half of the global cereal stocks. Other food stocks remain highly concentrated in a few exporting countries, including India (USDA 2023). China and India are, however, not predictable due to public involvement in the management of food stocks. For instance, China's agricultural policy is a major source of uncertainty, given its heavy dependence on imports of animal feed. President Xi Jinping warned against underestimating the risk of food shortages and underlined the importance of public actions to guarantee grain security linked to national security (MacDonald 2020). With increasing living standards, the same applies to the supply of meat and vegetables. Measured in terms of global food trade, an aggressive import strategy by China or reduced exports could lead to further turbulence and supply shortages on the world market.

3. Causes of a prolonged food crisis

3.1 International price movements

The causes of food price inflation are complex. The direct vulnerability to international food price shocks increases with a country's food import dependency. Specifically, higher international prices translate directly into an increasing food import bill. For instance, besides many small states and islands (SSI), several countries around the world spend a large share of their export revenue on food imports.[2] In these countries, international food price shocks, amplified by local climate and economic shocks and conflicts, have led to significant increases in domestic food price inflation across local markets in LMICs and High-Income Countries (HICs). Domestic food price inflation usually responds to international price spikes with a time lag, dependent on a country's integration into international supply chains. This

[2] Several countries spend more than half of their export revenue on food imports (Bonilla Index>0.5). These countries are Haiti, Gambia, Guinea-Bissau, Niger, Nepal, Sudan, Sierra Leone, Syria, Tajikistan, Somalia, and Yemen.

is also indicative of the development of domestic food price inflation levels over the last 24 months. Food price inflation (nominal and real) was relatively stable during the Covid-19 pandemic in 2020, started to increase in 2021, and has reached unprecedented levels since then without a slowdown in view. On the other hand, expansive monetary policies and overspending to provide an economic stimulus, in response to the economic downturn, have increased general inflationary pressure, which requires a different policy response than global food market failures (Algieri et al. 2023).

3.2 Fertilizer accessibility and availability

The consequence of increasing fertilizer prices on LMICs, especially in African countries, is not immediate, but reduced fertilizer use leads to lower yields and production in the coming years. Fertilizer prices are at record highs. The distribution of natural resources needed for chemical fertilizer makes local production difficult and increases import dependency. Limited local production is partly responsible for high fertilizer prices and low rates of adoption in many LMICs, particularly in Africa where the green revolution has been halted (Badiane et al. 2022). Due to the high level of fertilizer import dependency, domestic fertilizer prices also move alongside international prices, which also caused a significant increase in local fertilizer prices in Africa. For instance, the price of urea increased between January 2021 and the end of 2023 by around 60% in Kenya, Mali, Burkina Faso, and Nigeria and by 90% in Ghana. This will lead to reduced agricultural productivity and food supply in Africa because yields are more responsive to fertilizer application rates than in other regions. Fertilizer use and crop yields have grown in parallel over the past decades, but application rates in Africa have remained distinctly low, at about 20 kg per hectare, whereas Europe is at about 90 kg and Asia at about 180 kg (FAOSTAT 2023). The overuse of fertilizer in North America, Europe, and South Asia has created large nutrient surpluses associated with environmental pollution, contrasted with soil nutrient depletion in Africa (Dobberman et al. 2021). Due to these differences, agricultural yields and food production are much more responsive to fertilizer use in Africa than in other regions of the world (Table 1 and Figure 3).[3]

[3] The cubic relationship give the best statistical fit. In the fixed effects model, the quadratic relationship performs best.

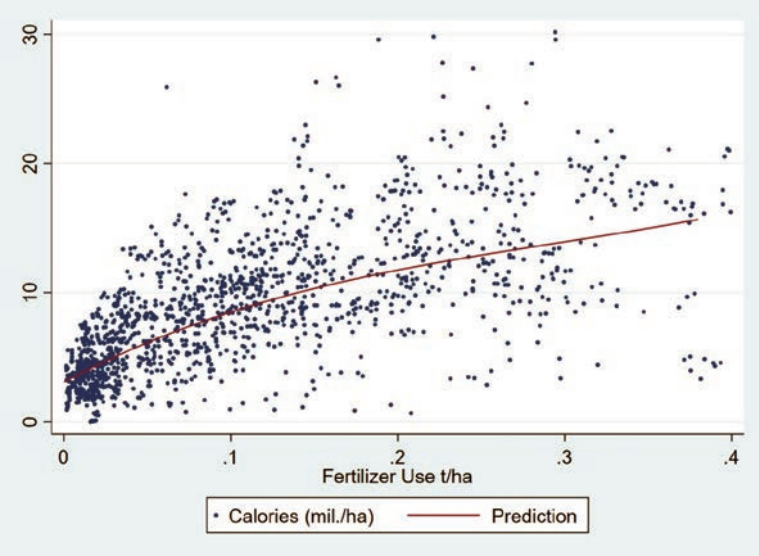

Figure 3. Global fertilizer response function. Data source: Authors' illustration based on USDA and FAOSTAT 2022.

Dependent variable **cereal yields (mil. calories/ha)**	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) FE
Fertilizer variable	Total fertilizer	Total fertilizer	Nitrogen	Potassium	Total fertilizer
Fertilizer use per ha	68.78*** (25.18)	57.69*** (21.00)	84.06*** (14.36)	321.2*** (19.30)	17.25*** (9.79)
Fertilizer use per ha^2	-164.2*** (-9.81)	-129.8*** (-7.90)	-205.5*** (-3.95)	-4091.5*** (-11.48)	-18.54*** (-5.14)
Fertilizer use per ha^3	185.3*** (6.96)	151.8*** (5.87)	293.0* (2.52)	15005.3*** (8.31)	
Weather controls	NO	YES	YES	YES	YES
Time trend	NO	YES	YES	YES	YES
R^2	0.56	0.61	0.28	0.29	0.31

Note: t -statistics in parentheses* p<0.05, ** p<0.01, *** p<0.001. Weather controls include rainfall and temperate levels and deviations from the long-term trend. R^2 for the FE regression is from within variation.

Table 1. Relationship between fertilizer use (ton/ha) and cereal yields (mil. calories/ha).

For African countries, it is expected that fertilizer usage for cereals could reduce by around 20%, which is equivalent to a reduction of around 4kg/ha at the current level of fertilizer consumption in Africa. Reduced fertilizer usage suggests a reduction in calories per ha by around 250,000. This is equivalent to 96 calories per person per day for Ethiopia and 115 calories per person per day for Uganda (derived from Table 1). Besides direct production effects, reduced fertilizer use is accompanied by general equilibrium/macroeconomic effects and subsequent lower agricultural output. This could lead to reductions in agricultural output by 3%-8% and overall GDP by 1%-3% annually for several African countries (Badiane et al. 2022). To make fertilizer more accessible and affordable for African countries, it is essential to both build resilient and sustainable global fertilizer markets, that take note of shortages in LMICs, and to increase efforts to build up private fertilizer markets in Africa (Malapas 2022).

3.3 Economic slowdown and macroeconomic instability

The economic consequences of the COVID-19 pandemic on LMICs are unprecedented and many countries have not recovered. Global GDP declined by more than 3.7% in 2020. Employment in many LMICs, especially in the informal sector, dramatically decreased and remittances – an important factor for livelihoods and economic stability – sharply dropped by 25% in sub-Saharan Africa (Usman et al. 2022). The global food crisis will create significant additional fiscal and economic costs. The international community, particularly the international financial institutions, is asked to provide a supporting role in this, incl. humanitarian and financial assistance, as well as policy advice and capacity building (Rother et al. 2022).

These effects are mostly the result of domestic demand reductions as well as global spillovers through tourism and export losses. Data also suggests a strong decline in (foreign direct) investment by more than 50% in 2020 (Lakermann et al. 2020). For Africa, economic growth was more than 8% lower than it would have been without COVID-19 (UNECA 2020). Increased investments in social protection programs also added pressure to African economies and contributed to an overall fiscal deficit expansion of about 6.5%. However, in many LMICs the economic recovery from the COVID crisis is slow. In almost half of the global economies, growth rates lag behind pre-COVID levels (IMF 2023). The result of macroeconomic instability was expansive monetary policy and the use of fiscal stimuli to mitigate crisis effects. In consequence, the food crisis has turned into an in-

flation crisis in many countries worldwide. High inflation and the inability to service debts can cause domestic economic crises that further reduce incomes and endanger progress in the fight against global hunger and render mitigation policies (i.e., social protection responses) difficult.

4. Consequences of a prolonged crisis and vulnerabilities

Food price inflation is one of the main risk factors for the undernourished and those at risk of becoming food insecure. Price fluctuations primarily affect poor populations in LMICs and threaten the stability and reliability of the global food system. Higher staple food prices reduce the real income of poor consumers who spend a significant portion of their income on food. Price spikes force households to switch to cheaper and less preferred foods that contain fewer nutrients or are of lower quality (Matz et al. 2015, d'Souza and Joliffe 2014). A basic food plate for a healthy diet remains unaffordable for many poor households (Masters et al. 2021) and becomes even more expensive with rising food and fuel prices. Lower dietary quality is associated with increased levels of malnutrition, particularly among chil-

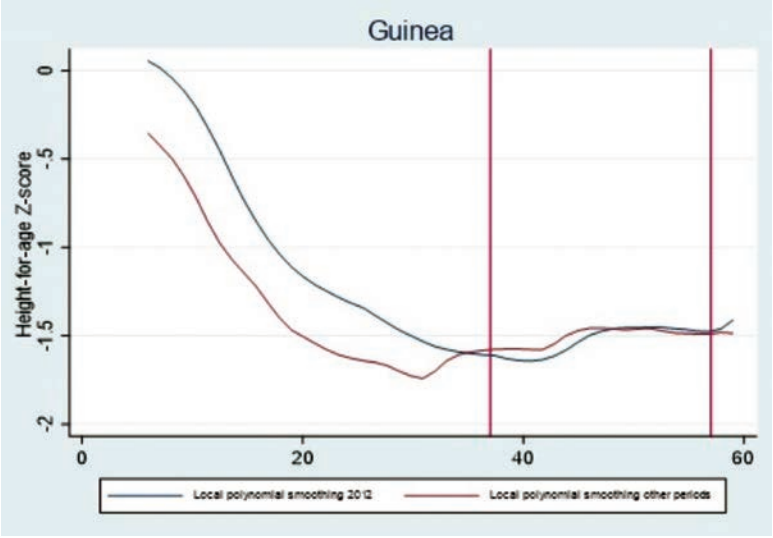

Figure 4. The effect of the 2008 global food crisis on child height in Guinea.* Data source: Kornher et al. 2023.

*The graph is extracted from a cohort study.

dren. Low height at younger ages below five years is a key predictor of later in life health and economic outcomes (Hoddinott et al. 2013).

While there is substantial evidence that exposure to severe economic shocks during early childhood is associated with lower height and increased prevalence of stunting, up until today, there is still limited evidence on the longer-term nutrition effects of the global food and economic crisis of 2008. Comparing height-for-age z-scores of children exposed to the 2008 crisis in-utero (e.g. Figure 4 between the red bars) in a cohort study of 12 African countries to children of the same age cohort who did not grow up during the 2008 crisis, Kornher et al. (2023) find that the exposure to the crisis negatively affected child height by about 0.1 standard deviations. Usman et al. (2021) also show that food price spikes are associated with increased short-term child mortality in LMICs. These results prompt the urgency of policy actions.

Which countries are most vulnerable to the current food crisis? Unlike in 2008-2012, the ongoing food crisis is the outcome of multiple related factors. For this reason, we examine vulnerability as the combination of exposure to different risks. We consider import dependency to measure the exposure to international food price development, food price inflation for domestic factors, conflicts, economic downturns, and vulnerability to climate shocks. The methodology is outlined in Table 2. In total, 58 countries are exposed to at least three risk factors. Figure 5 maps those countries with a GDP per capita of less than 10,000 USD. Haiti is the only country that is exposed to all five risks. Afghanistan, Antigua and Barbuda, Bahamas, Jamaica, Lebanon, Libya, Sri Lanka, Mexico, Myanmar, Sudan, Solomon Islands, Timor-Leste, and Venezuela are exposed to four risks.

Indicator	Import dependency	Food price inflation	Conflict	Economic downturn	Climate vulnerability
Definition	Imports of >500 calories per day per person	Double-digit inflation in 2022	Listed on the 2022 World Bank list of Fragile and Conflict-Affected States	2022 GDP<2019 GDP	World Risk Index Exposure >1
No. of countries	92	104	37	50	101

Table 2. Exposure to different types of risks.

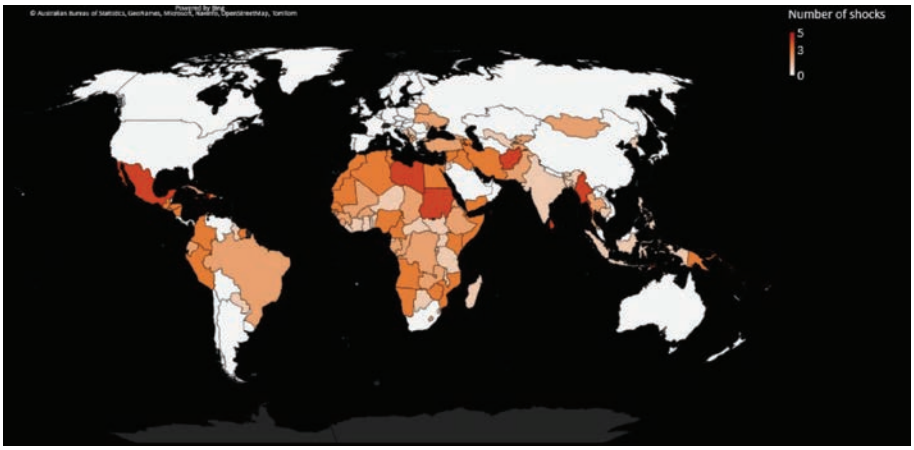

Figure 5. Countries' exposure to different risks (number of shocks). Data source: Authors' illustrations based on various sources.

5. Conclusion and policy implications

Average food prices saw an unprecedented 15% increase toward the end of 2022 – and much higher levels in many countries. The increase in food, fertilizer, and energy prices began before the Russian invasion of Ukraine. Price expectations and economic sanctions on Russia and its ally Belarus have created additional shortages in global fertilizer markets. Decreased fertilizer usage by 20% in Africa and in many other countries may cause significant production shortfalls, causing further threats to food security in some LMICs. The global economy still has not recovered from the economic decline during the COVID-19 pandemic. Public spending to mitigate the consequences of the pandemic increased short-term borrowing and indebtedness causing macroeconomic turbulences.

The international community and governments around the world were alarmed by the Russian invasion of Ukraine in February 2022. The G7 has emphasized its commitment to the achievement of the SDGs, including food security, and launched the Global Alliance for Food Security in May 2022 to coordinate the fight against global hunger in the face of a looming crisis. This initiative has made additional emergency support available. Its longer-term effectiveness to make the international agri-food system more resilient needs to be seen. The international community was keen to avoid mistakes made during the 2008-2012 food crisis. The G7 and EU have urged the international community to keep food markets open and have engaged

in finding solutions to enable Ukraine grain exports via land and alternative sea routes, after Ukraine's Black Sea ports were blocked, and later through the Black Sea Grain Initiative. It is key to improve the short-functioning of the global food market to reduce the inflationary pressures from international food markets.

On the other hand, the G7 and several allies have imposed economic sanctions on Russia and Belarus. But while these sanctions did carve out food and fertilizer products, sanctions on the banking and insurance industry and individual firms have made trade more difficult and expensive. Furthermore, blocking Belarus from using Baltic Sea ports and the difficulty in insure Black Sea shipments from Russia had, at times, adverse side effects of economic sanctions. Due to the political tension between Russia on the one side and NATO on the other side, the political coordination to keep food and fertilizer markets open should be maintained at the G20 and UN levels. The Black Sea Grain Initiative, which has shipped 12 million tons of grain – about half to developing countries – since July 2022, sets an example and must be continued to ensure adequate supply in international markets.

International financial organizations, together with the role of Rome-based food agencies, the WTO, and the AMIS should be strengthened to increase market transparency, trade functioning, and policy coordination. This includes substantial emergency programs to increase fertilizer availability in LMICs, increase debt relief, food aid, and budget support to expand social protection, including scaling humanitarian actions in and around hunger-prone zones impacted by climate crises and conflicts. However, regional coordination on food and nutrition security is essential. Regional trade agreements and common multilateral strategic grain reserves could empower developing regions to become resilient to global market shocks (Kornher and Kalkuhl 2017).

Global food crises response and global food systems reform issues need to be added to the UN agenda and the ongoing follow-up to the UN Food Systems Summit 2021 (von Braun et al. 2023), in addition to national pathways of food systems transformations. Long-term responses need to address sustainable productivity growth, and sustainable land use, especially in low-income countries, with technologies and innovations (Chaichebelu et al. 2021). To increase agricultural productivity, the allocative efficiency of fertilizer usage needs to improve by increasing fertilizer availability in Africa through local production, increasing nutrient efficiency worldwide, and the expansion of sustainable soil and land use (Doberman et al. 2021).

The latter is called for from a climate policy perspective in any case. Last, restructuring the global food system (without counteracting environmental and climate goals) is required. This includes disincentivizing the demand for bioenergy and meat in high-income countries to expand food production and availability.

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Expanding Access to Treatment for Malnourished Children

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The Hunger Crisis is Devastating for Communities and Especially for Children: The world is seeing a hunger crisis of unprecedented proportions. More than 900,000 people[1] across the globe are one step away from famine, caused by the current global food security crisis, climate change, and conflict. This is particularly dangerous for children.

East Africa is experiencing its worst drought in more than 40 years after five consecutive years of failed rainy seasons. Increased temperatures, severe droughts, locust invasion, and flooding, have damaged agricultural land, reduced grazing pastures for livestock, and devastated livelihoods and diets. Millions of people are barely able to meet minimum food needs by depleting essential livelihood assets or through crisis-coping strategies. At the end of last year, around 20 million children[2] across Ethiopia, Kenya and Somalia were facing the threat of severe hunger, thirst and disease.

In times of severe food insecurity and famine, malnutrition surges, especially among children under five years old, can have lifelong health and sociological impacts.[3] Globally, up to 60 million children are currently experiencing wasting or acute malnutrition (too thin for height), the deadliest form of malnutrition, increasing their risk of death up to eleven-fold. Cases continue to rise rapidly in near-famine contexts, like Somalia.

An effective treatment exists but few malnourished children receive it. Treatment with ready-to-use therapeutic food (RUTF), an easy-to-administer, shelf-stable fortified peanut butter paste has shown to be highly effective for more than 20 years. The majority of malnourished children who receive this treatment fully recover within weeks. And yet globally, just 20

[1] https://www.wfp.org/global-hunger-crisis

[2] https://www.unicef.org/press-releases/more-twenty-million-children-suffering-horn-africa-drought-intensifies-unicef

[3] https://www.unicef.org/nutrition/child-wasting

percent4 of children suffering from wasting can access this treatment, leading to 1-2 million deaths annually.[5]

The current global system for the treatment of wasting is not working for children and their caregivers, nor for health systems. It is unnecessarily complex, heavily reliant on hard-to-reach health centers, underfinanced, siloed, and challenging to scale. Currently, treatment is delivered through a bifurcated system that treats severe and moderate forms of acute malnutrition with different products, different supply chains, and different delivery points, supported by UNICEF and WFP respectively. In addition, children are diagnosed and treated according to complex weight-based calculations, primarily through formal health facilities. When fuel and food prices are surging, and cash-strapped families are facing impossible decisions, the need to travel to a health facility can prove an insurmountable barrier.[6]

This is exacerbated by a lack of sustainable multi-year funding, distributed in short-term bursts of emergency funding. RUTF supply chains have been unreliable, and lack transparency. Additionally, there is no cohesive, flexible global guidance on treatment protocols, preventing national governments from procuring and selecting among all evidence-backed tools.

A body of research shows a more cost-effective and scalable way to deliver treatment for acute malnutrition: Over nearly 10 years of research,[7] the implications of various simplifications to the wasting treatment protocol have been tested, and demonstrate that a simplified, combined protocol using a single product, simplified MUAC-based diagnostic criteria, and simplified dosing is equally effective and in fact more cost-efficient than the standard, more complex, approach. The simplified approach can be delivered at the last mile, including by community health workers with tools adapted for low levels of literacy and numeracy. Simplified approaches are an important piece of the solution to closing the treatment gap.

According to data in Mali,[8] for the same resources, you can treat 31% more children with severe acute malnutrition (SAM) or 66% more kids suf-

[4] https://www.rescue.org/article/why-do-most-children-affected-acute-malnutrition-go-untreated

[5] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8050919/#:~:text=Globally%2C%20it%20is%20estimated%20that,%25%20%5B11%E2%80%9314%5D

[6] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6587873/

[7] https://www.rescue.org/report/simplified-combined-protocol-evidence-overview

[8] https://pubmed.ncbi.nlm.nih.gov/36432609/

fering from moderate acute malnutrition (MAM) using a simplified protocol. UNICEF reports that to date, 52 countries have used[9] some form of simplified treatment approaches.

The ComPAS trial,[10] a 4,000 patient randomized control trial in South Sudan and Kenya published in 2020, concluded that simplified, combined treatment for SAM and MAM provides at least the same benefit as standard care. 76.3% of children treated with the combined protocol recovered compared to 73.5% recovery with standard treatment protocol. The rate of deaths was 1.8% for both the combined and standard protocol, while both protocols had a recovery time of about 10 weeks. No evidence of a difference in additional secondary outcomes including non-response, default and average daily weight gain was found.

The simplified, combined protocol has been tested in different operational settings, following over 100,000 children across 5 countries. Our operational research shows the simplified protocol is effective across multiple countries and contexts. Data shows that the protocol achieves high recovery rates ranging from 85%-95%, well above the humanitarian SPHERE standard of 75%. This effectiveness is sustained among children who are particularly vulnerable. Recovery rates are over 80% even among children with severe wasting, concurrent wasting and stunting, and the youngest patients.

Community health workers (CHW) can effectively deliver treatment, further enabling reach and decentralization. Simplifications to the traditional protocol can enable CHWs to treat children with uncomplicated wasting who live far away from health centers, increasing coverage in hard-to-reach areas. Research in Mali 2022,[11] showed that treatment by CHWs resulted in high recovery (94%), similar to the treatment by formal health care workers, and low RUTF consumption per child recovered, and can safely be adopted by CHWs to provide treatment at the community-level. Similarly, a study in South Sudan showed that deploying CHWs to treat SAM in areas with high prevalence and low treatment access leads to higher recovery, and shorter treatment time. Proper adaptations of tools and protocols can empower CHW cadres with low literacy and numeracy to successfully complete treatment steps.

[9] https://www.simplifiedapproaches.org/
[10] https://www.ennonline.net/fex/53/thecompasstudy
[11] https://www.mdpi.com/2072-6643/14/22/4923

Ready to Use Therapeutic Food is both a major cost driver of treatment and a binding constraint to scale. (1) Currently, many countries are facing product shortages in the face of food insecurity and increased demand. The product is often in short supply, leading to stock-outs; (2) There are long, unpredictable lead times from producer to health facility; (3) The product is expensive, and its price limits coverage. This is a well-documented problem, with key issues on price and availability discussed in UNICEF's 2021 RUTF Supply Market Outlook.

Unprecedented influx of financing for wasting treatment led to an increased demand for production in 2022 and 2023, but the RUTF manufacturers cannot keep up with ongoing demand. The standard formulation of RUTF is derived from raw materials shipped from all over the globe, manufactured primarily in western countries, and then shipped at expensive rates to high-burden countries. There is a lack of transparency in the supply chain that makes it challenging for governments and implementers to scale treatment accordingly. Simplified approaches and alternative formulations of RUTF provide multiple opportunities to enhance efficiencies in the supply chain.

Using the simplified, combined protocol is one treatment approach that notably increases the cost-efficiency of malnutrition treatment in two key ways. First, the simplified protocol reduces the dosage of RUTF for some children with SAM. Following a standard protocol, the current weight-based dosage for SAM children can result in children receiving up to 5 sachets of RUTF per day. The simplified protocol effectively recovers SAM children with a consistent dosage of 2 sachets per day. As RUTF expenses are often the most significant single cost of malnutrition treatment, a *simplified protocol uses 39% less RUTF to treat children with SAM* than the standard protocol. Second, treating MAM and SAM cases at a single delivery point can lead to efficiencies when more children benefit at each site while site level fixed costs remain the same. The simplified, combined protocol enables scale by maximizing limited resources to avert preventable child deaths.

Another option that may impact the supply chain includes using alternative formulations of RUTF that optimize local ingredients and improve local production opportunities. Currently, production is primarily in the global north, and shipping, import taxes and delivery raise the costs associated with procuring RUTF. Bringing production closer to the communities affected by malnutrition simplifies the supply chain and generates income-producing opportunities.

Despite the evidence of more cost-effective, scalable approaches, treatment coverage has not significantly improved. We have seen progress with global and national guidelines evolving to allow the use of simplified approaches, but primarily "in exceptional circumstances". This includes the MAM Decision Tool for Emergencies,[12] the UN Joint Call to Action[13] on Child Wasting, the Guiding principles for scaling-up wasting programming[14] note from US AID Bureau of Humanitarian Affairs and the Global Nutrition Cluster, and the Covid-19-specific implementation guidance by UNICEF and WHO. Global guidance and financing should support national efforts to adapt simplified and cost-effective approaches to treatment. This will facilitate the ability to maximize resources in each context and is critical to enable scale.

Global guidance and financing should facilitate the flexibility for national governments to select among all evidence-based approaches to treatment. Three things would lead to real movement: first, we need to set targets with teeth, such as flipping the 80% treatment gap to 80% treatment coverage by 2030. We need a set of clear goals linked to sustained funding and transparent accountability to provide an organizing principle, and a galvanizing mission across all stakeholders. Second, we must drive the uptake of innovations through nationally-led strategies and plans. National and subnational programs have the greatest context knowledge and the most direct accountability to clients. They should serve as the convening point – setting a strategy that gets costed and funded as a single plan, then galvanizing the constellation of national and international partners actions to achieve that strategy. Lasty, it is critical to lock-in sustained, predictable funding through both global and domestic investment. One of the challenges of wasting is that a significant and growing proportion of the funding is short-term, unpredictable humanitarian assistance. While humanitarian crises exacerbate wasting, this has been a steady state global crisis with tens of millions of children affected annually, even in years without major global food insecurity.

[12] https://www.nutritioncluster.net/resources/decision-tool-mam-emergencies-2014-updated-2017

[13] https://www.childwasting.org/

[14] https://www.nutritioncluster.net/sites/nutritioncluster.com/files/2022-11/Guiding-Principles-Scaling-up-Wasting%20Progamming-During-Global-Food-Nutrition-Crisis-v3%5B50%5D%5B6%5D.pdf

The 2023 Global Report on Food Crises[15] estimates that, in the 13 USAID-UNICEF priority countries, there are approximately 26.5 million wasted children. The back of the envelope cost of treating 80% of all children with wasting in these 13 countries is approximately $1.7B annually. This is achievable – we've seen it done before with U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund in the fight against AIDS. PEPFAR increased treatment rates for AIDS from four to 75 percent globally – largely by increasing the accessibility of anti-retroviral therapies. Twenty-five million lives were saved.

We need a global coalition to help end wasting and reduce child mortality as a global injustice. Time and again we have seen the power of faith-based activism to bring about change on global social justice issues – from the HIV/AIDS response to debt relief – especially where existing solutions fail to reach the most vulnerable.

We need a movement to bridge the gap between the science and policy change needed to drive lasting change. Wasting is the sharpest end of the problem – the greatest danger to the most vulnerable children – and the area with the clearest set of solutions.

Faith-based partners can lend solidarity in rallying leadership, resources and transparent accountability for acting on the science and scaling known solutions.

Most global problems do not have clear solutions, but this one does. With national governments in high-burden contexts in the lead, alongside global strategic leadership, political will, and sustainable financing, we can achieve the reform needed to address this decades-long public health emergency.

[15] https://www.wfp.org/publications/global-report-food-crises-2023

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Driving the Humanitarian Paradigm Shift to Mitigate or Prevent Food Crises: Anticipatory Humanitarian Action for Less Losses and Preserved Human Dignity

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Welthungerhilfe

Abstract

Faced with increasing challenges such as rising food insecurity and cascading and compounding risks, the humanitarian system needs to find new ways to cope with rising humanitarian needs. Anticipatory Humanitarian Action (AHA) enables humanitarian actors to act upon forecasts and early warnings before a crisis materialized. The created window of opportunity is used to implement early actions supporting communities to prepare for imminent hazards. To utilize this anticipative method best, humanitarian networking and partnering is needed to help mainstream and scale this innovative approach. Through the practical application of the approach Welthungerhilfe gained practical experience on how AHA can help to avoid losses and damages before they occur. The Madagascar case study presented showcases on how AHA works and why it needs to be scaled.

Drawing from its AHA networking and partnering at global and local levels as well as from its practical field work, Welthungerhilfe calls the humanitarian system to advocate and promote a common understanding of AHA, to assure open-source data and open-access to risk models, to act beyond economic reasoning, to understand and account to people and communities at risk, and to go beyond humanitarian action. Overall, Welthungerhilfe concludes: AHA saves lives, AHA avoids suffering, AHA reduces humanitarian needs.

1. Humanitarian paradigm shift and Anticipatory Humanitarian Action

Today 350 million people are in need of humanitarian assistance. With current humanitarian crises only exacerbating due to manifold factors, such as climate change and protracted or newly emerging conflicts, humanitari-

an needs are even further on the rise while crises tend to become more frequent, complex, and protracted. Therefore, humanitarian action is needed more than ever. This global humanitarian situation is accompanied by an increase in costs, which puts further strains on humanitarian actors (OCHA, 2023). But traditional humanitarian action must only be the last resort to support people. The humanitarian system is obligated to adapt to these new realities instead of only reacting to loss and damage; humanitarian actors need to find innovative ways to mitigate the impact of humanitarian crises.

Therefore, Welthungerhilfe is pushing for a humanitarian paradigm shift away from solely relying on reactive humanitarian interventions responding to a shock and the resulting spike in humanitarian needs. Instead, Welthungerhilfe pursues more proactive modes of support to prevent impacts of the shock which ultimately help to reduce death, suffering and loss of livelihoods while making more efficient use of existing limited resources. While strengthening the resilience of communities and individuals and accelerating efforts in emergency preparedness and response planning, Welthungerhilfe intensively engages in anticipation (Welthungerhilfe, 2019). This is to avoid or mitigate loss and damage caused by shocks before they even occur and preserving human dignity in the process (Figure 1).

Under this umbrella of Anticipation Welthungerhilfe employs the concept of Anticipatory Humanitarian Action (AHA). It is defined as "acting ahead of predicted hazards to prevent or reduce acute humanitarian impacts before they fully unfold. This requires pre-agreed plans that identify partners and activities, reliable early warning information, and pre-agreed financing, released predictably and rapidly when an agreed trigger-point is reached" (GFFO, 2022). Thus, early actions as part of Anticipatory Humanitarian Action are implemented according to pre-built and pre-agreed Early Action Protocols (EAP) with pre-agreed financing ("fuel money") after an early warning is issued but before the actual predicted hazard occurs or its impacts fully materialize (Figure 2). Therefore, Anticipatory Humanitarian Action enables humanitarian actors to make use of the window of opportunity created by acting on available forecasting information.

By acting early, Anticipatory Humanitarian Action (AHA) provides comparative advantages on costs and efficiency compared to the reactive humanitarian action (Anticipation Hub, 2023a; WFP, 2020). However, despite all economic reasoning, AHA first and foremost is an ethical obligation for the international community, humanitarian practitioners and science alike. To enable this action ahead of impacts, forecasting of e.g., droughts

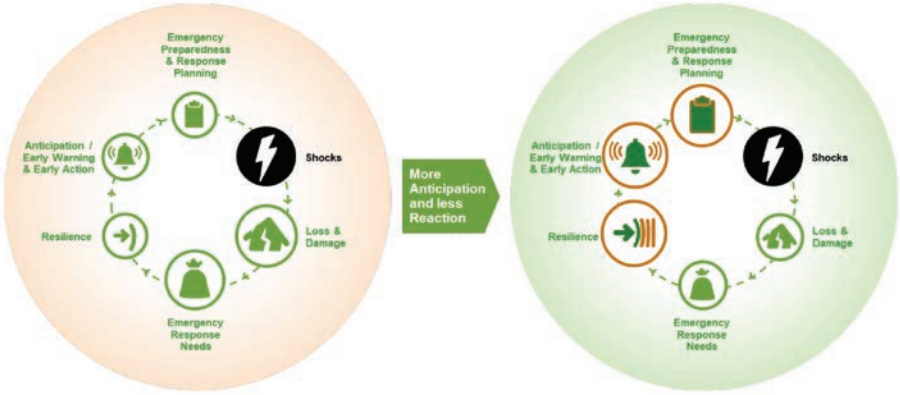

Figure 1. Humanitarian paradigm shift towards increased anticipation and preparedness.

calls for science-based solutions in the sense of generating, analysing, and sharing scientific data for practical use. Here, Welthungerhilfe has been working in the context of droughts and food security over the past years and draws on its humanitarian networking and partnering actions and on a practical case of AHA in Madagascar.

There is a global momentum for amplifying Anticipatory Humanitarian Action, yet the number of active frameworks, hazards and the scale of the projects is still small and does not match the potential (Anticipation Hub, 2023b). Achieving this humanitarian paradigm shift towards increased anticipation and scaling up AHA to its full potential requires the pooling of a wide range of competencies and concerted efforts. Accordingly, an innovative, agile and anticipatory humanitarian actor landscape and the strength-

Figure 2. Positioning of early action part of AHA between an issued early warning and the actual disaster (Graph adapted from German Red Cross).

ening of complementary partnerships from humanitarian, development and science are important (Mogge et al., 2021). This applies to both the global level as outlined in Chapter 2 and within the practical work in countries, provided by an example on drought in Madagascar in Chapter 3.

2. Humanitarian networking and partnering on anticipating food crises

Increasing acute food insecurity: Changing climate, increasing conflict, mass displacement and other stressors (like economic crises and pandemics) put particular pressure on food security all over the world. As a result, progress in tackling hunger has largely halted as shown by the 2022 Global Hunger Index (GHI) score (Welthungerhilfe, 2022). At the same time, acute food insecurity has reached extremely alarming levels worldwide over the past decade. Today, according to the seventh edition of the Global Report on Food Crises, over a quarter of a billion people are facing acute levels of hunger in 58 food-crisis countries and territories, and some are on the brink of starvation (Food Security Information Network, 2023).

Complex risks: Food crises can result from several causes and hazards. In many cases, different stressors interact, leading to cascading and compounding disaster risk. Natural hazards like e.g., droughts, cyclones, floods, landslides, or pests, can add to underlying risk drivers (conflict, crises, climate) and exacerbate negative food security outcomes. Strengthening multi-hazard early warning systems can help to anticipate different hazards allowing for Anticipatory Humanitarian Action to protect lives and livelihoods against the most acute impacts of these shocks.

AHA at scale can help: There is growing evidence that Anticipatory Humanitarian Action can help curb and reverse current food insecurity trends as it can ensure that local food production and economic and physical access to food are maintained despite shocks. The Rockefeller Foundation in a recent report on food security saw Anticipatory Humanitarian Action emerging as one of four key recommendations that, if implemented at scale, can contribute to global food security and provide best practices to work towards SDG 2 (The Rockefeller Foundation, 2023). Likewise, the International Food Policy Research Institute's (IFPRI) 2023 Global Food Policy Report stresses the important role anticipatory action can play in future food policies and announces a CGIAR research initiative i.e. aiming to strengthen anticipatory action in complex crises (IFPRI, 2023).

Mainstreaming AHA in humanitarian coordination: Against this backdrop key stakeholders active in food security increasingly engage in close exchange and collaboration to make AHA work to prevent and mitigate food crises: develop shared principles, make use of synergies, and push for collective action. Already in 2021, Welthungerhilfe provided input to the annual partners meeting of the global Food Security Cluster (gFSC) on the potential of Anticipatory Humanitarian Action to address drought-induced food insecurity (Semet & Burakowski, 2021). For the current revision of the gFSC 2023-25 Strategic Plan (forthcoming), Welthungerhilfe in its role as member of the gFSC Strategic Advisory Group led the workstream on a specific anticipatory action pillar that will be integrated in the strategy plan (Food Security Cluster, n.d.).

Convening food security actors to align and agree on core principles: Contributing towards a similar objective, the Food and Agriculture Organization of the United Nations (FAO), the World Food Programme (WFP) and the Global Network against Food Crises (GNAFC) convened a workshop on "Anticipating Food Crises" which facilitated technical and strategic dialogue and exchange on priorities and alignment between several key actors engaged in AHA, incl. UN Agencies, the Red Cross / Red Crescent Movement, Non-Governmental Organizations, and academia resulting in agreements on core principles and criteria for mainstreaming and scaling up AHA in food crises contexts. This discussion focused around leveraging food security information to inform AHA, enhancing evidence on AHA impact and efficiency, increasing use of AHA in protracted crisis and as a catalyst for operationalizing the humanitarian-development-peace (HDP) nexus in food crisis contexts (WFP et al., 2023 forthcoming).

Influence high-level policy discussion: Key considerations on AHA have also been discussed intensely during the European Humanitarian Forum 2023 (European Humanitarian Forum, 2023). Though only a spotlight on a complex discussion, they already shed some light on challenges still existing on the way towards mainstreaming AHA – particularly regarding food crises – as envisioned in the humanitarian paradigm shift. The partnership of humanitarians not only with development, climate and peace actors, but importantly also with science and academia, can help to better understand some of these complexities and improve different elements of this crucial approach. Particularly the work on forecasts, Acute Food Inse-

curity projections, triggers (including both natural and social scientific analyses) as well as a comprehensive evidence agenda that supports proving the assumptions of the benefits of AHA, will require a close collaboration that allows scientific findings and evidence to be directly translated into practical contributions in the fight against hunger.

Networked civil society: Within the NGO sphere of AHA, the Start Network through Start Fund Anticipation (Start Network, 2023a) and Start Ready (Start Network, 2023b) provides member organisations with access to funding in the event of impending or emerging crises and disasters in order to implement early actions that mitigate the predicted harmful impacts. The forecasts are supported by the Forecast-based, Warning, Analysis, and Response Network (FOREWARN) of the Start Network (Start Network, 2023c). FOREWARN consists of scientists and humanitarian practitioners from various institutions and organisations and is tasked with developing a scientifically sound and verifiable basis for decision-making. Welthungerhilfe actively participates in advisory and decision-making committees in both the Start Fund Anticipation and FOREWARN.

Collective learning: Overcoming isolated work in the different spheres of UN, IFRC and NGO, but rather to learn and engage collectively in scaling up AHA within the humanitarian system, is the aspiration of and facilitated by the Anticipation Hub (Anticipation Hub, 2023c). Here, thematic working groups are addressing different aspects and challenges of AHA. This interaction by different stakeholders is mirrored in the Anticipation Hub Advisory Group which "aims to have diverse membership with a broad range of practical, scientific and policy knowledge and experience from different geographical and sectoral backgrounds" (Anticipation Hub, 2023). Through its advisory work and engagement in the Anticipation Hub, and by sharing respective data and experiences from its practical field work (Anticipation Hub, n.d.), Welthungerhilfe contributes to collectively scaling up AHA (Anticipation Hub, 2023b).

Welthungerhilfe draws from years of experience in practical implementation of AHA, generating best practices, sharing its experiences and evidence on its effectiveness to further push the humanitarian paradigm shift with other humanitarian actors on all levels. Chapter 3 will provide a more detailed insight in Welthungerhilfe's AHA implementation on the case of drought anticipation in Madagascar.

3. Drought Anticipatory Humanitarian Action in Madagascar: Mitigate negative food security outcomes

In Madagascar, smallholder farmers are already heavily impacted by the changing climate especially by the increase of extreme weather events. Since they are often reliable on rain-fed crops without access to coping strategies like irrigation, hazards like droughts, storms or strong rains pose immense risks for their food systems causing acute food insecurity (IPCC, 2022). This affects the poor and hence most vulnerable within an affected community the most. In line with the call for "effective action for protecting the poor" (PAS, 2023, internal communication), anticipating drought events and taking AHA to prevent acute food crises increasingly gains in importance.

Functioning of AHA mechanism in general: Anticipatory Humanitarian Action uses detailed hazard and risk analyses to identify extreme weather events such as droughts in due time and thereby enables the people at risk to act ahead of impending crises through early action. The financing of assistance is guaranteed by the donors before a crisis occurs. In so-called Early Action Protocols (EAPs), the allocation of funds and the responsibilities of those involved are defined and pre-agreed. This ensures rapid and efficient action before an imminent threat turns into a disaster with high losses and damages (Figure 3). Welthungerhilfe has been engaged in this field since 2015. With financial support by the German Federal Foreign Office and in cooperation with local partners, Welthungerhilfe is now pursuing this approach regarding droughts in multiple projects in Kenya, Madagascar, and Zimbabwe (Semet & Burakowski, 2022).

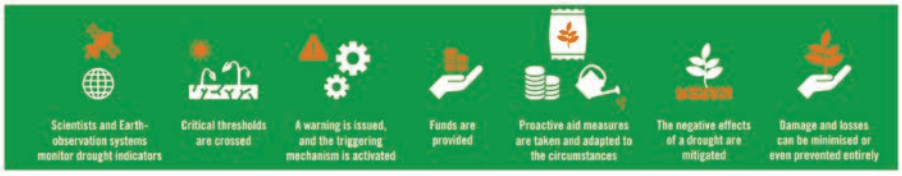

Figure 3. Functioning of the Anticipatory Humanitarian Action mechanism.

Hazard modelling to predict droughts: To enable AHA in droughts, it is necessary to understand the different drought risks in the affected regions. Based on open data from global long-term observations of indicators – for precipitation amounts, soil moisture, and water availability of plants –

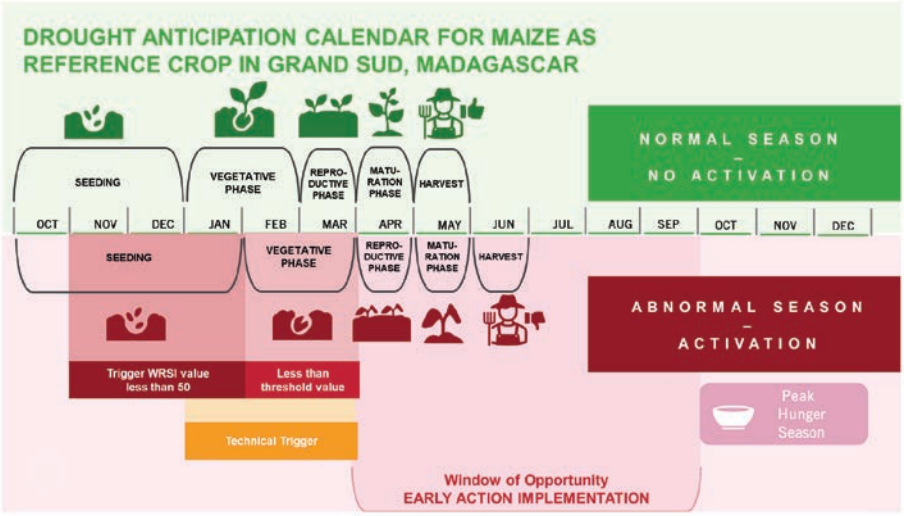

Figure 4. Drought anticipation calendar for the reference crop uphill rice for Grand Sud, Madagascar.

past drought events are analysed to generate insights for current drought monitoring. The indicator used by Welthungerhilfe in Madagascar is the Water Requirement Satisfaction Index (WRSI). The WRSI indicates the soil-dependent water supply level of agricultural crops over the course of the growing period. The WRSI is calculated within the framework of the GeoWRSI of the Climate Hazards Center at UC Santa Barbara, a software program performing crop-specific water-balance-modelling using satellite data. The GeoWRSI software with the satellite data is freely accessible. As a result, humanitarian organizations can even create their own long-term data sets for a historic analysis of past droughts and use the possibility of this open data themselves. Supplementary to the satellite-based WRSI data, publicly available precipitation observation data from local meteorological services is used. The combined use of these data sets helps to validate the GeoWRSI results (Semet & Burakowski, 2022).

Based on the WRSI, Welthungerhilfe assesses which regions in a certain country were particularly frequently affected by drought events and how the WRSI data of the locally used staple crops have developed over the decades (10-day measuring intervals) along the vegetation period (Figure 4). From these analyses, WRSI thresholds are defined at which drought events and subsequent water-related damage to staple crops and harvest losses are

to be expected. These thresholds are incorporated into the respective current drought monitoring. They serve as an alert mechanism and lead to the activation and implementation of the EAPs, including the release of the financial resources allocated for this purpose.

Early actions used to prevent hazard impacts: Within the development of the EAP, vulnerability studies are conducted to analyse how harvest damages and harvest losses will affect a certain population and which early action will support communities most successfully to prevent hazard impacts. In Madagascar, for example, early cash assistance was identified as the most feasible and effective option to mitigate drought impacts. With financial support by the German Federal Foreign Office (GFFO) through the Start Network early cash was transferred each month to particularly vulnerable households when the drought threshold was reached in spring 2021, even before harvest failures led to food insecurity. Welthungerhilfe decided to implement the cash transfers up until the lean season to sufficiently support project participants during the hunger period as well. The cash assistance was provided via digital transfer to accounts on mobile phones, which the households had previously received and were assisted in using. This credit can be exchanged for cash or used as a means of payment in shops. After the completion of this forecast-based drought assistance in Madagascar, the mobile phones remained in the households and communities for further use (Semet & Burakowski, 2022).

Rigorous monitoring to generate evidence on effectiveness of AHA approach: To check whether the mobile cash distribution had the intended effect, distributions were closely monitored in this Madagascar case (Figure 5). The aim was to trace the progress of the early action once implemented, and to evaluate the added value and lessons learned from each distribution.

This showed that 80-90 per cent of beneficiaries were 'satisfied' or 'very satisfied' with the process of early cash distribution. A post-distribution evaluation also indicated how people used their cash distributions, showing that more than 85 per cent of respondents used some of their money to buy basic food staples. This was confirmed by focus group discussions, in which participants explained that they spent the majority of their cash on white rice, generally to stock up in order to survive the coming months of drought. Households also used money to prepare for the start of the school year (14.2 per cent), for basic necessities (12.4 per cent), agricultural inputs

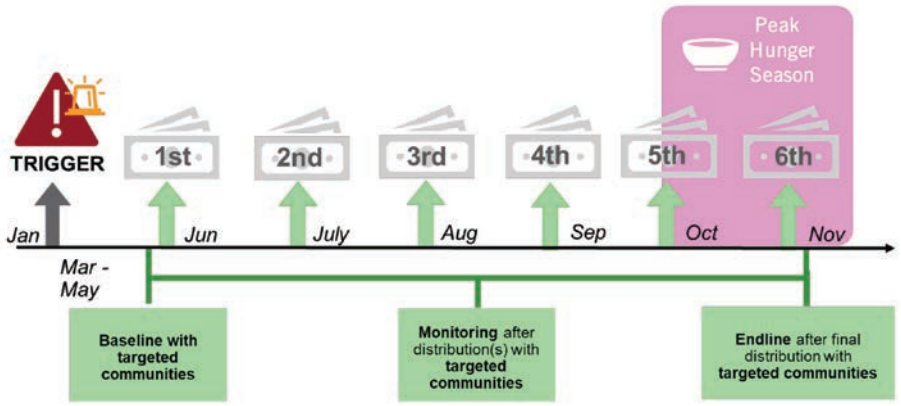

Figure 5. Trigger activation monitoring to assess impact of early cash intervention through various indicators such as the Food Consumption Score Index.

(8.5 per cent), medicines (6.7 per cent) and agricultural equipment (2.7 per cent). Some project participants (30.9 per cent) spent part of their money on things besides daily household needs. These included house repairs, paying debts, reviving small businesses (e.g., purchasing raw materials) and non-essential items such as furniture. Around 5 per cent of respondents saved some of their money to serve as an emergency fund if further problems arose during the lean season. Overall, the post-distribution monitoring shows that the early cash distributions were effective and that project participants put their cash to its intended uses. A close monitoring of the Food Consumption Score Index shortly before, during and after the distribution of early cash showed that the food security situation was stabilized or even slightly improved for most project participants. This can already be counted as a success as project participants did not slip into increased food insecurity with proceeding drought conditions experienced (Burakowski & Semet, 2022; Burakowski, 2022).

4. Conclusions and Outlook

Drawing from its networking and partnering at global and local levels as well as from its practical field work, Welthungerhilfe concludes that the following challenges need to be addressed to achieve the humanitarian paradigm shift away from merely reactive humanitarian action towards scaling-up AHA within the humanitarian system.

Advocate and promote a common understanding of AHA: In part due to its growing momentum, there is a risk of blurring the AHA approach by labelling a rapid emergency response being an early action in the sense of AHA. This can weaken AHAs potential to become the future priority and default approach and provide maximum impact in a yet underused window of opportunity immediately ahead of disasters. Clear definition must be established and followed to protect the intention of AHA and its core concerns. Welthungerhilfe therefore advocates for the definition in the G7 Foreign Ministers' Statement on Strengthening Anticipatory Action in Humanitarian Assistance defining Anticipatory Humanitarian Action as: "acting ahead of predicted hazards to prevent or reduce acute humanitarian impacts before they fully unfold. This requires pre-agreed plans that identify partners and activities, reliable early warning information, and pre-agreed financing, released predictably and rapidly when an agreed trigger-point is reached" (GFFO, 2022).

It is important to promote that AHA is not exclusively about the timing of the measure, but also about the quality and objective. Especially in slow-onset crises, it is often not possible (or necessary) to clearly define the starting point and what was before and after. However, AHA is always designed to protect and to prevent or reduce needs (instead of alleviating needs that have already arisen). This is the special new quality of AHA.

Assure open-source data and open-access to risk models: Humanitarian action shall never become a business! Selling data and claiming intellectual property rights to risk models developed will limit their respective access (thereby impact) as well as sustainability and opportunities for collective improvement. AHA should remain a common good by using shared models and open-source data for transparency, optimization, further development, and collective learning amongst all actors governmental and non-governmental is essential to generate synergies and increase sustainability in handling and maintaining risk models and putting them to maximum use.

Act beyond economic reasoning: Monetary advantages and efficiency gains of AHA compared to classical emergency response, recovery and rehabilitation costs must be analysed by expanding and including an ethical component of saving lives, providing support in a more dignified manner, and avoiding misery and traumata for people and communities.

By doing so, the humanitarian imperative must become reality, i.e., when we can see disasters coming, we must not remain idle and allow people and communities to go into misery by experiencing losses and damages.

We need to do what we can to avoid the latter. We have all means at our hands to support a more dignified way of thinking about humanitarian action. Thus, the advantages of AHA must be seen and promoted far beyond favourable cost benefit analyses. If we continuously improve our ability to predict disaster in cooperation with science, we cannot just wait and see. The humanitarian imperative extends also to acting ahead of predictable disasters to save lives and avoid unnecessary human suffering.

Understand and account to people and communities at risk: AHA comprises understanding and quantifying risks, risk modelling actions and setting thresholds, followed by the development, implementation (upon triggering), and maintenance of Early Action Protocols (EAP), thus before and after the actual early action support of people and communities at risk requires additional works and investments, including close collaboration with science.

However, AHA is not merely developed at the desk and is not simply a modelling issue. It is an ambition wherein science, and humanitarian practitioners meet realities of people and communities on the ground. Thus, exchange with people and communities at risk is essential to understand their vulnerability and coping mechanisms. To put the costs for these field works into value, a reference community (participating in the initial EAP design) and scaling community (in sufficiently comparable contexts and livelihoods) approach (RCSC Approach) is a pathway to combine efficiency and accountability, knowing that ideally all communities should be involved, if only e.g., to ensure that early warnings are understood and transformed into early action. Thus, to take AHA to scale remains the challenge for the future and is demanded by Welthungerhilfe within the humanitarian system (Iseli, 2021; Mogge, 2021).

Accountability does not end with the end of a project. In the context of Early Action Protocol (EAP) development for AHA, people-centred humanitarian action requires mechanisms which assure deliverables after respective project durations, the EAP had been developed. This applies also to EAP maintenance and the resources involved. Hence, it is important to establish (Mosebach, 2023).

Go beyond humanitarian action: The work invested by people and communities at risk and by AHA agents into risk analysis must be infused into HDP nexus programming. This includes avoiding that development efforts are destroyed, and anticipating and mitigating conflict impacts.

Finally, we conclude that AHA saves lives, AHA avoids suffering, AHA reduces humanitarian needs and is more dignified and more efficient than traditional reactive humanitarian action, especially with the scientific community at our side. A close collaboration between the science and AHA communities will be of utmost importance to validate and provide evidence for this again and again to help us improve and convince decision-makers and critics on AHA.

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2. THEORY, ETHICS, AND APPROACHES FOR ACTIONS TO PREDICT, PREVENT AND MITIGATE FOOD CRISES

Governance Must Change to End Hunger

Catherine Bertini
Former Executive Director of the World Food Programme (1992-2002) and 2003 World Food Prize Laureate. Managing Director of Global Nutrition Security at The Rockefeller Foundation

Meeting here in Vatican City reminds us that for at least two millennia, humanity has lived under a principle to help others survive – to reach out to our brothers and sisters.

Although we, as a people, may still have the intention to support each other to survive and to thrive, we have not yet found an answer to do so comprehensively and to ensure that:

- people are not hungry
- children are born healthy and can thrive in infancy and as toddlers
- people living in the midst of disasters have adequate access to food
- the numbers of crises dissipate so that fewer people are unsafe and cut off from food.

Almost eighty years ago, most of the world celebrated peace. As a result, there was optimism as new organizations and systems were created to help keep the peace and support the well-being of nations. Today we can see that many of those entities, as thoughtful and hopeful as they were at their creation, have not succeeded in "ending the scourge of war" nor in ending hunger and poverty. The United Nations Security Council is perhaps the best, and worst, example, made especially poignant as we watch with sadness the loss of life in Ukraine.

Although not the topic of this session or this paper, we must at least rhetorically ask, especially while we are in these hallowed halls, how can peace be again made a higher calling, a broader priority?

Food Security Since WWII

Immediately post war, the Marshall Plan was extended to 16 countries in Europe. Millions of children had access to food in schools and families collected rations of canned food. The United States added a new component to its own schools by the addition of milk throughout the country as

a result of the National School Lunch Act of 1946. Forty-two countries met in Quebec City in October 1945 to create the Food and Agriculture Organization (FAO) to enhance nutritional well-being, rural conditions, efficiency and distribution of food production, "and thus contributing toward an expanding world economy and ensuring humanity's freedom from hunger".[1]

More international organizations were created with the establishment in 1961 of what has now become the UN World Food Programme (WFP), initially designed to distribute surplus commodities from wealthy countries to countries in need, and in 1977 a finance facility called the International Fund for Agricultural Development (IFAD).

For perhaps four decades, the agricultural and food security issues were primarily based around an anti-poverty agenda, as the vast majority of hungry people faced desperate poverty, not war and only occasionally natural disasters. With that in mind and with traditional donor governments looking for efforts to decrease poverty, improve potential commercial consumer prospects, and develop or keep international friendships during the "cold war", as much as a quarter of Official Development Assistance (ODA) was assigned to agriculture-related support. This began to change in the 1980s.

After the 1989 fall of the Berlin Wall and the 1991 collapse of the Soviet Union, there was much talk in donor circles of the "peace dividend" – funds that could be saved from international development accounts no longer considered necessary to keep the peace. By 2008, agricultural-related activities were approximately 4% of ODA.

Of course, in place of development expenditures, more and more resources were allocated for immediate food security needs due to the significant rise in internal strife and regional wars. Humanitarian aid grew quickly to outpace all other development priorities and continued needs of people living in poverty and severe hunger.

Organizations like WFP had been recently reorganized to be able to meet urgent hunger needs – operating more like an emergency management agency than a slow-moving bureaucracy, while others stayed in the development mode.

[1] "Basic Texts of the Food and Agricultural Organization of the United Nations", Food and Agricultural Organization of the United Nations, https://www.fao.org/3/mp046e/mp046e.pdf

Why are humanitarian crises so much more compelling than crises of poverty? My theory is that human beings can see the stark nature of hunger of a war victim; they can feel the pain of flood or earthquake survivors. But it is more difficult to identify with a woman and her children who are living in peace and a calm climate but with no income and few options for food. Photos and news coverage of each circumstance are just not the same.

Traditional donor governments are democracies; they strive to make popular decisions. Each has an altruistic streak but also a mission for self-interest preservation. But self-interest is often defined as short term.

Take two cases in point. When Syrians were pouring across the border into refugee camps in Jordan, Lebanon and Türkiye, their needs for shelter and food were high. At first, donor governments were generous. But the large and mostly unwelcome influx of Syrians into Europe began just weeks after the European Union cut back on its funding for food assistance in those camps. Faced with a lack of food, people migrated to where they hoped to find it – Europe.

In Central America, for years in the 1980s and 90s, the United States funded programs in countries whose governments were allied with the US and fought the governments that were not. Once governments were generally supported by the Americans, large flows of aid stopped. Funds were not sent to build institutions of the rule of law, or education or health. Now, two generations later, hundreds of thousands of people from the region are fleeing the violence, poverty, and lack of functioning systems and moving to where they hope to find peace – the United States of America.

Perhaps governments' international collaboration needs to refine "self-interest".

New Crises – New Self-Interests

For decades the FAO and World Bank reported fairly stable numbers of hungry people. Today, however, is different. There are growing numbers of hungry people. The promises that were made by governments at the United Nations in 2015 – to end hunger by 2030 – will not be met in the next seven years. In fact, today's assumption is that the number of people living without knowing where their next meal comes from will be higher in 2030 than when the promise was made.

Across the globe, people are struggling with food, fuel, fertilizer inflation. They are surprised and often harmed by severe changes in temperature, by more droughts, floods and fires. We all can see the flaws in our social support

systems even more starkly as a result of tepid or negative responses during the global pandemic. Millions of people are still dodging bullets and moving households to attempt to be safe from fighting. And as if that is not enough, the two countries who supply most of the world's wheat are mired in war.

As a March 2023 report from the Chicago Council on Global Affairs and The Rockefeller Foundation says, "While these stark, evidence-based reminders of what is at stake can weigh us down with inertia…. it can also spark actions and mobilize resources and lead to embracing disruptive new thinking and solutions".[2]

For starters, let us flip the imperative of needs.

- Where are the people who are most at risk of hunger?
- Who are they?
- What do they need?

People living in the midst of war need war to end. That is imperative number one. Only specific people and governments can influence this. Let us encourage them to begin.

People living in conflict need help today, yes, but they also need the resilience of programming into sustainable options for tomorrow. A recent report from The Rockefeller Foundation encourages "localization" – funding that is given to local organizations for their decisions and management. Despite any reasonable ideas in this paper or stated or funded by any one of us outside a crisis area, the most workable solutions are those that will be based in the community, not in a capital.[3]

In families everywhere, the individuals most at risk are pregnant women, their infants and young children. Without adequate nutrition, the children will be stunted for life and an entire generation will be less productive than their better fed neighbors. Two studies this year, one by the Center for Development Research at the University of Bonn[4] and one by the Interna-

[2] Chicago Council on Global Affairs and The Rockefeller Foundation, "Defining the Path to Zero Hunger in an Equitable World", March 2023. https://globalaffairs.org/research/report/defining-path-zero-hunger-equitable-world

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tional Food Policy Research Institute (IFPRI),[5] showed that the long-term impact of the last food price crisis in 2008-2011 was the significant stunting of children. There are two actions that could help alleviate stunting – more available social safety nets and more understanding of the critical importance of nutrition for pregnant and breastfeeding mothers.

Farmers with challenges of fast-moving changes in temperature need seeds to grow crops that are resilient and that are supported by science-based outcomes.

Communities and donors who support them need to anticipate future potentialities, according to the recent report from The Rockefeller Foundation, and invest in planning and prevention.

Donors cannot continue to use post-WWII conventional funding silos – this is for development; this is for emergencies. Nothing is for the "in-between".

And institutions that were created in a different time should get careful review. Are they still fit for purpose? Are the funds spent in supporting their work still relevant and are they cost-effective in ending hunger and in building more productive agricultural outputs and rural communities?

And one day, maybe, the world will understand that if our mission is to end hunger, then we must partner with the person in each household who is most invested in ending hunger. More often than not, this is a woman. We must listen to women about what they need so that our investment and their labor and needs actually match.

Conclusion

In 1945, the world needed stability, clear boundaries, economic development, and peace.

In 2023, peace is still a prerequisite to prosperity and progress. But it is the need of individuals and of communities which must be recognized and for which our support for adequate nutrition must be applied. Governance, contributions, and collaboration must reflect this if we are to reverse the trend of increasing hunger.

This can be done, and we must start now.

[5] Lukas Kornher, Awudu Abdulai, and Muhammed Usman, "The fortune of birth at the right time – The long-term effects of the 2008 food and economic crisis on child health", Center for Development Research at the University of Bonn, 2022.

Moral and Ethical Issues of Actions and Non-Actions in Humanitarian Crises

Cardinal Peter K.A. Turkson
Chancellor of the Pontifical Academy of Sciences

Introduction

This, indeed, is a propitious occasion for the Pontifical Academy of Sciences of the Holy See, not only to help widen the scope of reference of the conversation about *how to prevent and mitigate Food and Humanitarian Crises with Science and Policy formulation*; it is also an occasion to invite the Holy See to bring her moral authority and her teaching of ethics for *food justice in a post Covid-19 recovery world, ridden with conflict and displacement of peoples, as we see in Syria, Afghanistan, Ukraine and Sudan*. For, the question of hunger and access to food, is a truly *moral issue,* since it is about the lives of human persons, as the past three Popes have variously observed. Using Cardinal Cardijn's famous discernment process of *see, judge* and *act,* we shall look at an ethical compass for navigating instances of *food and humanitarian crises*.

See

Hunger is too real in this world. We either experience it or know about it. We do not lack information and reminders about millions of impoverished human beings who lack nourishment for body, mind and spirit. In fact, we are inundated by information about malnutrition, hunger and starvation through reports, figures and statistics by UN agencies like Rome's own Food and Agricultural Organization (FAO), IFAD, by national Governments, NGOs, academic and research units; and by media images of conflict and climate which have caused hungry men, women and children.

In at least two workshops of this Pontifical Academy of Sciences on *Reduction of food losses and waste* in 2019 and on *Science and innovation for a sustainable food system* in 2021, and in webinars, on *women and food* and on *jobs, technology and food justice* which the Vatican office for development prepared with the Permanent Mission of the Holy See to FAO, IFAD and WFP, the scary and disconcerting state of our global food system was graphically presented and analysed. They showed how local Caritas groups and humanitarian aid organizations help to shore up the deficiencies and disparities in access to food through their food production and distribution networks. They illus-

trated the observations of FAO experts that global hunger has been on the rise for several years already: that in 2019 the number of undernourished people in the world had increased by 60 million in relation to 2014, and this in spite of the increase in food production. They feared that, even discounting the effects of the Covid-19 pandemic, this trend would result in 840 million hungry people in the world by 2030 – far from the *Zero Hunger* objective contained in Sustainable Development Goal #2;[1] and if the pandemic worsened the situation for us, the climate crisis, poor governance and raging conflicts around the world with population displacements are bound to make the situation truly dismal.

Just as 3 Ts (*tierra, techo, trabajo*) express the need-drivers of grass-root movements and the Latin American *Popular Movements,* so do 3 Cs (*conflict, Covid-19* and *climate change*) capture the key drivers of food scarcity and hunger in the world today. Their combined devastating effects on all stages of food production and its supply chain are alarming. It is estimated that the pandemic alone plunged over 132 million people into undernourishment.[2] This was particularly true of the countries in Southern Africa; and just as their food systems were beginning to recover from the ravages of Covid-19, the recent spate of storms and flooding from tropical cyclones have plunged them into a beggarly dependence on humanitarian food and water. Indeed, behind every one of these numbers are people going to bed hungry; families who cannot bring food to the table; and children whose growth and development is stunted.

Judge

As Pope Francis observed on the occasion of the World Food Day (Oct, 2020): *"For humanity, hunger is not only a tragedy but it is also shameful"*. In fact, as he wrote in *Fratelli Tutti (189), "hunger is criminal", since "food is an inalienable right"*. Pope Benedict XVI illustrated the point about the "*right to food*" in his encyclical *Caritas in Veritate* (n. 27) saying: "*the right to food, like the right to water, has an important place within the pursuit of other rights, beginning with the fundamental right to life. It is therefore necessary to cultivate a public conscience that considers food and access to water as universal rights of all human beings, without distinction or discrimination*" (Civ. §27).

[1] https://www.un.org/sustainabledevelopment/hunger/

[2] FAO, IFAD, UNICEF, WFP and WHO. 2020. The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets. Rome, FAO. https://doi.org/10.4060/ca9692en

Food insecurity, however, is not simply the lack of food. A series of inter-connected factors which affect food production and distribution in all its stages underlie the crisis of food insecurity. They are economic, ecological, political, social and cultural (religious and traditional). Therefore, the crisis of food insecurity is a complex and multi-faceted issue, and its solution must recognize this complexity and seek to address it in all its dimensions. Therefore, food systems in a post Covid-19, conflict-ridden and climate-plagued world must be more robust, resilient and sustainable; and reimagining and regenerating such robust food systems requires a holistic approach, in the sense in which *integral ecology* is presented in *Laudato Si'* (§137ff). Every factor which is contributory to the crisis of food insecurity and humanitarian crisis must be reckoned with: nothing left to chance or considered as an independent variable. Everything is inter-connected and inter-dependent: ecological, economic, political, cultural, religious etc.!

From the religious and anthropological points of view, we recall the observation of Pope Francis that: "*The violence present in our hearts, wounded by sin, is also reflected in the symptoms of sickness evident in the soil, in the water, in the air and in all forms of life*", (LS §2). Similarly, Pope Benedict XVI also believes that: "*The way humanity treats the environment influences the way it treats itself, and vice versa…*", so that contemporary society needs to review its lifestyle (Civ §51). In this sense, the crisis of food insecurity is not unrelated to the way we treat ourselves and the environment. It is as much an *anthropological issue as it is ecological, economic, political, lifestyle etc*. And, if as Pope Benedict XVI notes: "*The elimination of world hunger has also, in the global era, become a requirement for safeguarding the peace and stability of the planet*" (*Civ* §27), then, indeed, the peace of the world depends on how we deal with hunger in the world!

Act… An Ethical Compass/Trajectory Out of Crises

So, how do we deal with hunger?

When in 2015 Italy hosted the *Food Expo in Milan,* it mounted a campaign that called for a "*change in lifestyle through the collective force of our moral and spiritual energies*" to overcome hunger. The Expo encouraged support for local initiatives which included *cutting waste, maximizing land use for food production, help for women in agriculture, application of the fruits of scientific research in farming and food production, and making peace the really indispensable context for food production*.

But the greatest contribution of the 2015 Food Expo to overcoming hunger lay in the theme of the Expo itself: "*One human family, food for all*"

was the prophetically pregnant title and slogan of the Milan Expo. Simply converting the first part of the title/slogan into a *conditional clause,* we would have a statement of a *pre-condition* which is necessary for a solution of the food crisis and world hunger. So, if instead of reading: "*one human family, food for all",* we read: "*when we live as one human family, there is food for all",* such a reading of the Expo theme immediately indicates a solution to global hunger; a *solution that is anthropological and human*; and it also makes global hunger truly a *human issue*. For, hunger comes from a lack of solidarity, hunger comes from failing to feel, to relate to and to behave as brothers and sisters. And like every great *human* issue, global hunger immediately becomes *a moral or ethical issue*. It involves the exercise of human freedom: We are free to show disinterest and indifference. We are free to exercise good will; and in our creativity, we are free to act responsibly/show responsibility or not. The choice is no one's but our own. That is why in his video message to the opening ceremony of the Expo, Pope Francis called for a change of mentality and lifestyle.

From the lessons of the 2015 Expo in Milan, we may now identify two fundamental principles to inspire and guide action: the *dignity of each human being* and the *common good*.[3] In making decisions in light of these principles, we are inevitably drawn towards actions that are ethical and that:

(i) support and expand the development of agricultural workers and respect their innate dignity

(ii) support small producers and cooperatives that adopt less polluting and more inclusive means of production (cf. *Laudato Si'*, 112);

(iii) apply the new technologies available into the agricultural and fishing industries that help "tilling and keeping" the earth (cf. Gn 2,15); this means working it while caring for it (cf. *Laudato Si'*, 67); and

(iv) implement a global system that respects our common home by allowing for the regeneration of resources and the distribution of the fruits of the earth equitably.

In fact, the principle of the common good is inextricably linked with the universal destination of goods, since "it is not in accord with God's plan that [the Earth's] gift[s] be used in such a way that ... benefit ... only a few" and unjustly leave behind a great part of humanity (*Laudato Si'*, 93).

[3] Cf. Compendium Social Doctrine of the Church, nn. 164-170. See https://www.vatican.va/roman_curia/pontifical_councils/justpeace/documents/rc_pc_justpeace_doc_20060526_compendio-dott-soc_en.html#Meaning%20and%20primary%20implications

Food for all is not an impossible enterprise. What is needed is the courage to put those talents and our creativity to the service of something new, something that is guided by a genuine anthropology: the true character and sense of the human person, as a relational being with a vocation to realize its *common good* in and through *solidarity*. Indeed, "*when we live as one human family, there is food for all*"! Mitigating the current global food and humanitarian crisis is not an impossibility. It is an invitation to a re-discovery of our humanity: as relational being, inter-connected and inter-dependent, wired to respond to solidary conduct for the dignity and wellbeing of all!

From Community Vulnerability and Nutritional Status to Crisis Preparedness and Response Capacity

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1. Introduction and Background

In the past decades, Africa has been hit by several shocks that have resulted in widespread impacts. Particularly, the last three years witnessed a series of shocks with the onset of the COVID-19 pandemic, the Ukraine crisis, and natural disasters. The shocks are not only severe by themselves but also have been mutually reinforcing. Moreover, natural disasters are occurring more frequently with higher intensity in recent times (UNECA, 2023). COVID-19 has triggered a global crisis that has affected all walks of life, resulting in a reversal of progress made in advancing livelihoods for millions of people (Fall and Court, 2021). Studies show that the onset of COVID-19 affected the health, poverty, and food security status of the continent and seriously challenged the wellbeing of the most vulnerable groups. For Africa as a whole, the pandemic resulted in the first economic recession in more than two decades, added millions of people to the undernourished category, and reversed progress made in reducing hunger and malnutrition (Tefera et al., 2021).

Similarly, the Ukraine crisis led to deteriorating food security status in several countries in Africa, in particular in countries that heavily depend on wheat and fertilizer imports from Ukraine and Russia (Badiane, Fofana and Sall, 2022; Ehui et al., 2022). In addition to these global crises, Africa has been severely challenged by climate change, locust outbreaks, and drought in recent periods (Flowers, 2022). All these shocks put significant negative pressure on vulnerable communities and risk exacerbating poverty and malnutrition problems.

It is not normal, nor should it be acceptable, particularly for national and community leaders, that every shock leads to such large-scale suffering and destruction of livelihoods. It is therefore imperative, and actually feasible, for governments to devise and implement effective measures to boost the preparedness and response capacity among the most vulnerable communities. This requires taking deliberate action that boosts community resilience

through sustained action, in normal times, to address the key drivers of vulnerability, as well as better targeted interventions when crises hit.

The first step and most urgent action is to make the necessary investments in better understanding the nature, patterns and drivers of community vulnerability to guide the above action and interventions. If lack of access to health services is a major driver of vulnerability, then a long-term priority action should be to invest in preventive health services and other programs in target areas. Likewise, if vulnerability is related to marginal environments leading to low productivity and crops that are poor in micronutrients, then the focus would be on how to improve farm practices, farm management, and access to improved varieties to help boost the intake of micronutrient-dense foods in such communities. Alternatively, if the root cause of vulnerability is lack of access to infrastructure or markets, then this needs to be addressed during normal times before crises hit. Finally, if high prevalence of chronic disease is undermining the capacity of a community to absorb shocks, then the appropriate course of action would be to invest in normal times in reducing the prevalence of such diseases.

This is what investing in understanding the patterns and the nature of vulnerability allows us to do. Once we know the causes of vulnerability, deliberate action needs to take place to drive the vulnerability down. More importantly, better understanding of vulnerability and its root causes allows governments to fine tune responses during times of crisis because they know exactly which communities are likely to be hit first and hardest and what levers to use to boost capacities to absorb shocks.

This paper proposes simple and low-cost strategies to systematically address the challenges and issues mentioned above. Section 2 below briefly describes the effect of the Ukraine crisis in selected African countries to illustrate the level of unpreparedness to take on shocks. Section 3 presents a comprehensive indicator of vulnerability that captures both the patterns and long-term drivers of vulnerability. It is followed in Section 4 by a discussion of the household micronutrient adequacy gap as an indicator for targeting and tracking short-term interventions to respond to shocks during crises. The last section provides a summary of findings and conclusions.

2. Recent Crises Revealed the Chronic Vulnerability and Unpreparedness of African Countries

It is true that shocks happen everywhere in the world. However, the question that we need to answer is why, in the case of many African countries, do shocks routinely result in widespread and large-scale disruption of

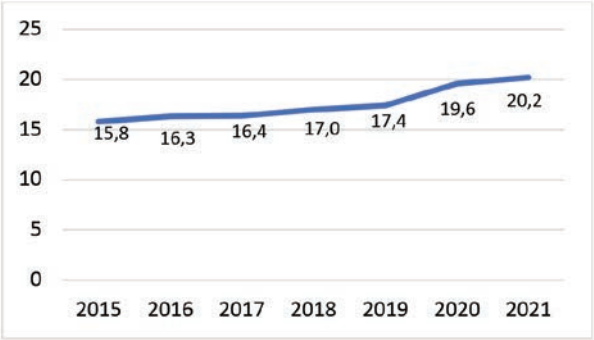

Figure 1. Prevalence of undernourishment in Africa (%).

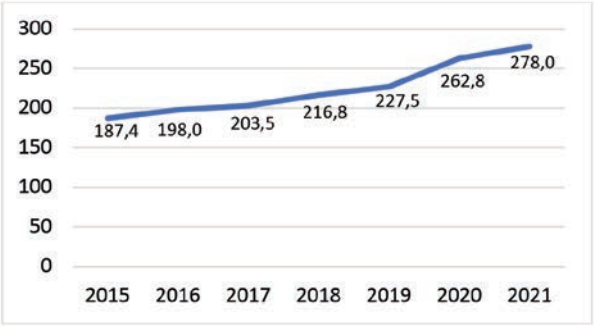

Figure 2. Number of undernourished people (million).

Source: Authors based on FAOSTAT (2023).

livelihoods, not just during crises but long after shocks have taken place? Just in recent years, shocks related to climate change have challenged the food security of millions of households in different parts of the continent. For the Sahel region or the Horn of Africa, a delayed rainy season can have dire consequences for communities (Ilboudo Nébié et al., 2021; OCHA, 2022). In recent years, several parts of Africa have been hit hard by floods, desert locusts, and drought with significant effects among the most vulnerable communities (UNCC, 2020).

The COVID-19 pandemic significantly increased the prevalence of malnutrition, pushing a large share of the population into the malnourished category (Figure 1). The crisis resulted in a situation where one-fifth of the continent's population is considered malnourished, representing a significant change compared to the previous five years: by the end of 2021 an

additional 50.5 million people were added to the category of malnourished compared to the 2019 pre-pandemic period (Figure 2). Judged by any standard, the addition of such a large number of people to the malnourished category is significant, alarming and above all unacceptable.

Africa's recovery from COVID-19 has been hampered by the breakout of the war on Ukraine. The impact of the war on the continent's food security has been a major area of concern because Russia and Ukraine are dominant players in major agricultural commodities. The two countries are major exporters of wheat and sunflower oil and seeds and leading suppliers of fertilizers to a sizable number of African countries (Badiane et al., 2022a; Badiane et al., 2022b). The war affected the continent through the disruption of trade, food and fuel price hikes, and the resulting macroeconomic instability (UNDP, 2022). Findings show that poverty rates are not only expected to increase following the war, but are also forecasted to persist at high levels in the coming years. Figure 3 below shows the trends in poverty levels for selected countries, which are set to rise through 2023 before stabilizing in 2024, albeit at higher levels than at the onset of the crisis in 2022.

The question here is why should a single crisis, be it as wide-ranging as COVID-19 or the Ukraine war, raise poverty levels by such high magnitude? No matter how pervasive and how comprehensive the shock has been,

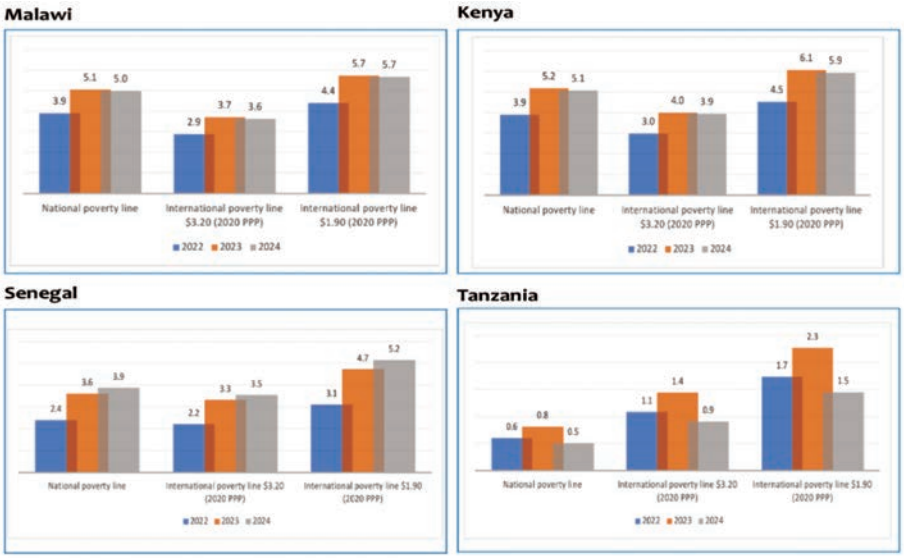

Figure 3. Impact of Ukraine war on poverty in selected countries. Source: Badiane et al. (2022c).

the level and lingering effects of its impact give rise to serious questions of preparedness and response capacity. The root causes are high levels of unaddressed chronic vulnerability combined with limited command over factors exposing communities to recurring shocks. The next two sections discuss options for how Africa could be better prepared to respond to and minimize the impacts of shocks when and where they occur.

3. Understanding Patterns and Drivers of Vulnerability for Greater Response Capacity

The proposal here is to follow what we call the Snowplow Principle. In the global North, towns and municipalities usually know where to park the snowplows before the snow falls. This is because they know exactly which part of the city and which neighborhoods will be the most affected before impending snowstorms. Snowplows are positioned and ready to go in the areas where traffic and people's lives are known to be most exposed to disruptions. The idea here is for governments in Africa to work towards attaining a similar level of preparedness regarding crises, whether related to drought, or flood, or market disruptions. The goal is to create the necessary capacities to: (i) better understand the nature of disruptions associated with various shocks; (ii) have a clear course of action to restore normalcy; and (iii) create the tools and mechanisms to intervene when and where needed. In other words, what is needed for African countries to attain the same level of preparedness when facing shocks as municipalities in the global North when dealing with snowstorms?

The first avenue towards boosting preparedness is to better understand what drives vulnerability and how vulnerabilities are structured across all communities. For that purpose, a comprehensive and composite indicator that measures vulnerability along all its major dimensions is proposed. The composite vulnerability index (CVI) covers dimensions of poverty, malnutrition, access to infrastructure, access to health services, disease prevalence, and climate variability.

Based on the indicators listed above and following Ulimwengu, Magne Domgo and Collins (2021), we use principal component analysis (PCA) to generate scores under each dimension for each location. Prior to using PCA, indicators are transformed such that higher values correspond to greater vulnerability. Sub-indexes are then constructed by assigning each score to one of four categories, with thresholds based on the mean and standard deviation of scores for all locations. The sub-indexes are then combined

with equal weight into a composite index. The thresholds are designed, assuming a normal distribution, such that approximately 25 percent of observations fall into each of the following categories or classes: a) Much more vulnerable, b) More vulnerable; c) Less vulnerable, and d) Much less vulnerable. The composite index provides an overall ex-ante picture of areas and communities that are likely to have the least capacity to absorb shocks and thus where to park the snowplow. In other words, the index can guide countries in establishing the required institutional infrastructure and creating effective programs that can be triggered for timely interventions. The constituent sub-indexes provide more information on the factors driving vulnerability and hence which type of additional equipment to put on the snowplow. That is, they can help guide the design of particular interventions that best match the actual nature of vulnerability. Both the composite and sub-indexes provide guidance for sustained government action to boost resilience in normal times, just as municipalities undertake road improvement, draining and other infrastructure investment to ameliorate conditions during snowstorms.

Figure 4 shows the example of the composite indicator and sub-indexes constructed to assess community level vulnerability to COVID-19 in Mala-

Figure 4. Composite vulnerability I\index for Malawi. Source: Matchaya and Nhlengethwa (2021).

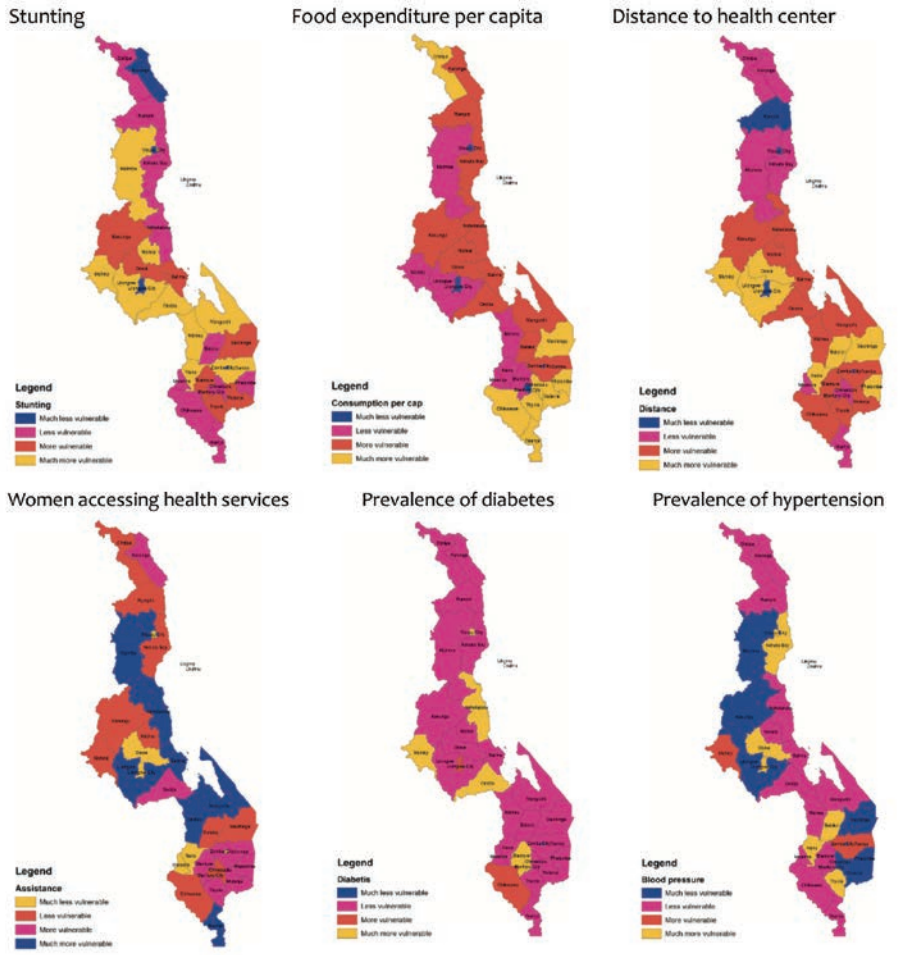

Figure 5. Dimensions of vulnerability in Malawi. Source: Matchaya and Nhlengethwa (2021).

wi. The sub-indexes included in constructing the composite indicator cover nutrition, food consumption expenditure, access to health services, disease burden, and population density (Matchaya and Nhlengethwa, 2021). Accounting for all factors that affect overall vulnerability at community level, Figure 4 reveals the communities that rank highest in terms of vulnerability, that is where the pandemic would be expected to have the most serious consequences (red color). They are the areas in which the government needed to be equipped with the knowledge and tools for whom to target, what to do and how to do it in a timely fashion. Furthermore, the communities

in red should not be particular targets of government action only during times of crises but also during normal times, when the focus should be on factors driving chronic vulnerability as determined by the set of sub-indexes. Figure 5 below maps the various sub-indexes reflecting the main driving factors of vulnerability in each community.

The approach proposed here offers guidance for possible courses of action to boost resilience and reduce vulnerability over time while raising the level of preparedness and creating capacities to respond to eventual shocks.

4. Targeting and Tracking the Impact of Interventions, Policies and Programs for Increased Response Effectiveness

The above discussion has highlighted the importance of better preparedness and more effective targeting of crisis response interventions in areas that need the most attention in tackling the impact of shocks. These are two major building blocks of what is needed to stop the devastating effects of shocks among vulnerable communities. For that, it is also necessary to be able to assess whether, when and to what extent livelihoods in affected communities have recovered and normalcy has been restored. The critical question here, therefore, is how to evaluate whether interventions are working, assess their impact and track the speed of recovery among affected households in near-real time.

The composite vulnerability indicator in the previous section cannot be used for the above purpose. The reason is that changes in its key components such as poverty, prevalence of chronic diseases or access to services take place rather slowly, in some cases in matters of years. We therefore need an indicator that is comprehensive enough and which allows to measure and track short-term changes in household livelihood status. This is similar to how emergency room doctors monitor a patient's vital signs as they track their recovery status. When a patient undergoing a health crisis is admitted in the emergency room, the medical staff prioritize two things. The first is to take his or her temperature and blood pressure irrespective of the cause of the sickness, because they offer a good indication of whatever disruptions are affecting the human body. Second, they continue monitoring whether the patient' vital signs are returning to within the normal range, an indication of whether their intervention is having the desired effect.

The idea here is to adopt an approach of monitoring and tracking the recovery process among affected communities that is based on the same Vital Signs Principle. Application of the principle would mean crisis man-

agement programs that would track changes in household livelihood status and prioritize speed of return to normalcy, in a way that can be tracked and monitored to assess the progress being made in near-real time. For this purpose, it is proposed to use a measure of the micronutrient adequacy gap (MAG) as an indicator of livelihood status which can be changed through crisis intervention measures and tracked in the short run to monitor success and impacts among affected households. The indicator simply measures the degree of adequacy of household intake of key micronutrients compared to recommended levels. This can be computed by using data from household consumption surveys and relevant food composition tables. The MAG indicator reflects several livelihood dimensions among target communities, such as poverty, disease prevalence, access to services, environmental degradation, etc. It is therefore closely aligned with the earlier composite vulnerability indicator but is more amenable to short run changes and thus suitable for tracking responses to emergency interventions.

The indicator can be computed for a wide range of micronutrients on the basis of available food consumption data and relevant food composition tables. This simply involves quantification of various foods consumed by the household, conversion to micronutrient equivalents using the food composition table, and comparison to recommended intake levels for each micronutrient. Intake can be calculated as an average on the basis of adult equivalents or for individual age groups and by gender. The assessment can be further disaggregated between rural or urban communities.

As part of the preparedness strategy, countries can carry out and regularly update representative household consumption surveys in the most vulnerable areas to obtain the necessary reference baseline dataset. It is useful to complement the consumption survey with a similar survey on the production side. In addition to the evidence based on the composite vulnerability indicator discussed earlier, the information from the surveys and the related nutrient adequacy gap analysis provides targeted guidance in designing resilience-building programs that would boost local production and intake of micronutrients during normal times. The information can also be used in times of crisis to determine the best type of foods and seeds to distribute in affected communities. The same surveys can then be repeated as necessary during or post emergency interventions to monitor impact and progress on the ground by comparing adequacy levels before, during and after interventions.

The map in Figure 6 below presents results from micronutrient production and consumption adequacy gap analysis among rural and urban

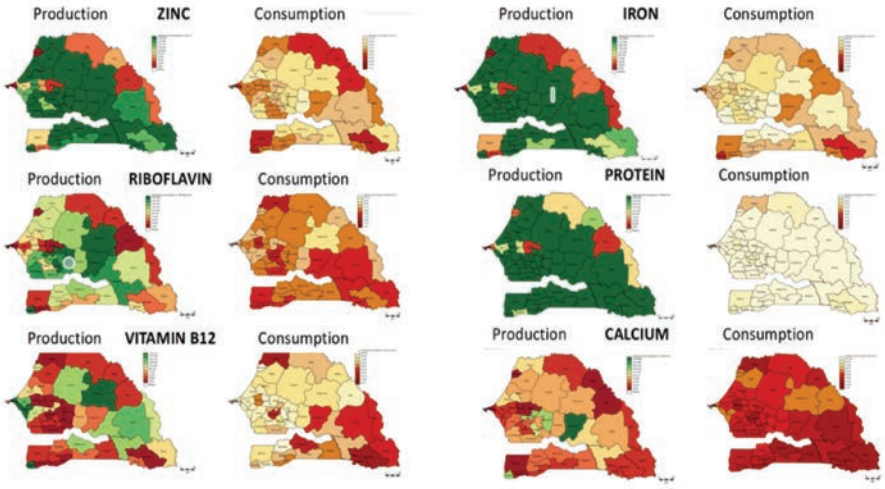

Figure 6. Micronutrient adequacy gap for Senegal (Consumption vs Production). Source: Magne Domgo et al. (2023).

communities of Senegal. A total of 13 nutrients are covered in the Senegal study, of which 6 (calcium, iron, zinc, protein, vitamin B12, and riboflavin) are presented here. The maps show considerable deficiency levels for calcium, riboflavin, and vitamin B12 as indicated by the red colors. Long-term resilience-building interventions in these red zones should ideally include food production (breeding, seed distribution) and consumption (school feeding, food for work, cash transfers, price subsidy) programs targeting crop and food varieties that are rich in vitamin B12, riboflavin, and calcium.

The composite vulnerability indicator and the micronutrient adequacy gap indicator complement each other in guiding the design and sequencing of resilience programs for better targeting and maximum impact during normal times and during crises. The former allows programs to address the more structural drivers of vulnerability and targeting of the most exposed communities. The latter facilitates the crafting of shorter-term interventions and the tracking of impact in near-real time.

5. Protecting Livelihood Status from Policy Shocks

The advantage of the approach to preparedness and response readiness outlined above is that it enables a more effective and timely course of action to boost resilience in normal times and protect livelihoods and restore nor-

malcy during crises. In the real world, community livelihoods are disrupted, not only by different types of shocks but also by government policies in various sectors, albeit often in an unintended and indirect way. Community resilience strategies should include safeguards to minimize the negative impact of such policies, which contribute to eroding resilience capacities and exacerbating chronic vulnerability. For that purpose, it is possible to carry out ex-ante assessment of the impacts of regular government policies (tariffs, taxes, subsidies, export controls, price controls, etc.) among vulnerable communities by evaluating the likely impact on micronutrient adequacy gaps among vulnerable communities.

The same ex-ante analysis can also be implemented to assess the anticipated impact of impending shocks among exposed communities and thus foster readiness for action. If it is possible, for instance, to have a very early understanding of the likely effects of an unfolding drought, or flood, or market disruptions on food supplies, prices or income, the expected changes in micronutrient intake can be estimated and used as guide for timely planning of interventions and choice of appropriate instruments to protect and restore livelihoods.

What is required for the ex-ante analysis, whether in the case of government policies or impending crises, are data on how household micronutrient intake changes with changes in food prices and income. The estimation of such price and income elasticities of micronutrient demand can be carried out using the same data from the household consumption surveys. The findings of the ex-ante analysis make it possible, for instance, to determine a priori the level of price subsidy or income transfer that would compensate for the effects of a given policy change or shock to protect or restore consumption levels in targeted communities to pre-crisis levels.

Figure 7 shows estimates of the price elasticity of demand for various micronutrients for both rural and urban households in Senegal. The food items included in the assessment are cereals, pulses, vegetables and tubers, fruits, meat and fish, milk, oil, and sugar. As one would expect, the results show that demand for the micronutrients, in general, declines with rising prices. But because households adjust their consumption mix by, for instance, substituting food items with lower prices, they may shift to food alternatives with higher content of some micronutrients and thus boost intake for such micronutrients. Similarly, one would expect the elasticity of micronutrient demand to be closely linked to the behavior of demand for food items that are rich in a given micronutrient. For instance, in both ur-

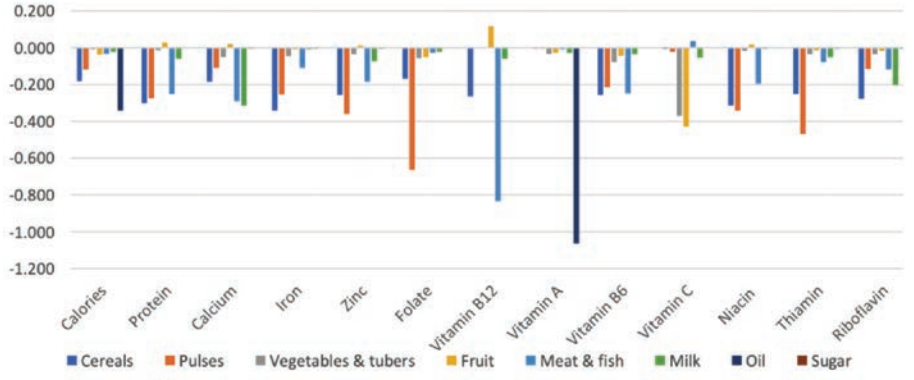

Figure 7. Elasticities of demand for calories and micronutrients with respect to food pricesSource: Magne Domgo et al. (2023). Source: Magne Domgo et al. (2023).

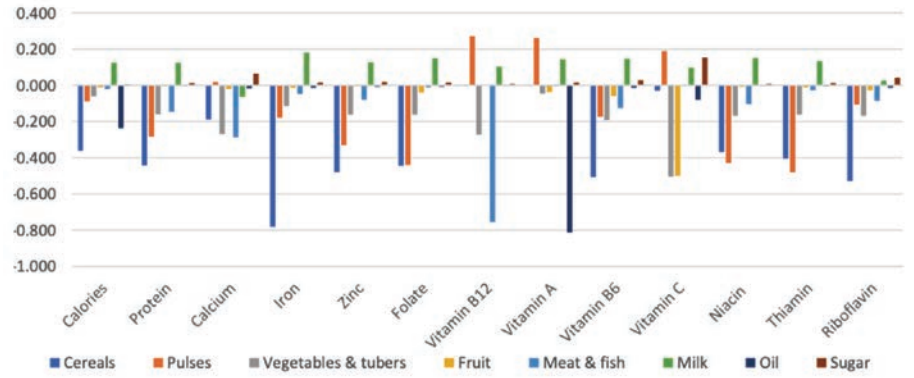

Figure 8. Income elasticities of demand for key micronutrients. Source: Magne Domgo et al. (2023).

ban and rural areas of Senegal, adjustment in demand for edible oil is the main determinant of the price elasticity of Vitamin A intake with respect to changes in prices, while for Vitamin B12 it is changes in meat and fish demand that drive the response to price changes. Similarly, changes in demand for cereals and pulses are important contributing factors to changes in the intake of folate, thiamin, and zinc, as well as iron.

How demand for key micronutrients changes among the same households with changes in income is shown in Figure 8. Rising income normally raises purchasing power and increases the affordability of food and thus increases demand, which in turn boosts the consumption of micronutri-

ents. Income elasticities are higher than one for several micronutrients, e.g. vitamin B12 and calcium, indicating that an increase in income generates more than a proportionate increase in the intake of these of these nutrients. This happens when food items such as meat or milk that are consumed in greater quantities by higher income households are also dense in these micronutrients.

6. Final Recommendations

Avoidance of large scale disruptions and, oftentimes, irreversible suffering triggered by increasingly more frequent shocks requires adequate preparedness and readiness to design and implement impactful interventions to protect livelihoods among the most vulnerable households and communities. This is only possible through resilience strategies that use: (i) a comprehensive indicator that captures clearly the nature and drivers of community vulnerability to enable an efficient planning and delivery of emergency interventions that are timely and properly targeted; (ii) an indicator that can capture near-real time changes in household livelihood status and thus serve as a metric to track the impact of crisis response measures and progress towards restoration of normalcy during and immediately post emergency; and (iii) combine both to develop priority investment programs to tackle, during normal times, the most important drivers of chronic vulnerability and boost the capacity of the most exposed households and communities to absorb future shocks.

Consequently, and in order to reverse the current situation, this paper advocates for a level of preparedness, readiness and targeting akin to what is observed among well managed municipalities in temperate regions with clear operational plans to position the snowplows, adequately equipped and at the right spots, long before the first snowflakes touch the ground. That is what is referred to figuratively as the Snowplow Principle. A multidimensional vulnerability indicator is proposed that can help identify the communities that have the least capacity to absorb shocks and are thus bound to be hurt the most for adequate prioritization, timely planning, and effective execution of crisis response programs.

While adopting the above approach and principle, it is recommended to furthermore prioritize speedy recovery and return to normalcy. Just as emergency room medical staff prioritize bringing fever and blood pressure levels back within normal ranges, crisis response interventions must focus on restoration of livelihood status back to normal so as to avoid further

erosion of resilience and entrenching of chronic vulnerability. The term used to illustrate this approach is the Vital Signs Principle. An indicator of the gap in micronutrient intake among target communities is proposed as a metric to monitor and track the effectiveness and progress of emergency interventions in protecting household livelihoods and restoring normalcy.

Finally, it is recommended that resilience strategies, in addition to boosting capacities to respond to shocks, invest in sustained efforts during normal times to fight the underlying causes of chronic vulnerability. This is similar to municipalities investing in emergency road infrastructure or medical staff treating the underlying health conditions that triggered the trip to the emergency room. The various components that constitute the recommended composite vulnerability index and the micronutrient adequacy gap indicator are also identifiers of the main drivers of chronic vulnerability and thus of possible priority investment areas to boost resilience and household capacities to absorb future shocks.

The approach to resilience strategies that is recommended in this paper is relatively simple to design and administer. The indicators of vulnerability and livelihood status that are proposed employ simple methods of relative scoring and ranking and use data that is readily available or easy to assemble. What is needed at most are light touch consumption surveys in target communities for baselining and during crisis times. No sophisticated software is needed, besides for the estimation of price and income elasticity parameters, which requires econometric packages but can be commissioned as a one-off task. Additional major advantages of the proposed approach are the use of indicators that are intuitive and can be represented in maps that are easy to communicate and accessible to all stakeholders, thus creating the conditions for participatory implementation and community empowerment.

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The Role of Women's Empowerment in Food Crises Prevention and Mitigation Under Climate Stress

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Abstract

Despite small improvements, gender and social inequalities remain pervasive; they lead to worse outcomes for women and children and Indigenous populations during food, energy, and environmental, including climate, crises, widening gaps in access to food and employment and increasing overall inequity in income between the rich and the poor. At the same time there is considerable evidence that women have large roles to play in crisis mitigation, particularly in the most vulnerable populations, and that their engagement in decision-making processes supports crisis prevention. To avoid that humanitarian and food crises increase gender and social inequities and to ensure that women can exert their agency in reducing crises impacts, governments, donors and practitioners need to actively work with and for women, girls and Indigenous populations, providing opportunities for their active participation in decision-making processes and policy responses at all levels, ensuring access to digital tools, information, finance, and raising awareness on and actively working toward preventing gender-based violence.

Climate, food, water and energy crises are increasing

What do poor bioenergy policies, the COVID-19 pandemic and climate extreme events have in common apart from a lack of human ingenuity? They all contributed to global food and energy price spikes. Three such crises have now occurred in just the last 15 years (Figure 1), leading to immense human suffering, ranging from malnutrition to associated civil strife and violent conflict, gender-based violence (GBV), loss of schooling and increased child marriages. These food price spikes directly led to increases in food insecurity: In 2021, between 702 and 828 million people were chronically hungry and 3.1 billion people lacked access to a healthy diet, even be-

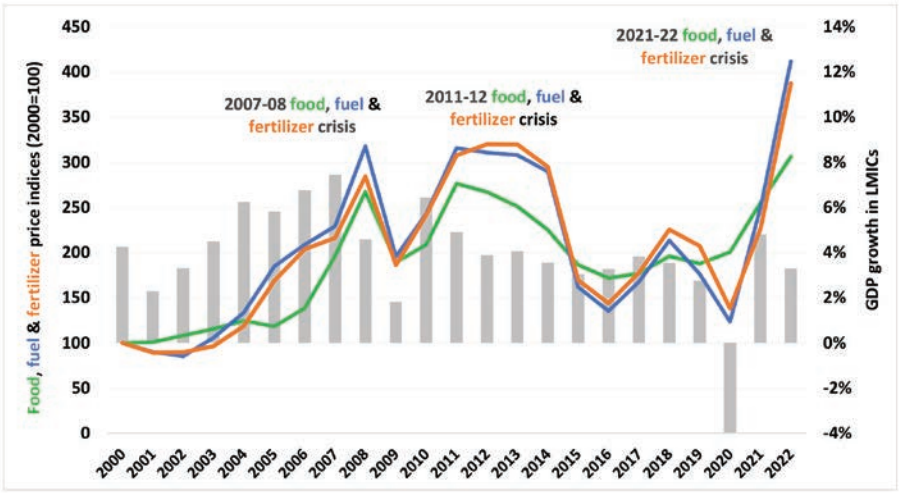

Figure 1. Food, fuel, fertilizer and Gross Domestic Product trends in Low- and Middle-Income Countries, 2000 to 2022. Source: Headey and Hirvonen (2022).

fore the war on Ukraine led to yet higher food price inflation (FAO, IFAD, UNICEF, WFP, WHO 2022). At least 150 million more women than men were experiencing food insecurity (Selva and Janoch 2022).

Figure 1 masks much larger food price spikes experienced in many low- and middle-income countries (LMICs). Examples include the 48% (April 2023) year-on-year food price increase in Pakistan linked to an acute balance-of-payment crisis and political uncertainty, the more than 100% year-on-year food inflation experienced in Venezuela in the first half of 2022 (no later data available), and the 200% average year-on-year food price inflation experienced in Lebanon over the last 12 months.

Food price shocks can be yet more extreme in local areas within countries linked to intrastate conflicts. In such conflicts, food prices do not only increase, but access to food may be entirely cut off in parts of countries. An example was the intrastate civil war in Ethiopia leading to a severe famine with an estimated 13 million people in need of food aid in Tigray and surrounding regional states, as banking and telecommunications, and fuel and food access were cut off.

While water cannot be easily added to Figure 1 because it is not traded globally, water scarcity and variability linked to climate change, environmental degradation, poor policy and lack of investments have clearly been

drivers and multipliers of food and energy crises; and the often poor responses to global food and energy crises have worsened water security.

Gender inequities increase with food and humanitarian crises

Given existing gender inequalities in access to productive resources, services, and agency, due to harmful social norms, food and humanitarian crises put women and girls at a higher risk of hunger and malnutrition (Njuki et al. 2022). Experience shows that crises can reduce women's resources and agency more quickly and deeply than men's widening gender inequalities (World Economic Forum 2021).

It is therefore not surprising that the recent FAO report on the Status of Women in Agrifood Systems (2023), notes that the gender gap in food insecurity is worsening – the gap in the prevalence of moderate or severe food insecurity increased from 1.7 percentage points in 2019 to 4.3 percentage points in 2021; while the World Food Program estimates that COVID-19 pushed an additional 47 million girls and women into extreme poverty, reversing decades of progress (WFP 2022). Job losses in agrifood systems were much more pronounced for women than men during the COVID-19 pandemic as they were more likely to work without protection in the informal sector to start with. Food and humanitarian crises are also more likely to result in girls rather than boys being pulled from school, and in increases in GBV, with long-term implications for their reproductive health, income-earning opportunities, and well-being for themselves and their children. Moreover, to cope with shocks, households may dispose of women's financial assets first, especially when these are more liquid or secondary to the household's main livelihood activity (Shean and Alnouri 2014). The erosion of women's incomes, savings, and assets leaves them with fewer options to deal with rising prices of food, energy, and agricultural inputs and can lead to permanent increases in gender inequities.

A study of COVID-19 impacts in five African countries showed increases in GBV and a lack of access to safe spaces and services for youth, especially girls and young women. As schools closed, and school feeding programs were suspended, adult (71%) and youth (52%) respondents reported an increase in the economic and sexual exploitation of girls for food in rural and informal settlements (MIET Africa 2021).

Governments are left in precarious fiscal situations during food and energy price spikes, particularly if they linger for months and years. When the going gets tough – that is extreme fiscal distress – weaker and less vocal,

and more remote segments of society often lose protection or are forgotten in relief efforts. Budgetary shifts can disproportionately affect the most vulnerable, including women and female heads of households, exacerbating existing structural barriers and intersecting forms of discrimination (CWGL 2019; Oliveira and Alloatti 2022). When governments reduce expenditures on education and health, the burden of providing these services is often transferred to households and communities, putting additional pressure on women and reinforcing traditional gender roles (Quisumbing et al. 2008).

Women and children are especially vulnerable to rising food prices. Even before the pandemic, women were more likely to experience food insecurity and malnutrition than men, with intra-household inequality often driving nutritional deprivation in women and children, rather than poverty (Brown, Ravallion and van de Walle 2019). To cope with rising food prices, households tend to spend less money on food, often by prioritizing staple foods and reducing consumption of nutrient-rich foods (Brinkman et al. 2010). Women act as "shock absorbers" for their households during food price crises, reducing their own consumption to leave food for others (Quisumbing et al. 2008). Rising food insecurity and malnutrition pose the greatest risks for children and pregnant and lactating women, who may suffer repercussions to health and productivity that can span across future generations (Martorell and Zongrone 2012). Food price increases can also lead farm households to hoard food crops, which contributes to further price increases (Timmer 2010), food loss and waste due to spoilage and pests, and greater exposure to health risks, such as aflatoxin.

Both climate- and conflict-induced food and humanitarian crises can be highly detrimental to agricultural areas. During crises, costs of agricultural inputs, particularly inorganic fertilizers, pesticides, and fuel for agricultural machinery rise, threatening to widen the gender gap in agricultural productivity. Women farmers already have less access to resources, such as fertilizers (Peterman, Behrman, and Quisumbing 2014). Higher input prices can lead to conflicts within households, and women tend to have less influence over decisions about how to allocate increasingly expensive resources (Quisumbing et al. 2008).

Importantly, many of the gender-blind crisis responses that have been implemented in response to recent food and humanitarian crises have likely worsened outcomes for women. For example, fertilizer subsidies or e-vouchers targeted to landholders are less likely to reach women farmers due to their limited control over land. Moreover, these transfers often use

digital platforms, which again are less likely to benefit women due to the well-documented gender digital divide (GSMA 2022).

Women have key roles in crisis mitigation and prevention

Women and other marginalized groups have important contributions to make in both crisis prevention and, following crisis onset, in their mitigation. For women and other marginalized groups to exert these roles, they require supporting policies, institutions and investments that are described in the following.

Crisis prevention

Shair-Rosenfield and Wood (2017) find that the proportion of female representatives in a national legislature prolongs peace following a negotiated settlement due to their increased spending on welfare, as compared to military, and by improving public perceptions, particularly in states with nominally democratic political institutions. Similarly, McCarthy and Kilic (2017) find that women's representation and voice enables communities to negotiate and enforce agreements to provide public goods, which is particularly important in times of crises. Greater public goods provision, in turn, increases agricultural productivity and consumption per capita.

As such, women leaders and women's organizations need equal and meaningful participation in decision-making spaces at multiple scales to develop more inclusive processes, design gender-responsive interventions, coordinate implementation across sectors, and monitor and evaluate the gendered impacts of the crisis response. If women's voices are formally represented in crisis planning and response, programs are more likely to be more equitable and effective.

More research and awareness raising is needed to fully mainstream understanding of women's roles in peace-making and peace-keeping.

Crisis mitigation

Social networks and women's groups are essential to help governments and NGOs reach those most affected by food and humanitarian crisis. As an example, women's groups in Sri Lanka intervened quickly following the 2004 Tsunami responding to reports of violence against women in shelters and elsewhere. They mobilized funds and distributed items overlooked by relief agencies such as underwear and sanitary towels and successfully lobbied for adequate lighting and covered bathrooms to increase women's

safety and called for women's representation in camp management (Fisher 2009). Similarly, the Self-Employed Women's Association (SEWA) in India with 1.5 million women members working in the informal sector served as intermediary between women and the government during relief efforts under the COVID-19 pandemic. As part of this initiative, SEWA has also supported community-based, decentralized economic activities based on the 100-miles principle that supports local communities to weather and overcome supply chain disruptions during economic and other crises.

Women's associations in India and elsewhere have also been shown to be effective at promoting economic empowerment, helping women access public entitlements, and increasing women's political engagement.

Informal networks are equally important during crises. For instance, in the conflict in Yemen, women's social networks enabled them to share food, shelter, information, and emotional support (Kim et al. 2022). Inputs from women's groups and networks are essential to ensure that relief programs address women's needs in their specific context.

Climate- and conflict-driven food and humanitarian crises raise the risk of GBV both inside and outside the home, including early and forced marriage as a coping mechanism. Expanding access to health, trauma, and legal services are essential for victims, but so is prevention. Targeted incentives, such as conditional cash transfers, can help by taking pressure off families and reduce adverse outcomes for women and girls, such as early marriage. Gender transformative approaches that engage women and men together in addressing conflicts and sharing resources as well as involving local religious leaders in crisis mitigation can reduce GBV as well.

To be able to take adequate response options during food and humanitarian crises, women need access to information on coping and resilience strategies. To effectively reach women and other vulnerable groups, resources and approaches must be tailored to address the specific needs of women, girls and other disadvantaged groups and they must use channels that women can access and trust. As an example, women farmers are more likely to access information from informal channels, such as women's groups and neighbors rather than from agricultural extension services. Closing the gender digital divide, including increasing women's mobile phone ownership, and removing other biases inherent in digital tools, such as their linkage to a savings account, is essential given the growing provision of information and relief services through these tools (Rowntree et al. 2019). Some organizations are tackling the digital divide head on through innovative product

development, such as digital training modules accessible via mobile phone. Besides these approaches, affordable microfinance and mobile money programs can also help support women during food and humanitarian crises. During the 2008 food price crisis in Bangladesh, microfinance programs targeting women improved their livelihood prospects, including helping them rent more land so that their families could grow food (FAO, IFAD, UNICEF, WFP and WHO 2021).

In addition to resources and information, women also need financial support and access to financial products that are tailored to meet their specific needs during food and other crises. Worldwide, women, the poor, the young, Indigenous people, and those outside the workforce all continue to have lower financial account ownership rates, on average, compared to men and high-income adults, older persons, and the employed, with negative implications for their economic empowerment, resilience, and well-being (Demirgüç-Kunt et al. 2022). Women often trade in informal market settings, which are typically excluded from public sector initiatives, such as subsidy programs and social protection measures. Major barriers for women to access support programs, such as costly registration fees, collateral requirements, and the requirements of documentation that might be difficult or impossible for women to obtain, should be reduced. The private sector must also be leveraged, but with guidance to enable companies to recognize women's value as a market segment, to better target women, and to provide gender-responsive financial tools to effectively reach women.

Lessons from both the 2008/2009 food crisis and the COVID-19 pandemic have shown that targeted cash and food transfer programs are the most effective and efficient means of helping households smooth consumption despite rising food prices (Grosh et al. 2011; Gentilini et al. 2022). These social protection programs serve as an important safety net in supporting food security and nutrition for women, especially the most vulnerable – pregnant women, single mothers, those with young children at risk of malnutrition, women with disabilities, older women, and refugee women. However, there are numerous studies that have shown program weaknesses regarding targeting, program mechanisms, and their sustainability. As an example, most COVID-19 relief transfers in LMICs were short-lived (Gentilini et al. 2022). Moreover, recognizing that decision-making around where food assistance is prioritized within a household is driven by social norms, gender-transformative approaches are necessary to ensure urgent assistance fully benefits all members of the household. Cash transfer pro-

grams can also help women retain access to financial resources, but barriers to their financial inclusion need to be overcome to enable women to access these programs (e.g. when payments are made electronically). Moreover, cash transfer programs must be equipped to support migrant and refugee women to access official identity documents, which they may have left behind when they were forced to flee. Determining individual needs within households is one way to ensure better response to the food security dynamics within families.

Social assistance programs that include additional services, such as support for childcare and incentives for adolescent girls to stay in school, can have a longer-term positive impact on women's livelihoods. Providing incentives for girls to remain in school during times of crisis can ensure that the next generation of women has greater economic opportunities.

Evidence from previous crises suggests a heightened risk of GBV, affecting particularly women and girls, both inside and outside the home, including child early and forced child marriage and other types of GBV. Efforts should go beyond providing services for women and girls experiencing GBV and sexual exploitation to include prevention and protection measures and livelihood rehabilitation programs, designed together with development partners and local women's organizations. Addressing the exploitation of women and girls is critical: one step forward is to guarantee continued education opportunities by reducing school fees or providing long-term zero interest credit linked to school attendance. A greater focus on incentives to retain school enrollment of adolescent girls will go a long way to ensuring longer term economic prosperity and food security. One option is to offer cash-based transfers or food vouchers to families as an incentive to ensure school retention. In many countries, additional top-ups or take-home food bundles are offered to secure the continued participation of adolescent girls in school during times of crisis, while also supporting their food security.

Finally, to develop and implement gender-responsive approaches to humanitarian crises, more timely, accessible, and localized, sex-disaggregated data and evidence are required to understand the differential impacts of both the crisis itself and implications of potential responses on women and girls, and men and boys in different contexts. Given that women tend to have lower resilience capacities, gender analyses that assess women's needs and priorities in different contexts are critical.

Although some evidence exists, data should be collected more systematically and be accessible and more widely used. Information is needed on

immediate effects of food and humanitarian crises as well as crises responses. Key areas with missing information include the incidence of GBV, and longer-term impacts on gender equality and women's empowerment, and well-being outcomes, such as food security, nutrition, and resilient livelihoods. These data can also help stakeholders understand how to support women as economic actors in agri-food value chains, including the important role of women farmers in supporting food security in the current season and future growing seasons.

Conclusions

Intentional efforts and commitments from all actors are essential to ensuring that women are actively engaged in preventing food and humanitarian crises and in mitigating their outcomes. Achieving this will require crises interventions that prioritize gender equality and the empowerment of women and girls, instead of blanket interventions.

Women-led and women's rights organizations must take center stage in crises responses and have their voices heard at national and international platforms. A strong focus on justice, equality, inclusiveness and human rights must be at the heart of every effort to counter the socio-economic impact of food and humanitarian crises; and crises responses need to help build more resilient agri-food systems and rural livelihoods.

Despite the many challenges that women and girls are facing, they are essential to the success of any crisis response. Finally, key actor groups must shift the rhetoric away from describing women as vulnerable victims, towards recognizing the resilience that women display around the world during times of crisis.

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Nutrition-Sensitive Food Systems Approaches to Address Food and Humanitarian Crises

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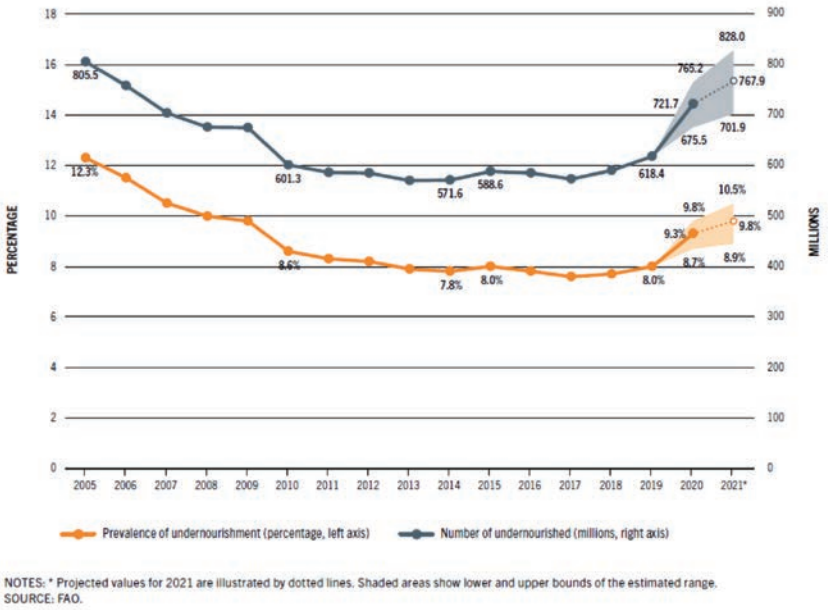
Global hunger and malnutrition are on the rise. Crises such as climate change and increasing global food prices have reversed the success in reducing global hunger, especially in meeting the targets of Sustainable Development Goal (SDG) 2: Zero Hunger. Approximately 670 million people will still be hungry by 2030. Africa has the highest proportion of people suffering from hunger (20.2%), followed by Asia (9.1%) and Latin America and the Caribbean (8.6%) (FAO, IFAD, UNICEF, WFP and WHO, 2022). COVID-19 and the Ukraine conflict further exacerbated the rise in global hunger and mal-



NOTES: * Projected values for 2021 are illustrated by dotted lines. Shaded areas show lower and upper bounds of the estimated range.
SOURCE: FAO.

Figure 1. Trends in global undernourishment. Source: (FAO, IFAD, UNICEF, WFP and WHO, 2022).

nutrition; 150 million more people were hungry due to COVID-19; while the Ukraine conflict triggered a shortage of about 30 million tons of grains in Africa, along with a sharp increase in cost (Yohannes-Kassahun, 2023).

Malnutrition is now on the rise, with 22% of children under the age of 5 years suffering from stunting, while 5.7% are overweight. Many people, especially women and children, are suffering from micronutrient deficiencies, due to poor access to and availability of diverse, healthy diets. Malnutrition in vulnerable populations, such as women and children in the first 1000 days of life, may have intergenerational negative consequences, and in the long term, lead to decreased national productivity, and increased spending on public health care, education and related systems.

Fragmented food systems have led to negative impacts such as inequality in access, availability and distribution of food, especially for the poor and vulnerable. Acute crises and shocks further exacerbate these impacts. The food systems framework presents the multi-dimensional linkages, stakeholders and interactions that must be used to frame the development and design of interventions, both short- and long-term, in order to address food

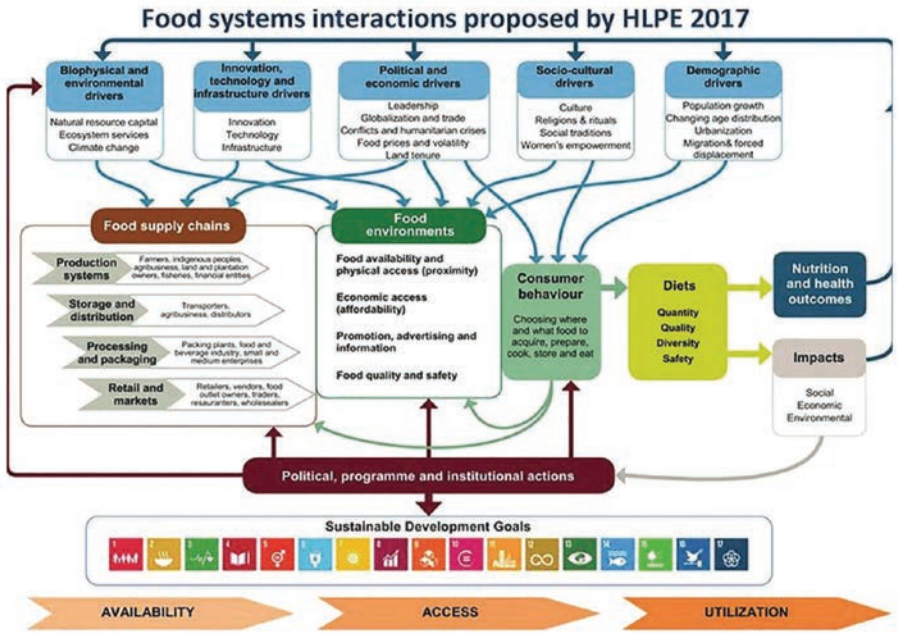


Figure 2. Food systems interactions by HLPE 2017. Source: (HLPE , 2017).

and humanitarian crises (HLPE , 2017). This framework shows us how science-based evidence and data can empower policymakers to adopt and operationalize actions that will affect food supply chains, food environments and consumer behavior towards sustainable healthy diets, so that the multiple targets of the SDGs are met.

Nutrition-sensitive food systems approaches enable practitioners to design and develop people-centric innovations that bring nutrition to the fore. Nutrition-sensitive food systems approaches are context- and culturally-specific, and can be adopted and adapted to meet the multi-faceted challenges to address food and humanitarian crises. Nutrition-sensitive food systems approaches move the narrative from feeding hungry populations to nourishing people; ensuring that the foods consumed not only meet the energy requirements of an individual, but are also diverse, nutritious, safe and healthy. Nutrition-sensitive approaches can be integrated into multiple entry points in the food systems framework, and through pathways such as developing innovations, shaping policies and building capacity.

Short-term actions must be responsive while taking into consideration the need to make decisions with gaps in information availability and risks. It should also be noted that short-term responses may have long-lasting consequences; which may further affect people who are already vulnerable.

Figure 3. Farmers by their orange sweet potato farms in Southern Madagascar. Source: CIP 2022.

In June 2021, a severe drought hit Southern Madagascar, causing the worst case of hunger and malnutrition in the region in the past 40 years. The situation worsened due to COVID-19, and as many of the people in this region are smallholder farmers, whose diets and livelihoods are dependent on their own production. The International Potato Center (CIP), a CGIAR center, together with a donor and partners, put in place a nutrition-sensitive intervention, using orange sweet potatoes, to benefit more than 80,000 households across the nine districts in Southern Madagascar. Orange sweet potatoes complemented the availability of other main staple foods, rice and cassava, and at the same time provided vitamin A, to these communities (International Potato Center (CIP), 2022).

Three drought-resistant, early-maturing varieties of orange sweet potatoes were distributed to farmers, complementing the existing local varieties that were already in cultivation. Stock vines were made readily available in these regions through a decentralized vines multiplier (DVM) system. In addition, 'community agent pairs', a woman-man pair of trainers, were engaged to ensure dissemination of stock vines to individual households. These Community Agents (CA) were trained to use digital tools to collect relevant production and household data. Nutrition messaging and cooking demonstrations were also included as part of this intervention, which

Figure 4. Solar drying tent for fish in Odisha. Source: WorldFish, 2022.

further empowered the households in these communities to benefit from consuming these orange sweet potato varieties.

The State Government of Odisha, India, in 2021, launched a nutrition strategy to address malnutrition, especially among young children, adolescent girls, and pregnant and lactating women. In the strategy, one of the interventions was the use of small fish and fish-based products as nutritious and safe foods. Together with WorldFish, a CGIAR center, solar drying tents were constructed for women self-help groups in coastal communities to produce dried small fish and fish powder, which were then packed and distributed to Anganwadis (child care centers); and used in Take-Home Rations (THR) and Hot Cooked Meals (HCM), in school feeding programs (WorldFish, 2021) (Chadag, 2022).

The use of solar drying tents greatly reduced the time needed to dry fish; while increasing the nutrient density and improving food safety. When processed into fish powder, the benefits increase. Small fish powder has a long shelf life, at ambient temperature, and can be packaged in different sizes for long-distance transport. Small fish powder can be directly added into cooked dishes; and easily integrated into ready-to-use therapeutic food (RUTF) packages, commonly used in food aid, in response to food crises.

Figure 5. Fish traders adapting to COVID-19 protocols in Bangladesh. Source: WorldFish, 2022.

This is an example of how CGIAR, together with partners, delivers impact by shaping and operationalizing nutrition-sensitive policies to improve food and nutrition security. While these policies are developed with a long-term goal, the strategies and innovations, such as small fish powder, can be integrated as immediate solutions to address food crises.

While we cannot always predict the onset of crisis, there are many nutrition-sensitive food systems approaches that can be adopted to build resilience and adaptability in times of shock and disruption. Also, we can combine science-based evidence and nutrition-sensitive training and messaging to build capacity of diverse actors: from governments to communities and households; through multiple entry points of food systems.

During the COVID-19 lockdowns in Bangladesh, CGIAR centers including the International Maize and Wheat Improvement Center (CIMMYT), the International Food Policy Research Institute (IFPRI), the International Rice Research Institute (IRRI) and WorldFish galvanized coordination and research capacities across food systems to respond to the country's needs. These CGIAR centers implemented the following nutrition-sensitive approaches to secure food systems in Bangladesh (CGIAR, 2020) (Belton, et al., 2021):

1. Provide advice on relief efforts, including to front liners and food aid agencies, on foods to include in household food aid programs to ensure nutritious and safe diets and long-term food storage.
2. Assessment of impacts on small- and medium-scale agribusinesses and advice and support for ways to overcome business disruptions.
3. Improve resilience of food supply chains through technical and logistical support for local food production initiatives.
4. Developing a platform to collect, monitor and disseminate real-time information of food, labor, inputs and feed supply and prices.

These multidisciplinary approaches, and through engagement of diverse stakeholders, enabled better-coordinated and informed actions to respond to the COVID-19 pandemic in Bangladesh. As Bangladesh, as well as global communities, are building forward, these programs should be strengthened, expanded and adapted to build preparedness and capacity of stakeholders before the onset of the next crisis.

While food and humanitarian crises are often unpredictable, many nutrition-sensitive approaches and innovations can be adopted and adapted to secure and build resilient food systems, especially for those who are most

vulnerable. Science-based evidence and innovations must be complemented by sound policies and strong capacity building programs to equip diverse actors with nutrition-sensitive food systems approaches. Greater investments in science and capacity building initiatives, especially among first responders and front liners, are needed to address food and humanitarian crises.

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3. RESEARCH AND PRACTICAL INSIGHTS FROM ACTIONS ADDRESSING FOOD AND HUMANITARIAN CRISES – LOCATION- AND PEOPLE-SPECIFIC

Food and Humanitarian Crises: Insights and Lessons from the Horn of Africa and Ethiopia

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This paper considers the scale, causes, and consequences of food and humanitarian crises in the Horn of Africa, with a focus on Ethiopia. Also examined are proven, promising, and innovative actions taken by food assistance actors, along with major lessons learned and implied research issues regarding food systems in conflict situations.

Scale

The Horn of Africa is suffering from the impacts of the most severe and protracted drought in decades, followed by torrential rains and flooding.[1] Across the region, at least 31.9 million people require lifesaving and life-sustaining assistance, including 17.2 million in Ethiopia, 8.25 million in Somalia, and 6.4 million in Kenya (FEWSNET, 2023; OCHA, 2022). The recent heavy rainfall may improve the situation in several areas, but torrential downpours have resulted in flash floods and loss of homes and livestock in areas already impacted by the drought. Acute food insecurity is widespread (Figure 1).

Over 23.4 million people are enduring high levels of acute food insecurity in Ethiopia, Kenya, and Somalia. About 13.2 million livestock have died since the beginning of the drought – 6.8 million in Ethiopia, over 3.8 million in Somalia, and 2.6 million in Kenya (OCHA, 2023a), eroding the primary source of livelihood, income, and nutrition for pastoralist communities. Water insecurity is leading to a rise in diseases and protection risks, further compounding the situation. Significant outbreaks of cholera and measles are ongoing in all three countries, seriously impacting vulnerable children. The recurring climatic shocks, widespread food insecurity, and damaged livelihoods are exacerbated by conflict and displacement that contribute to towering humanitarian needs in persistently complex emergencies.

[1] The Horn of Africa comprises the dryland areas of Ethiopia, Kenya, and Somalia.

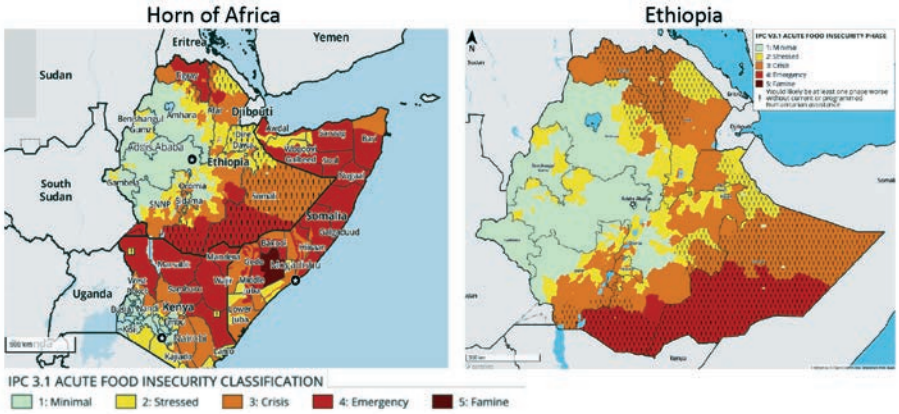

Figure 1. Projected food insecurity in the Horn of Africa and Ethiopia – February to May 2023. Source: FEWSNET (2023).

Causes: Focus on Ethiopia

Ethiopia is highly vulnerable to multiple interacting hazards (Figure 2). In 2022 and 2023, these hazards included the effects of severe and unprecedented drought in the eastern and southern parts of the country, and heightened levels of violence in other parts of the country, most notably in western Oromia, pushing more people into displacement, food insecurity, malnutrition and increased protection concerns. Failed rains severely impact pastoralist and agro-pastoralist communities, particularly in the eastern and southern parts of the country, aggravating food insecurity, malnutrition, access to water and a worsening health situation with an increase of disease outbreaks. Many parts of Ethiopia are simultaneously affected by both weather shocks (drought and flooding) and conflict, including large parts of Afar, Amhara, Oromia, and Somali regions (Figure 1) (OCHA, 2023b).

The signing of the cessation of hostilities agreement (COHA) at the end of 2022 brought peace and improved access in Northern Ethiopia (Afar, Amhara and Tigray). But humanitarian needs stemming from the two-year conflict remain high. Increased support is required to facilitate returns and scale-up recovery efforts. Conflict has continued or escalated in other parts of the country, most notably in Oromia, impeding humanitarian access and driving high needs and displacement within the region and to neighboring Amhara region (Figure 3). In Benishangul Gumuz region, hundreds of thousands of people remained displaced for most of 2022. As hostilities

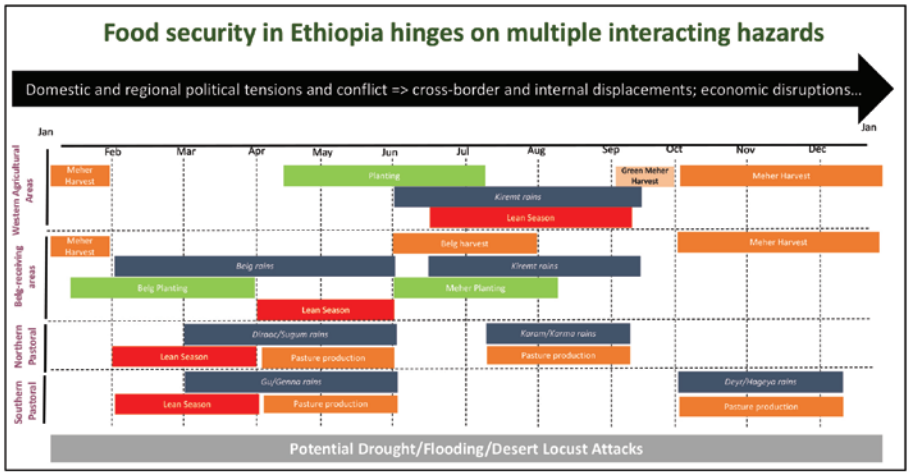

Figure 2. Interacting hazards in Ethiopia. Source: WFP Ethiopia Country Office (unpublished chart).

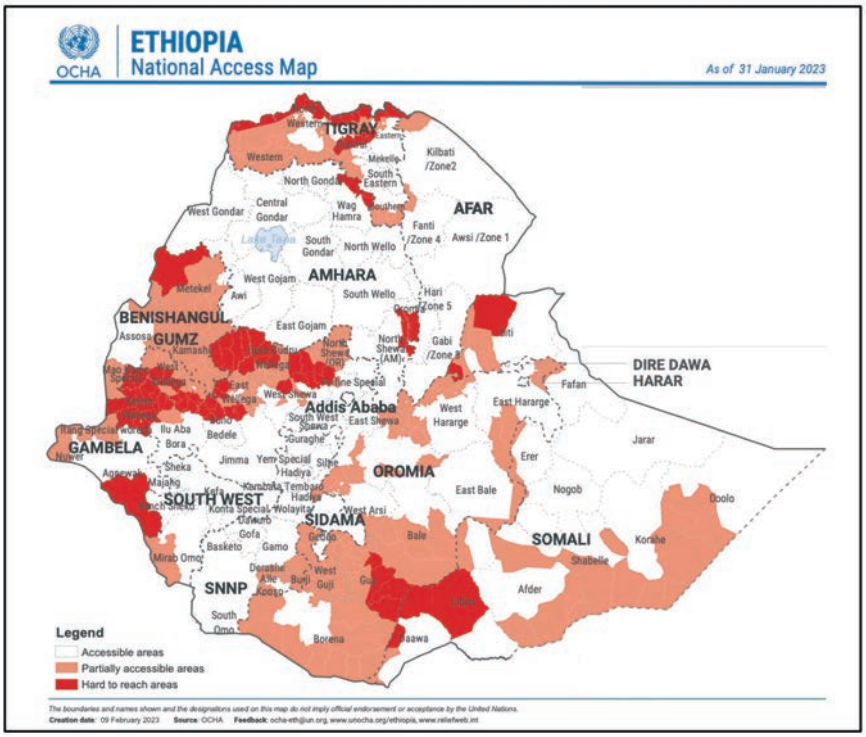

Figure 3. Access challenges in Ethiopia. Source: OCHA (2023c).

with armed groups ebbed and flowed throughout the year, small numbers of IDPs started returning spontaneously while the regional government unveiled plans to return the several thousands of IDPs to their original areas by end of first quarter 2023. However, the frequent blockage of the main supply routes by conflict in neighboring Oromia is economically isolating Benishangul Gumuz, causing serious economic shocks and price inflation and destabilizing access to refugee camps in remote border areas. Inter-communal violence in several regions, including Oromia, Sidama, Somali and SNNP, also continues to trigger displacement and ensuing humanitarian needs (OCHA, 2023b).

Consequences: Focus on Ethiopia

The 2023 Ethiopia Humanitarian Response Plan (HRP) requires US$3.99 billion to support more than 20 million people across the country. This includes an estimated 4.6 million internally displaced people (IDPs). Under the HRP, an estimated 13 million people are targeted for humanitarian response in drought affected areas. The food assistance component of the HRP targets 20.1 million people at a cost of $2.6 billion (OCHA, 2023b). Between April

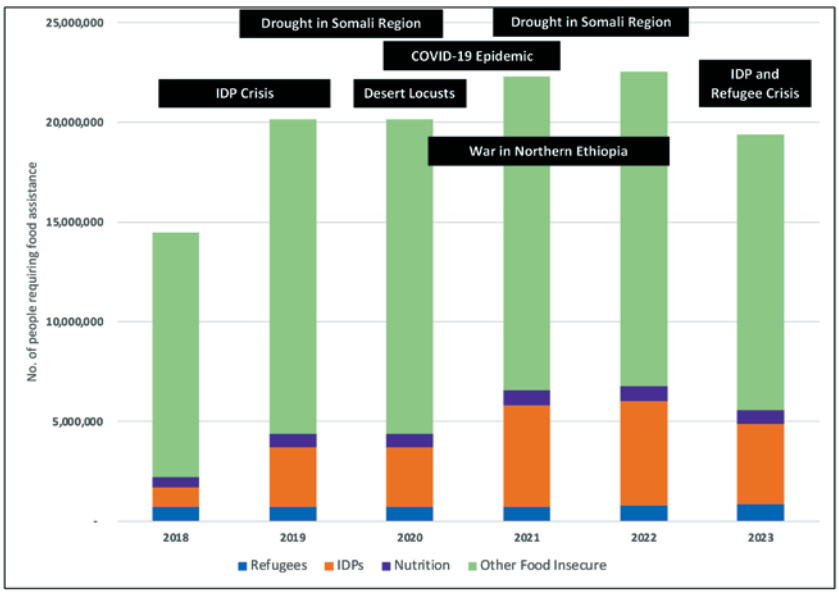

Figure 4. The evolution of food assistance needs in Ethiopia between 2018 and 2023. Source: Author's calculations based on data from WFP, UNHCR, and OCHA.

and December, WFP alone requires $1.34 billion for its relief, nutrition, and refugee operations (WFP, 2023). Following findings of massive diversions of food assistance across the country, WFP and the US-supported consortium of NGOs suspended food assistance operations in June.

The current challenges are not new. Following Prime Minister Abiy Ahmed's rise to power in 2018 and the fundamental political, economic, and social reforms he led, Ethiopia endured one major convulsion after another due to interaction of the disruptions unleashed by these reforms with drought, flooding, inter-ethnic conflict, massive internal displacement, desert locust invasions, COVID-19, and, ultimately, civil war in northern Ethiopia. Food assistance was at the heart of each response to the humanitarian impacts of these convulsions. The number of people requiring food assistance rose from 14.5 million in 2018 to a peak of 22.8 million in 2022 (WFP, 2018; WFP, 2022.

Proven, Promising, and Innovative Actions Taken: Focus on Ethiopia

The central questions are clear:

1. Where are the vulnerable and food insecure?
2. How many are they?
3. How can they be reached?
4. What is driving their vulnerability and food insecurity?
5. How can this vulnerability and food insecurity be overcome – using which instruments, programmes, and platforms?
6. How do we know that the vulnerability and food insecurity has been overcome – which measures are relevant?
7. How can we prevent future descents into vulnerability and food insecurity?

Food assistance comprises a unified response to these questions, where food assistance refers to multi-faceted efforts to empower vulnerable and food-insecure people and communities to access nutritious food. It seeks not only to save lives and livelihoods in the short term, but also to combat the root causes of hunger over the medium to long term. Food assistance thus includes instruments such as in-kind food, vouchers or cash transfers used to assure recipients' access to food of a given quantity, quality, or value. Focused food procurement is a powerful demand-side tool (Omamo et al., 2010).

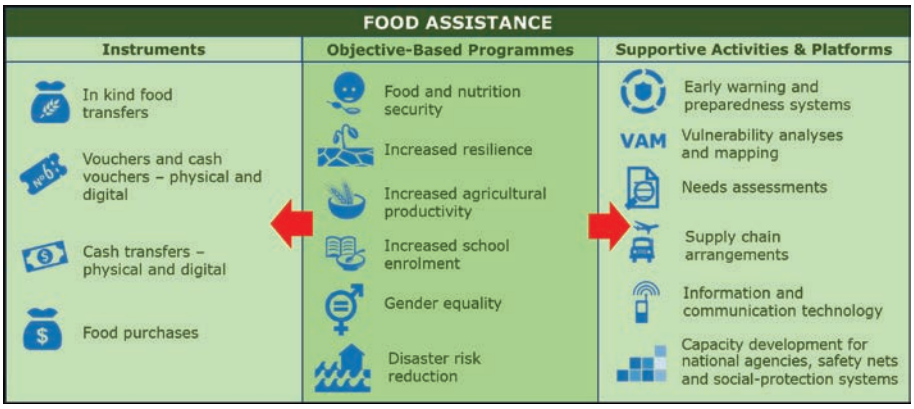

Figure 5. Food assistance defined. Source: WFP Ethiopia adapted from Omamo et al. (2010).

Innovations in Food Assistance		
Instruments	**Objectives**	**Platforms**
Anticipatory forecast-based cash transfers to communities in drought- and flood-prone areas	Food and nutrition security and resilience to climate shocks	Vulnerability analysis and monitoring; market analysis; supply chain arrangements
Pre-positioning of food stocks in flood-prone areas and remote conflict-exposed refugee camps	Food and nutrition security, resilience to climate shocks, reduction of conflict-related supply chain risks	Vulnerability analysis and monitoring; supply chain arrangements
Fresh food vouchers and nutrition education for food insecure women and children	Reduction of child stunting	Retailer contracts; financial system expansion; capacity building of local administration
Satellite weather index-based insurance in drought-prone areas	Resilience for pastoralists and agropastoralists	Vulnerability analysis and monitoring; remote sensing; financial system expansion
Home-grown school feeding in food-insecure areas	Increased school enrollment and improved nutrition + increased agricultural productivity	Vulnerability analysis and monitoring; supply chain arrangements
Local purchases of specialized nutritious products	Food and nutrition security + increased agricultural productivity	Supply chain arrangements

Figure 6. Community-empowering and food system-strengthening food assistance innovations. Source: Author based on Omamo et al. (2010).

These instruments are applied in specific programmes to pursue a range of objectives for targeted populations, such as nutrition improvement, increased agricultural productivity, gender equality, education expansion, or disaster risk reduction. Several supporting activities and institutional platforms such as early warning and preparedness systems, vulnerability analyses, needs assessments, supply-chain arrangements, information and

communication technology, and capacity development of national agencies, safety nets and social-protection systems define the effectiveness and sustainability of these instruments relative to the objectives. Food assistance thus extends beyond the traditional view of "food aid" as transfers of food commodities to hungry people to include development and implementation of interventions to prevent hunger and address its myriad drivers and implications (Omamo et al., 2010).

The key innovations entail new processes and new routines that change when, how, and where given instruments are applied, aiming to empower vulnerable communities in their own food security while strengthening food systems (Figure 6).

Lessons: Research on Food Systems in Conflict Situations

Much has been said and written of late about the linkages between conflict and hunger and food insecurity. Typically, two claims are made. First, that conflict breeds hunger. This claim is supported by ample evidence. Second, that hunger contributes to conflict. Support for this claim is largely anecdotal, but perhaps the lack of definitive evidence of causality is not significant. Hunger does plenty of damage without a contributory connection to conflict.

For the first claim (that conflict generates hunger) to hold, the pathways from conflict to hunger must run through food systems. But how? How exactly does conflict impact food systems in ways that promote hunger? Through which processes and mechanisms does this happen?

Recent developments in Ethiopia's conflict-impacted food systems suggests six conflict-to-hunger channels in food systems: (1) conflict turns self-reliant rural producers into dependent urban consumers, abruptly; (2) conflict destroys trust-based relationships that underpin food trade; (3) conflict always creates black markets for food – always; (4) conflict empowers dispersed and anonymous security officials as primary decisionmakers in food systems; (5) conflict disrupts the "transformation functions" that connect food supply and demand; and (6) conflict clouds and distorts humanitarian decision-making, hobbling the humanitarian food system. At the end of each pathway are food shortages and hungry people.

1. **Conflict turns self-reliant rural food producers into dependent urban food consumers, abruptly.** Many wars play out significantly in rural areas, causing large numbers of farmers, herders, and traders to flee

from their homes and communities, usually to the nearest significant settlement, hoping to find safety, shelter, and access to services. Suddenly, small towns that may not even appear on maps must absorb thousands of people. Despite the staggering generosity of local communities, these huge and unexpected influxes of people are never fully accommodated and served. Severe hardships appear almost immediately in these new "urban" locations, with hunger prominent, driven by food shortages and surging food prices. Urbanization is a global trend, meaning more and more food is being consumed in urban areas. But this brand of sharp conflict-driven expansion of urban food consumption is grossly premature, with immediate hunger as its companion, and with the seeds of future hunger sown in the abandoned fields it leaves behind.

2. **Conflict destroys trust-based relationships that underpin food trade.** Everyone has an irrefutable *force majeure* reason for not following through as agreed. Long-standing bargaining relationships between sellers and buyers are disrupted or upended altogether, undermining the trust on which food trade is based, turning everyone into a liar as contracts can be honored only in the breach. Conflict also fragments seasonality in food prices, blunting a vital incentive for private food storage, and disrupting the complex trust-based arrangements that govern this central dimension of food systems. Local food stocks dry up, open trade dwindles, shortages appear, prices rise. People go hungry.

3. **Conflict always creates black markets for food – always.** The demand for food rises and falls as prices change, but it never disappears. Given the shortages created by disrupted relationships and networks in food markets, anyone who can acquire, store, and move food with any kind of predictability makes a lot of money during conflicts. Such people can traverse even the tightest of blockades. Not surprisingly, such people are often military leaders or those close to them. Important incentives to take decisions that boost food availability are weakened, at best. Shortages persist and intensify. Prices soar. People go hungry.

4. **Conflict empowers dispersed and anonymous security officials as primary decisionmakers in food systems.** There are countless examples. Think of the armed soldier or police officer on alert at a checkpoint near a conflict frontline. He or she is the beginning, the middle, and the

end for the convoy leader seeking passage for a column of trucks loaded with food to be given or sold to people caught on the other side of the line. For the soldier or police officer, only his or her local commanding officer's opinion matters. And for that local commander, facilitating the movement of food across the frontline is an unwelcome addition to already fraught and complicated responsibilities, even if there are thousands of hungry people waiting for that food. Even the most powerful national political leader pressing for the food to reach those hungry people will quickly back down when confronted by security-clad facts forcefully conveyed by a local force commander. So the food does not move. Shortages persist. People go hungry.

5. **Conflict disrupts the "transformation functions" that connect food supply and demand.** Again, food demand is never-ending. So, too, therefore, is the need for food transformation – i.e., for food transport, storage, and processing, and for the finance and insurance that lubricate them. Irrespective of its scale or reach, every food system features physical locations and areas where concentrated food transformation is undertaken. Invariably, the locations and areas where these transformation activities must take place are also locations and areas over which warring parties fight the hardest. Think of the one all-asphalt road connecting two major towns in a contested area – a road that food transporters use routinely. Picture the town with the only fuel depot within a 200 km radius and thus the town where scores of mid-size grain millers have situated their operations. Imagine the main town on the long and vulnerable road from the border to the capital – the town with reliable power and internet connectivity and thus home to a regional army command base, but also the town where transporters position their fleets, and where warehousing capacity is significant. The factors that define the efficacy of food transformation are also militarily potent. With every outbreak in fighting, transformation stalls. Shortages persist. People go hungry.

6. **Conflict clouds and distorts humanitarian decision-making, hobbling the humanitarian food system.** The humanitarian system is not immune to the political fault-lines and animosities that underlie and drive conflict. Often implicitly but sometimes explicitly, global humanitarian leaders take sides based on their personal friendships, ambitions, religious beliefs, political allegiances, and cultural biases – buying into

polarizing propaganda, ignoring glaring facts, promoting questionable narratives. Issues that need to be prioritized or voiced are not prioritized or voiced, and vice versa. Trust breaks down. Humanitarian country teams that routinely respond with speed, accuracy, and unity to natural disasters are almost impossible to effectively coordinate in conflict situations. Context-sensitive decisions of local representatives of donor countries and international humanitarian agencies are overruled from donor capitals and agency headquarters. Mixed signals abound. Inertia, delays, and unnecessary complications plague humanitarian responses, and thus also the humanitarian food systems that dominate those responses. Shortages persist. People go hungry.

These six conflict-to-hunger channels through food systems signal the challenges to be addressed if this deadly relationship is to be weakened or broken. Viewed together, they suggest a rich and deep research agenda for food policy and programme analysis in conflict contexts. They also reveal the opportunities to be seized so that the second claim about the link between conflict and hunger (that hunger contributes to conflict) does not come to be supported by hard facts.

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The Food Crisis Fueled by Climate Change, is Set to Worsen Humanitarian Crisis in the Sahel

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Abstract

The Sahel is known for its harsh living conditions heralded by severe climate impacts and its limited resources. Food security is highly dependent to unpredictable impacts of climate change resulting to severe shortages of food supplies, increasing the risk of conflict and humanitarian crises that further exacerbates the vulnerability of local populations. Fatalities and human displacements due to food deficit have triggered various forms of programs and global support for humanitarian aid and disaster relief in the Sahel for many decades. With farming practices imported from conventional colonial systems, food production has largely focused on the narrow range of species produced for cash and industrial agriculture, and its value chains have been less favorable to farmers communities' food demand. This paper demonstrates that there are forgotten opportunities based on local knowledge to grow neglected local species that are climate-tolerant and highly profitable. Reducing humanitarian crises in the Sahel will depend strongly to our ability to improve the food system in pace towards climate-adapted production relying on safer farming methods from the local land-based livelihoods to create and link to food and income while securing the increased demand of food.

Introduction

The Sahel is a hotspot of increasing global temperatures linked to climate change, but above all, the disruptions of hydrological cycles due to severe and more erratic rainfall have exacerbated the already critical state of food scarcity in the region (IPCC, 2023) . The rural poor in Sahel suffer

the most from these changes and need a range of food security strategies to meet the growing food demand.

Options have been tested to support changes in cropping systems and patterns, shifting from cereal-based systems to cereal-legumes, and diversifying production systems towards higher value-added and more water-efficient options (Thomas, 2008). These changes cannot be achieved without paying greater attention to non-climate factors, some of which are social transformations aimed at enhancing the value of certain practices over the status quo.

The Sahel is a unique geographical region where the prevalence of malnutrition and hunger is the most known worldwide. Paradoxically, the Sahel is home to a number of neglected species that can contribute to the nutrition of populations (Padulosi et al., 2013). The deterioration of local food systems is amplifying humanitarian crises. Food security and human development, under the influence of climate change and global trade, are key to mitigating armed conflict. There is an urgent need to integrate the diversity of non-accounted food sources into local food systems.

There is a growing interest in neglected plants and practices in the Sahel, as numerous studies are established to investigate the importance of social transformation based on new sources of quality food to achieve nutrition security in vulnerable communities and identify the main underlying reasons for the decline of food per capita in the Sahel. Several studies have shown that the prevalence of malnutrition is significantly higher in the region and where there is a severe deterioration of local food systems (Capone et al., 2014).

There is an urgent need in the Sahel to develop and use guidelines for new approaches to improving the food deficit, with the aim of helping countries make the best use of biodiversity for food and agriculture in their nutrition programs. Studies have been carried out to highlight the need for evidence, specifically to promote knowledge, conservation, development and use of plant varieties and cultivars used as food, as well as wild, neglected and underutilized species contributing to health and nutrition (FAO, 2016). Focusing on climate conditions is necessary, but not enough, to establish a new image of the Sahel.

Innovative approaches for improved food security will encompass and manage the diverse interactions between food, water, energy, and land, all associated with climate change and variability, amplified by trade and population pressure under aridity conditions.

Identification of the challenges for solutions

The Sahel is undergoing climate change more rapidly than other regions and is already experiencing vulnerabilities which further exacerbate the impacts – variable production (Figure 1) more easily disrupted by conflict, sparser populations further from centers of governance, poorer infrastructure, and the export of much capital. However, African drylands also possess many remarkable resources and opportunities that are poorly recognized or mobilized, and, when undisrupted by external influences, the institutions and knowledge of local community provide both traditional and innovative options for future livelihoods. Whilst the Sahel faces many of the same challenges as other parts of Africa, it has been characterized by recurrent humanitarian crises since the mega-drought that severely affected the region, which were exacerbated by armed conflicts.

These food crises in the Sahel started occurring since the long series of droughts from the 1970s which over time painted a grim image of an endemic food deficit in the region. Analysis of annual rainfall negative anomalies (deficit) shows that the region has not recovered its rainfall patterns before the first drought hit of 1968-1972 (Figure 2).

Additionally, in the Sahel, the population lacks the minimum assets needed to initiate the most basic responses towards resilience. Some of the improvements seen despite the armed conflicts are canceled out by continuous crises, some due to climate change, others to political and economic challenges. We have witnessed mass migration in many African landscapes, but particularly in semi-arid regions, due to the lack of opportunities. In Africa, everything – from food diversity to natural assets – can be linked to sustainable food systems, job creation and improved population health. It is impossible to retain people, particularly young people and women, if the

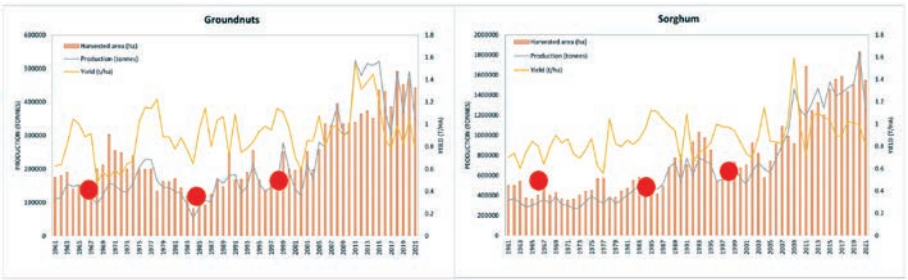

Figure 1. Mali recurrent food crisis due to climate change.

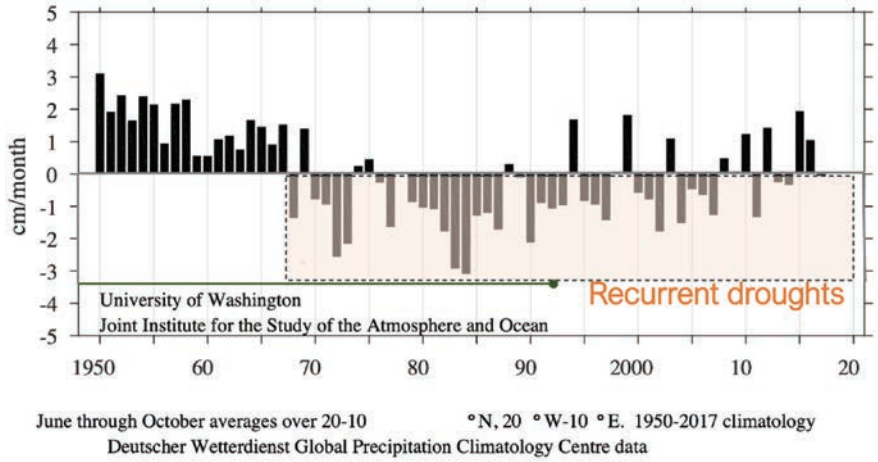

Figure 2. Sahel precipitation anomalies 1950-2017.

only message they get from our decision-makers is despair, which inhibits possible processes to lift communities out of poverty.

The global food trade has taken a new turn since the Ukraine War. Almost all countries in Africa are concerned about world market disruption and food flow change due to the abrupt decline in the grain supply and the inputs assets for wheat production. This Ukraine crisis is a wake-up call for additional efforts towards food sovereignty, as stated during the Heads of States appeal during the Dakar Food Summit in January 2023[1] for the development of the adequate partnerships and private sector mobilization to unlock Africa's food production potential. Similarly, efforts to promote food security in Africa have been an important policy objective of AUC (Agenda 2063)[2] with several goals linked to quality food through improved agriculture, e.g., modern agriculture (5), healthy and well-nourished citizens (3), high standard of living (1).

Evidence of food and humanitarian crises in the Sahel

All climate change projections for the next decades imply extremes events with massive spatial dislocations of agricultural production potential. Changes in rainfall patterns are most significant in the Sahel. Rainfall

[1] https://www.afdb.org/en/dakar-2-summit-feed-africa-food-sovereignty-and-resilience
[2] https://au.int/agenda2063/goals

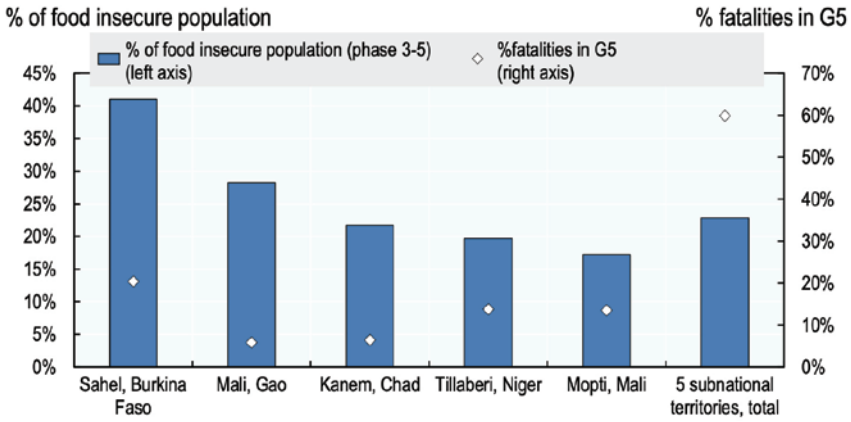

Figure 3. Food insecurity in Sahel subnational territories witnessing most violence (Source: Environmental Fragility of the Sahel: OECD, 2022).

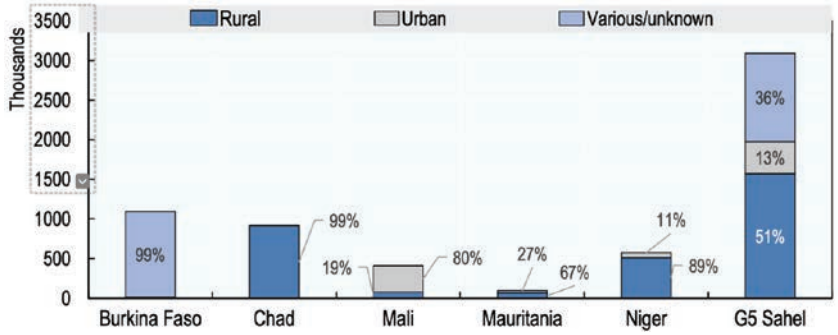

Figure 4. Forcibly displaced populations by location (urban/rural or unknown) in Sahel countries, 2020.

trends in the Sahel vary from a strongly negative to a moderately positive trend, with spatial and temporal variability increasing the likelihood of drought spells during the rainy season and extreme rainfall events. These changes will require additional efforts on agricultural adaptation, which will obviously include substantial changes in land use.

Given the close relationship between agriculture productivity and humanitarian crises in the Sahel (Figure 3) (Graves et al., 2019), particular attention should be given to rainfall changes as precursors of social-economic crises. This may happen as a result of the individual impacts of farmers,

who may choose to migrate temporally (rural migration to urban centers) or move permanently to other locations, mostly within their own countries (Figure 4). It also takes the form of collective actions, with government-backed programs such as the Great Green Wall, or non-state support (Feed the Future, FEWSNET, WFP, etc.).

In the Sahel, there is a strong historical evidence of the severity of crop production shortfalls (Mbow et al., 2008), but it is not evident that climate change is the only cause. For instance, the drought of the seventies and early eighties did not appear to have been solely caused a major abandonment of agricultural land. Since the mid-eighties rainfall has recovered slightly (Mbow et al., 2008), yet the rainfall variability seems to have increased. Many other factors influencing large-scale land use have also changed: the national population continues to grow at over 3% per year, rural exodus is increasing, and the economics of crop production and animal husbandry has been impacted by fluctuating input and product prices. Furthermore, the institutional framework is also changing: land tenure systems for croplands and rangelands are undergoing change, both formally/legally and informally, and decentralization of natural resource management is underway.

Expected prices of agricultural inputs, as well as actual prices, are partly externally determined, controlled by world market prices and political decisions on subsidies, as well as influenced by local factors, such as transport costs, etc. Examples of economically-induced changes in land use include the importance, for the extent of groundnut production, of fluctuating world market prices and the removal of subsidies on mineral fertilizers, which took place in the 1980s (Mbow et al., 2008); while economic incentives to increase millet and groundnut production were very limited. Imported foods, notably rice, replaced millet as a staple food in the urban population's diet. However, the urban demand for vegetables, meat and milk has increased and prices have improved over the last decades.

Various options to bring back a food secure continent (countering imported options)

The Sahel is characterized by its diversity, both in terms of ecosystems, but also in terms of practices and cultures. This diversity is at the heart of the lives and livelihoods of Africa's population, who depend on natural products for most of their needs. The relationship between the survival of African communities and the assets of nature is stronger here than anywhere else in the world, due to poverty (in Africa). Furthermore, the

so-called 'arid' and 'semi-arid' zones of the Sahel – where famine is most often reported and where most of the major challenges of land degradation arise – are where most agricultural landscapes are found. Therefore, if we really want a better Sahel in terms of resilience, poverty alleviation and ability to respond to climate change, the key lever is promoting the Sahel's potential (Mbow et al., 2021). Th potential is enormous.

These include tailored empowerment for locally-led solutions within national plans that take remoteness into account; support for aggregating neglected natural resources in African urban markets; strengthening capital inflows (such as global mechanisms for funding adaptation, including loss and damage, e.g., Santiago Network) in these regions to re-invest in physical, social, human and environmental infrastructure and services. This impact-driven approach will be part of co-created, specific visions that will serve as beacons for improving livelihoods, reducing conflict and reframing emigration in the face of climate and other changes.

To promote sustainable agricultural methods and design anti-erosion resource management programs, it is essential to identify the most appropriate soil and water conservation technologies. Proven innovation and tested solutions exist in drylands and can be scaled up.

Climate-smart agriculture (CSA) is a practice with great transformative potential in the Sahel more than anywhere else in Africa, significantly improving lives and livelihoods (Sinclair et al., 2019). Examples of CSA include cover cropping, crop rotation, soil nutrients management, nitrogen fixation, mulching and use of crop residues, agroforestry, sustainable land management, carbon amendment and reduced tillage (Lipper et al., 2014).

Ecosystem functions, including biodiversity and water services, are essential for increasing resource efficiency and productivity, and ensuring resilience. Ecosystem-based adaptation (EBA) plays an important role in the development of an agricultural sector that is linked to viable supply and demand value chains, well integrated into the broader landscape, climate-resilient and environmentally and socially sustainable (Muthee et al., 2017).

A call for integrated approaches

The colonial system almost destroyed the intrinsic value of integrated land management, which was the secular approach across the continent (Figure 5). The monocropping approaches inherited from western farming systems are the opposite of the way Africans are used to farming. It is this multifunctionality (Minang et al., 2014) that we are returning to, and it is

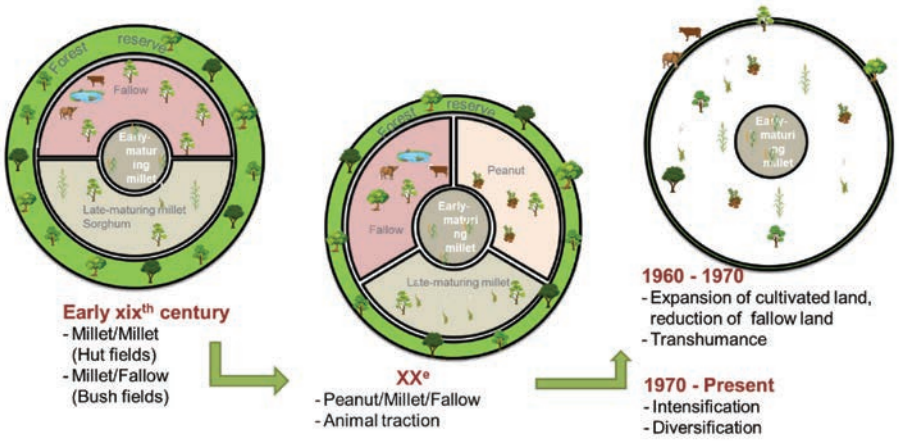

Figure 5. Land use and soil quality change over time along with various agricultural systems (modified from Masse et al. (2018)).

really where we should be heading in the future. A variety of integrated land-based livelihood activities, which have always existed in African drylands, therefore need to be significantly re-invented/re-valued, because of their potential to significantly improve food and water security, even in the face of climate change, given appropriate investments and stability. In particular, the landscape approach, which is the traditional default approach to land management in Africa, needs to be adopted as part of various land-based policies. It has been (revived) because of evidence that has helped people understand that the best way to find the balance between food, nature and people is to develop a holistic landscape approach.

In addition, (agro) biodiversity can contribute immensely towards achieving various adaption needs such as food products, fuel wood, soil fertility and various ecosystem functions. Most of Africa's drylands are facing major environmental problems such as biodiversity loss, deforestation, habitat degradation and increased risks of climate change. Efforts to conserve biodiversity while maintaining agricultural and pastoral production are the main challenge for rural poor. To maintain ecosystem health and diversity, most conservation efforts have focused on preserving the desired ecological traits in the face of growing demand for land for various purposes.

Four cross-cutting issues need to be addressed in the Sahel to reduce inequity and eccentricity of vulnerable communities, while unlocking diverse

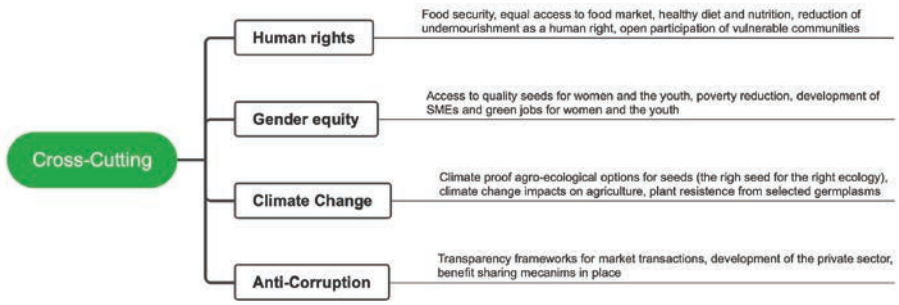

Figure 6. Four cross-cutting conceptual frameworks for food security in the Sahel.

green job potentials for women and youth (Figure 6). Significant efforts are necessary to help the poor and vulnerable use transformative innovations to access relevant agricultural inputs, including quality seeds, and develop practices to adapt to climate risks and benefit from legal instruments to protect people through proper governance structures and equitable role for the different value chain actors.

Actions towards improved lives and livelihood

Resolute efforts for scaling up adaptation in resource-poor conditions and food insecure communities are needed and require that various forms of agriculture be operated around small-holder farmers (Figure 7), where most of the population is engaged in a variety of livelihoods, including renewable energy, water resource management, and coping mechanisms related to income diversification. Any locally-owned practices and ecosystems can be aggregated/packaged for subsequent scaling up mechanisms. This can be achieved through significant services from science-based outcomes that ensure sustainable food production, but also health and education for vulnerable communities, including solid peer-to-peer learning in similar environments in the drylands. Some of Sahel's dwellers, prepared for mass migration, are now returning to the land; many others are finding new livelihoods in the nearby towns to produce food for the urban market (urban agriculture). Reducing net emigration has succeeded, with a more regular ebb and flow of people moving between the drylands and Africa's large cities.

Diversification of food sources is important to improve nutrition in the Sahel, where we have dozens of plants that produce quality food, quality cereals, and quality grains. Therefore, the diversification we need in any landscape

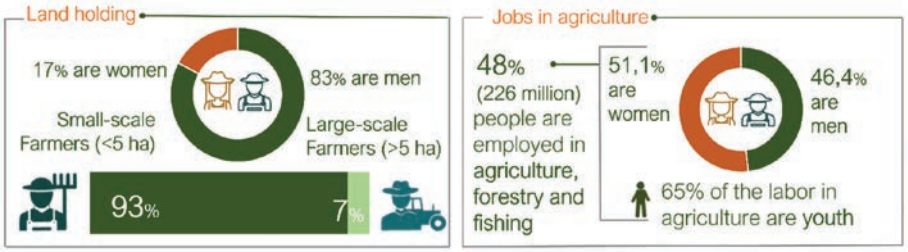

Figure 7. Land hold and jobs in agriculture in Africa.

should be easy in Africa. We need to promote this diversity to improve both quality and quantity, food for a good diet and for nutrition. This is, indeed, a triple victory: a win for food, a win for health, and a win for the environment.

Local development through income generation, food loss reduction, and the promotion of local value chains for millet, sorghum, and groundnuts deserves full attention to stabilize and offer a decent future for its populations. However, realizing this potential requires improved entrepreneurship in agricultural production, starting with a secure and sustainable supply of quality seeds. The creation of new opportunities in crop production must be underpinned by the transformation of existing business models through greater role of the private sector, mainly SMEs, to enhance income diversification for various stakeholders along the value chain. For agricultural networks in which small farms predominate, the main development potential lies in simultaneously addressing the different components of the farming systems by improving the seed quality, managing soil health and increasing resilience to climate risks.

Addressing the impediments for a brighter future

1. Risks associated with increasing market demand for food products, fueled by rapid urbanization and the growth of the region's middle class (solution: improve yields and meet projected demand) where connectivity is very weak
2. Risks related to the weakness or absence of local corporate services to support efficient supply chains for high-value natural resources
3. Risks linked to available credit to trigger the private sector to develop the supply chain of quality seeds and to source from farmers in order to create green jobs through SMEs that retain young people in their countries rather than attempting risky migration outside Africa

4. Risk related to institutional arrangements for the application of technologies that improve production and reduce food losses.

Conclusion

Human security in the Sahel is intrinsically linked to other security issues such as food security. The region needs to work on a new framework that allows the many opportunities to be pursued together and over longer time periods to counter the effects of severe climate change. Returning to forgotten practices and food sources will help maintain momentum towards ambitious food, land, and climate security goals. Food security could serve as vector of resilience if current practices are extended to unused opportunities that can help provide high quality products, particularly for vulnerable communities. This paper shows the importance local responses that are cost-effective and capacity-effective, that can generate benefits from neglected local species.

Conflict as an obstacle to food security in the Sahel deserves special mention. Current conflicts in the Sahel are associated with non-climate factors such as poor land management or limited rural infrastructure and markets, which exacerbate the problem. Many Sahelian countries despair of making progress, as most positive advances are cancelled out by recurring conflicts. Conflict can be fueled by climate change, land competition, resources scarcity such as water. Conflicts in the Sahel are fundamentally due to the synergic effect of various variables, including climate change and the current political crisis. There is no silver bullet to reduce humanitarian crises in the Sahel but improving food security is a good option to start building the minimum asset endowment for human dignity.

Promoting local responses can be useful if and when value chains are conducive to meeting local food supply needs. This requires a politically stimulating approach that captures the full resource value of commodities produced in the Sahel and helps develop appropriate investment for food production.

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Targeted Interventions and Civilian Risk Preference in Food Insecure Areas of the Lake Chad Basin

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Abstract

The Lake Chad Basin (LCB) region is battling the scene of continuous violent conflicts and climate-induced displacement. While the state counterinsurgency measures have helped regain some of the areas controlled by non-state armed groups, a large portion of the agriculturally-rich areas in the region remain a battlefield between the state and insurgent groups. The inaccessibility of the civilian population to the contested areas has disrupted food production systems, causing a sharp rise in food prices in state-controlled areas and influencing civilians' preference for armed-group-controlled areas for food security. In this paper, we examine the effects of state and non-state intervention programs on civilian risk preferences in the frontline areas. Drawing on empirical data from two frontline cities in Nigeria and Cameroon, we find that the intervention programs targeting housing, healthcare and business/skill training reduce the civilian propensity to migrate to the insurgent-controlled areas to secure agricultural access resources. Specifically, young and middle-aged business/skill training participants are significantly likelier to stay in state-controlled areas over the insurgents-controlled areas than non-participants. While women profit more from healthcare and housing support than men, we do not find any gender-specific effect of business/skill training on civilian risk preferences. Our study offers insights into short-term measures that can be explored to reduce civilian risk preferences in conflict-torn spaces where non-state armed groups use to access to agricultural resources to control civilians and civilian behaviours.

Keywords: Armed conflicts, Boko Haram, Cameroon, Food security, Nigeria

1. Introduction

Prolonged conflicts exacerbate food insecurity, affecting civilians' coping strategies, risk preference and trust in the state's ability to honour its social contract on providing welfare and security (Boege et al., 2009; Orjuela-Grimm et al., 2022). Recent studies have shown that civilians' inaccessibility to agricultural resources during armed conflicts can sway their loyalty in favour of non-state armed groups who appear to have greater control over the territory (Bahiss et al., 2022; Kemmerling et al., 2022). Such risk preferences are well documented during armed conflicts in Mali, Afghanistan, the Philippines and Somalia, where civilians had to pay taxes and levies to the insurgents to access agricultural resources (Bahiss et al., 2022; Revkin & Ahram, 2020; Weigand, 2017). In the Lake Chad Basin region, which traverses Nigeria, Chad, Nigeria and Cameroon, civilians' coping strategies include bargaining and co-optation with armed groups or a deliberate outmigration to the areas controlled by armed groups in order to access lakes, rivers and other agricultural resources.

Responsiveness of the state to the critical needs of civilians living in crises can improve state legitimacy, enhance how civilians make better decisions on the frontlines and reduce the possibility of altered loyalty in favour of insurgent groups (Balch, 1974; Bøås & Strazzari, 2020). As a result, the state often implements or supports intervention programs to improve its presence in the areas where the non-state armed groups are perceived to be gaining ground and to minimize the effects of armed conflicts on the civilian population in frontline areas (Obamamoye, 2019; Raeymaekers, 2011). However, while chunks of research on the impact of food insecurity in conflict situations have mainly focused on rural-urban migration (Orjuela-Grimm et al., 2022; Riebe & Dressel, 2021), few studies have attempted to explore civilian outmigration from frontline cities to rural areas, especially the areas under the control of non-state armed groups.

This research aims to examine the effects of state and non-state intervention programs on civilian risk preferences in the frontline areas. To achieve our objective, we analyse how intervention programs affect civilian migration choice on access to agricultural resources in state-controlled and armed-group-controlled areas in the Lake Chad Basin region. The LCB region faces violent conflicts and climate-induced displacement (Ruppel & Funteh, 2019). While the state's counterinsurgency operations have helped regain some of the areas controlled by non-state armed groups (Oriola, 2022), a large portion of the agricultural-rich areas remain a battlefield between the

state and insurgent groups (Oginni, 2021). The inaccessibility of civilians to the contested areas has caused food shortage and a sharp increase in food prices in state-controlled frontline areas (Fudjumdjum et al., 2019; The Economist Group, 2022), driving civilians' preferences for armed-group-controlled areas for food security (Oginni, 2023, forthcoming).

Drawing on empirical data from two frontline cities in Nigeria and Cameroon, we find that the intervention programs targeting housing, healthcare and business/skill training reduce civilian risk preferences. Specifically, young and middle-aged business/skill training participants are significantly likelier to stay in state-controlled areas over the insurgents-controlled areas than non-participants. Furthermore, while women profit more from healthcare and housing support than men, we do not find any significant gender-specific effects of business/skill training on civilian risk preferences. Our study offers new insights into short-term measures that can be explored to reduce civilian risk preferences in conflict-torn spaces where non-state armed groups employ accessibility to farmlands to control civilians and civilian behaviours.

2. Background

Increasingly, there have been spatial shifts in the nature and scale of urban displacement in the last few years In the Middle East, for example, Syria's conflicts have forced many people to flee to cities in Jordan and Lebanon – about 80 per cent of the Syria refugees live in cities across the world (Lintelo, Lakshman et al., 2018; Sangapala, Sultana et al., 2017). Similarly, the protracted conflicts caused by the Al-Shabaab insurgent groups forced many Somalis to relocate to cities, towns and suburbs in Kenya, Uganda and Ethiopia for protection and livelihoods (Nikuze et al., 2019). The situation is not different in the Lake Chad Basin region, in which frontline cities have been central in the ongoing Boko Haram crisis.

LCB region is connected in many ways, especially regarding resources and rich cultural ties, but has been devastated by the violent extremism of Boko Haram terrorist groups. Boko Haram terrorists were initially presumed to have been fighting the war against the corruption and secularity of the Nigerian government before they turned violent in 2009 (Azgaku, 2015; Marc-Antoine Pérouse de Montclos, 2015; Adesoji, 2019). Since the emergence of violent extremist groups, over 4.5 million people have been forcibly displaced from their homes, while 20,000 lives were lost to the crisis (IDMC, 2018; Okoli & Iortyer, 2014; Yusuf, 2019). Although the Mul-

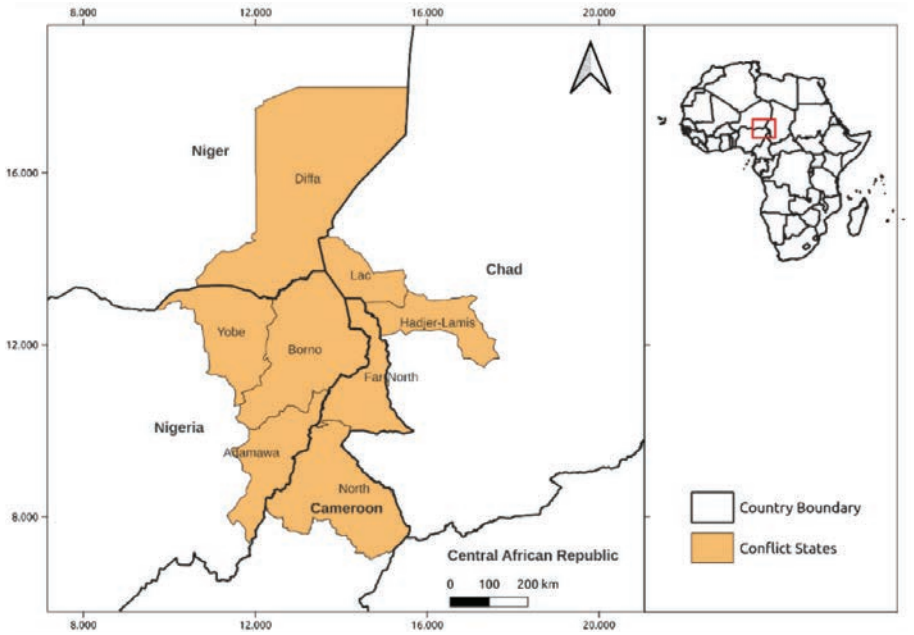

Figure 1. Map showing conflict-affected areas in the LCB region. Source: Author.

tinational Joint Task Force (MJTF) established in 2015 by the governments of the four countries has succeeded in "technically" containing the expansion of terrorist activities (Nagarajan et al., 2018; Zenn, 2017 Obamamoye, 2019), the continuous onslaughts in villages and communities in the remote areas remain a significant setback on food security in the region.

Frontline cities in the Lake Chad Basin have attracted a large number of civilian population (Magrin et al., 2018). However, state presence is very weak in these cities, characterised by multiple challenges that range from governance deficit to localized land-tension, climate fragility to widespread poverty, youth unemployment and low level of illiteracy (IDMC, 2018; Nagarajan et al., 2018). About 80 percent of the displaced resettling in these cities live outside the registered camps, usually in the informal settlements where there are poor health facilities and housing, transport system and inaccessibility to clean water (Fudjumdjum et al., 2019).

Nigeria, Chad, Niger and Cameroon, facing a decade of armed conflicts from non-state armed groups, have remained within the range of the top fifth to seventeenth rank on Failed State Indicators (FSI) over a decade,

suggesting that elements of state fragility are very much present within the LCB region. Compared to Gabon (in Central Africa region) and Ghana (in West Africa), which have witnessed a declining trend on FSI, the four LCB states have a high record on security threats to the state, fractionalized leadership, fragmentation of state institutions or power struggles, poverty and uneven development, amongst others (Bøås & Strazzari, 2020).

Since 2017, several intervention programmes have targeted civilians in frontline areas of the LCB, following the success achieved by the Multinational Joint Task Force (MJTF) on counterinsurgency in many frontline cities that were occupied previously by the armed groups (Albert, 2017; UNDP, 2021). State and non-state intervention programs, though often limited to the areas densely populated by internally displaced persons (IDPs) and returnees, have been implemented across the frontline cities in line with the Lake Chad Basin Regional Stabilisation Strategy. For example, the multisectoral recovery project (MRP) in the LCB covers livelihood recovery, service delivery and rehabilitation. The commonly identified interventions within the LCB RSS are housing support, healthcare and business/skill training. Our interest is to examine the effectiveness of these interventions on civilian risk preferences in terms of migration choice between staying within state-controlled areas and leaving for insurgent-controlled areas. To what extent do intervention programs influence civilian risk preference in food-insecure and conflict-torn spaces?

3. Methodology

This study adopts mixed methods. We combine cross-sectional data with 5 focus group discussion and 54 in-depth interviews. The data was collected in Mubi (Nigeria) and Maroua (Cameroon) between between August and December 2019. The study is part of a larger research project on mapping stabilisation vectors in the LCB region (Alupo et al., 2018; Oginni, 2021; Oginni et al., 2018, 2020; Opoku et al., 2020, Oginni, 2023a, 2023b, forthcoming). Our cross-sectional data consists of 2024 households: 761 households in Nigeria (Mubi) and 1263 households in Cameroon (Maroua). This represents 81% response rate of 2500 household survey in the frontline cities after adjusting for incomplete response. A city which has been previously occupied by armed group takes on 1, otherwise 0. In this case, Mubi takes on the value of 1 and Maroua takes on the value of 0. Intention to migrate to access farmlands takes on 1, otherwise 0 and we coded this as stay and exit option respectively.

We are interested in the effects of intervention programs on civilian risk preferences on access to agricultural resources in the frontline cities. Specifically, we intend to estimate on average how different versions of intervention programs (housing, healthcare and business/skill training) affect civilian migration choices in the frontline. Thus, we implemented a causal Double Machine Learning (causalDML) for program evaluation to estimate the effect heterogeneity of intervention programs on migration choice (Heiler & Knaus, 2022; M. C. Knaus et al., 2022). CausalDML is developed based on DML methods and it allows the flexible use of standard statistical tool such as OLS, t-test, supervised learning for estimating the causal parameter of interests. CausalDML is applied under unconfoundedness which assumes access to a vector of pre-treatment variables (M. C. Knaus et al., 2022).

The advantage of DML compared to ML is that it overcomes overfitting problems associated with regularisation through the use of Neyman orthogonal scores and cross-fitting that help reduce bias and produces $N^{1/2}$ consistent to estimates the parameter of interests (Bach et al., 2022). For our study, we evaluate three intervention programs under the multisectoral recovery project (MRP) of the LCB Regional Stability Strategy, namely, housing, health and business/skill training. We are interested in the average potential outcomes (APO), average treatment effect (ATE), average treatment effect on treated (ATET) and to compute group average treatment effect (GATEs) to determine who benefit or suffer more or less from participating intervention programs within the area based intervention areas: Maroua I, II, and III as well as Mubi North and Mubi South.

APO is the average potential outcome of the intervention if the whole civilian population affected by armed conflicts were assigned to the intervention programs. ATE indicates the average effects in the population while ATET covers the subpopulation that is observed in the intervention programs. GATE is a conditional average treatment that is useful for subgroup analysis (categorical variables) or heterogeneity along continuous variable (Heiler & Knaus, 2022; Knaus et al., 2022).

First, we code the version of the interventions to be multivalued treatment using R-package following the guideline for estimating causal parameter of interests (Heiler & Knaus, 2022). Then, we implement causalDML via R-package. The result produced APOs, ATEs and ATETs. So, we obtain APOs, ATEs and ATETs from the means of the estimated doubly scores estimated through causalDM R-package. We estimate GATEs through OLS of the pseudo-outcome of pre-treatment variable (that is, gender, age

group, income, education and city-specific characteristics (Heiler & Knaus, 2022). We also estimate GATEs for income via kernel regression because they are continuous variable. The procedures we followed to arrive at our results, including the detailed steps on how to implement causalDM on R-package, are outlined in Knaus (2022).

4. Findings

Civilian risk preferences in the frontline areas of the LCB region

Prolonged conflicts can increase civilian risk preference, especially when the state is seen as incapable of providing food security and other livelihood opportunities to cushion the effects of conflicts on the civilian population (Bahiss et al., 2022; Jackson et al., 2022). We asked study participants what could influence their migration choice and whether they consider leaving their former farmlands in insurgent-controlled areas. Table 1 shows factors influencing civilian risk preferences in frontline cities in Nigeria and Cameroon. Some participants shared that a sharp rise in food prices and their inability to engage in other works to earn income informed the decision to return to their former farmlands even if Boko Haram controlled the area. Due to land scarcity in state-controlled areas, civilians fleeing the scene of continuous are unable to secure farmland in relatively secured areas due to intense competition and population growth.

Table 1. Mapping civilian risk preference on access to agricultural resources in the frontline

Key drivers	Participants' view
Rise in food prices in frontline cities	'I spent my whole life over there. There is absolutely nothing to do here in the city to feed my family except I go back to my farm. I am limited to what is available in the markets compared to planting varieties in my farm. It is expensive to feed a family of seven here.' (47 years, Maroua, Cameroon)
Land scarcity in state-controlled areas	"You know that it is very difficult to secure farmland here. You have to think of moving far from the city and these areas are not safe too. So, the locals have to feed themselves first by allocating farmlands to their people (32yrs, Mubi, Nigeria)
Selective restrictions on access to rivers, lake and farmlands in contested territories	'I heard some people still farm in the areas but they are paying some levies to the commanders there (that is, Boko Haram). Some military officers also worked with local security to fish there. Why should I not return to the areas? I am willing to pay any levy to feed my family. (28yrs, Mubi, Nigeria)

Social networks and skill mismatched	'Our friends and families still live in the area. The only problem is that we have to find someone to speak to the commanders first so that they allow us to farm during this season and pay levy later after harvest. I was only trained as a farmer by my father before his death. People here drive repair handsets, drive tricycle and barbing salon. I did not learn that. So I am not connected to the city in anyway' (44yrs, Mokolo, Cameroon)
Unequal access to humanitarian supports	'Some people were allocated land because the NGO registered them as a refugee. NGO distributed fertilizers to them before farming season. You know I do not have any connection to anyone. I will go back to my farm at any cost.' (Mokolo, Cameroon)
Future uncertainty about conflict resolution	'You know this crisis appear endless. We often hear that government has cleared some villages occupied by Boko Haram but you know our people there always come back here to tell us that the same Boko Haram attack their farms. But they are still better there than us here in the city because they can feed themselves and pay no rent like us here (52yrs, Mubi, Nigeria)

Future uncertainty about resolving armed conflicts in the LCB affects civilians' risk aversion or tolerance of access to agricultural resources. Future uncertainty emerges from low confidence or trust in the state's capacity to restore peace and enhance livelihood recovery in conflict-torn spaces. Some participants shared that the state's declaration of victory in some villages did not run in parallel with the scene of continuous onslaught in most remote areas where Boko Haram, ISWAP and other militias collect levies and punish whoever refuses to do so. Figure 2b-g shows the change in the spatial pattern of attacks from NSAGs between 2011 and 2022. While the Boko Haram insurgency was limited to Nigeria territory between 2011 and 2012 (Figure 2b), the insurgents expanded to the Far North region of Cameroon after two years (Figure 2c).

Later, Boko Haram launched its first attack in Chad after the Chadian government indicated an interest in participating in joint counterinsurgency operations in the LCB region. While the success of the operation of MNJTF limits the activities of Boko Haram to remote areas between 2016 and 2018, the emergence of ISWAP and other NSAGs beyond conventional frontlines has increased civilian causalities in recent years (Figure 2f-g). The new security threats, coupled with the challenge of early warning and response, have been exploited by Boko Haram and ISWAP for their recruitment drive in the LCB region. Between 2021 and 2022, the armed

conflict incidents spread to the northcentral of Nigeria and spiralled into farmer-herders conflicts due to the southward migration of conflict-affected populations around the LCB region (see Figure 2g). However, a recent study has shown that very few people migrate outside conflict zone in the LCB region (Oginni, 2023b, forthcoming).

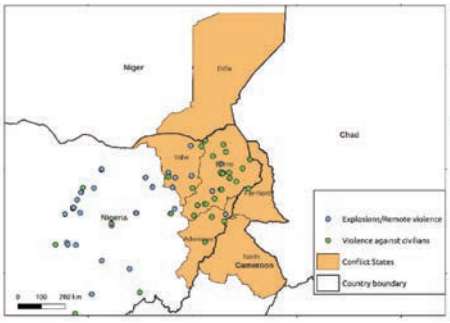

Figure 2b. Armed conflict incidents (2011-2012)

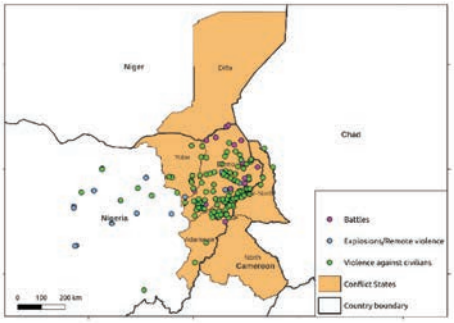

Figure 2c. Armed conflict incidents (2013-2014)

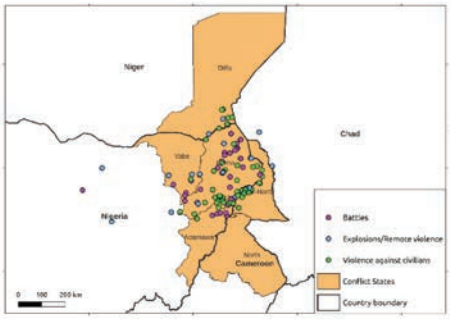

Figure 2d. Armed conflict incidents (2015-2016)

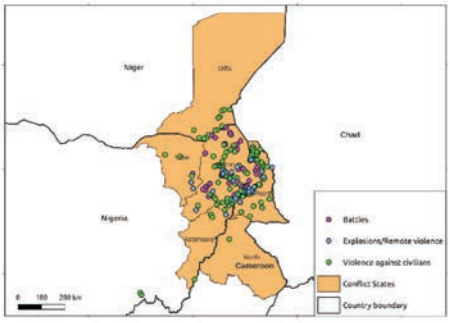

Figure 2e. Armed conflict incidents (2017-2018)

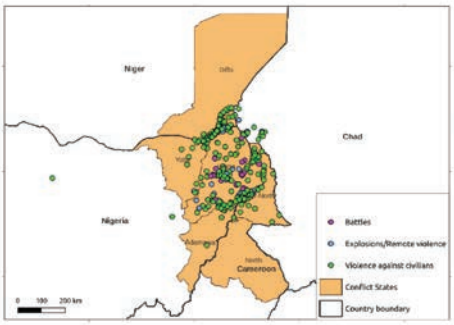

Figure 2f. Armed conflict incidents (2019-2020)

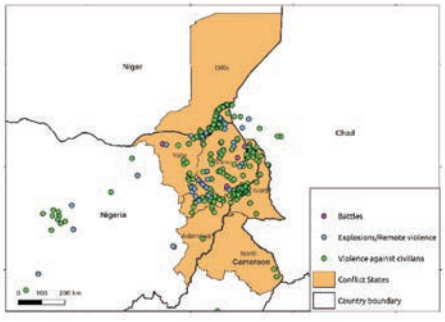

Figure 2g. Armed conflict incidents (2021-20222)

Source: Author. Data source: ACLED.

Effects of intervention programs on civilian risk preferences

Table 1 shows the intervention by program types and the demographic characteristics of participants and non-participants. Participants are civilians who participated in any of the three intervention programs. In contrast, non-participants who live within the targeted intervention area are, therefore, eligible to participate but did not eventually participate. About 52% (1053 households) participated in the programs, while 48% (961) did not participate in any of the three programs. More men participated in the three programs than women, while young and middle-aged adults participated in the three programs than older adults. Overall, participants who participated in one of the three intervention programs have a higher income than those who did not.

Table 1. Descriptive statistics of participation in interventions by program type.

Participants (N = 961; 48%)	Non-participants (N = 1063; 52%)			
	No program (1)	Housing (2)	Healthcare (3)	Business/ Skill training (4)
No of observations	1063	601	131	229
City/Country:				
Mubi (Nigeria)	0.56	0.19	0.03	0.22
Maroua (Cameron)	0.51	0.36	0.08	0.05
Gender (men)	0.58	0.52	0.55	0.55
Marital status (Single)	0.26	0.21	0.19	0.26
Age				
Middle aged adults	0.21	0.37	0.24	0.30
Older Adults	0.27	0.28	0.24	0.31
Young Adults	0.52	0.35	0.52	0.39
Education				
High	0.13	0.09	0.06	0.09
Low	0.54	0.63	0.60	0.45
Medium	0.33	0.28	0.34	0.46
Income (XAF/NGN)	47309	52213	32139	50099
Migration choice (stay choice)	0.341	0.664	0.773	0.715

Our interest is how intervention programmes affect civilian risk preferences, especially civilian migration choices on access to agricultural resources in state-controlled areas and Boko Haram-controlled areas. Here, we compare three programs (housing, healthcare and business/skill training) to non-participation. Specifically, our interest is to compare ATE and ATET (see Table 2). A higher ATET suggests the effectiveness of the program assignment (Knaus et al., 2022). ATE and ATET estimates indicate significant differences in the effectiveness of intervention programs. The three programs (housing, healthcare and business/skill training) show a positive effect (about 0.05 or 5% on average) on the civilian choice of staying in the state-controlled frontline cities. However, a comparison of ATE and ATET reveals no significant difference between the three programs. As Heiler and Knaus (2022) and Knaus et al., (2022) suggest, this might indicate that the program assignment fails to take advantage of the effect heterogeneity because we expect ATETs to be higher than ATEs if the program assignment is well-targeted.

Table 2. Average effects of pro-state intervention programs

	Estimate (1)	Standard Error (2)
Panel A: Average potential outcome (APO)		
No participation (Control)	0.357	0.014
Housing support (shelter)	0.743	0.015
Healthcare and food support	0.742	0.034
Skill Acquisition and Business	0.668	0.058
Panel B: ATE		
Housing support – No participation (Control)	0.386***	0.020
Health and Food Supports – No participation (Control)	0.385***	0.036
Skill Acquisition and Business – No participation (Control)	0.311***	0.059
Panel C: ATET		
Housing support – No participation (Control)	0.377***	0.025
Health and food Supports – No participation (Control)	0.343***	0.050
Skill Acquisition and Business – No participation (Control)	0.298***	0.040

Notes: The Table reports DML based point estimates and standard errors of average effects (p ‹ 0.001 **; p ‹ 0.01 **; p‹ 0.05*)

Heterogeneous effects of targeted interventions on civilian migration choice in the frontline.

Here, we study the effect heterogeneity at different scales by estimating group average treatment effect (GATEs) for gender, income, age groups and city of the subgroups. We performed the GATES using a standard OLS regression with the pseudo-outcomes of pre-treatment variable (Knaus et al., 2022). After estimating the DML for average effects, we use the dummy variables for gender, age groups and city and their respective reference groups as covariates (for procedure see Heiler and Knaus, 2022; Knaus et al., 2022). Then, we used kernel regression GATEs for variable income based on the R-package casual DML package (Knaus et al., 2022).

Table 3 shows the results of the standard OLS regression for GATEs. The results show significant gender differences in the effect of housing and healthcare programs. Women, as a reference group, profit more on average significantly from participating in the intervention programs. However, the effect disappears for women on business/skill programs. Panel C shows the OLS regression result of the age group but with two dummies (Middle-aged and Older adults). Again, young adult is the reference group. The F-statistic is not significant at 5% level for health, housing and business/skill training programs. However, it shows that young adults benefit substantially more or suffer less from participating in the three programs. Older adults only benefit more or suffer less from housing programs, while young and middle-aged adults benefit from business/skill training.

Table 4: Group Average Treatment Effects (GATEs) of intervention programs.

	Housing	Healthcare	Business/Skill Training
Panel A:			
Constant	0.436**	0.461**	0.405**
	(0.031)	(0.057)	(0.080)
Gender (male)	-0.086*	-0.159**	-0.136
	(0.042)	(0.077)	(0.107)
Panel B:			
Constant	0.453**	0.323**	0.335**
	(0.032)	(0.058)	(0.080)
Non-returnee	-0.117*	0.087	-0.011
	(0.042)	(0.077)	(0.107)

Panel C:			
Constant	0.365** (0.025)	0.346** (0.045)	0.267** (0.062)
Age (Middle aged Adults)	0.056 (0.0.052)	0.085 (0.095)	0.254* (0.132)
Age (Older Adults)	0.185* (0.086)	0.138 (0.158)	0.161 (0.22)
F-statistic	2.614	0.688	1.944
Panel E:			
Constant	0.457** (0.034)	0.447** (0.062)	0.315** (0.087)
City (Maroua – Cameroon)	-0.111* (0.043)	-0.119 (0.079)	0.0233 (0.110)

Note: This tables highlight OLS coefficients and their robust standard errors.

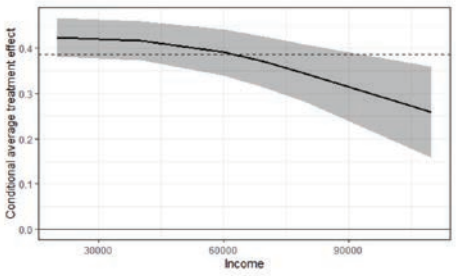

Figure 3a. Housing.

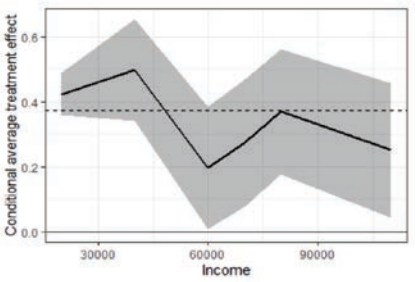

Figure 3b. Healthcare.

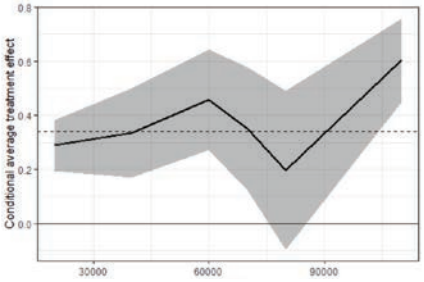

Figure 3c. Business/Skill Training.

Figure 3. Effect heterogeneity of intervention on income.

In addition, we performed nonparametric GATEs for income the subgroups. While we find a notable effect of business/skill training on income, we do not find any effect of housing and healthcare on income. Figure 3a-c show the result of non-parametric GATEs for income). Our survey did not cover which business/skill trainings the participants benefit from. However, some participants shared that some soft trainings improve their level of understanding and satisfaction with the state efforts on counterinsurgency.

> I have participated in a series of peace dialogue sessions with government and NGOs. I understand that government is fighting to protect us from the armed group [Boko Haram]. So, I would rather stay where I feel more protected even though I can barely feed my family (31, Mubi, Nigeria).

5. Discussion and policy implications

Access to agricultural resources during armed conflicts remains a critical tool that non-state armed groups often use to control civilians and civilian behaviours (Kemmerling et al., 2022). This is particularly evident when prolonged conflicts prevent the state from guaranteeing food security in the frontline areas and increase civilian risk preferences, including co-optation and bargaining with non-state armed groups for alternative livelihood (Jackson et al., 2022; Weigand, 2017).

As demonstrated in this study, the inaccessibility to agricultural-rich areas of the LCB region has influenced civilian risk preference for the insurgent-controlled areas to secure alternative livelihoods. Boko Haram and ISWAP insurgents capitalised on the rise in food prices, land scarcity in state-controlled areas, restrictions on access to insurgent-controlled areas, and perception of unequal access to humanitarian assistance to control civilian behaviours. Targeted interventions on healthcare, housing and business/skill training have some potential to reduce civilian risk tolerance in the frontline and outmigration to insurgent-controlled areas. Interventions that target business/skill training may be a short-term option to pursue in a situation where the state cannot guarantee accessibility to farmlands due to evolving security scene. Yet, the more significant proportion of the conflict-affected population resettling in urban areas is farmers without the required skill sets to navigate the urban economy.

In addition, the study findings suggest that the conventional narrative of rural-urban migration during armed conflicts only holds for some situations. In the LCB region, like other regions battling violent conflicts world-

wide, we observe outmigration to remote areas for food security among civilians whose livelihood depends on access to farmlands, rivers, lakes and other agricultural resources. Here, there is a potential area for further research on the dynamic of migration within crisis zones.

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Opportunities and Solutions for Agricultural Development to Address the Acute Food Problem in South Sudan

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1. Introduction

The current food crisis is probably the worst in a decade. With the consequences of climate change coinciding with trade restrictions and conflict, years of progress in the battle against hunger and poverty are being rapidly reversed. Many countries are responding with policies that amount to food protectionism, which on a global level will only lead to further food insecurity as richer countries outcompete poorer ones in the race for scarce resources. There is a need for urgent structural changes to global food systems, rooted in both sustainable food and agricultural practices and adequate planning.

The war in Ukraine and an increase in extreme weather events are stretching already fragile food supply chains following shutdowns during the COVID-19 pandemic. As the Ukrainian war continues to suppress food production, droughts in Europe and Africa since 2022, as well as floods in countries such as Pakistan, have contributed to high food prices and shortages worldwide. Combined with a rise in fertilizer and labour costs, these have created inflationary pressures.

The current food price volatility exposes the fragility of our global food system: rising food insecurity, social unrest, displacement, and migration are all possible effects. In fact, the increasing food crisis might soon lead to more social unrest, wars, and conflict as we fight for survival.

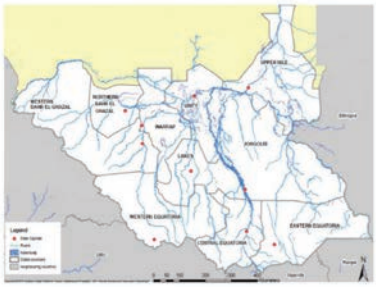
The effects of climate change on agriculture have resulted in lower crop yields and decreasing nutritional quality due to drought, heatwaves and flooding as well as increases in pests and plant diseases. Climate change impacts are making it harder for agricultural activities to meet human needs.

Armed conflicts have directly caused food insecurity and starvation by disruption and destruction of food systems, reducing farming populations, destroying infrastructure, reducing resilience, and increasing vulnerabilities, disruptions in access to the market, increasing food price or making goods and services unavailable.

In South Sudan, up to 95 percent of the country's population depends on farming, fishing or herding to meet their food and income needs. Yet, South Sudan faces one of the world's worst humanitarian and food security situations. South Sudan has 7.7 million people facing acute malnutrition or starvation as it enters its fifth year of severe food insecurity, according to new research measuring the intensity of food insecurity across populations, produced by Cafod and anti-poverty group Development Initiatives. Investing in agriculture sector development is crucial to long-term peace and development in South Sudan.

2. Important facts

- Land area: approx. 650,000 sq. km
- Population => 12.4 million
- Low population density-(13 people per sq. km)
- High population growth rate (3%)
- Rural population => over 90%
- Employment in Ag => Over 83%
- Youth Population => over 70%



- Abundant water sources (many rivers and tributaries)
- High rainfall running 9 months a year – average rainfall ranges from 500 mm to 2000 mm per year.
- High potential for irrigated agriculture – at present less than 3% of cultivated land is irrigated.
- High potential for rice and other water-intensive crops
- Potential for fish harvest is up to 300k tons/year.

- Suitable for agriculture => 75%
- Highly suitable for crop cultivation => 50%
- South Sudan has seven distinct rural livelihood zones.
- Farming systems are mostly small-scale subsistence and traditional agriculture.
- 12 million cattle, 20 million sheep and 25 million goats (FAO)
- Fisheries potential of 75 000 tons/year

3. South Sudan Food Security Situation from 2016-2023

For the last 7 years the food security situation in South Sudan has been descried as "dire", with over half of the population needing food assistance – normally from WFP and other food distributing organizations in the country.

Let us look at food security using the FAO definition: *"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and. healthy life".*

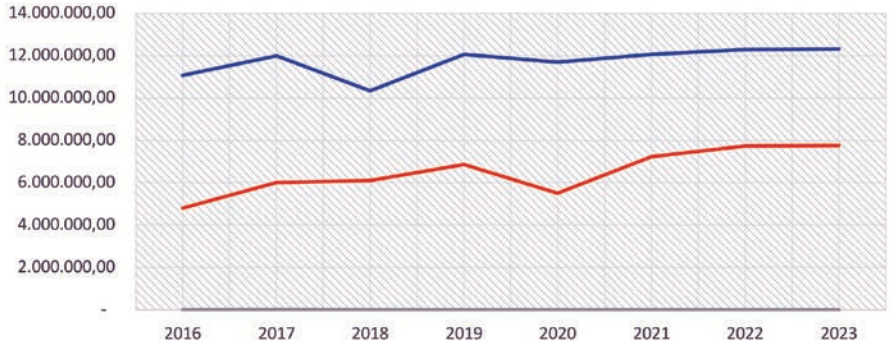


Figure 1. Food Security IPC 2016 to 2023 (source, author compilation from IPC data).

Let's look at:

a) Physical access (Availability): In 2022, Sudan needed 1,477,200 tons to meet its basic annual cereal requirements. It was able to produce 936,200 tons of cereal, leaving an overall cereal deficit estimated at 541,000 tons. This translates to over 600 million dollars of imports usually from neighboring countries through the aid system or government subsidies.
b) Economic access to food: Food Inflation in South Sudan averaged 65.93 percent from 2008 until 2023, reaching an all-time high of 513.20 percent in December of 2016 and a record low of -32.60 percent in February of 2021. Consumer Price Index in South Sudan increased to 16473 index points in February 2023. The maximum level was 18863 index points and minimum was 53.49 index points. High food prices and limited income for communities, coupled with high depreciation of the local currency, all inhibit economic access to food.

c) Nutrition aspects: Between July 2022 and June 2023, an estimated 1.4 million children under five are expected to suffer from acute malnutrition based on analysis and estimations from the results of the SMART nutrition surveys, Food Security and Nutrition Monitoring System (FSNMS) and program admission trends.

Why does South Sudan continue to remain in a Food Insecurity Crisis despite its very high agricultural potential?

4. Characteristics of the agricultural economy of South Sudan

The decades of conflict have largely eroded the agricultural potential of South Soudan and destroyed its agriculture-based livelihoods. Despite its rich agro-ecosystems, the country is undergoing a serious humanitarian crisis, with extreme levels of poverty, and has been relying heavily on international aid. Food insecurity in South Sudan is mostly driven by the economic and markets impact of conflict, as well as population displacement, low crop yields, climatic shocks, and difficulties for humanitarian access.[1,2] Farmers have fled their villages for towns. Among those who have stayed behind, many have been unable to access enough land to go beyond subsistence farming and are afraid to travel to town for inputs and sales. Many farmers have lost animals to disease and theft, and fear keeping livestock in an insecure environment. Farming in less suitable areas has also exposed them to the increasing climate risks. In addition, markets for agricultural products have been profoundly disrupted and value chains have disintegrated amid the drastic decline in production, insecurity on the roads, loss of assets, and a breakdown in local market demand.

Insufficient local food production has led the country to become a significant net food importer. The current value of crop production, which represents the "realized agriculture potential" in South Sudan, is only about US$600 million. Crops, together with livestock and fishery products, would make up about US$800 million worth of total agricultural value, which remains relatively low compared with that of neighbors, Uganda with nearly US$10 billion in 2021 and Kenya roughly US$22 billion. South Sudan is now a net cereal importer with an estimated gap of over 500,000

[1] World Bank (2020), *South Sudan Conflict Economy*, chapter "Agricultural and Food Insecurity Dynamics (2006-2020)". Draft document, July 9, 2020.

[2] United Nations Security Council (2019). *Letter dated 9 April 2019 from the Panel of Experts on South Sudan addressed to the President of the Security Council* (S/2019/301). https://digitallibrary.un.org/record/3801695?ln=en

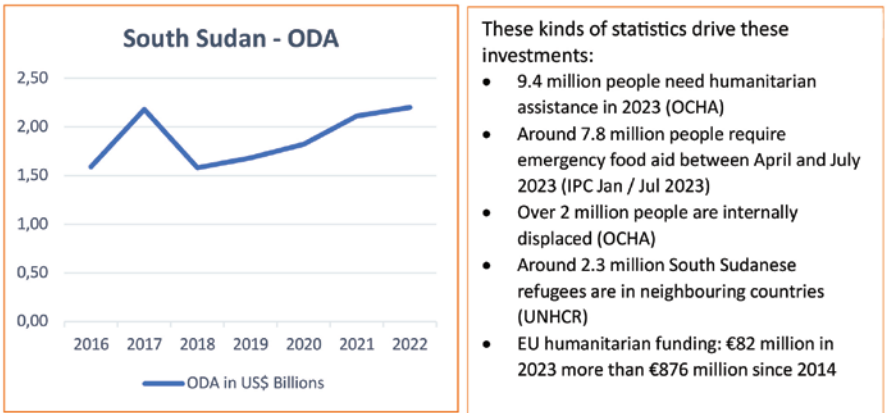


Figure 2. South Sudan Aid Assonance in the last 7 years totals to 13.16 US$ billion av 1.88 US$ billion annually.

mt in 2022. In the current disrupted markets, local products compete with imports even of basic grains and vegetables, which come from commercial imports, particularly from Uganda and Sudan.

South Sudan depends on massive humanitarian food aid to meet its food gap (over 500,000 mt of mixed commodities in 2022). The country received US$1.6 billion ODA in 2018 and US$2.11 billion in 2021, with the highest being US$2.18 in 2017. Between 2016 and 2023, South Sudan received ODA of US$13.16 billion.

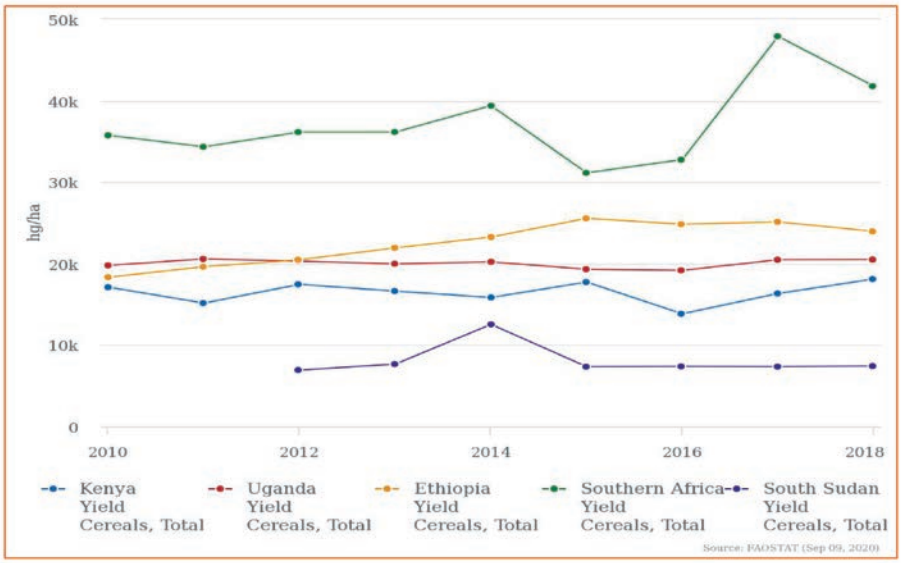
Most of the support was received in the form of food aid and other humanitarian assistance (71%). *While the dependency on humanitarian aid was necessary for a young country emerging from conflict, a shift from humanitarian to development-oriented agriculture growth path should become critical for South Sudan's food security.*

Chronic underinvestment in the provision of public services and rural infrastructure has further contributed to low productivity levels of South Sudan agriculture. According to the data from MAFS, agriculture received only about 0.3% of the national budget in South Sudan,[3] which falls well short of the Malabo commitments. For example, in 2018, its cereal yield (kg/ha) was about 18% of the average in South Africa, and about a third (31%-41%) of that of Kenya, Uganda, or Ethiopia. Limited use of farming inputs and

[3] World Bank internal briefing, July 22, 2020.

modern machinery/equipment are the most significant limiting factors for agricultural activities along intensive and extensive margins. The country can only meet about 17% of its seed needs domestically; the rest are imported from Uganda, Sudan, Kenya, Italy, and the Netherlands.[4] Mechanization is limited to land preparation and sowing and essentially occurs in demarcated large-scale (about 200 ha) commercial farms in Upper Nile, as well as in some un-demarcated traditional farms.[5] Agriculture in South Sudan largely remains at subsistence level with average field sizes of two feddans/acres per household, crop yields being very low: hardly one ton per feddan/acre due to use of poor-quality seeds, tools, and agronomic practices.

Comparison of the cereal yield (kg/ha) of South Sudan and its neighbors, 2010-2018



Source: http://www.fao.org/faostat/en/#compare

[4] World Bank internal briefing, July 22, 2020.

[5] FAO (2020). Special Report – 2019 FAO/WFP Crop and Food Security Assessment Mission to the Republic of South Sudan.

CFSAMs Special Reports – May 2020. https://doi.org/10.4060/ca9282en

5. Strategic solutions to South Sudan's Food Insecurity situation

Despite the enormous challenges, South Sudan's agricultural potential represents a development opportunity not only to improve food security, but also livelihoods, jobs and peace in the country. Agriculture, including crops, livestock and fishery, is still the major source of livelihoods for most South Sudanese people. Yet the productivity sector is among the lowest in the world, with rudimentary food value chains. Developing agri-food systems can have a tremendous job-multiplier effect beyond primary production, yielding to new and adequate job opportunities in the more downstream segments of the food value chains (FAO/WB 2022).

Rich pedoclimatic endowments and agro-ecosystems in South Sudan makes it suitable for the development of diverse livelihood opportunities.[6] Based on the precipitation, water availability and livelihood patterns, there are seven main livelihood zones in the country, where different types of agriculture are practiced (Figure 1). Pastoralism occurs mainly around the Nile River running North-South through the center of the country and West of the Nile in the South.

Whereas livestock raising can mainly be found in eastern areas, about 60% of the population depends on it for food security and income generation.[7] South Sudan had in 2010-2011 the sixth largest livestock herd and the highest livestock per capita holding in Africa.[8]

[6] World Bank (2019), South Sudan: linking the agriculture and food sector to the job creation agenda.

[7] Special Report – FAO/WFP Crop and Food Security Assessment Mission to South Sudan, 2019.

[8] Government of South Sudan (2016), Comprehensive Agriculture Master Plan, Juba.

5.1. Crop Production Potential

Crop farming occurs in a wider area. Main crops cultivated are sorghum (70% of area sown to cereals in 2019),[9] maize (22% of the cereal area), cassava, groundnuts, sesame, pearl and finger millets, beans, peas, sweet potato and rice. Vegetables, peas and beans are produced near homesteads, mainly for home consumption (most fresh vegetables in markets come from Uganda, Kenya and Sudan).[10] Fruits are also grown throughout the country, mainly for local consumption.

South Sudan's agricultural potential has been further enhanced by lengthening of rainy seasons over the past decade.[11] An analysis of 2006-2019 historical climatic data finds that areas where agriculture faces high levels of seasonal vulnerability have decreased since 2006. The expected trend is that growing seasons will start earlier and last longer. This shift toward less vulnerable conditions is important for crop production and thus food security. There is also significant land suitable for livestock rearing that could improve the livelihood of pastoralists and agro-pastoralists in the dry lands of the country.

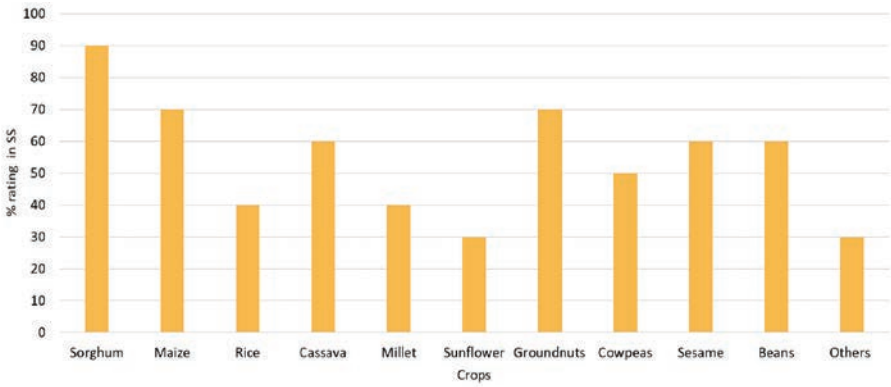


Figure 3. Common Crops of South Sudan – a rich diversity of food basket (source – Enterprise Inc study report, 2021).

[9] FAO (2020). Special Report – 2019 FAO/WFP Crop and Food Security Assessment Mission to the Republic of South Sudan.

CFSAMs Special Reports – May 2020. https://doi.org/10.4060/ca9282en

[10] Government of South Sudan (2016), *Comprehensive Agriculture Master Plan*, Juba.

[11] World Bank (2020), *South Sudan Conflict Economy*, chapter on "Agricultural and Food Insecurity Dynamics (2006-2020)". Draft document, July 9, 2020.

5.2. Fisheries Potential

South Sudan has abundant fishery resources with an estimated total area of 80,000 km^2 of fishing ground that is centred along the White Nile River system, which encompasses the largest permanent wetland in Africa (FAO/WB, 2021). South Sudan's capture fishery may be categorized into subsistence and commercial fishery, with the former being both the largest and most important fishery. Currently, the total annual fish production in South Sudan is estimated at 114,000 tonnes. A large proportion of South Sudan's population resides in rural areas (80% of total population) and there are up to 35,000 people engaged in fishing activities nationally, with many more involved in periphery fishery activities such as transportation of fish and fisheries products. *Fishing is largely viewed as a supplement to agricultural activities for consumption. In communities along banks of water, fish are estimated to account for over 80 percent of daily diets.*

5.3. Livestock Potential

According to a Food and Agriculture Administration (FAO) report, "South Sudan's livestock population is estimated at 12 million cattle, 20 million sheep and 25 million goats according to the National Ministry of Livestock and Fisheries Industry, making it a world leader in terms of an-

imal wealth per capita. The livestock could benefit from investments that will lead to improving animal health and nutrition, commercializing livestock and its products and introducing value addition technologies for livestock products (milk, hides and skin, beef and mutton)".

6. Strategies for solving the increasing food insecurity situation in South Sudan

To feed this dire food insecure population of South Sudan, it is important to focus on the opportunities that exist and invest in sustainable solutions that will ensure:

6.1. More than doubling cereal production from 900k to 1.8m metric tons/year by increasing agriculture productivity through private-public sectors-led access to inputs (seeds and fertilizer), extension and mechanization. Increased use of technologies that will increase cropland cover from only 3.8% (2.7 m ha) to 14.2% (9.2 m ha) of total land. This should lead to an increase in per capita cropland from 0.32 to 0.99 ha. Investing in agricultural technologies and community mobilization to ensure an annual increase of more than 20% for roots and tubers, more than 30% for cereals and more than 25% for horticultural crop. Lastly, this will also call for investment in technologies to increase average yield of cereals from less than 0.9 tons per ha to 3 tons per hectare.

6.2. Agriculture sector development policy and planning framework. Strengthening the enabling policy environment and partnerships at community level through a private sector-led initiative. At the national level, primary responsibility for agriculture is vested in the Ministry of Agriculture and Food Security (MAFS) and the Ministry of Animal Resources and Fisheries (MARF). The mandate of the Ministry of Agriculture and Food Security (MAFS) is to transform agriculture from traditional subsistence farming to achieve food security through scientific, market oriented, competitive, and profitable agriculture without compromising the sustainability of natural resources for future generations.

There is a Comprehensive Agricultural Development Master Plan (CAMP), an investment plan developed to align with national development policies and objectives and with the policies and strategies of the Ministry of Agriculture and Food Security (MAFS) and other related ministries of Ministry of Animals Resources and Fisheries (MARF), and Ministry of

Electricity, Dams, Irrigation and Water Resources (MEDIWR). CAMP was devised to achieve national and sectoral visions, policy, and development objectives over the period 2015/16-2039/40. CAMP is also the investment plan under the framework of the Comprehensive Africa Agriculture Development Programme (CAADP) of the African Union to achieve continental and regional agricultural development objectives. The government needs support, both financially and capacity-wise, to review and to implement the investment plan in CAMP.

6.3. The Private Sector in South Sudan

Building the base for strengthened market access by analyzing the market dynamics and providing strategic direction for future country programming with the aim of enhancing market access. The private sector component in the government's Growth Strategy and Vision 2040 underscores the need for efforts to encourage and nurture local entrepreneurship with a view to broadening growth and employment opportunities. Apart from a few, almost all formal businesses in South Sudan are micro-, small-, and medium-sized enterprises (MSMEs). Small and MSMEs dominate all sectors of the economy.

However, there are limited number of MSMEs operating in the agricultural sector, even though more than 70% of the population in subsistence agriculture is essentially micro- and small-enterprise based. Private sector growth is challenging and difficult in agriculture, mainly because of the business environment and influx of humanitarian relief food, seed and utilities. Thus, there is a need to design programs to sustainably transit from humanitarian to developmental support.

6.4. Agriculture Markets and Trade

Both agricultural input and product markets in South Sudan are underdeveloped. No effective investment can be made in scaling up production, however, without strengthening markets. Nevertheless, there is a shortage of information on the market structure. This curtails the levels of structured interventions. As a result of the underdeveloped marketing arrangements, post-harvest losses at the farm level and within markets are very high, as are food prices. Further, the absence of ICT in rural communities limits market information generation and dissemination. This also restricts market size, outreach and agricultural value chains development. Consequently, the economic benefits of modern telecommunication still elude rural areas in South Sudan.

Furthermore, there are policy and logistical issues that prevent markets operating optimally. Too much influx of unregulated imports from other countries, increased dependence on relief free aid etc. undermine the local market dynamics. Understanding of such forces is key to ensuring the right interventions in commercial agriculture in South Sudan.

6.5. Strategic Partnerships

An enabling agricultural policy and regulatory environment that incentivizes domestic and international agribusiness firms to expand investments in delivery of agricultural technologies in input, and understanding of the output markets in agricultural value chains of staple foods, is a prerequisite for transforming the sector. Hence, efforts by development partners to empower government to initiate a community-led policy change to enact policies and put in place regulations that promote and protect equitable private investment in arable land development, encourage market-driven inputs production and distribution system, adopt a national investment code and actively promote domestic and foreign trade in agricultural commodities; and support the regional inputs and commodity trade.

6.6. Building environmental sustainability and resilience

South Sudan is characterized by multiple crises and threats that include conflict and instability, natural hazards (such as droughts and floods), plant pests and animal disease. Resilience building should become a priority area for the development partners and government. The major hazards faced by communities are: (i) insecurity due to conflict (including ethnic conflict, cattle rustling, competitions over water and grazing lands); (ii) high incidence of pests and disease in plant and animals; (iii) hydro-metrological hazards (late onset and erratic rains; long dry spells; droughts). *It is important to work with the government, other development partners and stakeholders including households, communities, and private institutions to adopt a system-wide approach that ensures the coherence and integration of humanitarian, development, and policy intervention to strengthen the resilience of communities and households to food and nutrition insecurity*.

6.7. Gender Integration:

"If women had the same access to resources as men, they would increase yields on their farms by up to a third" (UFAD, 2023). In South Sudan, women contribute more than half of the agriculture labor, but their crucial role and contribu-

tion to food security is often unrecognized. It will be difficult for the country to increase agricultural production and food security without involving the women who provide farm labor. Gender equality is smart economics, a core development objective for sustainable economic transformation. Achieving gender equality can enhance productivity, improve development outcomes for the next generation, and make institutions more representative. *It is against this backdrop that I am proposing to mainstream gender into the design, implementation, monitoring, and evaluation of a delivery model for agriculture interventions in South Sudan with the aim to optimize the participation of all gender groupings, including men, women, and youth. The purpose of a broad-based participation in all aspects of the Agricultural Transformation Agenda in South Sudan is to improve the relevance of program interventions, their impact, sustainability, and management.*

7. Conclusion

The main drivers of food insecurity in South Sudan are conflict, climate, and culture as drivers of food insecurity in South Sudan. The delivery of food and livelihood assistance in South Sudan has been disrupted by three years of consecutive flooding, localized conflict, and youth agitation. In addition to conflict, increasing food and fuel prices, displacement, poor harvests, and climate shocks such as floods are the main drivers of food insecurity. High inflation continues to reduce households' purchasing power, with people unable to meet their basic needs.

With its huge growth potential, agriculture can help the country to achieve a rapid and sustainable economic growth, better than any other sector. Since most of the people live in the rural areas, success in agricultural development will improve the livelihoods of rural people by reducing poverty and enhancing their food security, which are the country's priority goals.[12] After the CPA, South Sudan had several livelihood and food security development projects implemented by various international NGOs. Some interventions introduced during this period are still operational in several communities. These include continued use of improved cultivation practices; ox-ploughing; community-led maintenance of access roads; community management of storage facilities and mills; and production of seeds by farmer groups. The reason for the successful continuation of these interventions should be identified, and their characteristics studied with a view to scaling them up under future development programmes. Devel-

[12] South Sudan Development Initiatives.

opment partners and donors must honestly assess the impact of free food distribution to the same communities year over year, on the people served. Could these funds be invested at least 50/50 on initiating development potential of the agriculture sector?

In addition to the above, there are many other non-agriculture issues that need to be addressed, if agricultural development is to be enhanced. These include expansion and improvement of the road network, streamlining the multiple taxation system and developing more supportive policies and regulatory framework, and spearheading the launching of programmes that induce farmers and the private sector to invest in agriculture. These could comprise provision of rural financing to farmers and their organizations; support to the private sector to service the rural areas, including support to traders, wholesalers and transporters, mechanics, blacksmiths, seed producers and processors; basic food processing entities; and the like. The kind of support needed by these categories of private sector operators would be financial and technical. Since the rural areas have limited financial capacity, some system of financing of activities, e.g., on competitive matching grant or credit, is justified if implementation of development programmes is to be expedited. Together with these interventions, there is a need to supply appropriate farm machineries including draft animals to ease the farm power shortages and introduce technologies that reduce postharvest losses and add value to the row agricultural products. Financing of private sector service providers aimed at leveraging resources and services (marketing, processing, transportations, and input supply) to rural smallholder farmers should also be sought.

The Challenge of Responding to Multiple and Compounding Food Shocks. The case of the Democratic Republic of the Congo

John M. Ulimwengu[1]

1. Background

The Democratic Republic of the Congo (DRC) has been the centre stage of various crises, ranging from political instability, violence and insecurity to the biggest outbreak of Ebola in the world's history. As a result, the country's development status remains low, characterised by pronounced malnutrition, high poverty rates and fragile livelihoods (INS, 2019; Marivoet, De Herdt, & Ulimwengu, 2019).

At the same time, the DRC is endowed with countless natural resources. The country has the potential to become one of the richest economies on the continent and a driver of African growth. Given that around 65% of total population live in rural areas, the agriculture sector has by far the biggest potential to be an engine of *inclusive* development.

Despite its significant agricultural and mineral resources, the DRC has the largest number of food insecure people in the world, resulting from a combination of factors including conflict, increased food prices and transportation costs, as well as the ongoing impact of the COVID-19 pandemic and other epidemics. The country's protracted food crisis is compounded by one of the world's longest-running armed conflicts with armed forces associated with foreign forces that continue to fight intensely in the eastern territories. According to the 2023 Global Report on Food Crises (GRFS) (FSIN, 2023), the Democratic Republic of the Congo has the highest numbers of people in IPC Phase 3 or above, at about 26.43 million, accounting for over 55 percent of the region's total number of people in these phases, mostly due to compounding shocks the country experiences.

[1] https://www.ifpri.org/profile/john-ulimwengu

The armed conflict in Eastern DRC has led to the displacement of people, often forcing them to abandon their farms and livestock. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) reports that as of 2021, there were over 5 million internally displaced people in DRC (OCHA, 2021). The displacement severely undermines food production, leading to food shortages in the region. The ongoing conflict has led to the destruction of infrastructure crucial for agriculture, such as irrigation systems, storage facilities, and roads needed for the transportation of food and farming inputs. This has also reduced the ability of farmers to engage in productive agriculture, leading to food insecurity (FAO, 2020). Even when food is available, conflict can make it difficult for people to access markets due to safety concerns. Roads are often blocked by armed groups, preventing the transportation of food to markets (WFP, 2021).

Timely response to these shocks becomes critical as households and communities that have lost their livelihoods because of a shock can rapidly deplete assets and engage in coping strategies with long-term effects on well-being. Given resources constraints, proposed responses must be based on evidence. However, in addition to the lack of adequate data, empirical misspecifications may lead to erroneous evidence; therefore, increasing the challenge to design, implement, and monitor required interventions in the face of multiple shocks. In this paper, using the case of Eastern DRC, I highlight the need for researchers and policymakers to consider the complexities and nuances of different shocks and their interactions in order to design more effective food security interventions.

2. Data and methods

I use a typology of shocks treatment (identical and independent shocks; non-identical and independent shocks; non-identical but dependent shocks) to assess how each specification determines the impact of shocks on households' food security. Identical shocks refer to the assumption that all shocks are the same and therefore can be addressed with a one-size-fits-all approach while independence stipulates that one shock does not affect the occurrence or magnitude of another. Data are from a households survey conducted in 2022 by the World Food Program (WFP) in one of the most affected provinces in the DRC, the province of Nord Kivu in Eastern DRC. The survey covered about 3,000 households.

Probit models were used to estimate the impact of shocks occurrence on food security in the region.

3. Results and discussions

The survey included twenty shocks; however, respondents were asked to list up to three shocks only. Figure 1 shows that 32.3 percent, 7.6 percent and 3.4 percent of surveyed households have been affected by one, two and three shocks respectively. It is likely that the number of households with multiple shocks would have been much higher had the respondents been allowed to report all the shocks they faced.

Among reported shocks, sickness/disease ranks first (Figure 2); indeed, for the last ten years, Eastern DRC has experienced Ebola, Cholera and COVID-19. Armed conflict combined with forced displacement affected around 40 percent of households. For more than thirty years, Eastern DRC has also been the epicenter of violence and civil unrest in country. As far as weather-related shocks are concerned, less than ten percent of households mentioned flood/drought.

These multiple and compounding shocks might explain why more than 50 percent of the surveyed households were under "non-acceptable" food security state (Figure 3). Indeed, 32.2 percent of surveyed households were under "Borderline" and 19.5 percent under "Poor" states.

Estimated results (Figure 4 & 5) suggest that shocks are likely to increase the probability of being in "Poor" state of food security while reducing the probability of being in "Acceptable" state. In other words, they increase the

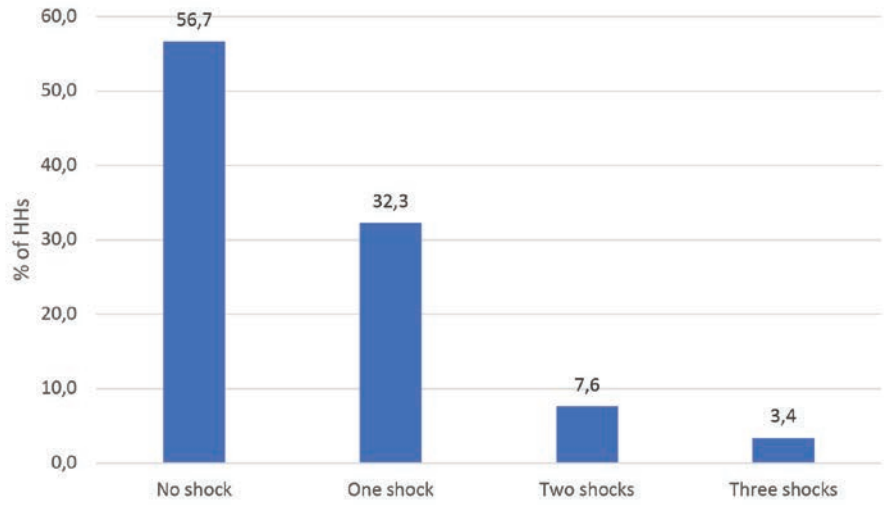


Figure 1. Percentage of households affected by zero or more shocks. Source: Author.

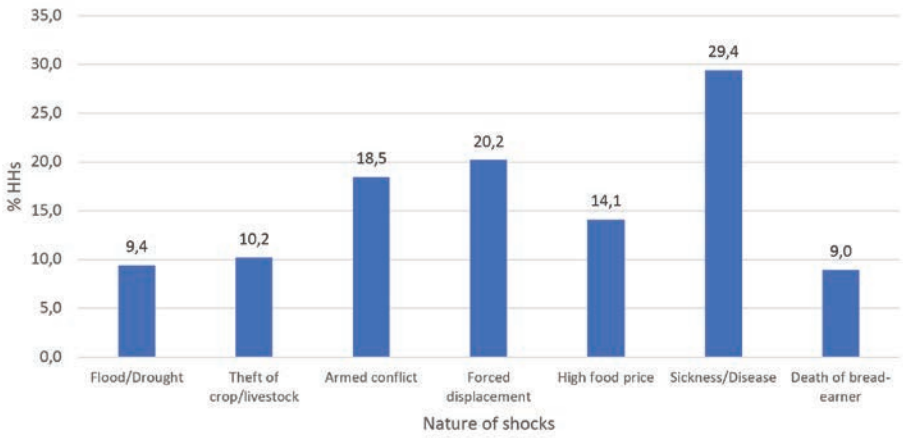


Figure 2. Percentage of households by type of shocks. Source: Author.

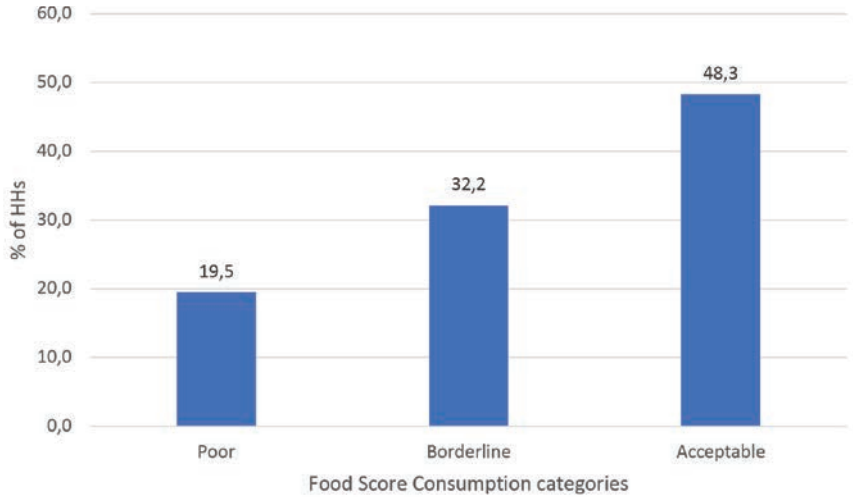


Figure 3. Percentage of households by Food Consumption Score (FCS) categories. Source: Author.

likelihood of bad state while reducing that of good state. The results also indicate significant difference in marginal effects across shocks; weather-related shocks (flood/drought) have the highest marginal impact followed by armed conflict and forced displacement. The difference is more significant when shocks are treated as identical; this happens when the question on shocks is formulated as "*has your household been affected by any shock*" without explicitly specifying which one. This results in one binary variable

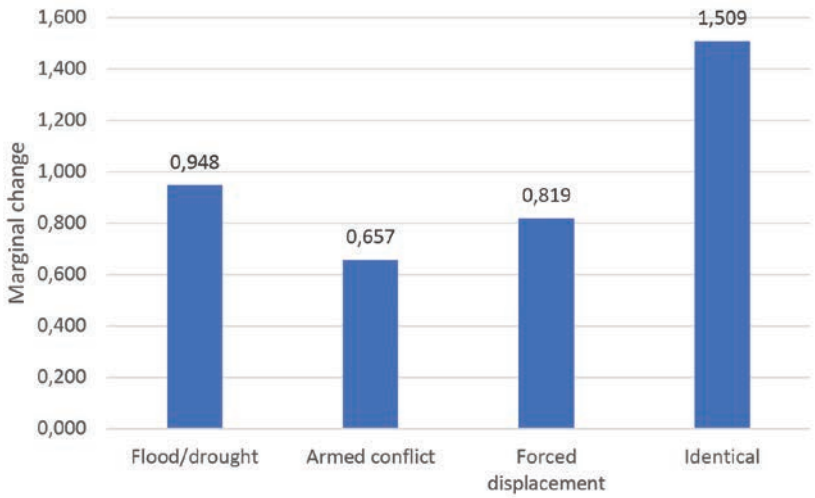


Figure 4. Marginal effect of shocks on the probability of being in "Poor" food security state. Source: Author.

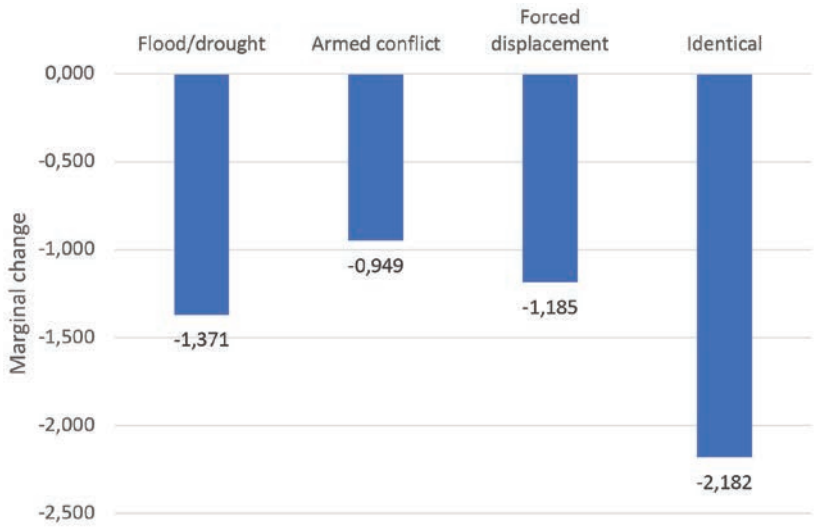


Figure 5. Marginal effect of shocks on the probability of being in "Acceptable" food security state. Source: Author.

(1 if affected, 0 otherwise). Treating shocks as identical increases the risk of mis-targeting and may lead to blind policy and interventions.

Multivariate probit (MVP) models account for the fact that these shocks are neither identical nor independent (Cappellari and Jenkins, 2003). As shown

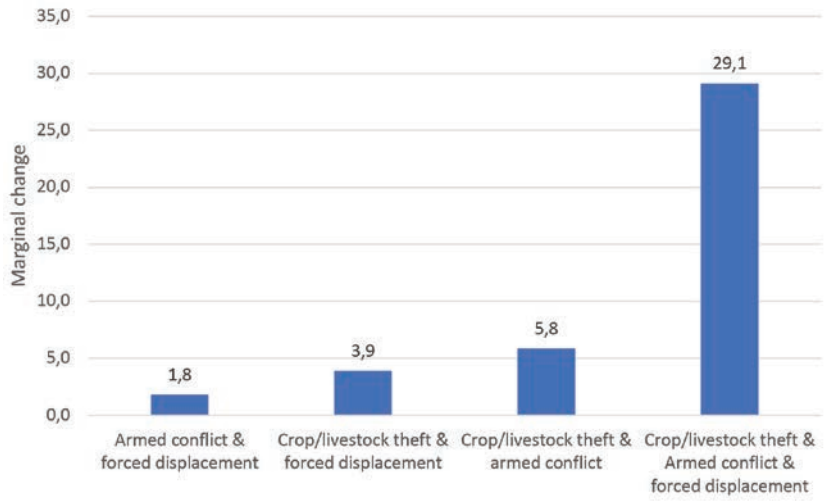


Figure 6. Marginal effect of compounding shocks on the probability of being in "Poor" food security state. Source: Author.

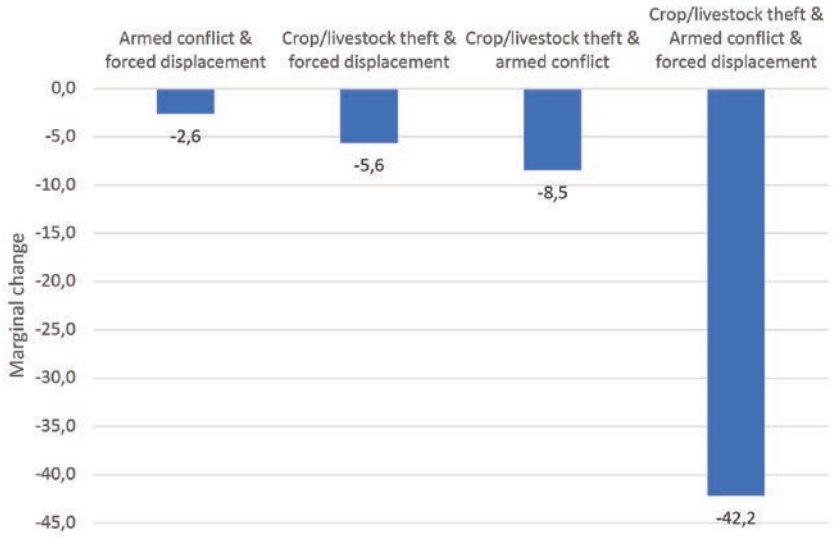


Figure 7. Marginal effect of compounding shocks on the probability of being in "Acceptable" food security state. Source: Author.

in Figure 6 & 7, the marginal effects of compounding shocks on food security escalate substantially compared to the individual shocks. Compounding shocks occur when multiple shocks happen simultaneously or in quick suc-

cession, leading to a cumulative impact. For example, a drought may reduce crop yields, while a pandemic may disrupt supply chains and limit access to food, creating a compounding effect that worsens food insecurity.

The marginal effects of compounding shocks on food security can be severe. They can lead to higher food prices, reduced food availability, and decreased access to nutritious food, which can increase malnutrition and hunger. In addition, they can affect food systems in different ways, such as by disrupting production, distribution, and marketing of food, creating further challenges. Furthermore, compounding shocks can have long-term effects on food security. For instance, they can reduce the resilience of households, communities, and countries, making them more vulnerable to future shocks. Therefore, addressing the root causes of food insecurity and building resilience to compounding shocks is essential to ensure sustainable food security for all.

4. Concluding remarks

The challenge of responding to multiple and compounding food shocks is a complex and multifaceted issue that requires a coordinated and sustained effort from various actors at the local, national, and global levels. In the case of the DRC, food shocks are resulting from various factors such as extreme weather events, diseases outbreaks, conflicts, and economic shocks. When multiple shocks occur simultaneously or in quick succession, the impact on food systems can be compounded, leading to increased food insecurity and malnutrition.

To address this challenge, it is important to adopt a holistic approach that considers the various interconnected factors that contribute to food shocks. This includes measures to improve the resilience of food systems, such as diversifying crops, building climate-resilient infrastructure, and investing in early warning systems. Additionally, efforts to promote sustainable and inclusive economic growth, reduce poverty and inequality, and build social safety nets can help mitigate the impact of food shocks on vulnerable populations.

At the same time, it is essential to strengthen coordination and collaboration among stakeholders involved in food security and nutrition, including governments, civil society organizations, private sector actors, and international organizations. This includes sharing information, resources, and best practices, as well as working together to develop and implement effective policies and programs.

Overall, responding to multiple and compounding food shocks requires a long-term, sustained effort that recognizes the complex nature of shocks and involves a broad range of stakeholders working together towards a common goal.

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Lessons Learned on Food Security in the Yemen Crisis

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1. Introduction

From the wealthy kingdom the Queen of Sheba to the "Arabia Felix" on Roman maps, Yemen was historically known as a rich, fertile, and fortunate land. In the late twentieth century, however, Yemen's economic growth was stalled by a weak central government and complex tribal patronage system. Unlike other neighboring Gulf states, Yemen has very limited oil reserves, and remittance income from migrants became a major source of income, displacing investment in agricultural production. Coupled with high population growth, Yemen increasingly became dependent on imported food supplies. Poverty and malnutrition rates were also high. In 2013, 46.5% of children under 5 in Yemen were stunted and 16.3% suffered from acute malnutrition (Yemen DHS 2013). These development challenges in Yemen exploded into a humanitarian emergency with the beginning of the ongoing war in 2015.

Currently, it is estimated that more than half of children in Yemen are malnourished and all areas of the country are classified as in crisis or worse by IPC. With a population of approximately 20 million, this makes Yemen by some accounts the largest humanitarian crisis in the world at present. Assessments of the situation also emphasize that the situation would be worse without ongoing humanitarian support. In the period from 2015-2022, an estimated 16 billion dollars was donated and spent through the interagency standing committee coordinated appeal. The World Food Program alone supports nearly 13 million of the most vulnerable people with emergency food assistance (WFP 2023).

The humanitarian response in Yemen is one of the largest in the world and many of the challenges and lessons in the response to the food security crisis in Yemen are generalizable more broadly to fragile and conflict-affected settings and import-dependent settings. Most broadly, the challenge in Yemen has been to balance the short-term perspective of needing to respond to an emergency situation with the realization that after over eight years of conflict, longer-term needs and interests also have to be considered.

In particular, lessons from Yemen include the degree to which import dependence increases vulnerability, the potential for expanded use of cash transfers, the importance of supporting the private business in the agrofood sector even during a humanitarian crisis, the role of local organizations, and the challenges of coordination on targeting.

2. Import dependence increases vulnerability

Even prior to the ongoing war, Yemen was highly dependent on imports for its food security, and local agricultural production suffered further during conflict. Imported wheat is a staple food source and poor households rely on wheat for almost the entirety of their calorie needs. This structure increased household vulnerability as the local price of wheat is highly affected by global price shocks, macroeconomic shocks, and conditions at Yemen's main international ports.

Yemen's food import dependence was most obviously a threat in an earlier period of the conflict in late 2017 to early 2018 when control of the port city of Al Hodeidah was contested and imports were blocked. Households reported greater food insecurity during this period, with a statistically significant increase measured in types of potentially harmful coping strategies employed such as skipping meals and eating lower quantities of food, and corresponding decrease measured in dietary quality as captured by the food consumption score (Tandon and Vishwanath, 2020). The political resolution of this blockade was vital, and the markets for staple foods have since functioned relatively well, and absolute shortages are not generally reported in market monitoring surveys;[1] however, affordability remains a key challenge.

The conflict has increased the cost of imported food for Yemenis. Increased restrictions on fuel imports, together with other diversions and tariffs, keep fuel prices high compared to other countries in the region and far above the subsidized price that prevailed prior to the conflict (Thomas 2022). In turn these high fuel tariffs, together with long delays caused by checkpoints and damaged infrastructure, have increased costs of internal transportation within Yemen. Private sector food importers also face high costs related to challenges of accessing finance due to financial sanctions, costs related to delays at ports for inspections, and increased insurance costs caused by the conflict situation.

[1] See REACH Yemen Joint Market Monitoring reports.

Additionally, the high import reliance means that global price shocks and terms of trade shocks have severe impacts on household's ability to afford wheat flour. Notably, when global wheat and fuel prices rose in early 2022 in the aftermath of the war in Ukraine, Yemeni households experienced higher prices locally. Staple food affordability has also been challenged by the declining purchasing power of the Yemeni Riyal. While the official exchange rate appears stable, the market determined parallel exchange rate reveals the rapid depreciation of the currency in the southern governorates controlled by the internationally recognized government where excess printing of new bank notes has resulted in high inflation.

In spite of the price rises, imported wheat remains the cheapest calorie source available in Yemen, so households are forced to spend an increasing share of their income for this essential commodity. In a survey of poor households in Al Hodeidah, calorie consumption from staple grains increased significantly during the conflict even as prices rose, and wheat consumption was highest as a share of consumption for the poorest households and those in villages with the highest reported prices (Kurdi et al. 2019).

Meanwhile, local production of staple food items is very low due to high production of the highly valued narcotic *khat,* combined with unpredictable rainfall and depleted groundwater resources, and decades-long under-investment in the agricultural sector.

Reducing vulnerability for Yemeni households requires thinking beyond short-term emergency food distribution to supporting agricultural recovery.

3. Cash transfers can work and have significant nutritional benefits

Cash-based programming for humanitarian responses has emerged as a growing trend in the past decade following widespread acceptance of cash-transfers in development programming (ODI 2015). Cash transfers are more easily scalable and cheaper than in-kind assistance and less distorting of local production systems. Studies in a variety of contexts also suggest that distributing cash leads to greater dietary diversity than baskets of staple food items, because households prefer to use some of the cash to buy non-staple food items such as locally produced fruits, vegetables, and animal products.

Yemen is prime example of a protracted crisis context, in which humanitarian food aid is no longer focused on short-term relief, but has become a long-term reality and major component of the national food supply. More

than half of households in Yemen receive some form of food assistance. This persistent situation means that the nutritional composition of diets (especially for sensitive groups like young children and expectant mothers) is as important as sufficient calories as there are life-long developmental consequences of childhood malnutrition (Leroy et al. 2019).

The benefits of cash transfers are particularly compelling when compared to costs. It is estimated that in the Yemen emergency response, in-kind food distribution had administrative costs amounting to approximately 77% of the value of the direct benefits received compared to only 16 to 17% for cash transfers or food vouchers (Ghorpade and Ammar 2021).

Research confirms that cash transfers worked well in Yemen at increasing dietary quality. An impact evaluation of the current Cash-for-Nutrition program of the Yemen Social Fund for Development (SFD), conducted during the civil war from 2015 to 2017, showed that cash transfers generated substantial benefits for child nutrition (Kurdi 2021). Cash for Nutrition provides households with young children with cash transfers equivalent to about 25% of their monthly food budget and provides monthly child and maternal nutrition education sessions led by locally-recruited community health educators.

The evaluation found that the program increased household food purchases by at least 17 percent and importantly that most of that increase came from purchases of nutrient-rich foods such as vegetables, fruits, milk, and eggs. Staple food consumption was unchanged. The program also significantly increased the number of food groups consumed by children ages 6-23 months, a critical window for early childhood development, by 0.45 food groups compared to a baseline mean of 3.0 on scale where 4 food groups is considered a minimally acceptable diet. Finally, the program significantly increased the probability of early initiation of breastfeeding, exclusive breastfeeding for babies under 6 months, and treating drinking water (Kurdi et al. 2020).

Through the combination of these improved nutritional practices and better food access, the Cash for Nutrition program decreased the rate at which children were diagnosed with acute malnutrition by 10 percentage points and prevented decreases in height-for-age and weight-for-age among children in the poorest third of eligible households.

Supporting evidence on the nutritional benefits of cash transfers in the Yemeni context is also provided by research conducted prior to the civil war. A comparison of food and cash assistance using a randomized con-

trol trial in Yemen prior to the current conflict found that cash transfers resulted in more nutritious diets for beneficiaries than equivalently-valued cash transfers (Schwab 2020). Similarly, analysis of panel data collected in 2012-2013 also found that while conflict was associated with higher rates of malnutrition, cash transfers decreased the negative impact of conflict on acute malnutrition by at least half (Ecker 2021).

4. Traders and other agro-food sector actors need support

In spite of the massive food distribution effort, the private sector still supplies the majority of food to households in Yemen. The humanitarian response has the potential to work together with the private agro-food sector to create greater resilience in the Yemeni economy, which in turn is vital to long-term food security.

Households in Yemen rely on small traders to purchase food on credit, so ensuring the sustainability of these small businesses indirectly benefits the households that take advantage of their services.

Approximately half of the food that households purchase is made on credit rather than in cash and the majority of small traders allow the use of credit (Kurdi 2021). By allowing purchases on credit without charging interest for late payments, small traders also play an important role in supporting risk-sharing at the local level. A model of small trader price-setting behavior that incorporates features described by Yemeni informants highlights that because all households using a particular shop tacitly agree to pay higher prices at local shops in exchanges for potential support from shopkeepers to be patient with repayment in times of crisis, the store acts as an informal insurance broker (Kurdi 2016).

Understanding the role of small traders in food security highlights the importance of combining humanitarian relief with development responses that help support small businesses and using cash-based approaches where possible.

In-kind food distribution can also be better integrated with the local market. A qualitative study found that the pilot Healthy Kitchen program in Yemen for providing school children with more diversified meals including fruits, vegetables, and sandwiches is extremely popular with beneficiaries as an alternative to distribution of high energy biscuits and date bars because of the greater variety and palatability of food, and the majority of the ingredients are able to be locally sourced, supporting Yemeni farmers (Bliznashka et al. unpublished).

In recent years, there has been an increasing realization that more international funding needs to be directed to development efforts in Yemen alongside traditional humanitarian response. With the relative peace since the truce in 2022, the scaling up of public works programs, support for farmers, and small business and value chain development are starting up in parallel with the continuation of food distribution and aid. A potential challenge is that traditional development interventions may fare less well in conflict-affected settings. A graduation program approach, for example, had much less satisfying results in Yemen than in other stable contexts, likely related to the added challenge for households of being faced with frequent shocks related to the conflict (Brune et al. 2022). The effectiveness of development remains to be measured, but anecdotally it is highly demanded within Yemen as people say they want to return to the dignity of providing for themselves rather than relying on handouts.

Rather than seeing conflict-affected contexts as fully devastated economies that need to be kept on life-support until conflict ends followed by complete rebuilding, it is worth understanding that trade continues during conflict, albeit at a higher cost and complexity than during peacetime. For this reason, investing in infrastructure construction, marketing support, and supporting agreements even at the local level to reduce trade restrictions and checkpoints is an important part of the broad goal of supporting sustainable food security.

5. Running interventions through local institutions contributes to sustainability

One of the notable successes in the Yemen humanitarian response has been to maintain some of the key national institutions as partners. Emergency support provided by international development assistance has been channeled through the Social Fund for Development, the Public Works Program, and the Social Welfare Fund, pre-existing national institutions that have maintained working relationships with both sides of the ongoing conflict (Ugo et al. 2018). The Social Fund for Development, for example, had been successful prior to the war in developing stakeholder ownership and trust through a decentralized approach and strong commitment to political neutrality (Al Iryani et al. 2015). In the eventual recovery, this will create the basis for re-establishment of a good governance through a nationally-owned and controlled social protection system, rather than enforcing dependency on external institutions.

As an example of some of the measurable benefits of this approach, comparing survey data from before and after participation, employees in a community-driven development program run by the Yemeni Social Fund for Development had significantly more trust in local government and other local institutions such as tribes and government officials as well as more optimistic perceptions about the potential for local community level cooperation (Bertelli et al. 2019).

6. Data, targeting, and funding remain key challenges

One of the main challenges identified in the Yemen humanitarian crisis has been a lack of coordination and data sharing, leading to imperfect targeting and lack of a cohesive response.

The general challenges with on the ground data collection mean that targeting is highly reliant on extrapolation from limited survey data, combined with poverty estimates generated before the war. While the existence of the Social Welfare Fund directory of beneficiaries provided a helpful starting point for individual targeting, the lists are widely known to be outdated lists.

An evaluation of the targeting effectiveness of the initial humanitarian response in Yemen in 2017 based on mobile phone monitoring data showed that aid delivery was concentrated in areas of higher need, but that there was room for improvement as food distribution adjusted to changes in announced IPC classifications, but not by enough to prevent deterioration in household food security in the most deprived areas (Tandon and Vishwanath 2021).

The various organizations working in Yemen even within the UN system have their own targeting methodologies and approaches. Both through donors and through the cluster system, there are ongoing efforts to better coordinate these approaches to prevent unintended duplication and to create synergies, where possible, through "geobundling" interventions in the same areas, but coordination is still an administratively difficult and time-consuming process.

Finally, the Yemen humanitarian response remains highly dependent on international donors, and vulnerable to funding shortfalls which are likely to continue.

7. Conclusion

How to best support household food security in Yemen is a vital question given the scale of the humanitarian emergency. An emerging body

of rigorous research contributes to identifying some key lessons learned from the experience in this country, which can be applied beyond Yemen: countries with high food import dependence are particularly at risk during conflict but may also find the greatest benefits from cash-based assistance; market actors are also important, including particularly small traders which are often overlooked in thinking about food systems; and working through local institutions appears to have potential for maintaining national governance infrastructure.

This review has also highlighted the degree to which research can be done and is currently ongoing even in difficult settings to help answer important questions about the effectiveness of the humanitarian response at protecting household food security.

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The State of Food and Humanitarian Crises: Insights from Afghanistan

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1. Overview

Afghanistan is a landlocked country located at the crossroads of Central and South Asia. The country has witnessed political and economic instability since the Soviet invasion of 1979. Following the Soviet invasion, the civil war during 1992-96 brought violent clashes between the various factions of the Mujahideen groups. In 1996, the hardline Taliban seized control over most of the country and imposed their rule, supported by their own interpretation of the Shariah law, until they were ousted by a US-led coalition in response to the 9/11 attacks in 2001. Since 2001, Afghanistan has been in a state of conflict parallel to the reconstruction efforts in almost all walks of life. The past two decades have seen the intervention by the international community to work closely with the then elected Government and address the country's struggle with widespread poverty, corruption, gender-based discrimination and political instability. In 2019, as with other countries, the fragile situation of Afghanistan was shaken by Covid-19 with limited healthcare facilities and resources to deal with the pandemic. After the US-Taliban deal or the Doha Agreement, on February 29, 2020, in Doha, to bring an end to the 2001-2021 war in Afghanistan, and the withdrawal of US and allied (NATO) forces, the Taliban took over Kabul on August 15, 2021. Since then, there have been reports of horrific human rights violations, killings and deprivation of women and girls of their right to work and education. The international community has been witnessing prevailing poverty, unemployment, lawlessness and the Taliban's disregard for international agreements and United Nations principles.

Since assuming power in August 2021, the Taliban have prioritized their agenda, while disregarding the fundamental needs and rights of the Afghan people. Consequently, Afghanistan has been recognized as the world's most severe and largest humanitarian crisis in 2023, with about 28.3 million people requiring humanitarian and protection assistance. According to projections, approximately 875,000 children are expected to suffer from acute malnutrition in 2023 as well as 2.3 million children and 840,000 women

from moderate acute malnutrition (OCHA, 2023b). Local sources suggest that the situation could be even worse than estimated, but the information is often censored, and international and local independent organizations have limited access to data in Afghanistan, where the Taliban's de facto regime still seeks political recognition.

This paper, therefore, highlights the insights from Afghanistan regarding the state of the ongoing food and humanitarian crises in Afghanistan. It highlights the challenges faced by the most vulnerable populations across the country, including refugees, internally displaced persons (IDPs), and those affected by conflict and natural disasters. The lack of factual data is another issue being faced by the humanitarian organizations on site. Without accurate and reliable information on the extent and severity of the situation, it is extremely challenging for the international community to fully understand the scale of the problem and provide effective assistance. The factual data deficiency has hindered the response of international aid organizations to the crisis, resulting in inadequate aid and resources being allocated to address the urgent needs of the most vulnerable population in Afghanistan. Overall, this paper underscores the need for increased efforts to collect and analyze data on the food and humanitarian crises in Afghanistan.

2. The scale of food and humanitarian crises

After the Taliban took over the country in August 2021, the food security situation worsened; nearly half of the population, or 19.9 million people, are acutely food-insecure (IPC 3+) with limited access to food, putting them at risk of malnutrition and mortality (WFP, 2023). Furthermore, approximately 6.1 million people are on the verge of famine (IPC 4), which has been designated as the world's largest and most severe humanitarian crisis. A recent humanitarian update from the United Nations (OCHA, 2023a) informs about Afghanistan being at the highest risk of famine in 25 years at times when the de facto Taliban are ruling the country since their takeover in August 2021. Since then, the food insecurity situation has reached alarming levels, with nine million people experiencing acute food insecurity between November 2022 and March 2023. Findings of the FSAC (2023) show that in April 2023, around 3.36 million people, accounting for 7.8% of the total population, require emergency assistance (IPC 4) and the number is projected to fall to 6.4% during May-October, 2023 (Figure 1).

Girls and women constitute 7.4 and 6.4 million, respectively, of the total 28.3 million individuals requiring life-saving aid (Figure 2) (OCHA, 2023b).

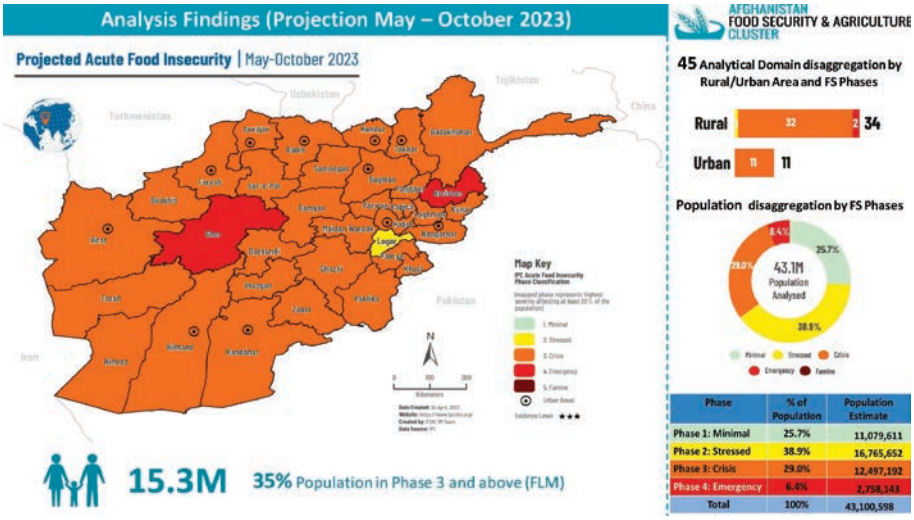

Figure 1. Projected acute food insecurity during May-October 2023 (FSAC, 2023).

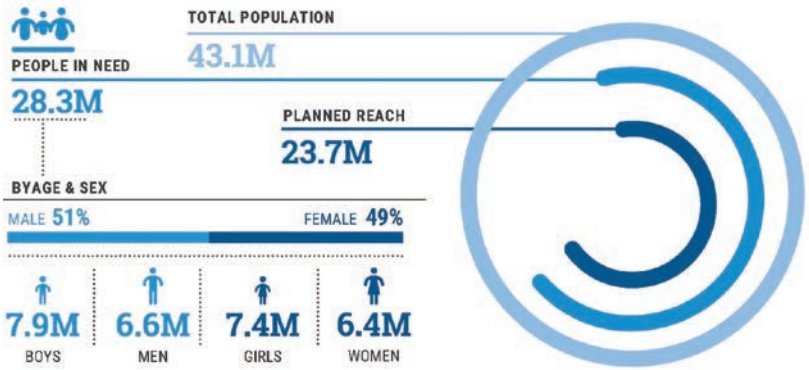

Figure 2. Statistical information of the people in need in Afghanistan (OCHA, 2023b).

These figures indicate a dire need for urgent action to address the food insecurity and malnutrition crisis to prevent further suffering and loss of lives.

According to the recent projection of the UN (2023), it is anticipated that four million children, as well as pregnant and breastfeeding moms, will suffer from acute malnutrition this year (OCHA, 2023a). Among the population in need, around 54% are children, 23% are women and 8.3% are people with disabilities of one form or another (OCHA, 2023a). Besides, 17.6

million people are expected to be needy of humanitarian health assistance during 2023 (OCHA, 2023a). The food security and malnutrition situation is worse in rural areas compared to urban settings due to the inaccessibility of international aid organizations as well as inaccurate diagnosis of the most vulnerable people in these areas.

3. Key drivers and factors of food insecurity and malnutrition in Afghanistan

The Taliban takeover in Afghanistan in August 2021 has worsened the pre-existing challenges of food insecurity and malnutrition impacting the country. The mix of factors contributing to food insecurity and malnutrition includes poverty, economic fragility, sanctions, inflation, climate change, and displacement due to conflicts and insecurity across the country. With the withdrawal of the United States and allied forces, international NGOs and diplomatic missions, and the imposition of sanctions on Afghanistan, poverty has become the fate of the entire population, as access to essential goods, including food, has become increasingly difficult due to the people's lowered purchasing power.

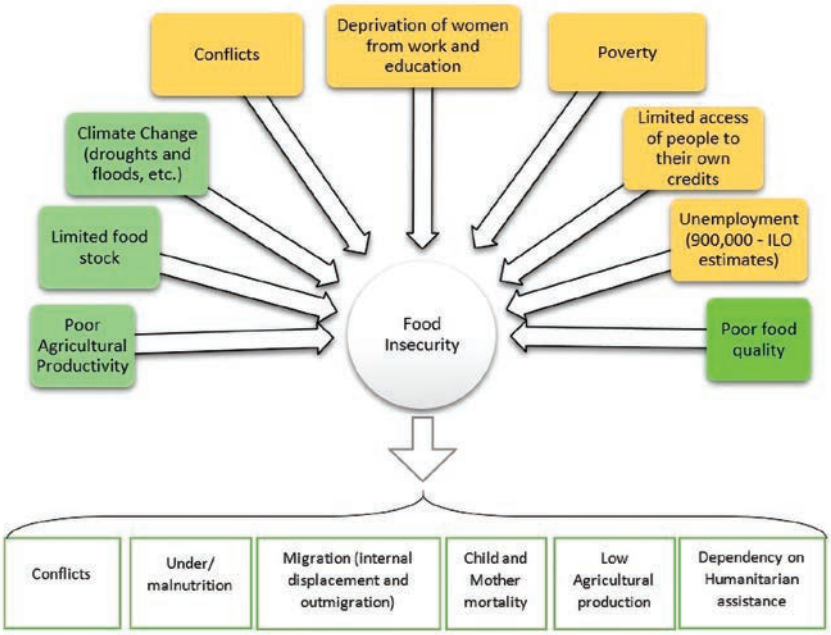

Figure 3. Drivers of food insecurity in Afghanistan.

The Taliban's strict limitations on female employment and education, coupled with their inflexible stance on human rights, and disengagement of the educated youth, have further deteriorated the country's economic situation and heightened the risk of malnutrition and food insecurity. The regime's restrictions on customers' access to their credits have compounded the crises of malnutrition and food insecurity in the country. Furthermore, droughts and floods driven by climate change have caused significant losses, particularly in regions that rely heavily on agriculture. The conflict and insecurity in Afghanistan have also displaced millions of people, disrupting their access to food and basic services, leading to the loss of assets and livelihoods (Figure 3). A recent study underscores Afghanistan among the world's top 3 regions to be more susceptible to the impacts of extreme heatwaves in the future (Thompson et al., 2023) which will seriously damage the crops yield, especially if the heatwaves are supplemented by drought conditions (GFDRR, 2023).

4. Consequences of food and humanitarian crises

Afghanistan is currently grappling with multiple crises that are worsening problems such as malnutrition and food insecurity, and causing considerable short- and long-term impacts on human well-being, health, and development. The prevailing conflict and internal displacement have disturbed the overall food systems due to the Taliban's de facto regime's self-oriented decisions and isolation from the rest of the world, disregarding any international or human rights laws. This situation has caused food shortages and an increase in food prices. In addition, throughout the country, droughts and other relevant climate disasters have led to crop failure and fatalities in livestock, which is disastrous for the already vulnerable subsistence farmers. As a result, an estimated 28.3 million Afghans, particularly children, women, and the elderly, are facing hunger, health issues, and malnutrition (OCHA 2023b).

The de facto regime's ban on women working and education is a serious violation of human rights which negatively affects their access to adequate food and health. Families who rely on their available capital are likely to deplete their financial reserves, restricting their options. This may exacerbate food insecurity and malnutrition, perhaps leading to elevated mortality rates among vulnerable groups such as pregnant women, children, and persons with special needs (Figure 3).

Anecdotal evidence from Afghanistan indicates that escalating levels of food insecurity and malnutrition have contributed significantly to height-

ened social unrest among the common population, conflicts and violence (Figure 3). These issues are often underreported and discouraged to be publicized by the ruling de facto regime. The adverse impacts of food insecurity on employment rates, economic opportunities, and the marginalization of educated youth have further amplified the risk of criminal tendencies in the country. On the one hand, these skilled workers are being compelled to emigrate due to unfavorable conditions back home; alternatively, they may be forced to comply with the policies of the ruling de facto regime; the latter can lead to the criminalization of their behavior in the society which can significantly impact their mental health.

5. Review of actions taken to address food and humanitarian crises

After the takeover of Afghanistan, amid the fear of collapse, UN donor agencies pledged assistance of $1 billion for Afghanistan (The Washington Post, 2021) which was supposed to be given to counter the humanitarian crises. Since then, the WFP has offered short-term aid to 23 million people in Afghanistan throughout 2022, including assistance to 12 million women and children, amid the historic levels of food shortages and malnutrition under the de facto Taliban regime. This aid was given in the form of 1.14 million metric tons of emergency food and commodities as well as almost USD 327 million in cash-based assistance. Due to the earthquake in 2022 which impacted much of southeastern Afghanistan, more than 1000 human lives were lost, including hundreds of homes and shelters; with assistance from other partners, around 3,691 metric tons of food items were distributed among 101,000 people in the most affected six districts of Khost and Paktika provinces (WFP, 2023a). Data from the WFP (2023a) shows that

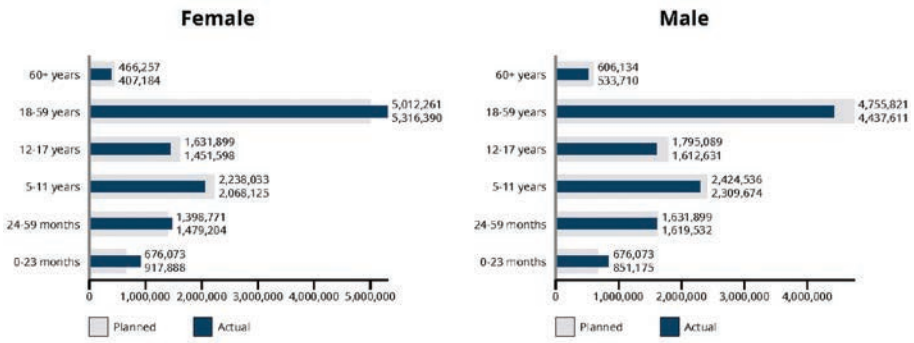

Figure 4. Beneficiaries by age and sex group (WFP, 2023a).

out of the total beneficiaries in 2022, 51% were female and 49% were male, among the most needy population in Afghanistan. Similarly, in both males and females, the maximum beneficiaries were in the age group of 18-59 years, followed by children, i.e., 5-11 years (Figure 4).

6. Challenges to the effectiveness of the humanitarian aid delivery

Despite attempts to reach out to the most vulnerable people in Afghanistan, the effectiveness of aid distribution has been questioned due to various factors which are given below:

- Firstly, the provision of aid temporarily often proved to be insufficient in addressing the long-term well-being of the population. Additionally, aid may not adequately fulfill the requirements of an entire household under their tough financial conditions, unemployment and unhealthy conditions.
- There have been reports of nepotism in the selection of vulnerable households by local and De Facto Authorities both at the capital and provincial levels, resulting in aid not reaching the most deserving beneficiaries. The uncooperative behavior of De Facto Authorities with implementing and donor agencies also poses a challenge to aid distribution efforts.
- There are several examples of no coordination within and among factions of De Facto Authorities regarding the distribution of foodstuff and selection of beneficiaries, leading to delays and potential discrimination in the provision of aid.
- Interventions by De Facto Authorities in the working procedures of implementing agencies have hindered aid distribution efforts. In most cases, individuals associated with De Facto Authorities have been forcefully added to the list of beneficiaries instead of vulnerable households, further highlighting the challenges in aid distribution efforts in Afghanistan.
- On-the-ground observations also indicate that some beneficiaries have been subjected to paying "fees" to De Facto Authorities or assisting them with their targeted missions in order to receive humanitarian assistance.

Overall, these factors demonstrate the need for a more coordinated and effective approach to aid distribution in Afghanistan to ensure that aid reaches those who need it the most and can make a long-term impact on their well-being.

7. Strategies for the enhancement of the effectiveness of aid delivery

In order to ensure the effectiveness of aid distribution, it is critical to identify the most vulnerable populations, which is often a complex process, especially in conflict regions such as Afghanistan. However, besides conducting a comprehensive need assessment for the identification of the most vulnerable population in a designated community, it has been usually effective to engage with local communities, village leaders, community development council (CDC) chiefs and village Shuras which are made of the community members themselves. Furthermore, targeting criteria could be used to identify the most vulnerable people such as their income level, gender, age and disabilities which could help prioritize assistance to those meeting these criteria.

In addition to the identification of vulnerable populations, several key strategies could be helpful in the improvement of the effectiveness of aid distribution in Afghanistan. Most of the strategies given below have already been tested in Afghanistan and have yielded positive results:

- Focusing on basic needs – prioritize addressing basic needs such as food, healthcare, education and clean water. By addressing these needs, aid can help build the foundation for a stable and prosperous society
- Long-term livelihood projects need to be designed and implemented to help build sustainable solutions to alleviate the current poverty and food insecurity challenges.
- Building infrastructure – Investing in infrastructure such as bridges, roads, and power plants can create jobs and stimulate economic growth. It can also improve access to basic services and help connect isolated communities.
- Encouraging private sector development – Aid should encourage the growth of private sector businesses and entrepreneurship. In the long term, this can help create jobs and stimulate economic growth.
- As per a routine exercise in the past two decades, cash for work could be provided which may help in creating jobs and reducing unemployment
- Another strategy would be to involve women in the implementation of these projects; based on the Taliban's limitation on women in all sectors, this initiative could be implemented by women for women.
- Additionally, efforts are needed to ensure free media coverage of the aid distribution which would help increase transparency and accountability in aid distribution.

- International observers and monitors should be involved in the implementation of these humanitarian projects to help ensure that aid is delivered fairly and reaches the most deserving people. This includes conducting third-party monitoring that examines aid effectiveness and use of resources.
- A community-driven social audit helps in the effective use of resources.
- Donor countries and agencies should strive to influence the De Facto Authorities to ensure that humanitarian aid is distributed to vulnerable households fairly and equitably.

By putting these tactics into practice, aid distribution activities in Afghanistan can be more successful and help to meet the needs of the most vulnerable population.

8. Conclusion

The ongoing humanitarian crises in Afghanistan require a comprehensive approach that addresses the root causes of food insecurity, overall poverty, economic fragility, climate change, and conflicts. The number of people exposed to the potential famine is currently among the highest in the world. It requires a sustained commitment by the donor agencies and the international community to provide humanitarian aid and assistance to the most vulnerable populations. With the De Facto regime of the Taliban in power, it is critical that the international community work together, pressurize the regime to listen to the demands of the Afghan population, stay committed to the UN Charter on human rights and collectively address the challenges of food insecurity and malnutrition as well as ensure that the Afghan people have access to the food and services they need to survive and enjoy at least basic human rights.

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Impact of Humanitarian Assistance on the Food Security of People Affected by Conflict, Drought, and Earthquake in Northwest Syria

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1. Introduction

The food security situation in Syria has drastically deteriorated since last year. In 2023, an estimated 15 million people will need some form of food and agriculture assistance, representing 68 percent of the total population. At least 12.1 million people are estimated to be food insecure, including all 2 million people living in camps who are deemed to be 100 percent food insecure, and 2.9 million people are estimated to be at risk of food insecurity, an alarming increase of people at risk who could shift to become food insecure during 2023 if the crisis continues at same worsening levels. The WFP remote food security monitoring and recent food security and livelihood assessment in Syria (FSA, FSLA) estimate that seven in ten Syrian families are food insecure with the highest concentration in Idleb (74 percent), Quneitra and Al-Raqqa (68 percent), Aleppo (61 percent), Deir-ez-Zor (56 percent), Al-Hasakeh and Hama (53 percent) Governorates, as the compounded crises have touched every aspect of people's lives, with access to food as one of the most pressing needs. Idleb Governorate continues to be impacted by the unstable security situation and the widespread economic crisis, which hit local communities as well.[2]

Trend analysis from the Joint Food Security and Nutrition Assessment 2022[3] has shown that the level of acute malnutrition among children and women is steadily rising in the country since 2019, whilst stunting, micronutrient deficiencies, and uptake of infant and young child feeding, and care

[1] Shafak Organization (SO): This is a non-profit humanitarian organization registered in Turkey since 2013 as a local NGO. Shafak is operating in northwest Syria and Turkey. Shafak is one of the main actors in food security in Syria response. www.shafak.org

[2] HNO 2023.

[3] Joint Food Security and Nutrition Assessment 2022.

practices remain concerning. While it is early to see a significant increase in acute malnutrition following the earthquake, the nutrition cluster in NW Syria is anticipating an increased caseload of just over 10,000 cases associated with the earthquake.[4] Children and mothers in Northwest Syria are particularly vulnerable to malnutrition. Between May 2019 and June 2021, chronic malnutrition rates among children aged under five jumped from 19% to 24.5%. Acute malnutrition also prevails among pregnant and lactating women with many facing increased health risks during pregnancy and breastfeeding. Children in Northwest Syria also suffer from high stunting rates, which can impact their educational prospects and overall ability to live happy and active lives. According to World Vision's latest assessment in the area, around 60% of families flagged the distribution of micronutrient supplements or powder as one of the most important nutrition needs due to growing food insecurity.[5]

In northwest Syria, 90 percent of the population, 4.1 million people (12.1 M people are estimated to be food insecure), were already relying on humanitarian assistance prior to the earthquake. Food insecurity had already reached alarming levels in 2021 and continued to deteriorate throughout 2022. In 2021 and 2022, Syria ranked 106 out of 113 countries assessed in the Global Food Security Index.[6]

2. Factors that have increased food insecurity in Northwest Syria

2.1. Conflict after 2011

Northwest Syria has been facing a protracted conflict since the early days of the Syrian civil war in 2011. The conflict has resulted in the displacement of millions of people, causing massive disruption to livelihoods, infrastructure, and services.

Since the start of the Syrian civil war in 2011, the number of civilians experiencing food insecurity in the country has grown substantially. Syria is among the six countries with the lowest levels of food security worldwide. At the end of 2022, 12 million people were food insecure, and 2.5 million were severely food insecure. Individuals in these categories com-

[4] Earthquake Response in Syria Humanitarian Situation Report No. 5.

[5] Dire consequences: 12 years of suffering in Syria. An overview of the most pressing needs shaping the humanitarian response in Syria today. March 2023.

[6] Global Food Security Index, The Economist Intelligence Unit, 2022. Available at: https://cutt.ly/CKAcxUB; https://impact.economist.com/sustainability/project/food-security-index/explore-countries/syria

prised more than half of the entire Syrian population. The present report highlights a range of violent conflict-related events that have contributed to the rise in food insecurity in Syria since 2017. The conflict has resulted in the destruction of significant numbers of Syrian bakeries, which has contributed to shortages of bread, which is a staple of the Syrian diet. Attempts to respond to Syria's food insecurity with humanitarian food aid have been severely hindered by access restrictions and violent attacks on food distribution efforts. Not only does shelling, artillery, and missile fire itself destroy crops, but insecurity generated by these actions also prevents farmers from accessing their lands. This was the case in northwestern Syria in the summer of 2019, when farmers were prevented from harvesting the crops they had planted. Subsequent crop losses for farmers in these areas were estimated to be between 25% and 100%.[7]

Crop destruction by fire: between 2017 and 2022 there were at least 198 incidents where crops or farmland was set on fire. The vast majority (91%) of all incidents were recorded in the summer months of May and June when Syria's key crop – wheat – is harvested. Incidents peaked in 2020, with over 40% of all cases recorded that year, while only five were reported in 2022.[8]

The destruction of bakeries affected civilians, for whom bread forms a staple part of their diet. In some cases, Syrian bakeries produced three tons of bread a day before the war, and civilians were dependent on them for bread. Hence, the inoperability of bakeries is likely to have had significant implications for the food security of Syrians and to have contributed to the country's bread crises.[9]

2.2. Drought after 2016

The area has also experienced a severe drought in recent years, which has added to the already precarious food security situation.

The key drivers of food insecurity in Syria have been both human and climate change induced. Syria suffered a significant drought between 2006 and 2010, while in 2020 and 2021 unprecedented levels of drought and rainfall scarcity were reported. As a result, the percentage of irrigated land

[7] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

[8] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

[9] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

in the country has almost halved. The high dependency on the import of a number of commodities, aggravated by poor agricultural harvest seasons in the country, has left Syria susceptible to high global food prices. The World Food Program reported that between 2020 and 2022 food prices in the country increased by 532%. As a result, 90% of the Syrian population is currently estimated to live in poverty. The Syrian economy has been further affected by the ongoing war in Ukraine, which has contributed to further driving up food and fuel prices. The damage and destruction of water infrastructure and facilities constitute a major humanitarian and health issue in Syria and have contributed to a shortage of water to irrigate Syrian crops and farmlands.[10]

These attacks exacerbate an already difficult situation for Syrian agriculture and food production. Syria has a semi-arid geography, meaning that ensuring access to water has always been "tenuous". Added to this, drought has increased demand: some of the worst droughts on record were experienced in 2020 and 2021, especially in the northern and eastern regions of Syria. Consequently, efficient water systems are crucial for the supply of water to the population and, most importantly, the irrigation of agricultural lands and crops. Indeed, in 2019 Syria's annual water requirements were estimated at approximately 12.9 billion m3, with agriculture thought to use 86-89% of this.[11]

When the Syrian crisis began in 2011, water was an important factor in sparking the revolt because the drought exacerbated the existing socio-economic distress. Since the conflict began, it has proved catastrophic for Syrian water resources; damaged infrastructure left entire regions without irrigation, drinking water, and hydroelectric power, rendering them increasingly vulnerable to seismic activity.[12] The effects of climate change on agriculture can result in lower crop yields and nutritional quality due to for example drought, heatwaves, and flooding as well as increases in pests and plant diseases. The effects are unevenly distributed across the world and are caused by changes in temperature, precipitation, and atmospheric carbon

[10] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

[11] Special Report 2021 FAO crop and food supply assessment mission to the Syrian Arab Republic.

[12] Sottimano A. and Samman N. (2022). Syria has a water crisis. And it's not going away. https://www.atlanticcouncil.org/blogs/menasource/syria-has-a-water-crisis-and-its-not-going-away/

dioxide levels due to global climate change. A range of measures for climate change adaptation may reduce the risk of negative climate change impacts on agriculture (e.g. changes in management practices, agricultural innovation, institutional changes, climate-smart agriculture),[13] and are sometimes considered part of changes toward a sustainable food system alongside (or in combination with) changes that reduce global warming from the food system.[14] The water crisis and drought-like conditions affecting Syria are coupled with existing damage and neglect of farmlands and irrigation systems as a result of a decade of crisis. Around 40 percent of the irrigated agricultural areas are no longer able to rely on the availability of water. Insufficient and poorly distributed rainfall in the 2020/2021 agricultural season, together with several heatwaves, the high cost of agricultural inputs, limited availability of irrigation water, and the high cost of fuel for pumping resulted in a contraction of the harvestable cereal area. The water scarcity, damaged irrigation infrastructure, and the low rainfall level have forced most farmers, especially in Rural Damascus and rural Aleppo governorates, to rely on surface wells to cover part of their irrigation needs. This will have a negative impact on groundwater decline and depletion, leading to high pumping costs.[15]

2.3. Earthquake Feb 6th, 2023

In February 2023, a powerful earthquake hit the border region between Turkey and Syria, causing widespread damage and loss of life. The quake caused further displacement of people, adding to the already massive numbers of internally displaced persons (IDPs) in the region. The impact of conflict, drought, and the earthquake on the people of northwest Syria has been severe.[16]

[13] Oppenheimer M, Campos M, Warren R, Birkmann J, Luber G, O'Neill B and Takahashi K (2014). Emergent risks and key vulnerabilities. In Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B (eds.). *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. pp. 1039-1099.

[14] Porter J., Xie L., Challinor A., Cochrane K., Howden S., Iqbal M., Lobell D. and Travasso M. (2014). *Food security and food production systems*. Cambridge, United Kingdom and New York, USA: Cambridge University Press. pp. 485-533.

[15] HNO 2022

[16] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

The earthquake impacted 3.7 million children and pregnant and lactating women and may exacerbate the nutrition situation of vulnerable children and women which was already alarming.

In addition to climate complexities, food prices, and the ongoing internal conflict, the various humanitarian crises in Syria worsened in February 2023 as a consequence of the earthquake in northwest Syria and southern-central Turkey. Hostilities in the region of the earthquake have hampered the delivery of aid, which led to accusations that life-threatening aid was being politicized due to the ongoing conflict.[17]

Against the backdrop of this complex crisis, Syria and Türkiye were hit by devastating earthquakes on February 6th, 2023, which only added to already compounded humanitarian needs and vulnerabilities, particularly in Northwest Syria. The earthquakes caused immense destruction and suffering in both countries, creating needs greater than any other natural disaster World Vision has responded to in over a decade. More than 50,000 men, women, and children have been killed, and more than 850,000 Turkish and Syrian children were displaced following the destruction of tens of thousands of buildings and homes on both sides of the border. In Northwest Syria, 4,500 deaths and 8,700 injuries have been reported so far, however, the number of casualties is still expected to rise as many people remain unaccounted for. More than 10,000 buildings have been partially or completely destroyed, and tens of thousands of people are seeking refuge in collective shelters or already overcrowded IDP camps, where some tents are now housing up to 15-17 people from families of 5-7. Humanitarian aid and search and rescue efforts were slow to reach Northwest Syria in the first weeks following the earthquakes, due to access challenges and funding not materializing quickly enough. As a result, local search and rescue teams could only comb 5% of affected areas in time to pull out any survivors stuck under the rubble due to limited equipment and capacity.[18]

3. Recommended humanitarian interventions to enhance the food security situation of affected people in Northwest Syria

Humanitarian assistance for food security plays a critical role in supporting vulnerable populations affected by conflict, natural disasters, and emer-

[17] The Links between Conflict and Hunger in Syria: Conflict, Hunger and Aid Access, April 2023.

[18] Dire consequences: 12 years of suffering in Syria. An overview of the most pressing needs shaping the humanitarian response in Syria today. March 2023.

gencies. Without access to food and nutrition, individuals and families are at risk of malnutrition, hunger, and even death. The economic and social impacts of food insecurity are also significant, including decreased productivity and income, increased poverty, and reduced access to education and healthcare, particularly affecting vulnerable groups such as women, children, the elderly, and people with disabilities.

Therefore, it is imperative that humanitarian organizations and governments prioritize food security and provide the necessary support to those in need. Failure to do so would result in a humanitarian crisis with potentially devastating consequences for millions of people worldwide. However, the ongoing conflict and displacement in the region pose significant challenges to the delivery of humanitarian assistance, including food assistance, as access to vulnerable populations remains limited, and the security situation is volatile. Despite these challenges, providing food assistance is vital to minimizing the impact of crises on people's lives and enhancing their resilience.

Different programs aiming to enhance food security are implemented in Northwest Syria that are funded by different donors, Local Non-Governmental Organizations (L-NGOs), International Non-Governmental Organizations (I-NGOs), and UN agencies. The food security-based interventions for the most affected households by conflict, drought, and earthquake include the following activities:

3.1. Food Assistance

- Cash & Voucher: Cash for food, Vouchers for food, and Multipurpose cash in those areas where markets are functional, and the supply of food commodities is in place.
- In-Kind: Food baskets, Ready to Eat Rations (RTERs), Bread distribution (free and subsidized), and bakery support on rehabilitation and inputs supply. Cooked meals were delivered at the collective centers, open fields, and informal settlements of IDPs affected by floods, storms, and conflicts.
- Blended Modality (in-kind and cash or in-kind and voucher, or voucher and cash).

3.2. Agriculture

3.2.1. Supporting the value chains (wheat, olive, pistachio, fig, barley, legumes, and vegetable) throughout three phases:

- Production and inputs: Distribution of agriculture inputs including irrigation and harvesting costs, provision of technical extension service, and climate-smart agriculture system sessions, soil analysis facilities; it is recommended to start engaging IDPs in the camps on these activities.
- Processing: Rehabilitation of the second phase of the value chain on infrastructures: seed processing, sorting, treating, and packaging, bakeries, flour mills, and silos for storage. Cash for work activities in rehabilitation linked with early recovery cluster activities, including vouchers and cash assistance.
- Marketing: To locally purchase wheat from farmers and feed the purchased wheat either into bread production (through a contract with flour mills and bakeries) or in wheat cultivation for the next season by contracting new farmers. For olives, to locally purchase olives from farmers and distribute the oil after milling to vulnerable people. Also, to purchase barley from farmers for fodder (barley) and provide seeds for the next agriculture seasons.

3.2.2. Supporting inter-cropping agriculture systems that include small-medium farming activities and home gardening (considering diseases transmission and the need for irrigation for the proposed crops under this approach) in specific areas.

3.2.3. Supporting the fodder crops cultivation to be linked with livestock-recommended activities.

3.2.4. Enhancing the integration between agriculture and irrigation activities.

3.3. Livestock

- Prevention of livestock epidemics through vaccinations (esp. Peste des Petits Ruminants (PPR), Lumpy Skin Disease (LSD), Sheep Pox, Enterotoxaemia, FMD, (ND: Newcastle Disease) and treatment of internal & external parasites.
- Support local fodder manufacturing and provide livestock breeders with fodder, raw materials, related equipment, and technical extension; it is recommended to provide premix during the drought or lack of fodder quality to prevent postpartum diseases and diseases caused by a lack of nutrients.

- Livestock value chains with priority on smallholder dairy and poultry value chains with related extension services.
- Provide treatment for livestock to prevent epidemic and local diseases (considering postpartum disease as the most important challenge that faces livestock) by mobile clinics, improve the productivity and the genetic pool of dairy animals by improving access to livestock services such as (artificial insemination and fertility treatments).
- Capacity building, Para vet (technical training for vets) inside Syria, and awareness sessions for livestock breeders; this activity can be provided by many livestock interventions.

3.4. Irrigation

- Rehabilitation of canals, wells, and pumps to sustain farming through cash for work and service providers.
- Supporting participatory irrigation.
- Support the solar system.
- Complementarity between rehabilitation of irrigation and agriculture assets and water harvesting.
- Supporting the Water User Associations (WUA).
- Supporting sewage treatment and greywater use for irrigation purposes.
- Consider climate change and water scarcity by using modern irrigation systems such as drip irrigation.

3.5. Income Generation Activities

- Cash for work activities aiming at creating linkages and synergies among irrigation, harvesting.
- Rehabilitation of the canal, flour mills, bakeries, and silos, considering the guidance from the CWG about the daily wages.
- Small business grants that link with agriculture and livestock activities.
- Food processing activities target mainly female-headed households by the provision of small business grants to establish small to medium food processing workshops.
- Supporting food processing to produce Ferekeh, producing burgle, food, and bread.

- Mud bakeries, pickles, jam, dry tomatoes, etc., and vegetable production by targeting mainly female-headed households, with the refreshment of local technical knowledge, connecting the HHs with local markets, and providing raw materials and tools.
- Create job opportunities related to agriculture, livestock, and irrigation activities.
- Support the existing businesses with survival support packages (market skills, grants, rehabilitation, productive assets) to maintain their business and protect their productive assets.
- Support more livelihood activities for camp residents to integrate them into the communities and decrease the number of dependent people in the camps.

3.6. Nutrition Activities

- Nutrition programs: providing supplementary feeding programs for malnourished children, pregnant women, and breastfeeding mothers.

4. Reports about food security interventions in North West Syria

After the recent earthquake, OCHA[19] reported that:

- More than 76,000 Ready-to-Eat Rations (RTE) of dry food have been distributed by 51 FSL cluster partners in the last four weeks as of 17 April.
- An RTE ratio is sufficient for one family of five for one week. Over the last week, 27,326 people have been reached through the distribution of RTEs and High-Energy Biscuits.
- More than 114,000 people were reached with Cash and Voucher Assistance (CVA), supported by six FSL cluster partners since the earthquakes struck. Out of this figure, 40,290 people were reached over the past month.
- A total of 664,152 cooked meals were distributed by 28 partners since the beginning of the earthquake response.
- Cooked meals were reported as a one-off distribution in 100 percent of cases.

[19] NORTH-WEST SYRIA Situation Report. Last updated: 28 Apr 2023.

– 193,916 earthquake-affected people who have access to cooking facilities were provided with one-off emergency food baskets, distributed by 15 partners.

In 2022, WFP and the other partners delivered aid from across the Turkish border into Syria, reaching an average of 2.7 million people every month. This work included early recovery and livelihood support to strengthen the resilience of communities across Syria.[20]

In Syria, in addition to providing immediate food assistance in quake-affected cities, WFP has resumed its regular general food assistance for 5.5 million people every month following a brief pause after the earthquakes. This includes regular monthly assistance either in-kind or cash-based to 1.4 million in non-government-controlled areas of the northwest.[21]

According to the WFP, food assistance has helped to reduce the prevalence of acute malnutrition among children under five from 13.9% in 2019 to 11.7% in 2020. The WFP also reports that cash assistance has helped to increase household food consumption and dietary diversity among beneficiaries.

5. Measuring the impact of food assistance for one of Shafak's projects with two different modalities

Shafak, in partnership with Goal International, implemented a food security program to support individuals affected by the conflict in Afrin, Syria. The program provided food baskets and cash assistance to eligible households. A total of 9829 households received cash vouchers, and 3924 households received food baskets. In June 2022, Shafak conducted a food security analysis to measure the impact of the program. The analysis covered the program intervention area, with a representative sample size of 458 for cash intervention and 464 for food baskets.

The report found that the program had a positive impact on the food security of assisted households, with a reduction in the prevalence of severe and moderate food insecurity. However, the report emphasized the need for sustained and increased humanitarian assistance, including food assistance, to address the ongoing food security crisis in Northwest Syria.

[20] https://www.wfp.org/news/un-humanitarian-leaders-urge-security-council-preserve-cross-border-aid-lifeline-north-west

[21] https://www.wfp.org/news/wfp-reaches-half-million-earthquake-affected-people-syria-and-turkiye-and-replenishes-stocks

The analysis also assessed the ability of households to meet their basic needs. Of the assisted households, 93.6% were able to meet their basic needs all the time. However, 6.2% could only meet their basic needs sometimes, and 0.2% reported never being able to meet their basic needs.

Other types of humanitarian assistance for food security include programs implemented by Shafak Org and Care International in Aleppo's Azaz district, covering 13 communities, 9002 households, and 49,204 individuals in 2022. The targeted households were identified as food insecure, with low and borderline Food Consumption Score (FCS) indicators. The program was designed to provide food rations and multi-round cash (cash for food) of $50 per household per month for the right months.

This program contributed to minimizing the economic impact of the Syria crisis and enhancing the resilience of the most vulnerable households, specifically strengthening Syrian families' livelihoods, protecting their assets, and reducing their negative coping mechanisms to ensure they are better able to meet their essential needs and have access to activities that support their wellbeing.

To measure the impact of this food program on the affected people, Shafak conducted a baseline, midterm, and endline survey where a representative sample of 400 interviews, including male- and female-headed households, were conducted.

The program aimed to minimize the economic impact of the Syria crisis, enhance the resilience of the most vulnerable households, and strengthen Syrian families' livelihoods to ensure they can meet their essential needs and access activities that support their well-being.

The program had a positive impact on the food security and resilience of the targeted households.

- Indicator 1 shows that the program was successful in reducing the use of negative coping strategies by conflict-affected households. The baseline value was 11, but this improved to 1.88 at the endline, which is a significant improvement.
- Indicator 2 shows that the percentage of households with poor food consumption scores (FCS) decreased from 34% at baseline to 3% at endline, which is a significant improvement.
- Indicator 3 shows that the percentage of households with borderline FCS decreased from 47% at baseline to 30% at endline.

- Indicator 4 shows that the percentage of households with adequate FCS increased from 19% at baseline to 67% at endline.
- Indicator 5 shows that the percentage of households with little to no hunger in the household increased from 95% at baseline to 100% at endline.
- Indicator 6 shows that the percentage of households with moderate hunger in the household decreased from 4% at baseline to 0% at endline.
- Indicator 7 shows that the percentage of households with severe hunger in the household remained at 0% throughout the program.

Overall, the program had a significant positive impact on the food security of the targeted households, as indicated by the improvement in all the indicators.

6. Case study: Shafak food security program in NW Syria

In order to enhance the food security situation in INW Syria, Shafak has been implementing food security activities since 2013. The activities included the distribution of food baskets, ready to eat kits, flour, bread, and cooked meals, food value vouchers and cash for food, in addition to livelihood activities such as agriculture and livestock that increase the production. Moreover, income-generating activities enable families to meet their basic needs.

7. Conclusion

Food assistance has played a crucial role in addressing the food security needs of people affected by conflict, drought, and the recent earthquake in northwest Syria. The provision of food assistance in the form of food baskets and cash transfers has helped to alleviate immediate hunger and malnutrition, while livelihood support has helped to improve self-sufficiency and reduce dependence on aid.

Impact of Prolonged Conflict Besides Other Shocks on Food Security Situation in Syria

Anas Al Kaddour[1]

Executive Summary

The protracted Syria crisis (so far, 12 years) has brought about catastrophic impacts on the Syrian community on different levels. Conflict continues to be the principal driver of humanitarian needs, with the civilian population in many parts of the country exposed to significant protection risks which threaten life, dignity and wellbeing on a daily basis. The scale, severity, and complexity of needs across Syria remain overwhelming, rendering a community that is highly dependent on the humanitarian aid. People continue to suffer from multiple and complex socioeconomic difficulties, weakened purchasing power, increased unemployment percentage, floods, drought, cholera and increased price of the fuel, water, and hygiene items all are drivers for food insecurity and exacerbating livelihood needs and eroding the resilience and recovery prospects for many families across the country. The combination of conflict, natural disasters (drought, floods, agriculture pests) and COVID-19, led to the depreciation of the Syrian economy. An estimated 15 million people need food and agriculture assistance. At least 12.1 million people are estimated to be food insecure, including all 2 million people living in camps who are deemed to be 100% food insecure, and 2.9 million people are estimated to be at risk of sliding into food insecurity. In total this constitutes over half of the Syrian population who need urgent lifesaving and life sustaining food, agriculture and livelihoods assistance, due to a convergence of vulnerabilities resulting from displacement, exposure to hostilities, and limited access to basic goods and services. This piece summarizes specific needs and gaps in the Food Security and Livelihoods (FSL) sector in Northwest Syria, and briefly outlines the strategy for implementing FSL programs in these locations.

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1. Introduction

The Middle East Center of Carnegie Endowment for International Peace (2015) stated that before the conflict before the March 2011 uprising, Syria was the only country in the region that was self-sufficient in food production and especially in staple agricultural crops such as wheat and barley. It had even turned into a regional exporter before a major drought in 2008-2009 forced the country to import large quantities of wheat for the first time in many years. De Châtel (2014) reported that after only four years of devastating conflict, the country is turned into a net importer of wheat, with dwindling production of fruit and vegetables. Amidst a record increase in prices of more than 800% in the last two years alone, the Economic and Social Commission for Western Asia (EMHRM) estimates that around 90% of the Syrian population has been living below the poverty line.[2] Local currency depreciation and an increase in unemployment have exacerbated the situation by eroding the purchasing power of Syrians. In mid-2019, a basic food ration was estimated to cost at least 80 per cent of an unskilled worker's monthly salary, and 50-80 per cent of a civil servant's salary. Total economic loss was approximately $442 billion in 2018, and the country's gross domestic product (GDP) lost around 65 per cent of its value compared with pre-conflict levels (WFP, 2022a). Moreover, Alkaddour (2022) mentioned that insecurity, lack of financial and physical access to a quality input, and depletion of the agriculture areas followed by low crops harvesting during 2021 season were the factors that affected people's food security and resulted in a significant gap in supply and demand, mainly for wheat and forage crops. The impact of Syria's crisis continues to hinder people's ability to meet their immediate food needs and livelihoods, in a context marked by very complex drivers and contributing factors. This includes economic worsening and weakened local currency, soaring food and non-food prices, as well as drought-like conditions and severe agro-climatic fluctuations, water scarcity, and limited energy supply. In addition, food and agriculture commodity price increases, inflation, lack of purchasing power due to limited livelihoods and income sources and population movements have had an important economic impact. According to the whole of Syria Food Security Sector (2023), the food security situation in Syria has drastically deteriorated since last year and has been exacerbated by the February 2023 earthquake;

[2] Euro-Med Human Rights Monitor. 2022. Syria: Unprecedented rise in poverty rate, significant shortfall in humanitarian aid funding.

three weeks after the earthquake, WFP noted food prices were high in affected areas, with bread in particular costing 20% more in Aleppo compared to last year. The 2023 HNO figures (published prior to the catastrophic February 2023 earthquakes) for Syria indicate that 15.3 million people in Syria (approximately 69.2% of the population) are in need, of which 18.7% are identified as being in extreme or catastrophic need (OCHA, 2023). The Earthquake also caused increased humanitarian needs in NWS due to loss of shelter and destruction of general infrastructure.

2. Previous Status of FSL Sector in Syria

The Middle East Center of Carnegie Endowment for International Peace (2015) stated that before the conflict, Syria was the only country in the MENA region that was self-sufficient in food production (wheat, barley, cotton, corn and sugar beet crops). The country's well-developed farming system, agricultural extension services and a state-command economy that focused on wheat production as a strategic food commodity, led to a relative food security of Syria. Traditionally, about 60% of cultivated land in Syria was used to grow wheat, with production concentrated in north Syria (Ahmad, 2016). Furthermore, according to the crop and food security assessment in Syria that was conducted by FAO and WFP (2019), wheat production estimated at 4-4.7 million MT, essential seeds reserves were enough to cover the country's consumption and seed security for at least 2-3 years. The government of Syria subsidizes all inputs, monopolizing most inputs (including seeds and fertilizers), is the sole buyer of wheat, controls all marketing channels and implements agricultural research to improve productivity. In 2010, the agriculture sector accounted for 18% of the country's GDP and 23% of its exports, and it involved 17% of its labor force in production. Some 46% of Syrians were rural dwellers and, of those, about 80% were sustained by income from agricultural work. Prior to the conflict, the food needs of Syrians were primarily met through a combination of a household's own production and purchases from the local markets through cash and credit.

The type of livestock pre- and post-crisis in Syria has not changed, with chickens listed as the most common livestock, sheep a clear second, and then a smaller number of goats and cows. There has been a clear reduction in the numbers of livestock kept since the conflict began. Women participate in most activities related to livestock production including milking, grazing, providing fodder, and manufacturing dairy products, whether for

home consumption or for sale in the local market. Prior to the conflict, veterinary inputs were manufactured locally or imported. The quality of veterinary inputs was monitored by the Ministry of Agriculture and Livestock through specialized laboratories to determine drug composition. All vaccines were imported by the Government of Syria (GoS) and were appropriate for diseases common in Syria. Pre-conflict, livestock breeders received support from the Ministry of Agriculture and Livestock through periodic vaccination campaigns. A modest 50% of the fodder needed for livestock breeders was available at both good quality and affordable prices (FAO & WFP, 2019).

3. Current Status of FSL Sector in Syria

3.1. Food Assistance

In NWS, of the 1.8 million people living in IDP sites, 23% are women and 56% are children, according to the 2023 HNO. The food security situation in Syria has drastically deteriorated since last year with an estimated 15 million people in need of some form of food and agriculture assistance. This represents an increase of 7% when compared to last year's number of 13.9 million and a 55% increase since 2019. Of those in need of food assistance, 59% are in extreme need, including all households in camps, which are 100% food insecure. High food prices and severe economic deterioration contribute to food insecurity across Syria. According to WFP (2022b),[3] the October 2022 standard reference for food basket was 52% dearer than seven months ago, the onset of the crisis in Ukraine, up 91% compared to a year earlier, reaching SYP 357,593 (USD 119 at the official exchange rate of SYP 3,015). Families have been simultaneously affected by a loss of income and purchasing power. By August 2022 the average household expenditure (855,499 SYP) exceeded average household income (533,514 SYP) by 60%, as compared with 49% in 2021. Moreover, the Joint Market Monitoring Initiative Dataset conducted by Cash Working Group in Northwest Syria found that in March 2023, the regional SMEB was recorded to be 1144,322 SYP (154 USD), which represents a +16 % increase for the SYP price since January 2023. The regional SMEB Food Component was recorded to be 840,005 SYP (113 USD), which represents an increase of +19% for the SYP price since January 2023. The informal USD/SYP exchange rate was recorded to be 7,450 SYP, which represents a +15% change since January

[3] WFP Syria Market Price Watch Bulletin, October 2022b.

2023. The informal USD/TRY exchange rate was recorded to be 19.18 TRY, which represents a +1% change since January 2023.[4] To cope, many households now rely primarily on a mixture of purchases from the local market (predominantly on credit) and humanitarian assistance. In most areas of NWS, the author noticed that the use of negative coping strategies remained relatively high with 17% of these households having a high rCSI score, 56% medium and 27% low. Some of the negative coping strategies utilized included limiting portion size and restricting adult consumption, early marriage, and child labor. Moreover, according to WoS FSS and iMMAP Post-Earthquake Wheat-Flour to Bread Processing Facilities Mapping Study for Northwest Syria (2023),[5] 19% of bakeries were reported to be non-operational due to the lack of access to wheat/flour and high operational costs and the inability to compete with NGO-supported bakeries. The daily portion of produced bread per individual in NWS has decreased 4% compared to Q3 2022. In terms of accessibility, the access and affordability of bread remained a challenge for vulnerable people. This is due to the increased selling price of 1 kg of subsidized bread in NWS which increased by 14% and reached 4.89 TRY/kg compared to 4.5 TRY/kg in Q3 2022. Moreover, the average reported selling price of 1 kg of unsubsidized bread in NWS was 9.77 TRY/kg with an increase of 5% compared to Q3 2022 (8.66 TRY/kg). Further, the impact of the February 6, 2023 earthquake in Türkiye and Syria, resulted in an increase in bread price that WFP noted to be high in affected areas, with the price of bread 20% higher than last year in Aleppo.[6] The absence of locally produced and manufactured basic food supplies has influenced reliance on imports whose cost is beyond the reach of many vulnerable people.

The pre-decided transfer values for voucher support no longer have the same purchasing power as intended when designed. The market assessments used to inform these values are outdated with the rise of prices not only in TRY but also in USD. For instance, the restricted vouchers for fertilizers, seeds, etc. are no longer sufficient to buy the planned supplies from the markets given current prices. In 2022, the value voucher for food commodities updated from 60 USD to 78 USD per family of 6 members to meet the high

[4] Cash Working Group Northwest Syria Joint Market Monitoring Initiative (JMMI) Dataset: March 2023.

[5] WoS FSS and iMMAP. Post-Earthquake Wheat-Flour to Bread Processing Facilities Mapping Study for Northwest Syria. March 2023.

[6] WFP. Syria Markets Update 18-25 February 2023.

prices of food commodities.[7] However, due to fund limitations it has decreased again to 65 USD, which could affect the FCS of vulnerable families bigger than 6 members.[8]

3.2. Agriculture Sector

Like all sectors of the Syrian Arab Republic's economy, agriculture has suffered serious setbacks since the beginning of the current crisis in 2011. Insecurity, lack of financial and physical access to food, and depletion of livelihoods were the three factors that affected people's food security. In particular, lack of financial and physical access to food is the result of lack of income, low purchasing power, fragmented markets, high prices and also the big drop in crops production. Agricultural production has experienced significant loss, particularly affecting rural farming and herding families. This is forcing people to migrate or to look for other sources of income. Wide areas of agricultural land with orchards or crops have been destroyed and farmers are facing shortages in the availability of agricultural inputs

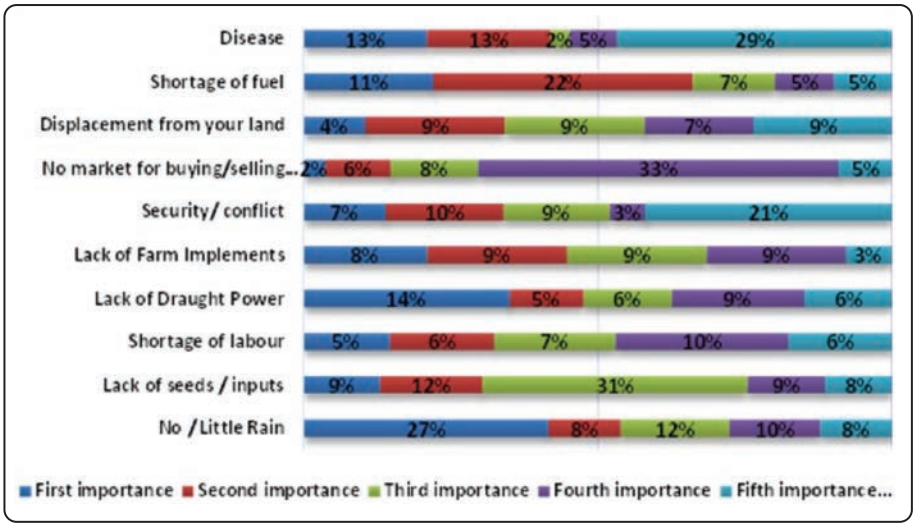

Figure 1. Main challenges faced agriculture sector in NWS.

[7] Food Security Cluster, Early Recovery and Livelihoods Cluster and Cash Working Group. 2022. Information Note: Ukraine Crisis and its impacts on northwest Syria markets.

[8] Cash Working Group (NWS) and Food Security & Livelihoods Cluster, Syria Cross Border HLG. 2023. Cash and Voucher Assistance (CVA) Transfer Values Interim Guidance.

(seeds, fertilizers, fuel ... etc.) or are unable to afford them due to soaring prices and big damage in infrastructure (irrigation structures, processing and storage facilities, private and public farming equipment and agro-sector buildings) and governmental services (extension, vaccine campaigns, loans, agricultural banks ... etc.). Some of the main challenges that the agriculture sector is subjected to are shown in (Figure 1).

During 2017, FAO estimated the overall financial cost of damage and loss in the agriculture sector over the 2011-2016 period to be at least 16 billion USD. The cost of damage to irrigation systems and other kinds of agricultural infrastructure, such as buildings, was also estimated at 3.2 billion USD.[9] The status of agriculture in Syria is closely linked to the food security of both host communities and displaced people across NWS. Gaps and shortfalls in agricultural production lead to higher levels of food insecurity as food prices increase, items face shortages, and reliance on imports increases. The conflict, as well as changes in weather patterns, has reduced wheat production to 1 million MT, 27% of the pre-crisis average of 3.6 million MT.[10] Wheat cultivation has followed an up and down pattern. The high prices of agriculture production inputs, especially fuel, fertilizers, pesticides etc., continues to limit agriculture input use by farmers and adherence to standard seed and chemicals dose rates. According to iMMAP Wheat Value Chain Assessment Study on Northwest Syria 2022, climate-induced aridity and water scarcity continue to affect Syria with below-average levels of rainfall in the 2021-2022 winter season, affecting wheat crop physiology and productivity. The study noted that wheat farmers encountered limitations in accessing chemical inputs like fertilizers and organic inputs. The study recorded an increase in fuel price, and the relative increased irrigation operational costs of pumping for water extraction was also reported as a major challenge for irrigated wheat crop production. Moreover, some farmers reportedly considered shifting from staple wheat to cash crop production, mainly due to the increased production cost of wheat, the lower production cost of cash crops, the lower needs of cash crops for irrigation, and the higher selling cost and profitability nature of cash crop production in NWS. iMMAP found that 23% of farmers intended to reduce the area of land cultivated by wheat crop during 2022-2023

[9] FAO. 2017. Counting the Cost, Agriculture in Syria after six years of crisis.

[10] Syria sanctions inflict suffering as al-Assad regime marches on, Conflict News. https://www.aljazeera.com/news/2021/1/16/is-syrias-sanctions-hurting-the-population-more-than-the-regime

season, largely due to the increased cost of agricultural inputs required for wheat production.[11] The decline in agricultural production output was not only limited to rainfed crops production systems but also to irrigated crops such as cereals, legumes, barley, and vegetables. Farmers reported that the highest contributors to wheat production costs are the use of chemical inputs, the use of machinery such as tractors and harvesters, and fuel. Wheat production output for the 2021-2022 agricultural seasons was less than 30% of the long-term average in Syria (HNO, 2023).

On the contrary, the low cost of cash crop production (cumin, anise, coriander, nigella seeds etc.), its less susceptibility to fire and its good harvest makes these crops compete with wheat production. Similarly, the production of traditional and essential crops (cotton and sugar beet) has disappeared too, and the replacement are again more profit-generating cash crops. However, crops production in this area is susceptible to severe ecological stresses during several growing seasons, i.e., frost or rainfall retention and high temperatures, frequent droughts and/or severe moisture stresses and outbreaks of pests and diseases. Crop production is also impacted by high labor costs, shortages of skilled workers, internal displacement, and fragmented markets, with disrupted supply chains. Since the start of the conflict, across the country, high costs for veterinary medicines drive households to engage in extensive destocking.[12] Domestic factories for manufacturing veterinary medicines and artificial insemination inputs in GoS-controlled areas have been destroyed or are out of service. The high prices of imported raw materials have also hampered domestic production of veterinary inputs. In NWS, the lack of stable transportation routes means that domestically produced veterinary inputs have been replaced with more expensive, imported products from Türkiye or Europe. Unfortunately, the absence of official governmental institutions to regulate imports has led to the sale of unreliable, low-quality, and counterfeit veterinary inputs in markets. Furthermore, Syria has experienced an increase in diseases affecting livestock. The most common endemic diseases encountered by households include Pasteurella and Foot and Mouth Disease (FMD). Post-crisis there has also been a rise in cases of smallpox. The prevalence of most diseases has increased by 7-8% since the start of the crisis. Livestock has also not been spared from the impact of the prevailing water shortage and

[11] iMAPP and Food Security and Livelihoods Cluster. Wheat Value Chain Assessment Northwest Syria. November 2022.

[12] OCHA. 2022. HNO Syrian Arab Republic.

scarcity, limited access to livestock production inputs, especially feed, and the generally unfavorable weather conditions (HNO, 2023). Seed supply has not yet been taken up by the local authorities and private seed companies and has thus been overlooked. The legal framework for a formal seed supply chain and certification scheme was implemented at a low level by the new established GOSM in North Syria due to financial limitations. This system is covering around 15% of the region's need of certified seeds. The certification scheme is traditional and below standard due to the limitations in laboratories. As quality control and certification is weak, farmers are not very interested in paying higher prices for seed because they cannot be sure that they are getting the genuine product; also due to the limited extension services, farmers are not applying recommended improved agricultural practices. Furthermore, because of lack of adequate storage facilities, market inaccessibility, inadequate processing facilities, and consumers' exploitation through inflated pricing, post-harvest losses are significant.

3.3. Other Shocks that Are Affecting FSL in NWS

3.3.1. Conflict

- Massive displacement as a result of the insecurity situation
- Direct airstrikes affecting markets, infrastructure, and people's assists
- Shootings of farmers and agricultural workers
- Movement restrictions as a result of the internal fighting between the armed groups
- Lack of fuel and electricity cuts have also affected the water supply
- Lack of specialized staff (brain drain)
- Detonation of landmines, UXO and IEDs
- Crop destruction by fire: Between 2017 and 2022 there were at least 198 incidents where crops or farmland were set on fire. The vast majority (91%) of all incidents were recorded in the summer months of May and June when Syria's key crop – wheat – is harvested. The conflict parties perpetrating these incidents varied across the country.[13]

3.3.2. Environmental Shocks

Together with several heatwaves, limited availability of irrigation water resulted in a contraction of the harvestable cereal area.

[13] Insecurity Insight. 2023. The Links between Conflict and Hunger in Syria.

- Insufficient and poorly distributed rainfall (drought) led to complete harvest failure, as shown in (Figure 2)
- Late rain also leads to failure harvest of crops
- Floods and frost
- Crop disease because of poor-quality seed and inputs (rust, Sun, leafhoppers, etc.)
- Farmers in several parts of the country drill new underground wells to irrigate farmland; pumping water from new wells is a problem with a trend in declining the regional water tables
- Dams and rivers are drying up.

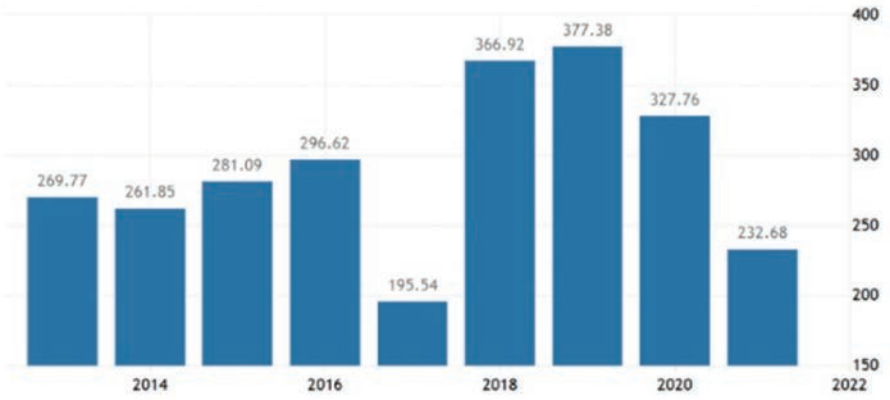

Figure 2. Syria annual precipitation 2013-2021. Source: Tradingeconomics.com, World Bank.

3.3.3. Economic

- Sudden inflation of Syrian pound against foreign currencies
- Complete breakdown of government subsidies
- Breakdown of supply routes and sources of raw materials leading to closure of the big factories
- Border closures (regional and internal) from time to time
- Massive rise in prices of fuel and agricultural inputs
- Purchases of farmers outputs no longer guaranteed
- High unemployment status (people are dependent on food support from NGOs, charities, and UN agencies)
- Youths employed in war economy as a source of income

- Malnutrition cases as a result of hard coping strategies besides poor HHDD
- Fund cuts
- Limited duration of humanitarian programs.

3.3.4. Impact of COVID-19

The coronavirus pandemic (COVID-19) is the greatest existential threat to life in the last 100 years. For Syrians, the pandemic, while undeniably traumatic, is just one more event in a litany of equally devastating hardships that have proven inescapable, difficult, and necessary to endure. More than a decade of war and a collapsing economy have forced 6 million or more Syrians into crowded living conditions along the Syrian border, into neighboring countries and failed states with fragile and fragmented healthcare systems. Syria is ranked as one of the least prepared countries in the world for emergency disease outbreak preparedness and response. A curfew in some areas was initially put in place to encourage people to stay in their homes to reduce their risk of disease exposure and onward transmission. However, individuals still need to leave home to collect their income. Conditions are far worse for those who live in north Syrian camps, where inadequate access to basic medical, water and sanitation facilities is commonplace, and a single tent may shelter as many as 5-10 people. Although face masks and disinfection liquids may be available in some markets in north Syria, most people can't buy them. Significant price increases in fuel and some shortages in basic goods, essential food items, and personal sterilization and protection items (such as face masks, hand sanitizers) have been reported across Syria. These factors, in combination with panic-buying, disrupted supply routes, reduced shop opening hours, reduced working hours, wages and household incomes and movement restrictions are likely deepening pre-existing vulnerabilities. Since the onset of the pandemic, border crossings between Türkiye and northwest Syria have been closed for individuals but remained open to humanitarian shipments and the minimum movement of NGO medical staff. Humanitarian actors providing cross-border food assistance also face operational delays due to new protection measures. In Türkiye (as well as in agricultural areas inside Syria), the most vulnerable in Syrian society are day laborers, who depend on daily wages to cover the basic needs for their family. For displaced Syrians with no financial safety net, staying at home immediately worsens food security for entire households. Small-scale farmers and migratory agricultural workers lose access to extension services, are hindered from working or hiring workers to help with the

harvest.[14] Following the outbreak of COVID-19, the oil black market grew sharply. Oil movement from opposition to government-controlled zones was restricted. The official oil price subsidized for farmers' use is SYP 180 per liter, while the price on the black market is SYP 350 per liter. Farmers, who receive only around 150 liters of subsidized oil per month, will therefore be reluctant to plant using irrigated systems owing to the high cost of production. Increases in oil and fertilizer prices, the two basic inputs for goods production (machinery, water pumping, nutrient supply), are expected to raise production costs by 40-50 per cent, which is not guaranteed to be followed by an increase in market prices because of Syrians' eroding purchasing power and reduced demand.[15]

3.3.5. Impact of Ukraine War

The war in Ukraine has plunged global food and energy markets into turmoil, raising high food prices even further. These increases have an impact on markets in Syria, which limit people's access to food. Simultaneously increased operational costs for FSS partners in Syria constrain their response at a time when people need it most. Ongoing price monitoring of commodities by WFP from 75 markets across all 14 governorates in Syria, indicate that food prices have risen after few weeks of the Ukrainian crisis. For example, the price of WFP's standard reference food basket at governorate level during the second week of March 2022 was at its highest level since monitoring started in 2013. By the second week of March the national average price of WFP's standard reference food basket was 18% higher than compared to its average price in February 2022 and 12% higher than the price during the first week of March.[16] Both the Syrian Interim Government (SIG) and the Syrian Salvation Government (SSG) simultaneously increased bread prices and lowered the weight of bread bundles. This led to bread queues becoming longer in addition to surfacing reports of corruption relating to the sale

[14] Community-led responses to COVID-19 are a matter of urgency in Syria https://blogs.ed.ac.uk/covid19perspectives/2020/05/21/community-led-responses-to-covid-19-are-a-matter-of-urgency-in-syria-write-lisa-boden-ann-christin-wagner-shaher-abdullateef-and-anas-al-kaddour/

[15] COVID-19 and Displaced Syrians Livelihoods along the Turkish-Syrian Border. Corona Times Publishing.

[16] WoS FSS. 2022. Repercussions of Ukraine crisis on food security in Syria.

of subsidized bread.[17] Moreover, the Turkish lira's depreciation in March, reaching 14.81 TRY per USD, resulted in a further increase in bread prices and reduction in bundle weights, which was also further exacerbated by a reduction or cessation of Turkish food exportation, particularly locally produced wheat, and regulated the export of flour throughout 2022, leading to future increases in bread prices in NWS. Livestock fodder became increasingly unaffordable. Oilseeds and the cooking oil created from them were at risk of being inaccessible due to increased prices and reduced supply.

As funding levels off due to donor nations' treasuries being stretched, and in the face of rising food costs, WFP has reduced rations for vulnerable populations in NWS, e.g., WFP reduced the transfer value of food vouchers under the cash-based transfer programs from 60 to 40 USD per family per month. Wheat price increased as both Ukraine and Russia are critical players in global wheat and maize markets, ranging among the top five exporters globally for both commodities. Together, the two countries supply 30 percent of wheat to global markets.

3.3.6. Impact of Türkiye-Syria Earthquake

Following the February 6th, 2023 earthquakes in Türkiye and Syria, communities in NWS have been pushed to the brink as the severity of humanitarian needs has deepened in affected areas. Although markets in affected areas of NWS have been shown to be largely resilient and open following the earthquakes, according to the recent REACH rapid assessment,[18] prices continue to trend higher than during the same period last year, according to the World Food Program (WFP's) Syria markets update.[19] While staples like bread were noted to be 20% and 6% higher in Aleppo and Idleb, respectively, the report also noted that diesel, which factors into the prices of a wide range of commodities, was more than double its price from the previous year in affected NWS areas. The dire economic and labor market situation in Syria has been further compounded by the devastating earthquake. Five governorates have been particularly impacted, namely Aleppo, Idleb, Hama, Lattakia and Tartous. It is estimated that these governorates, combined, are home to 43.4 per cent of the total population in Syria. The resulting

[17] Mercy Corps. 2022. The Russian-Ukrainian conflict and its food security implications in northwest Syria.

[18] REACH Earthquake Response Joint Rapid Assessment of Markets February 2023 NWS.

[19] WFP. Syria Markets Update 18-25 February 2023.

estimates suggest that, in the five affected governorates, some 170,000 workers were unemployed. This is the equivalent of 6.2 per cent of all employed persons pre-earthquake.[20] Moreover, as per FAO assessment 2023,[21] on average 35% of community-level agricultural structures were reported to have been damaged, with a range from 20 to 70% depending on the type of structure. The proportion of respondents reporting damages to roads is lower with around 20%, but the number of roads to be repaired may have significant impact for producers considering also increase in prices of fuel. Structures reported "Partial Damage" need in-depth structural assessment (structures may have to be demolished and rebuilt).

Critical Assumptions and Risks

- Access constraints remain one of the foremost challenges to humanitarian response in NWS
- Equality and equity in access to humanitarian assistance and basic services (especially for women) is still restricted through different administrative obstacles
- Difficulties and potential risks associated with staff security as a result of kidnapping and sometimes killing
- Resilience-building investments and programs aiming at reducing needs may continue being insufficiently resourced by stabilization and development fund
- Availability of quality agricultural, food items and prices
- Change in beneficiaries' behaviour (sell, cashing the CVA …)
- Obstacles or high fees to transfer money to employees, beneficiaries, and suppliers
- Since Türkiye and Russia are among the main actors in the Syrian Conflict, international development about these two actors will have impacts on humanitarian activities:
  - Potential economic deterioration in Türkiye (and thus in Syria) due to the dependency on Russian markets and tourism, with an increase in the inflation and poverty rates

[20] ILO. Impact of the February 2023 Earthquakes on Employment and the Labour Market in Syria.

[21] FAO. 2023. Post-earthquake rapid needs assessment on agricultural livelihoods and production in the northwest.

- Increasing aggressive reactions against refugees in Türkiye due to deteriorating economic situation
- Increasing wheat, fuel, and other commodities prices, which may affect the availability of some items related to humanitarian aid in Syria
- Limitations to the Export/Import and shipments processes, which may affect delivery dates and response time
- Vendors may have concerns and hesitation regarding long-term commitment contracts
- With the economic deterioration and the increased poverty, it is expected that the beneficiaries base will increase notably, with an increased demand for humanitarian assistance.

Recommendations

Specific recommendations to address the humanitarian crisis include:

- Continue providing life-saving food assistance to vulnerable populations in all areas affected by the crisis
- Increase the availability of locally-produced foods and support local preparation and packaging and distribution of food items, wheat/flour inputs and facility rehabilitation, with a focus on gradual scale-down to support mills and bakeries' transition to self-sufficiency
- Strengthening synergies with relief and development provides food/cash-based interventions where/when markets are functional and the feasibility is sound to support community or household self-help initiatives to rebuild, maintain and create assets to improve livelihoods and build resilience
- Improve the linkages between food assistance and livelihoods interventions to shift from assistance to self-reliance where feasible
- Given the disruption of the public sector and particularly the absence of any technical assistance to farmers, support can be provided to farmers' cooperatives, associations and farmers groups, activation or creation of cooperatives and establishment of seed production systems focusing on local varieties
- Provision of training and technical assistance is also needed on low input techniques and appropriate use of inputs (especially fertilizers, water, and pesticides). This can be done in the form of training of trainers

- Provide capacity-building schemes, including training on mine risk reduction besides crop and animal production, protection, and marketing (post-harvest management, food processing and preservation, technology investment in agriculture sector, cost recovery, community ownership of infrastructure)
- Incorporate disaster risk reduction (DRR) and climate smart activities throughout the planned livelihoods interventions
- Provide alternative sources of energy to irrigate irrigated land, rather than using poor quality and expensive fuels
- Support the agricultural industry, which is often based on agricultural products such as seeds, vegetables and fruits processing and marketing
- Forest sector (to recover the cut trees) is also important to consider
- Skills development, with a specific focus on women and youth (possible areas include agriculture and farming, livestock care, poultry, honey production, food preservation, marketing & storage, and handicrafts)
- Raise awareness and provide support to the sustainable management of natural resources (e.g., canals, dams, land) by introducing low-cost techniques (e.g., biogas, water harvesting)
- Rehabilitation of productive infrastructure, including irrigation, veterinary, storage, mills, and bakeries ... etc.
- Build community capital, promote community dialogue, and gender equality (to complement relief interventions).

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Haiti: Managing the Food Crisis, Activities and Lessons Learned

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The context of the food crisis

Since 2020, Haiti has been facing one of the most severe food crises in its history. The latest Humanitarian Response Plan[1] for 2021-2022, estimated the number of Haitians suffering from food insecurity at over 5.2 million, representing almost half the population. This food crisis is the expression of a multi-dimensional crisis that has been exacerbated since 2021, reinforcing the impact of a set of structural and systemic factors that have contributed to making the country one of the most exposed and vulnerable in the world. Haiti has experienced three major disasters in the space of 10 years (the 2010 earthquake, Hurricane Matthew and the 2021 earthquake).

In the same period, the country experienced Tropical Storm Laura, the COVID-19 pandemic and the resurgence of cholera. While the country was already entangled in a deep political and institutional crisis, from 2021 onwards Haiti was plunged into a situation marked by the exacerbation of political struggles, including the assassination of President Jovenel Moise in July 2021, and the extension of gang violence, which control large swathes of the country's territory, gain control of the country's main roads, challenge the state's monopoly on violence and perpetrate increasingly horrific acts against the population (kidnapping, rape, ransom, murder and massacres).

The combination of these factors has led to a deterioration in the population's living conditions, reducing their purchasing power and their ability to access food. Gang control of the country's two main roads has cut off access to markets and food supply chains. The roadblocks imposed on the population prevented the free circulation of agricultural goods. The country's domestic markets could not be supplied with food products. The fuel crisis and the terror exerted by gangs on merchants prevented them from supplying the markets, thus reducing their income.

The war in Ukraine has had a major impact on food prices, and consequently on vulnerable households' access to food. In September 2022, food

[1] See OCHA (2023), Haïti: Plan de réponse humanitaire.

prices were 40% higher than a year earlier. Food inflation was accompanied by a 44% rise in fossil fuel prices. The strong dominance of food and fossil fuel imports on Haiti's consumer markets is a highly vulnerable factor for the Haitian economy, which is experiencing a structural crisis in its balance of payments due to low foreign currency earnings and is under constant pressure to depreciate its currency. To bridge the balance-of-payments gap, in January 2023 Haiti received credits of around $105 million under the IMF's emergency assistance "food shocks" window. These credits are intended to help finance feeding programs and cash and in-kind transfers to vulnerable households.

Other structural factors explain the recurrence of acute food insecurity crises in Haiti. First and foremost, there is the sector's low technological level, low productivity, regular crop losses, low levels of private investment and budgetary discrimination. The sector's contribution to GDP, which was 50% in the 70s and 80s, is now just 20%. At $400 per capita, agricultural GDP per year is much lower than national GDP. Trade liberalization measures taken by the Haitian government in the 80s and 90s dealt a fatal blow to the country's food self-sufficiency, leaving the local market to imports and contraband products.

The Haitian food system is at the heart of intense struggles for control over resources, in a context marked by the collapse of agricultural production, the increasing concreting of farmland and the exacerbation of the process of urbanization, the growing importance of the market for food imports and the scarcity of the foreign currency needed to finance them.

The first reflections on a Haitian Triple Nexus of development-humanitarianism-peace identified agriculture and food security as an "arena of contestation", a place of confrontation between the subsistence strategies of the vulnerable populations and the control of productive resources by the elite, a place of expression for popular protests against the high cost of living.

Over and above the structural problems facing Haiti's agricultural sector, the level of food insecurity is determined by the power of private players who, given the configuration of the imported food market (existence of monopolies and oligopolies on almost the entire range of products), have the ability to impose the price of these goods, making them scarce on the market and exposing vulnerable populations to recurring food security crises.

It follows that the peace component of the Haitian Nexus is closely linked to the solutions that will be found to the dysfunction of the food system. The

latter covers a vast field of issues and challenges, ranging from the development of a "legal framework governing land use", to the "distribution of occupancy and usufruct rights between farmers and owners", to the protection of agricultural areas.[2] This is a huge challenge that can only be met through reform of the State, the dismantling of gangs and the retreat of the rentier actors who hold the country's economy and state institutions hostage.

Food crisis response plans

An analysis of the activities announced and undertaken as part of the country's food crisis response plans specifically over the years 2020/2021 and 2022/2023, reveals a sustained effort to capitalize on the lessons learned since the earthquake of January 12, 2010, against a backdrop of a drastic drop in humanitarian aid to the food sectors, and underfunding of UN-coordinated appeals.

Emergency operations have been marked over time by a series of shortcomings that have clearly reduced the effectiveness of interventions.

First and foremost, there are the problems of coordinating responses to food crises between humanitarian actors. This coordination proved highly deficient due to the fragmentation of actors involved in emergency humanitarian operations: between UN agencies, international humanitarian NGOs, local NGOs, and government bodies, for example, which were not always able to fully play their role of coordinating and ensuring the coherence of emergency interventions. These coordination problems were compounded by the fact that the participating institutions have different orientations, competencies, and mandates.

Another major concern in emergency operations has been the question of targeting the most vulnerable. How can the most vulnerable beneficiaries be reached when the data available from humanitarian organizations in the field or from state administrations is not standardized and is produced on the basis of different methodologies? Even when data does exist and is usable, it only enables us to draw a certain map of the vulnerable populations identified in the area affected by the disaster, but it does not give us a precise idea of the populations directly affected by the disaster and therefore requiring urgent intervention.[3]

[2] See Nations Unies (2022), Analyse Commune de Pays, Port-au-Prince, juillet.

[3] For a more complete analysis of these deficiences, see, among others, Oxford Policy Management (2017), Étude sur la protection sociale réactive aux crises en Amérique du Sud et dans les Caraïbes, Étude de cas sur Haïti, Oxford.

The question of the mechanisms to be adopted and put in place to modulate aid in kind, cash transfers or to arbitrate between pure cash and cash+ is of paramount importance, all the more so as these decisions often have to be taken in the absence of financial structures in the disaster zone.

Another problem was the weakness of early warning systems, and the level of availability of stocks of goods and services to formulate an emergency response to a food crisis.

Capitalizing on lessons learned

Analysis of UN humanitarian response plans and other appeals shows that a genuine process of capitalizing on lessons learned over the past 10 years has been evident. Answers have been found to quasi all the problems mentioned above, facilitating the adoption of an integrated approach. The new approach emphasizes the need to build beneficiaries' resilience so that they can stabilize their food and nutritional security.

In the new response plans, a decompartmentalized approach is favored. The interventions range from the distribution of hot meals and health promotion activities to the implementation of support programs for agricultural, animal and plant production, and the promotion of agricultural cooperatives. At the same time, cash transfers ensure that beneficiaries have the capacity to respond to the impact of shocks well before they occur. Cash transfers thus help to prevent beneficiaries from developing negative behaviors in crisis situations, such as consuming their seeds, selling their assets, etc. The new approach aims both to enable beneficiaries to respond to shocks and to benefit from actions (e.g., distribution of inputs and tools) to boost production.

At the same time, income-generating activities must be supported by credit and savings promotion activities. These activities are not part of a classic sequence in which emergency operations are developed first, followed by development activities, with the result that the latter are neglected once the shock has subsided. From the outset, the aim is to ensure consistency between activities geared towards emergency, i.e., short-term solutions, and medium- and long-term activities to promote production.

As for the coordination of actors, a multi-disciplinary and multi-sectoral approach has been adopted, involving UN actors, public administrations at national, departmental, and communal level, international and local NGOs, the private sector, and donors. However, major challenges remain to be addressed to make this coordination more effective. Humanitarian actors have

yet to be fully integrated into coordination processes. The massive influence they have had in managing the country's recurrent crises has led to a weakening of the State's decision-making structures and an erosion of its crisis management capabilities. Recapturing the State's emergency humanitarian intervention capacity is a prerequisite for regaining its legitimacy in the eyes of the population. What's more, local communities continue to suffer from their low level of involvement in humanitarian programs. The humanitarian response to the August 14, 2021, earthquake in the south of the country, for example, was criticized by local communities, who were very dissatisfied with the services provided by emergency aid and felt excluded from decisions taken in their communities.[4]

Towards a new approach to food crises

The effort to capitalize on the lessons learned over the past 10 years has been facilitated by a major effort to reflect on strengthening food security and nutrition in Haiti. Several strategic documents have framed this reflection, such as the *Politique et Stratégie Nationale de Souveraineté et Sécurité alimentaire et de Nutrition* (2018).[5] The new approaches to food security issues have benefited from a paradigm shift observed among Haiti's development partner institutions. Indeed, analysis of the latest documents published on Haiti by these institutions testifies to the mobilization of a political economy approach that contrasts with conventional analyses of the country.

This approach has helped to identify the mechanisms by which the country's economic, political, and social vulnerability is reproduced, and to draw attention to the structural underpinnings of repeated humanitarian crises. The documents in question analyze the configuration of goods and services markets dominated by monopolistic and oligopolistic behaviors (World Bank, 2016; United Nations 2022), the under-capitalization of the food sector, the historical status of the agrarian sector and the role of agrarian rent in the construction of the Haitian state and the issues surrounding the control of this rent, the interplay of actors in the struggles for productive

[4] See Ground Truth Solutions, Trust must be earned: Perceptions of aid in Haiti. A reality check on post-quake accountability to affected people, April 2022, https://reliefweb.int/report/Haiti/trust-must-be-earned-perception-aid-haiti-reality-check-post-quake-accountability

[5] Primature Haiti (2018), Politique Nationale de Souveraineté et Sécurité alimentaire et de Nutrition, Document de Politique.

resources, the use of violence as the main instrument for resolving crises, as well as the country's dependence on imports.[6]

The new approach to food insecurity was facilitated in the institutional field by the *One UN Plan*, which highlighted the problems linked to the inefficiency of development activities in fragile states like Haiti, and the need to make humanitarian, development, and peace intervention coherent and complementary. This concern was expressed through the adoption in Haiti of a Triple Nexus.

Although the Triple Nexus is not yet operational, a space for discussion has been created between the UN Country Team, the Humanitarian Country Team, and local NGOs on the project of building a common understanding of humanitarian needs in Haiti. The initial work carried out as part of the Triple Nexus defined three objectives to be achieved through the 2021-2022 PRP,[7] namely: a) reducing the need for humanitarian assistance linked to food insecurity, b) social protection with a view to providing safety nets for the most vulnerable, c) environmental restoration and risk and disaster management. The second objective is to develop a social protection system that is reactive to crises and shocks.

I'd like to dwell a little on the second objective, because the social protection component is a fine example of the progress that has been made in mobilizing lessons learned. Haiti's social protection system is rickety: with a formal component that covers only around 10% of the population, and social assistance and pension institutions with very limited resources and a very low level of governance. Over the past 10 years, this system has undergone a certain transformation with the introduction of cash transfer programs financed with funds from Venezuela's Petro Caribe program.[8] With the end of Petro Caribe, the multiple cash transfer programs that had been set up by the Haitian state ceased to operate. These programs were characterized by an excessive fragmentation of beneficiaries into multiple groups: mothers, students, etc., which made their administration costly and inefficient in the absence of adequate technical capacity and a sustainable funding horizon.

[6] World Bank, Georgiana Pop (2016), Haiti-Let's Talk Competition. A Brief Review of Market Conditions. Nations Unies Haiti (2022), Analyse Commune de pays, op cit.

[7] Nations Unies Haiti (2022), Analyse Commune de pays, op cit.

[8] Petro Caribe was an energy cooperation agreement between Venezuela and the Caribbean countries.

Some challenges and stakes of the Haitian Triple Nexus

In recent years, technical and financial partners have mobilized substantial resources to move the social protection agenda forward, providing the Ministry of Social Affairs and Labor, in charge of social policy, with technical and financial support to help it strengthen its capacity to coordinate and regulate the sector, draw up a Social Protection and Promotion Document[9] and initiate an active social promotion policy in favor of segments of the population in vulnerable situations. The aim is to strengthen their economic autonomy, promote their access to basic social services and develop their capacities.

However, the implementation of this component of the Triple Nexus is fraught with problems. Given that the Haitian economy has been growing at a negative rate for the past four years, that the contributory component of the social protection system represents only 10% of the population, and that the informal sector is the country's largest employer, there are serious doubts about the sustainability of funding for this program. To implement such a program, a sustainable fiscal space is required. The strategy that was found was to end fuel subsidies, which account for around 12% of budget expenditure, and finance the program with the resources saved. The decision was also taken to make the Ministry of Social Affairs and Labor the sole coordinating and regulatory body for the social protection and promotion policy, by granting it budgetary space estimated at around 400 million gourdes (approximatively $ 3 millions) in the 2022-2023 budget.

However, this Ministry is not accustomed to managing such substantial resources; moreover, it has historically been the preferred funding channel for populist political actors. The sustainability of this budgetary space is therefore not guaranteed, even if mechanisms for controlling and monitoring these funds have been put in place. To ensure the success of this aspect of the Triple Nexus, it will also be necessary to systematize and consolidate the information systems available to the vulnerable people who stand to benefit from the promotion and social protection funds.

Another policy area revealed by the Triple Nexus discussions is the need to reduce the country's heavy dependence on imports, implement a policy to win back the domestic market, and rearm tariffs to support the development of local production capacity.

[9] Ministère des Affaires Sociales et du Travail (2020), Politique Nationale de Protection et de Promotion Sociales.

Strengthening the national food supply circuit must be a goal of the Triple Nexus. Implementing these policies, however, will require adjustments that will have implication for the Peace component of the Triple Nexus. We need to work towards more efficient border management with the Dominican Republic, and rigorous customs control, in order to put an end to large-scale smuggling – an essential element in regaining the domestic market and building food production capacity.

Addressing the peace component of the Triple Nexus is of paramount importance for achieving development objectives and building humanitarian response capacity. However, the conditions for implementing the Triple Nexus remain more than difficult, with the country's security situation even deteriorating in the course of 2023. To cite just a few examples of the negative repercussions of the security situation on the conduct of the Triple Nexus, the initiatives taken by UN agencies (UNOPS, UNDP, UNFPA) to set up local mediation cells have been slow to bear fruit, given the continuing virulence of gang violence in the communities. What's more, developments over the past few months have shown that cease-fire proclamations between armed gangs have been more in line with a logic of consolidating their strongholds than reducing violence against the population. On the other hand, the conditions for promoting community dialogue remain very difficult, given that the population continues to suffer daily atrocities at the hands of the bandits, and that trust between citizens has been completely eroded and needs to be rebuilt first.

The controversies surrounding the sending out of a military mission to the country to combat gang violence have shown the extent to which the country is crying out for a paradigm shift in the approach of the security issues. Then the recurrent recourse to an international armed force often serves the sole interests of the economic oligarchy and the political elite, and in many ways constitutes a bonus for their opposition to state reform, to public policies of social justice and to the end of the rentier economy that reproduce violence, poverty, and food insecurity.

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Ukraine – Addressing the Domestic Humanitarian Crisis and the Effects of the War on Global Food Systems

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Abstract

Russia's unfolding invasion of Ukraine is expected to have a far-reaching negative effect on global food security and Ukraine's economic growth. Over the last 30 years, Ukraine has emerged as an increasingly important global supplier of grains and vegetable oil, with a capacity to continue closing its productivity gap and delivering even more food to the global market. However, this trend was disrupted by Russia's unprovoked, full-scale military invasion of Ukraine in February 2022. The price of the continued war is already immense for Ukraine, including its agriculture. Beyond the terrible human toll, suffering, and destruction, the total estimated agricultural war damages and losses for Ukraine increased to beyond US$ 40 billion. Almost one-third of this sector has been destroyed and the destruction is only mounting; farmers experience a glaring shortage of liquidity and capital for current harvesting and planting tasks. In the current tight global market conditions and outlook, the capacity to replace the expected missing exports from Ukraine in the world is very limited and the Russian war in Ukraine remains a major risk to unsettle grain and oilseed prices and, as a result, further endanger global food security.

1. Introduction

Since the breakup of the Soviet Union, Ukraine has emerged as an important global supplier of grains, oilseeds, and vegetable oil. It more than doubled its production of grains and oilseeds and increased its exportable supplies by more than 40 times, reaching 10% of the world wheat, 15% of corn and barley, and 50% of sunflower oil in global exports (Glauber and Laborde, 2022). Abundance of black soils (27.8 mil hectares or almost

one-third of the total world stock), favorable climate conditions, landscape characteristics that allow for larger fields and large-scale farming, suitable geographical location and access to the Black Sea, on-farm and post-farm investments, have all been very instrumental for a substantial productivity increase. Nevertheless, Ukraine's agriculture was still performing below its potential and could have, possibly, reached yields as in the EU and in the US, making even a much larger contribution to the economy of Ukraine and to global food security (Nivievskyi et al., 2022).

Ukraine's economic and agricultural growth, however, was terminated by Russia's full-scale military invasion on February 24, 2022. It has already caused immense human suffering and economic destruction to Ukraine (World Bank, 2023) and has spilled over to every corner of the globe by means of food and energy inflation (Glauber and Laborde, 2022a; Ihle et al., 2022) and food shortages. This article provides an assessment of the scale of the humanitarian crisis in Ukraine caused by the Russian invasion and of the overall destruction and economic losses, including to agriculture. Also, we comment on implications with respect to food supplies from Ukraine and on global food security.

2. Mounting humanitarian crisis in Ukraine

The price of Russia's aggression is already immense for Ukraine and increasing daily. The total damage across sectors mounted to more than US$140 billion (Figure 1) or almost 73% of the country's 2021 GDP. Housing is the most damaged sector (38% of total damages), followed by transport (26%), energy (8%), commerce and industry (8%), and agriculture (Figure 3). The most affected oblasts are the ones that have seen the most intense fighting, i.e., Donetska, Kharkivska, Luhanska, Zaporizka, Kyivska, and Khersonska (Figure 2).

On top of the widespread destruction, the total economic and social losses amount to an additional US$290 billion, dominated by commerce and industry (30 % of total loss), explosive hazard management (clearing landmines and unexploded ordnance, 13%), transport (11%), agriculture (11%), and energy (9%, Figure 4).

Based on the damages and loss estimates, the total reconstruction and recovery needs are estimated at about US$411 billion (World Bank, 2023), with the highest estimated needs being envisaged for transport (22% of total needs), housing (17%), energy (11%), social protection and livelihoods (10%), explosive hazard management (9%), and agriculture (7%).

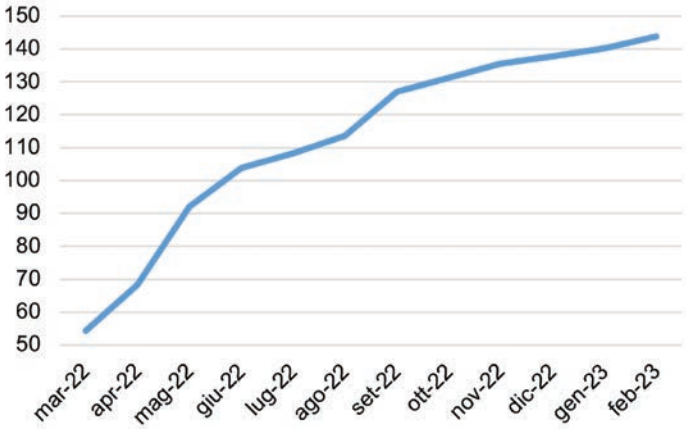

Figure 1. Evolution of total damage (in US$ bn). Source: own presentation using KSE (2023).

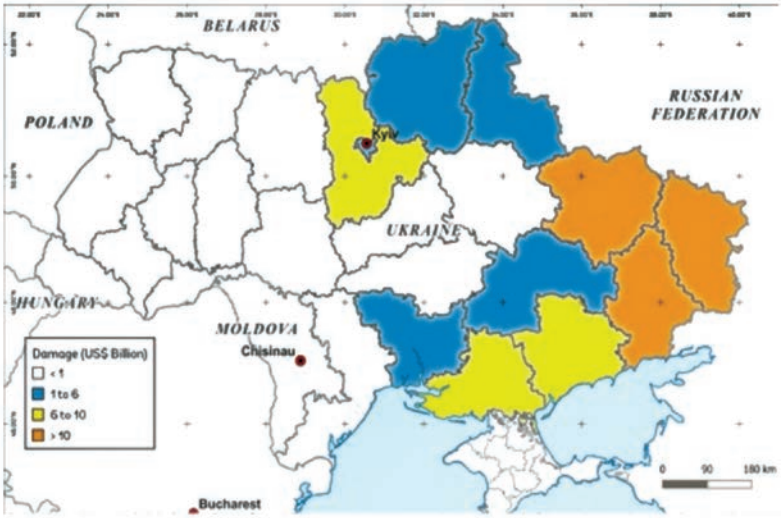

Figure 2. Regional distribution of damages. Source: World Bank (2023a).

Huge and mounting war damages and losses caused Ukraine's GDP to drop by 30% in 2022, generating unprecedent fiscal financing needs reaching US$54 billion, needed to finance primarily military expenditures. The consolidated budget deficit excluding grants amounted to 26.5% of GDP in 2022 (World Bank, 2023a) and it was covered mainly by external financial assistance and NBU monetization.

The figures above hide the terrible human toll and suffering caused by the Russian war, the significant losses of jobs and income in the private sector, the loss of purchasing power, and the loss of assets among Ukrainians, particularly the most vulnerable (World Bank, 2023a):

- Almost 10 thousand civilians have lost their lives, including 461 children (some sources report more than 100 thousand civilians killed); thousands have been injured.
- 13.5 million people (or almost 30% of Ukraine's population) have been displaced, including 8.1 million across Europe and 5.4 million internally displaced within Ukraine; and millions have lost their homes. At least 2 million children have left Ukraine and are expected to remain abroad in other countries in Europe, contributing to brain drain of human capital.
- 75% of IDPs and 62% of the general population need cash support. 24% of IDPs report that cash assistance was their primary source of household income. The share of households with insufficient food consumption increased over 2022: 25% for nondisplaced people and 30% for

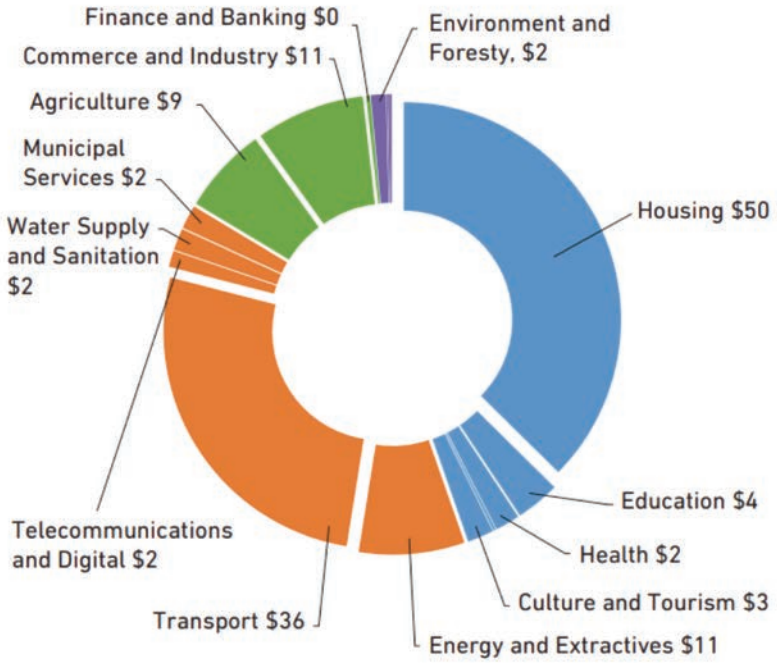

Figure 3. Total damage (in US$ bn): US$135 bn. Source: World Bank (2023a).

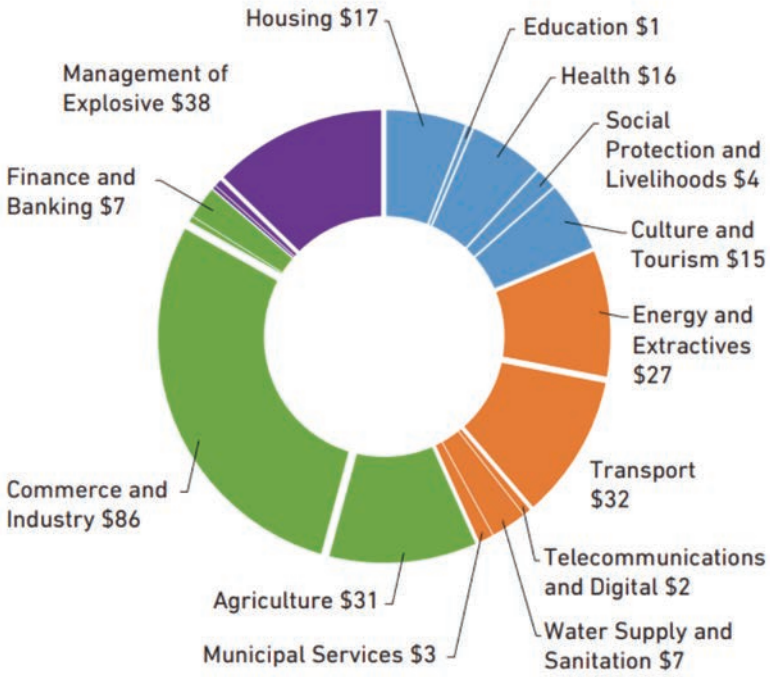

Figure 4. Total loss (in US$ bn): US$290 bn. Source: World Bank (2023a).

IDPs. Finally, 17% of IDPs require accommodation, compared to 4% of the general population.

- 7.1 million people have been pushed into poverty, as poverty increased from 5.5 to 24.1%, reversing 15 years of progress. Overall, there have been dramatic setbacks on many of the Sustainable Development Goals (SDGs), especially those related to poverty, health, education, energy, industry, peace and justice.
- Up to 10 million Ukrainians (or 25% of the population) are at risk of some form of mental disorder, ranging from anxiety and stress to a more severe condition.

3. Climbing agricultural war damages and losses

Agriculture is a key sector of the Ukrainian economy and is of vital global importance. Together with upstream (e.g. agricultural machinery) and downstream (e.g. food processing) industries, the entire agri-food sector's share of Ukrainian GDP amounts to roughly 20%. Ukraine's agricul-

ture is mainly crop-based, with grains and oilseeds increasingly becoming a backbone of agricultural growth (Figure 5) and accounting for almost 90% of the total arable land (Nivievskyi et al., 2022).

Over the last two decades, Ukrainian agriculture became an increasingly important source of staple food supplies. Agriculture accounted for 45% of Ukraine's exports in 2020 (Gagalyuk et al., 2022) and close to 60% during the wartime. On average over the 2018-20 period, Ukraine accounted for 10% of global wheat exports, 16% of global maize exports, and 50% of global sunflower oil exports (Glauber and Laborde, 2022). As Ukraine's agriculture was still performing below its potential, it could eventually have made an even much larger contribution to global food security (Nivievskyi et al., 2022). Figure 5 indicatively shows a possible growth scenario under a 'no war' scenario, assuming decelerating productivity growth as Ukraine approaches its productivity frontier and with additional output predominantly being supplied to global markets.

Ukraine's agricultural growth, however, was terminated by Russia's full-scale military invasion of Ukraine on February 24, 2022, with the expected immense consequences not only for Ukraine, but also for security in Europe, for energy markets and for global food security (von Cramon-Taubadel, 2022; Glauber and Laborde, 2022a). Essentially, almost a decade of agricultural progress has been reversed. Total grain and oilseed

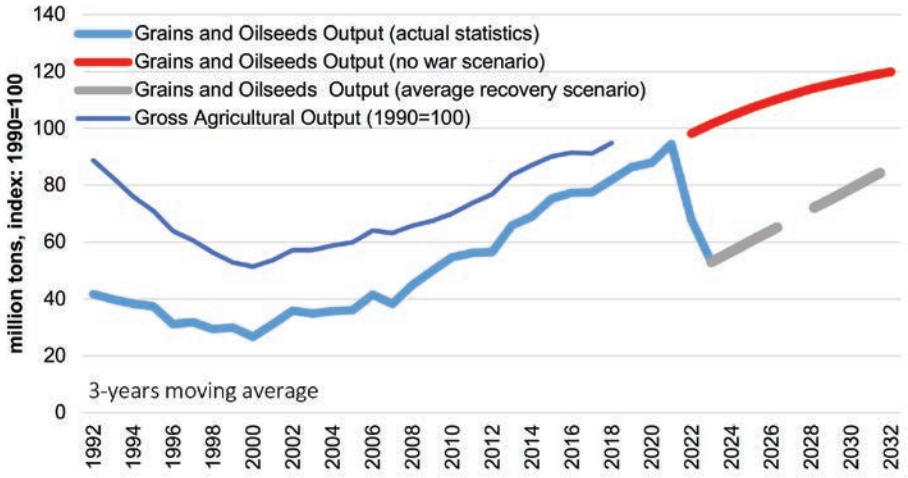

Figure 5. Agricultural growth and grain and oilseed output in Ukraine (3-year average). Source: author's presentation using USDA, Ukrstat, WBI and UGA data.

output is expected to be 53 million tons this year, or 50% of the record 2021 harvest. It might take at least a decade to return to the prewar output levels (Figure 5 depicts an average recovery scenario) if an average prewar productivity growth is assumed.

Total estimated agricultural war damages and losses for Ukraine have been increasing (von Cramon-Taubadel and Nivievskyi, 2023) and surpassed US$ 40 billion (World Bank, 2023). This estimate includes US$ 8.7 billion (Figure 3) or approximately 30% of the net capital accumulated in the sector before the war. In other words, almost a third of Ukraine's agricultural sector has been destroyed already. The largest categories of damages are agricultural machinery (US$ 4.7 billion), stored products (US$ 1.9 billion including 2.8 and 1.2 million t of grains and oilseeds, respectively) and damage to storage facilities (US$ 1.3 billion). The remaining categories include reductions in livestock numbers, damaged perennial crops such as fruit orchards, and, finally, destroyed and stolen inputs (World Bank, 2023; von Cramon-Taubadel and Nivievskyi, 2023).

While the estimated damages reflect the destruction of tangible assets and inventories, the losses estimate the foregone revenue due to lower yields and/or prices and due to additional costs accrued because of the war. Agricultural losses reached US$ 31.4 bn (Figures 4), which is roughly 75% of the gross agricultural output in 2021. Forgone revenues due to export disruptions and lower yields are the two major categories of losses.

The losses due to disrupted exports account for more than a half of total losses. Virtually all agricultural exports from Ukraine (about 93% and mainly grain, oilseeds, and sunflower oil) have been delivered to export destinations primarily in Northern Africa, the Middle East, and Europe by the sea via its Black Sea ports. Since the first days of the Russian invasion, however, Ukraine's Black and Azov sea ports were either occupied or blocked by the Russian naval fleet, thereby triggering panic and extreme growth in international prices (Ihle et al., 2022; Glauber and Laborde, 2022a). A huge backlog of exportable surpluses of grain, oilseeds, and sunflower oil in Ukraine's ports and in inland elevators, and insufficient capacity of alternative export routes to accommodate this mass, increased transportation costs and depressed domestic prices to the level or even below production costs (von Cramon-Taubadel and Nivievskyi, 2023; Martyshev et al., 2023, Nagurney et al., 2023), depriving the farmers of liquidity, increasing uncertainty and causing them to switch their business operations to a survival rather than a development mode. The negotiated Black Sea Grain Deal in

late July 2022 increased export flows considerably, but its reliability has been constantly undermined by Russia, and its functioning is continuously under the risk of suspension (Laborde and Glauber, 2022b; Laborde and Glauber, 2022), so the trade costs remained high and domestic prices in Ukraine correspondingly low (von Cramon-Taubadel and Nivievskyi, 2023; Martyshev et al., 2023).

The second major component in total losses is crop losses due to reduction in the harvested areas (since a substantial number of crops were produced on the territories directly affected by the hostilities) and, due to increased input costs and constrained liquidity, the farmers reduced their application rates of fertilizers and agrichemicals, thus cutting the crop yields (von Cramon-Taubadel and Nivievskyi, 2023).

4. Concluding remarks and continued threats to global food security

Mounting agricultural damages and losses due to Russia's invasion make Ukraine's agricultural outlook rather grim and subject to increasing concerns for global food security; more than 349 million people worldwide are projected to be food insecure in 2023 (more than double the number in 2020, World Bank, 2023b). Global grain and oilseed markets have been tight (von Cramon-Taubadel, 2022), making global food prices and security very fragile and sensitive to disruptions such as the war in Ukraine, and the capacity to replace the expected missing exports from Ukraine in the world is limited (Glauber et al., 2022). Despite a somewhat better outlook because of good harvests in major grain producing countries that contributed to declining global prices, the Russian war in Ukraine remains a major risk to unsettle grain and oilseed prices and, as a result, further endangers global food security (World Bank, 2023b). Hence, the current projections for this and the next season may even be optimistic, and this is bad news for the mounting global food insecurity. In other worlds, and, by no means exaggerated, every ton of grain and oilseeds from Ukraine counts.

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4. INNOVATIONS FOR SOLUTIONS IN FOOD CRISES

Innovative Actions in Humanitarian and Food Crises at Scale

Valerie Guarnieri
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1. Introduction

This paper is presented as an accompaniment to the World Food Programme's (WFP) engagement at the Pontifical Academy of Sciences workshop *Food and Humanitarian Crises: Science and Policies for Prevention and Mitigation* (took place 9-10 May 2023). The subject matter examined here is the role of innovative actions in addressing humanitarian and food crises at scale.

The paper offers a series of insights into the state of global food security; WFP's overarching response through which it responds to, reduces and shifts needs; and how WFP has developed, applied and mainstreamed innovation into its programmes.

The insights and case studies provided should be read as a cross-section of WFP's work where the application of innovative actions is yielding a measurable positive impact: either by allowing WFP to do its work more efficiently, or to deliver more effective outcomes for those people we are assisting.

We hope that this will provide a useful illustration of the value that can be yielded from investments in new forms of innovation in the humanitarian and longer-term resilience-building sectors.

2. The Global Food Security Landscape in 2023

As the World Food Programme (WFP) marks its 60th anniversary, the global food security situation is at a critical point. This represents the greatest and most complex food security crisis in modern times.

In 2023, WFP estimates that 345 million people are acutely food insecure across 79 countries with WFP operational presence and where data is available, an increase of around 200 million people compared to pre-COVID-19 pandemic levels.[1]

[1] WFP. February 2023. WFP Global Operational Response Plan: Update #7 – February 2023. https://www.wfp.org/publications/wfp-global-operational-response-plan-update-7-february-2023

Hunger has also grown more deeply entrenched. Up to 43.3 million people across 53 countries currently face severe hunger emergencies (IPC/CH Phase 4 and above or equivalent, including severely food insecure) as of April 2023 and are one step away from falling into famine if they do not receive immediate life- and livelihoods-saving assistance. This number has risen from 28.6 million in 2019 and includes at least 343,000 people who are expected to experience catastrophic conditions in Burkina Faso, Mali, Somalia, South Sudan and Yemen.[2]

Furthermore, the 2022 report on *The State of Food Security and Nutrition in the World* highlights that up to 828 million people were chronically food insecure (undernourished).[3]

These concerning headline numbers should be understood in the context of persistent and deteriorating underlying trends driving hunger and malnutrition. New wars and unresolved conflicts, the global climate crisis and recurrent economic shocks – including the ongoing economic fallout of the COVID-19 pandemic – are driving this downward spiral. A setback in poverty eradication, growing inequality and skyrocketing numbers of forcibly displaced have exacerbated the situation.

3. The response required

In this environment, it is critical that we step up to help those in need with high-quality, targeted programmes that can meet the scale of the challenge. This means addressing both short-term acute food insecurity and malnutrition, and addressing root causes of hunger.

At WFP we frame this as two continuous, connected agendas to tackle the global food security crisis: Saving Lives and Changing Lives.

– **WFP's Saving Lives work** targets support towards people experiencing acute food insecurity due to an emergency or protracted crisis. This encompasses WFP programmes and thematic areas that enable people to better meet their urgent food and nutrition needs.[4] Like in Yemen for example, where WFP is delivering lifesaving assistance to around 13 million

[2] WFP. April 2023. WFP Corporate Alert System April 2023.

[3] FAO, IFAD, UNICEF, WFP and WHO. 2022. The State of Food Security and Nutrition in the World 2022. https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-security-and-nutrition-in-the-world

[4] Programmes that feed into Strategic Outcome 1 in WFP's Strategic Plan 2022-2025. https://www.wfp.org/publications/wfp-strategic-plan-2022-25

acutely food insecure people (with in-kind food such as wheat and vegetable oil, and cash-based transfers),[5] or in Ethiopia, where in 2022 WFP's targeted supplementary feeding (TSF) programme assisted 2 million children aged 6-59 months with the treatment of moderate acute malnutrition, and treated over 1 million pregnant and breastfeeding mothers with acute malnutrition.[6]

- **WFP's Changing Lives work encompasses the** programmes and thematic areas that build resilience and self-sufficiency for the longer term and address root causes of hunger for people subject to recurring shocks, stressors and structural vulnerabilities. For the most part, they are programmes that:
  - **Support better nutrition, health and education outcomes**,[7] like in Benin where in 2022 WFP supported almost 1.2 million students with school feeding – the majority of them supported under the National Integrated School Feeding Programme (PNASI), which WFP is implementing on behalf of the Government of Benin.[8]
  - **Support improved and sustainable livelihoods,**[9] like in Malawi, where in 2022 WFP engaged 118,000 households in livelihoods programmes to boost crop production, reduce vulnerability to climate shocks, tackle food waste and increase access to markets.[10]
  - **Strengthen national programmes and systems**,[11] like in Cambodia, where WFP is working to strengthen the capacity of national, subnational and local actors to design, implement, coordinate and monitor effective food security and nutrition interventions.[12]

[5] WFP Yemen Annual Country Report 2022. https://www.wfp.org/publications/annual-country-reports-yemen

[6] WFP Ethiopia Annual Country Report 2022. https://www.wfp.org/publications/annual-country-reports-ethiopia

[7] Programmes that feed into Strategic Outcome 2 in WFP's Strategic Plan 2022-2025.

[8] WFP Benin Annual Country Report 2022. https://www.wfp.org/publications/annual-country-reports-benin

[9] Programmes that feed into Strategic Outcome 3 in WFP's Strategic Plan 2022-2025.

[10] WFP Malawi Annual Country report 2022. https://www.wfp.org/publications/annual-country-reports-malawi

[11] Programmes that feed into Strategic Outcome 4 in WFP's Strategic Plan 2022-2025.

[12] WFP Cambodia Country Strategic Plan 2019-2023. https://www.wfp.org/operations/kh02-cambodia-country-strategic-plan-2019-2023

Critically, these two agendas are linked. Changing Lives work reinforces Saving Lives work. In many contexts, the pressure on WFP and our partners to save lives will stay persistently high unless vulnerable communities' lives are changed through enhanced resilience and efforts to address the underlying challenges that fuel hunger.

4. Innovation and innovative actions at scale

In 2022, WFP and its partners reached a record 158 million people with food, cash, and commodity vouchers. This represents the largest number of people WFP has ever assisted in our 60-year history. And yet, it wasn't enough to arrest the escalation in the number of people experiencing food insecurity, as outlined above.

Despite donors' continued generosity there is a growing gap between the assistance that humanitarian and development actors can provide, and the number of people in need. For WFP this often translates to reduced food rations or reduced value of cash transfers for vulnerable people. For instance, WFP has been forced to cut back its lifesaving assistance for all Rohingya refugees living in the camps in Cox's Bazar in Bangladesh. As of March 2023, WFP has reduced its General Food Assistance voucher value from US$12 to US$10 per person per month, due to a US$125 million funding shortfall. Where WFP implements such reductions in assistance, there is a high level of risk that acute food insecurity could be further exacerbated.[13] So clearly, a business-as-usual approach to tackling humanitarian and food crises will not be enough.

It is therefore imperative that the design and implementation of assistance is as efficient and effective as possible. The financial resources that are available need to stretch further. And we must deliver programmes with greater speed and alacrity. More innovation will be essential to meeting these aims.

This is a mindset that is wholly embraced by WFP. Innovation and technology have been designated as key 'enablers' of WFP's Strategic Plan, in both the Saving Lives and Changing Lives agendas.

As WFP Executive Director Cindy McCain stated on assuming her new role: "*My priorities are clear: increase our resources, improve our effectiveness, and scale up partnerships and innovation to bring modern solutions to those most in need*". This focus is welcome and builds on WFP's substantial investment in this space through the WFP Innovation Accelerator.

[13] WFP. April 2023. WFP Corporate Alert System April 2023.

One of the pioneering innovation structures within the UN and wider impact ecosystem, the Innovation Accelerator was established in 2015 in Munich, Germany, to disrupt hunger and achieve the Sustainable Development Goals (SDGs). It identifies, supports and scales high-impact innovations, external startups, non-profit innovations and internal WFP solutions. It provides innovators with mentorship, hands-on assistance, access to funding, and connects them to WFP's field operations.

While targeting UN 2023 Agenda's Sustainable Development Goal 2 ('Zero Hunger'), WFP's Innovation Accelerator also provides innovation services to other UN and government agencies, accelerating impact-driven ventures around the world and contributing to strengthening the innovation ecosystem while driving progress holistically towards other Sustainable Development Goals.

To date, the WFP Innovation Accelerator has supported over 120 innovations, with 22 scaling-up globally to achieve significant impact. In 2022 alone, 37 million people across 88 countries were reached by Accelerator-supported innovations. Such innovations have raised more than $200 million in co-funding (via private and public investors as well as Accelerator-provided funding).

In the past two years, the WFP Innovation Accelerator has intensified work in 'innovative finance', launching the Innovative Finance and Venture Launchpad portfolio. The objective is to act as an enabler for WFP, to mobilise additional resources for programmatic interventions and to foster financial inclusion for the people we serve.

The rationale is that traditional grant-based funding alone may not provide sufficient resources to facilitate the Sustainable Goals by 2030. New forms of sustainable financing, pooling capital from public donors, philanthropies, development banks, and impact investors are crucial to closing the funding gap and achieving social impact at scale.

Two pioneering mechanisms being overseen at WFP's Innovation Accelerator are SheCan, a Blended Finance platform that promotes women's economic empowerment, and WFP Innovation Bridge, a catalytic financing facility that provides recoverable grants and concessional loans and guarantees to early-stage innovations, in close partnership with the United Nations Capital Development Fund (UNCDF).

Executive Director McCain has also outlined plans to establish an innovation taskforce, comprising the best minds in both the public and private sectors to recommend measurable steps to address hunger.[14]

[14] Executive Director Cindy McCain, first remarks on appointment at WFP – April

The following sections of this insights paper illustrate how WFP is implementing this approach in practice, in a selected range of WFP's programmes in both the Saving Lives and Changing Lives agendas.

They contain illustrative case studies on WFP's innovative actions being delivered at scale across several areas of programming: including WFP's processes and institutional arrangements; and the programmatic innovation that has been mainstreamed throughout WFP's provision of humanitarian and longer-term assistance: from cash-based transfers, to nutrition assistance, to climate-focused programmes.

These examples do not represent an exhaustive list of WFP's programmatic innovations being implemented around the world. Rather, they are a cross-section of WFP's work, and an insight into the valuable role that innovation can play in allowing humanitarian and development actors to address the scale of global food insecurity that we see today.

4.1. Cash-based Transfers (CBT)

WFP's cash-based transfer (CBT) programmes are a core part of WFP's programme offers in the Saving Lives and Changing Lives agendas. Ten years ago, CBT were positioned simply as an innovation to send people money to buy food. Since then, WFP has evolved its use of CBT in line with emerging technologies and a shifting food security context: WFP has accumulated technical expertise that allows it to reach people faster and more effectively, and a deeper understanding of the transformative impact that cash assistance can have on people's lives.

This form of assistance has proven to be a key innovation in its own right. It gives people the freedom to meet their essential needs as they choose, and stimulates local economies.

WFP has leveraged the growth of mobile money to send cash to people in hard-to-reach contexts. Cash-based programmes can be a starting point for financial inclusion by providing access to – and usage of – accounts and financial services to unbanked and underserved populations, often for the first time. When women are economically empowered, everyone benefits: economies grow, more girls are kept in school for longer, fewer children are married, and children's nutrition improves. Unleashing women's potential through such empowerment reduces poverty, and with it hunger.

2023. https://www.wfp.org/news/ambassador-cindy-mccain-takes-helm-wfp-critical-moment-global-food-security

Additionally, WFP is pioneering supporting government social protection programmes to create change at scale. During the COVID-19 pandemic, WFP supported 65 countries to adapt or scale-up social protection measures. Innovation is key for us to unlock the benefits of cash. In this case, innovation has meant that we make our cash operations easier and simpler for our colleagues in the field. We help WFP Country Offices create more effective and efficient cash programmes, and use innovation to create tools that they can adapt to their different country contexts.

Today, WFP sends money to people in 72 countries, including those that have been hardest hit during the global food crisis, such as Somalia, Yemen, Afghanistan, South Sudan, and Sudan, where markets are functioning, but people can't afford to buy food. Up to 80 percent of total cash-based transfers assistance was distributed in emergency operations in 2022, including those in Somalia ($474 million); Ukraine ($383 million); and Afghanistan ($357 million).

In addition to specific projects tackling different needs, one of the key areas WFP is working on is assurance. WFP created centralised Cash Services to make it easier and more efficient to implement cash programmes. It means that reconciliation processes and audits will also become simpler for WFP's Country Offices. Cash Services make it easier for Country Offices to ensure the right people receive the right amount of money when they need it most. WFP offers a suite of specialized expertise and tools for the delivery of cash programmes such as DAT (Data Assurance Tool) and the Payment Instrument Tracking (PIT) app.

The Data Assurance Tool (DAT)

We often manage many different datasets in our cash programmes that originate from different sources and have different formats. We have many important business needs for data, including being able to analyse it, detect anomalies and possible duplicate identities, derive insights over time, and reconcile transfers quickly to make sure we are sending money to the right people.

DAT supports implementation services through its data acquisition and secure storage functionalities, preventive and corrective controls, and detective controls and analytics to make data more accessible, provide secure and auditable data transformations and improve data quality, and to provide insights on cash operations quality, effectiveness, and assurance.

Verification and Card Services

Driven by the core challenges experienced by operations in the field, the Payment Instrument Tracking application was launched in 2020. Payment Instrument Tracking (PIT) is a single system providing the ability to capture the end-to-end process for tracking payment cards, including their last mile delivery. Run by WFP's Cash-Based Transfer division and supported by the WFP Innovation Accelerator Scale Up Enablement programme, the two-part application enables WFP to provide better service to beneficiaries by facilitating a simple and secure card distribution and identity verification process. This means shorter waiting times and a reduced risk of clerical errors. The innovation leverages open-source android devices that can be easily sourced locally. The application can be used offline and its modularity makes it flexible to adapt to specific contextual needs.

Since its launch in 2020, PIT has scaled up to fifteen countries with the most recent being Ukraine. In Ukraine alone, PIT will be used to verify, distribute, and track the entire life cycle of commodity vouchers for hot meals for one million displaced persons per month. In addition to the conventional use of PIT, using the application for the commodity voucher will allow for digital reconciliation of the number of vouchers distributed and be used to create a payment/beneficiary list for subsequent distributions. In 2022 the project digitally managed 500,000 payment cards and PINs, reaching 2.8 million people across Africa, Latin America, the Middle East, and South Asia

plugPAY

Developed by the Finance, Cash-Based Transfers and Technology Divisions at WFP, plugPAY is a digital payment solution that allows people to rapidly receive WFP's cash assistance. Using a human-centered approach, plugPAY incorporates direct transfers from WFP accounts so people can receive payments via their instrument of choice, directly into their own accounts. This 'one-stop-shop' approach uses standardized terms, procedures, and protocols, while also supporting governments in their transition towards interoperable and inclusive financial services ecosystems.

By the end of 2021, plugPay's team validated their proof of concept in Zambia, reaching 17,000 people and reducing WFP's transfer costs to FSPs from six percent to 0.2 percent, while the onboarding time for users was reduced by 90 percent. In 2022, plugPAY scaled up operations in Zambia and launched in Sri Lanka, reaching over 25,000 people in total. PlugPAY

reached the one million USD transfer value milestone by the end of December 2022.

Self-registration enabling rapid & remote cash assistance in Ukraine

The war in Ukraine continues to displace people, damage infrastructure, disrupt supply chains and hold back the country's economy. More than 5 million Ukrainians are internally displaced and nearly 8 million are living as refugees in Europe. One in three households is estimated to be food-insecure, rising to one in two in some areas of the east and south.

WFP teams in Ukraine and Moldova, and those in the Cash-Based Transfers, Technology, Finance, and the Programme Divisions of WFP worked quickly to develop an innovative self-registration tool that allows people to be identified and registered in a safe and reliable way via a smartphone.

This powerful and rapidly scalable self-registration innovation puts people at the heart of the cash programming process. It accurately logs the number of people in need of assistance and their eligibility, while maintaining the integrity of data in the system. The safe and secure tool has a back-end system that incorporates multiple corporate data, payment, and communication systems. Its interoperability means that people in challenging locations can receive their cash within 48 hours, compared to the usual four weeks.

WFP supports 3 million people a month in Ukraine, using a flexible mix of food and cash assistance (including work with local partners to distribute food rations near the frontline). Since the start of the conflict, the total monetary investment value into Ukraine's economy by WFP is estimated to be around $815 million – with the majority being attributed to cash assistance, strengthening individual purchasing power and domestic spending. WFP uses blockchain technology to ensure deduplication of beneficiaries, so that essential cash resources are used effectively.

4.2. Climate-focused programmes

The climate crisis is a key driver of global hunger. In the absence of critical progress on greenhouse gas emissions reductions, climate change is accelerating losses and damages in food systems which disproportionately affect the most vulnerable people, communities, and countries.

Against this backdrop, WFP is called upon to help local communities in climate risk hot spots to build resilience to climate shocks and stresses, and to protect the most vulnerable before climate hazards turn into disasters. Alongside a more purposeful scaling-up of emergency preparedness, this

involves strengthening innovative solutions that leverage early warning and climate information systems, as well as anticipatory action, disaster risk financing and insurance mechanisms.

Anticipatory Action (AA)

WFP recognizes the need for more forward-looking risk management systems to avoid predictable climate hazards turning into humanitarian emergencies. Thanks to progress in climate modelling and impact-based forecasting, this is now possible: robust early warning systems can facilitate decisions to release pre-arranged financing for pre-agreed actions which can protect lives and livelihoods before new climate shocks occur. Such anticipatory actions save lives, time, and money.

Launched in 2015, WFP's AA portfolio includes 28 countries in Asia, Africa, and Latin America and the Caribbean. Over 3 million people are covered, which means they are eligible to receive anticipatory action and early warning information in case a drought, flood or cyclone is forecasted. In 2022, a total of $16.5 million was rapidly disbursed for anticipatory activations in Somalia, Ethiopia, Madagascar, Niger, Nepal, and the Dominican Republic, resulting in 1.7 million people receiving anticipatory assistance as well as early warning messages to protect their lives, food security and livelihoods ahead of predicted flood, cyclone, or drought events.

For example, Somalia faces catastrophic hunger, with the extreme levels of drought further compounding the impacts of other recurrent climate shocks, persistent insecurity and instability. Five consecutive failed rainy seasons and the driest conditions in 40 years have contributed to 6.5 million people facing acute food insecurity. Shockingly, 1.84 million children under 5 face acute malnutrition, with 478,000 facing severe malnutrition and the risk of death without immediate treatment. Since the start of the climate crisis, over 1.5 million people have been displaced due to drought conditions.

In 2022, WFP implemented its largest anticipatory action activation in Somalia. Based on predictions of a fourth and fifth consecutive drought, WFP worked with the Government to deliver anticipatory cash transfers to almost 207,000 people through Somalia's Shock-Responsive Safety Net. WFP also disseminated early warning messages to 1.2 million people by radio to explain the risk of drought to people's crops and livelihoods, and suggested actions that communities could take to mitigate and prepare for the predicted drought conditions. Combined, anticipatory cash transfers and

early warning information empowered at-risk populations to make better informed decisions and prevent losses and damages from the predicted consecutive drought seasons.

PRISM (Platform for Real-Time Impact and Situation Monitoring)

PRISM is a climate risk monitoring system that enables governments in low- and middle-income countries to access climate hazard data via an open-source software solution. PRISM highlights the risks and impacts of droughts, floods, and tropical storms, alongside data on socioeconomic vulnerability. Incorporating different data streams into a single interactive map presents decision makers with comprehensive and actionable information on vulnerable populations exposed to hazards, allowing them to prioritize assistance and inform disaster risk reduction and social assistance programmes.

PRISM has expanded from Cambodia and Indonesia into Mongolia and Sri Lanka. Expansion into sub-Saharan Africa and Latin America is expected in 2023.

PRISM was included in the Digital Public Goods Alliance registry in 2021, recognizing its contribution as open-source software to achieve the SDGs.

The R4 Rural Resilience initiative

As WFP's flagship microinsurance programme, R4's innovative integrated climate risk management approach, enables the poorest smallholder farmers to secure their livelihoods, build resilience to climate-related shocks and access crop insurance through four risk management strategies:

1. *Risk Reduction*: Use of best-practice agricultural and post-harvest loss techniques, access to timely climate information services, etc.
2. *Risk Transfer*: Access to microinsurance to transfer most catastrophic shocks when engaging in risk reduction activities.
3. *Risk Retention*: Access to savings to absorb more frequent and less severe shocks.
4. *Prudent Risk Taking*: Increasing investment, including access to credit and markets, to improve income generation.

In 2022, R4 reached 2 million people across 15 countries, either through direct support to farmers, or through capacity strengthening to governments, like in Zambia and the DRC. Last year, the majority of payouts were triggered in Malawi, Kenya, Guatemala, and Senegal. The evidence

gathered from WFP-supported insurance programmes indicate that insured farmers are better able to cope with climate shocks compared to uninsured households. For example, insured farmers in Senegal only reduced their consumption by 8 percent after an extreme drought versus a reduction of 44 percent by uninsured. Across the country portfolio, WFP beneficiaries primarily reported using payouts to buy food (60 percent), agricultural inputs (34 percent) and for accessing basic services (24 percent). In Ethiopia, between August 2021 and February 2022, 28,297 pastoralist households received payouts totalling US$1.8 million over three rounds of consecutive distributions as drought persisted in the region. Surveys conducted after the payouts revealed that 70 percent of the pastoralists utilized their assistance within the first week, with 48 percent of the payout going towards protecting livestock (33 percent on feed and 15 percent on animal health).

In 2021, 3,500 R4 households in south Madagascar who were facing famine like conditions after several consecutive droughts received a $144 payout each. This payout was equal to seven months of unconditional cash transfers provided by WFP as part of its response.

R4 operates in 15 countries, including Bangladesh, Cuba, Burkina Faso, El Salvador, Ethiopia, Guatemala, Haiti, Kenya, Madagascar, Malawi, Mozambique, Nicaragua, Senegal, Zambia, and Zimbabwe. In collaboration with the WFP Innovation Accelerator, R4 commenced expansion in 2022, to provide microinsurance to smallholder cocoa farmers in West Africa, beginning with Ivory Coast.

WFP is launching a weather-index based insurance product in Kyrgyzstan in Spring 2023 to support local governments to protect vulnerable livestock herders against the consequences of extended winters and extreme droughts.

4.3. Nutrition programmes

Diets poor in vitamins, minerals and other nutrients are affecting the health, well-being and life prospects of hundreds of millions. After more than a decade of progress, malnutrition is on the rise globally, underpinning almost half of all child deaths. Furthermore, inadequate diets early in life have irreversible effects on health, growth and cognitive development of at least a quarter of all children currently under five worldwide. Unhealthy diets and deficiencies of vitamins and minerals affect the health and productivity of billions worldwide, and those who are food insecure are worst affected and can do very little to improve the quality of their diet.

There are however innovations that can contribute to making diets healthier, more nutritious and enable people to reach their full potential. Such innovations enable WFP to develop more targeted and sustainable solutions that promote healthy diets and lifestyles, prevent and treat malnutrition, and ultimately contribute to the achievement of the Sustainable Development Goals (SDGs). These innovations are aimed at improving the quality and nutritional value of the food provided and increasing the uptake of nutrition education and behaviour change interventions.

Examples of these innovative approaches to tackle malnutrition include a digital tool to streamline nutrition programme decision making, monitoring and reporting (CODA); nutrition-based e-learning activities (NutriFami), AI for nutrition surveys (Voice to Text AI), digital marketplace for nutrition (Ancestral Markets) and food fortification as a cost-effective way to add vitamins and minerals to staple foods.

WFP is committed to delivering nutrition assistance in emergencies, while tackling root causes of malnutrition so the most vulnerable are better equipped to cope with shocks.

CODA (Conditional On-Demand Assistance)

In resource-poor facilities, many field operations continue to rely on paper-based recording systems for their nutrition data gathering and analytics processes. This manual method can be inefficient and ineffective and often leads to errors, inability to track individual children through continuum of care and difficulties in both extracting and understanding the collected information. These gaping data holes limit the decision-making abilities of active stakeholders and can catalyze poor health and nutrition outcomes within the most vulnerable communities.

CODA is a digital solution designed to simplify and streamline nutrition programme guidelines and to record individual data. Using a mobile device and a durable smartcard, CODA replaces paper-based records to ensure individual information can be recorded, tracked, and monitored at an individual level. The goal is to empower users (health care workers) to provide better assistance to people and to enable stakeholders to make informed nutrition decisions through near to real-time data.

CODA fills a gap commonly identified in WFP operations related to case management, identification of people in need, optimization of resources, and informed decision making. The service is composed of both opera-

tional services and the digital product, to ensure that the right community receives the right assistance at the right time.

Chakki

Pakistan's national nutrition survey (2018) showed that 36.9 percent of the population faced food insecurity. Additionally, in children under 5, 18 percent were suffering from acute malnutrition; around 40 percent were stunted; and 29 percent were underweight.

Chakki is an innovative solution that aims to improve access to fortified wheat flour for up to 70 percent of Pakistan's population. To achieve this, small-scale millers (known as chakkis) are provided with skills, education, funding mechanisms, and innovative technology to both fortify flour, and in turn, educate their clients. By fortifying flour and facilitating its consumption, as well as teaching buyers about nutrition and health, Chakki is aiming to holistically tackle malnutrition in Pakistan.

In 2022, Chakki reached 2.2 million people, while increasing consumer demand for fortified food from 26 percent to 93 percent. It also raised $700,000 in funding and has integrated with government social security net programmes. Furthermore, Chakki established a revolving fund with local nutrition stakeholders to cover the cost of the transition to fortified flour for small mills.

Sanku

Up to 95 percent of the Tanzanian population (over 50 million people) do not benefit from large-scale food fortification programs because they source their flour primarily from small-scale mills that lack the capacity to fortify their product.

Sanku provides fortification tools, training and other support to small maize flour mills. Fortification technology comes in the form of a "dosifier" which enables small-scale mills to fortify their flour with a precise amount of critical micronutrients. Sanku's IoT-enabled dosifiers facilitate remote monitoring of the accuracy of nutrient premix dosing and quantity of fortified flour produced. Sanku offsets the costs of the millers' nutrients by bulk buying empty pink flour bags, which are then sold to the millers to pack their flour. The margins from flour bag sales cover the entire cost of the millers' nutrients, so mills can fortify their flour at no added cost.

In 2022, Sanku reached 4.5 million people (including almost 277,000 in Kenya as an expansion market). In total, 822 dosifiers were installed, with

193 in project mills (182 in Tanzania, 11 in Kenya). Supported by the WFP Innovation Accelerator and the Bill and Melinda Gates Foundation, Sanku is scaling in Tanzania, with plans to expand and develop solutions to reach new countries/markets.

WFP and Royal DSM partnership

Since 2007, WFP and the nutrition, health and sustainable living company Royal DSM have worked as partners towards the common goal of ending malnutrition worldwide. Under the banner of "Improving Nutrition, Improving Lives", the partnership aims to eliminate 'hidden hunger', a deficiency in one or more micronutrients, by creating sustainable and systemic change. Over 2 billion people, including one in two pre-school-aged children and two in three women of reproductive age, suffer from micronutrient deficiencies.

Through the partnership, WFP and DSM collaborate to: promote the global scale-up of fortified rice; increase the availability of, demand for, and consumption of nutritious foods on the open market; contribute to the global evidence base for investment in nutrition; and jointly advocate for investment in nutrition & raise awareness about our partnership. In particular, the partnership drives production and consumption of fortified rice, reaching more than 15 million people. In Bangladesh, for example, the partnership has supported more than 70 SMEs in building their capacity to produce fortified rice which looks, cooks, and tastes just like ordinary rice but includes essential vitamins and minerals that help curb micronutrient deficiencies.

4.4. Food security Research, Monitoring and Assessment

Food security is dynamic. In order to maximize humanitarian impact, it is imperative to effectively identify vulnerable populations in need of humanitarian assistance. This is why WFP has a full ecosystem aiming at providing globally accessible data. WFP uses real-time monitoring – a groundbreaking approach to food security monitoring and analysis, to provide partners and global decision-makers with streaming analytics on food security and key drivers – all in real time and in one place.

Real-time monitoring to underpins effective operations

To enhance targeted, effective, and efficient operations, real-time monitoring systems aim to provide near-immediate warning of deteriorations

in the food security situation of vulnerable households, enabling decision-makers, both global and local, to respond to crises as they happen. Real-time monitoring systems have been proven to provide upwards of 10 weeks of early warning in cases of food security crises, responding to deterioration months before changes in regular acute food security classifications. This information is regularly employed in the field, giving WFP and its partners a significant head-start in addressing sudden deteriorations in countries like Haiti, Afghanistan and Somalia.

Real-time monitoring data for public good

WFP's real-time monitoring data is a free public good available to the public and the broader humanitarian community to improve complementarity and facilitate knowledge sharing of global food security monitoring systems. Notably, real-time monitoring data is directly used in IPC/CH processes, providing a unique source of continuous data for global food security classifications. Additionally, data from the real-time monitoring systems feeds into projects and initiatives led by partners such as the World Bank, the Global Alliance for Food Security, the German Aerospace Center, the European Commission and many more

HungerMapLIVE Ecosystem: Predicting Global Food Security in Near Real-time

To make real-time data as digestible and actionable as possible, all information is processed and displayed in the HungerMapLIVE – an integrated global hunger monitoring platform that collects, processes and displays real-time information on key food security metrics (like insufficient food consumption scores, or crisis or emergency livelihood coping metrics), conflict, weather events, and other drivers of food insecurity – all in real-time and in one place. The HungerMapLIVE product ecosystem includes:

- **The HungerMapLIVE** global monitoring dashboard
- **Global Insights & Key Trends** daily reports
- **Regional Insights & Key Trends** daily reports
- **Country-level Insights & Key Trends** daily reports

Advanced data visualization tools then provide a holistic view of food security at the global, regional and country levels, via an interactive online map (https://hungermap.wfp.org/).

4.5. Supply Chain Planning and Optimization

In an environment of limited resources and evolving needs, planning and optimization of our operations is at the core of every effort to safeguard WFP's ability to deliver on its mandate in a timely and cost-efficient manner. WFP's Supply Chain Planning & Optimization teams leverage best practices in supply chain management and advanced analytics to enable faster response to emergencies, maximize use of available funding, minimize risks of pipeline breaks and develop contingency plans in response to anticipated challenges. Examples of this work include:

Optimus: optimizing operation designs

One of WFP's key challenges globally is identifying efficient and effective ways to serve people that require assistance. Optimus is an innovative tool that puts advanced analytics at the center of WFP's decision-making processes. Via this online decision support system, WFP staff on the ground can quickly explore and compare different operational plans, allowing them to rapidly identify the most cost-effective ways to assist people in need.

By incorporating multiple data sources, including beneficiary numbers, sourcing options, transport routes, and nutritional values, WFP staff can create scenarios, or ask Optimus to find optimal plans that take into account operational restrictions and preferences, including lead times, funding, nutritional value targets, and local procurement targets. Datasets are analyzed using mathematical models, providing key insights into food basket design, sourcing strategies, and delivery networks for any WFP operation.

Optimus has so far been used in 48 country offices, including complex emergencies such as Afghanistan, Ethiopia, Haiti, Somalia, Sudan, Syria and Yemen. It reached 7.2 million people in 2022, including 6 million in Ethiopia and Madagascar (two countries facing emergency level crises). To date, $50 million of savings have been shown.

Prisma: Support for operational decision-making

The extensive range of data and processes used in WFP's operations requires sophisticated, integrated systems that allow for a holistic picture of WFP's operations and to foresee potential issues. This is necessary to avoid delays, food commodity expiries, commodity pipeline breaks, and additional operational costs. WFP's planners use a tool called Prisma, a control tower that provides near-real-time, end-to-end visibility on WFP operations. Prisma automates complex analyses and reconciliations across units

and systems that would otherwise require high workload and be prone to human errors. Prisma allows WFP's country office management to take better planning decisions, and alerts on issues and potential risks affecting each operation.

5. Conclusion

As this insights paper illustrates, innovative actions have a critical role to play in the fight against global hunger and humanitarian crises more broadly.

In an environment where financial resources are being stretched and food security needs are growing, WFP and our partners cannot afford to neglect the efficiency and impact gains that new innovations can offer when applied at scale. As is evident in the case studies provided above, at WFP we are already seeing pay-offs on our investments in innovation: through efficiency savings and improved impact in our programming, in both our Saving Lives and Changing Lives work.

Moreover, as new technologies emerge and become more accessible and applicable, even in hard-to-reach contexts, there is an even greater incentive to take advantage of the opportunities on offer.

As the examples in this paper demonstrate, innovation in both process and products have become key weapons in the response to hunger. We hope that they will inspire our partners and colleagues in the humanitarian sector to double down on time, resource and staff investments in this area.

For our part, WFP is committed to continuing its investment in scaling up and rolling out existing and new applications of innovation, as we stay the course in our pursuit of a world without hunger.

Data Innovations for Identification of Agri-food Crises

Carlo Cafiero
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"…it will not be possible to tackle the many crises affecting humanity if we do not work and walk together, leaving no one behind. This demands, first and foremost, that we see others as our brothers and sisters, as members of the same human family, whose sufferings and needs affect us all, for 'if one part suffers, all the others suffer with it' (cf. 1 Cor 12:26) … the goals set are ambitious and may seem unattainable. How can we achieve them? First of all, by not losing sight of the fact that at the heart of any strategy are the people, with concrete stories and faces, who live in a given place; they are not numbers, data or endless statistics".
Pope Francis, 2022

"As long as primitive counts and raw scores are routinely mistaken for measures by our colleagues in Social, Educational and Health research, there is no hope of their professional activities ever developing into a reliable or useful science. We owe it to them, and to ourselves, to teach them how to construct measures which work as well as the ubiquitous physical measures by which they manage their everyday living, so that they can do a better job in making sense out of the profusions of data which they collect so enthusiastically."
Benjamin D. Wright, 1999

"Even in reasoning upon some subjects, it is a mistake to aim at an unattainable precision. It is better to be vaguely right than exactly wrong.
Carveth Read, 1914

Introduction

With this short paper, my aim is to present the analytic approach that underlies the Food Insecurity Experience Scale (FIES), a globally valid standard for measuring the severity of the food insecurity conditions experienced by individuals or households.

The FIES is the latest innovation in the long-established field of food security assessments. It has been created to address some of the continuing challenges analysts encounter when trying to respond to the growing demand for valid, reliable, timely and sufficiently granular food security data to inform action. My main objective is to motivate the choice of the ap-

proach that led to the establishment of the FIES, which relies on important innovations in the theory and practice of measurement in the human behavioral and social sciences, not only because it allowed addressing the fundamental questions of the validity and reliability of FIES-based measures, but also because a similar approach may prove useful in addressing some serious shortcomings of other tools currently used to generate widely-used data to assess food insecurity.

I start by reminding readers of the more traditional and perhaps more intuitively obvious approach in measuring food security, based on the analysis of food consumption data. My objective there is to explain why to be normatively correct, while being able to assess adequacy of food consumption at the individual or even at the household level based on the food data typically collected in practice, is an almost impossible task. A conclusion, reached for example by the round table of experts convened by FAO's Committee on Food Security (CFS) in October 2011 to discuss FAO methods for food security assessment, is that, given the nature of the food data that is typically available from most commonly available sources, including via carefully conducted population surveys, one has to limit the ambition of being able to provide very precise, disaggregated head-counts of the actual people who do not eat enough, and admit that the best that can be made is to provide rather approximate estimates of the prevalence of inadequate food consumption at the population level. The discussion will also highlight why some of the simplified methods for food consumption data collection, such as the ones used to inform the Food Consumption Score (FCS), originally proposed as being operationally feasible and because of that become very popular among analysts who conduct emergency food security assessments, are problematic. Rather than addressing them, these solutions exacerbate the validity problem ("are these numbers measuring what they are meant to be measuring?") and leave the reliability question ("how good are the measures obtained in different empirical contexts?") unanswered. As food consumption data will unlikely provide a solution to the problem of how to obtain valid, reliable, timely and feasible food security assessments, part of the profession looked elsewhere.

In the following section of the paper, I describe how, supported by convincing evidence cumulated over more than thirty years of research and applications worldwide, food insecurity at the individual or household level is best seen as a measurable latent trait. To do so requires relying on the so-called Rasch model, from the name of the Danish statistician who

first introduced it in 1960 in the field of pedagogy and educational testing. Though rapidly growing, applications of the Rasch model have not yet permeated all areas of social research and therefore can be still seen as an innovation, and that is why I devote a specific short section in this paper to present its fundamental elements, suggesting ways in which it may be invoked to improve on the analysis of existing data collected with food frequency questionnaires as the one currently used, for example, to compute the Food Consumption Score.

Applied to the severity of food insecurity, as it was done for the first time in 1995, when a team of researchers at the Economic Research Service of the United States Department of Agriculture used to analyze items collected with the food security supplement of the general population survey, the Rasch model has provided the conceptual and practical means to answer the validity and the reliability questions with reference to food security assessments. With that in mind, I will finally turn to the main objective of the paper, which is to illustrate the steps taken at FAO, starting in 2012, to develop the Food Insecurity Experience Scale (FIES), which can be described as a globally valid, complete, food insecurity severity measurement system that can be adapted for any practical situation in which household or individual food security assessments are required.

When is food consumption "poor", "borderline" or "adequate"?

A common interpretation of the food security question, when seen from the perspective of an individual, is to ask whether the person is consuming amounts of food that meet the requirements for an active and healthy life. This has led to operationalize empirical food security assessments by defining food requirements in terms of dietary energy and relying on the analysis of data on food consumption. To many, that may appear as a rather simple task. As put for example by Bill Gates, commenting on the method used to compute the Prevalence of Undernourishment (PoU) – still the most popular indicator of the extent of hunger in the world – "when the United Nations Food and Agriculture Organization calculates national rates of undernourishment, they don't do what you might expect: take a large sample of people and determine how many are not eating enough" (Gates 2013, 32). Unfortunately, things are not so simple, because of both a methodological and a data-related problem. From a methodological point of view, the problem resides in the fact that, as people can – and normally do – adapt their food consumption to their energy needs, observed food consumption

levels reflect, in part, underlying requirements, which are determined by individual characteristics such as sex, age, body mass and physical activity levels. Even if one could associate the relevant individual characteristics to each person sampled in Mr Gates' ideal survey, the problem would remain of how to establish the appropriate normative threshold for energy requirement. Nutritionists go as far as suggesting that the typical methods used to assess the adequacy of consumption in population groups can be used for all nutrients for which the correlation between consumption and requirements is negligible, but cannot be used for energy (see for example the discussion in Gibson 2005 section 8.3, pp. 214-220). Without entering into much technical detail, let it suffice to mention that, over the years, researchers working at the FAO statistics division have devised an appropriate methodology to control for the partial endogeneity of the cut-off threshold to be used to establish dietary energy inadequacy starting from food consumption data collected in population surveys.[1] The method recognizes that a certain degree of variation in the levels of dietary energy consumption is to be expected in any population group, including when no one is under- or over-consuming. The concept of the Minimum Dietary Energy Requirement (MDER), defined as the lower bound of the range of energy requirements determined by normal differences in body masses and physical activity levels of active and healthy people, is introduced as the appropriate normative threshold to use to assess the PoU (see Figure 1). This ought to be recognized as a quite sophisticated, important contribution to the analysis of social phenomena where it is of crucial importance not to confound diversity with inequalities.

The other important aspect to be considered when analyzing food consumption data with the aim to determine adequacy, is that one should obviously refer to levels of habitual, or usual, rather than occasional food consumption. As food consumption can vary from day to day, but also occasionally or periodically, due to seasonal variations or to cultural reasons, the data collected should be "cleaned" from the effect of excess variability that could be present because the data were collected with short refer-

[1] Details of the way in which FAO computes PoU estimates are given, every year, in an Annex of the State of Food Security of Nutrition report (https://www.fao.org/publications/sofi/en/) and can be found in the official metadata document of the SDG indicator 2.1.1 at https://unstats.un.org/sdgs/metadata/files/Metadata-02-01-01.pdf and the references therein. For an extended discussion on the PoU methodology, see in particular (Naiken 1996; 2003; 2014).

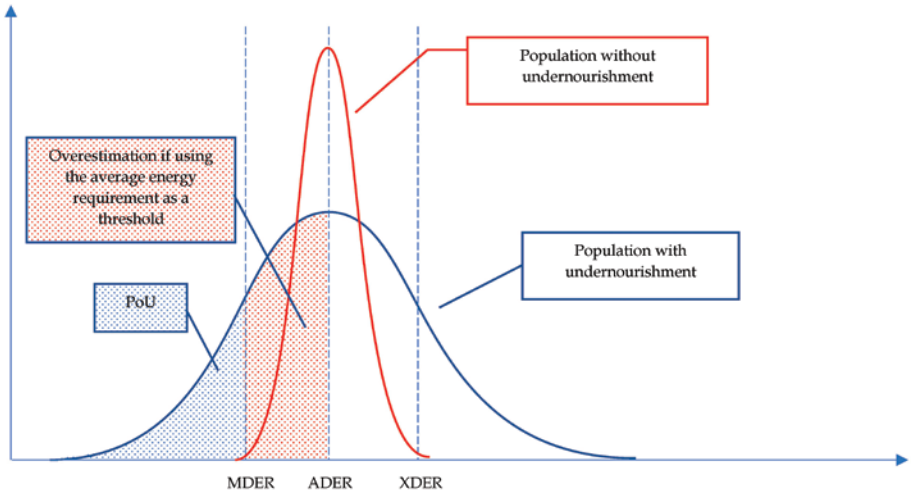

Figure 1. An illustration of the concept of Minimum Dietary Energy Requirement used as a cut-off point to assess the Prevalence of Undernourishment. The figure illustrates the problem arising when analyzing dietary energy consumption data, due to the fact that, even in a population group where everybody is adequately nourished, there would be levels of dietary energy consumption above and below the average dietary energy requirement. Using the average requirement, which corresponds to the recommended dietary energy intake level for that population group, would imply a systematic overestimation of undernourishment.

ence periods (to avoid recall bias), in addition to the many other sources of measurement error that must be recognized as always present in food consumption data collected in surveys.[2] The lesson learned from decades of experience by researchers at FAO and elsewhere when analyzing these types of data, is that collecting food consumption data of sufficient quality is difficult and that measurement errors – which can be significant – are virtually unavoidable. Neglecting them implies deriving systematic overestimation of the extent of food consumption inadequacy (See Figure 2).

But to treat excess variability in a meaningful way adds another layer of complication to the methodology used to obtain PoU estimates. As can be imagined, the resulting methodology may be difficult to grasp by people

[2] See FAO and the World Bank (2018) for an extensive treatment of the issue that must be considered when collecting food consumption data in surveys, to reduce the extent of possible bias.

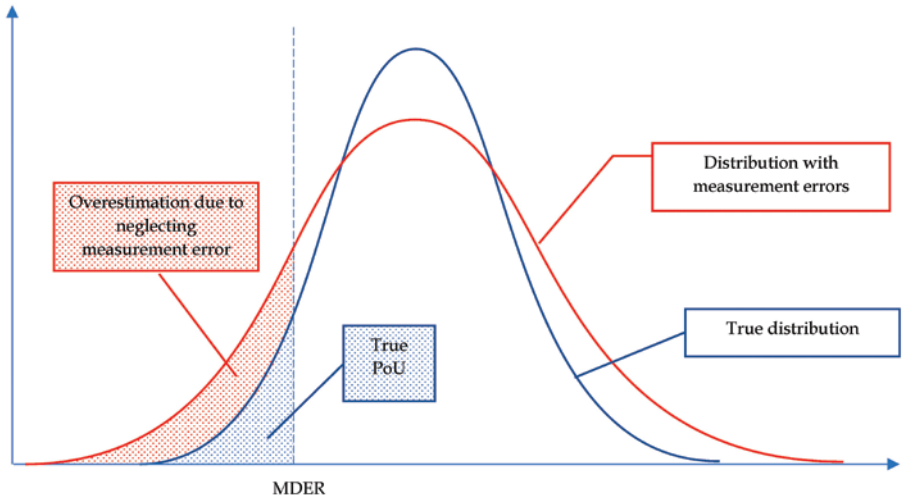

Figure 2. Why it is important to control for excess variability, when estimating the prevalence of undernourishment. The figure illustrates the consequence of estimating the PoU using a frequency distribution derived from data characterized by substantial measurement error. While the presence of measurement errors will not influence the estimated mean, it will inflate estimates of the variance of the distribution, leading to heavier tails.

who are not very familiar with sophisticated principles of statistical inference, which may well explain – though not justify – positions such as the one expressed by Mr Gates' quote above. However, Mr Gates was right on spot when, a few lines later in the same article he wrote: "This is no way to track an important piece of the first Millennium Development Goal (MDG). The countries of the world committed themselves to cutting hunger in half, but they don't know who is, in fact, hungry" (Gates 2013, 32). He was right and, from the discussion thus far, it should be evident that substantial improvements in the reliability of estimates of the extent of food insecurity, interpreted as the percentage of people with inadequate food consumption, might have been obtained only through the collection of more granular and detailed food consumption data, which unfortunately would imply substantial increases of data collection costs. Something else was needed.

One of the proposed solutions to conduct less expensive and quicker assessments relied on simplified food consumption data collection and analysis, as it is done with the Food Consumption Score (FCS), a concept de-

veloped by the World Food Program in the early 2000s to inform estimates of the prevalence of food insecurity in a population.[3]

The FCS is a simple numerical score that can take values on a range from 0 to 112 as a result of computing as a simple weighted average the frequency of consumption of food items from different food groups, during a 7-day reference period, as reported in a survey. The weights used to compute it are meant to a capture the "nutritional importance" of the various food groups, though it is unclear according to which criteria such importance is established. The computed score and conventional threshold values of 28 and 42 are used to classify the reporting households as having "poor" (FCS < 28), "borderline" (42 < FCS ≤ 28) and "adequate" (42 ≤ FCS) food consumption.

The attitude taken by food security analysts who created the FCS might be described using the same words Joel Michell, a researcher who has devoted significant efforts to study measurement in psychology (see for example Michell 1999), used to describe the one taken by psychologists, and that is worth quoting in full:

> *Guided by a mixture of Pythagoreanism and operationalism, psychologists have devised a wide range of procedures that generate numerical data, including mental tests, rating scales, attitude and personality questionnaires, and magnitude estimations. For many it seemed that no more was involved in psychological measurement than devising such procedures.*
> *Even if psychologists did not know exactly what they measured, they could be confident that because the procedures resulted in numerical assignments they must be measuring something.*
>
> (Joel Michell, 1990)

To underestimate the relevance of the FCS in contributing to the prevailing narrative on the frequency and severity of food crises would be a serious mistake. It is one of the metrics most frequently used today to assess the adequacy of food consumption during emergencies. As it has been included since the beginning in the reference table of indicators for acute

[3] The FCS was conceived as an attempt to simplify the collection of food consumption data in surveys by using less-demanding survey modules, such as food frequency questionnaire, so that data collection would be less expensive and surveys more frequent. See https://resources.vam.wfp.org/data-analysis/quantitative/food-security/food-consumption-score for technical guidance on how to compute it. For a more comprehensive critical discussion of these and other methods to conduct assessments of the adequacy of food consumption, see Cafiero et al. (2014) and Cafiero (2020).

food insecurity classifications, its values condition virtually all assessments conducted according to the IPC (Integrated Food Security Phase Classification), a set of protocols presented as a standard for food security assessments during emergencies. (IPC Global Partners 2021) Until very recently, FCS data collected by WFP or others were the main – if not the only – source of quantitative data used in IPC assessments. Moreover, very recently, WFP has launched the Hunger Map (https://hungermap.wfp.org/), an Internet-based data portal where the percentage of people with FCS-based "poor" or "borderline" food consumption is presented as the only indicator of current levels of food consumption.

Given its popularity, it is perhaps more important than ever to scrutinize the properties of the FCS as an indicator of food insecurity, starting with the validity question: Does it measure what it is supposed to be measuring? Obviously, to explore this question requires that the measurand, that is, the attribute being measured, is clearly identified. This is already a problem for the FCS, as which attribute of "food consumption" it captures exactly remains unclear. Paraphrasing Joel Michell, its proponents at WFP believed that, as the procedure described in the manual produces numbers, it must be measuring something.

Based on published attempts at validating it, where values of the FCS are contrasted with measures of the dietary energy contained in the food consumed by the households over the same reference period, one derives the impression that its proponents consider it to be a proxy for caloric consumption.[4] There is not much else to do than to report the charts presented by Wiesmann et al. (2009) and by Baumann, Webb and Zeller (2013) to explain why that attempt at validating FCS as a metric of dietary energy consumption failed.

The scatter plots reproduced in Figure 1 above show the extremely weak correlation that can be found between the two variables. Though, from a purely statistical point of view, the Pearson's correlation coefficients computed on the two variables can be considered significantly different from zero for series of the lengths considered in all four examples, this can hardly be interpreted as evidence that the FCS can serve as a good "proxy" of dietary energy consumption. Such a conclusion might have been defended,

[4] Though the way it is computed would suggest it to be more a metric of dietary diversity and hence of the overall quality of the diet, as it is described, for example by Kennedy et al. (2010).

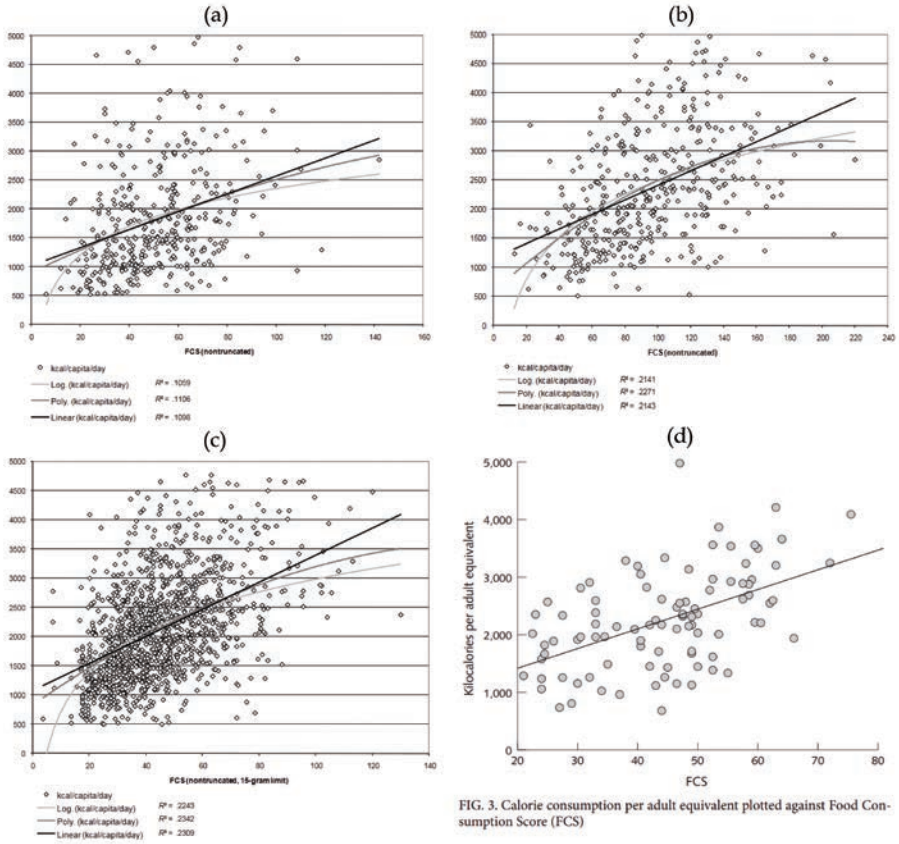

Figure 3. Note: the three charts in panels (a), (b) and (c) correspond to Figure 4, 8, 13, respectively, in Wiesmann et al. (2009), where household level food consumption (kcal/capita/day) is plotted against versions of WFP's FCS modified to achieve the largest possible correlation using data from Burundi, Haiti and Sri Lanka. The chart in panel (d) is taken from Figure 3 in Baumann, Webb and Zeller (2013).

eventually, if the correlation coefficient where positive, of an order of magnitude greater than, say, 0.9. So: the FCS is clearly not measuring dietary energy consumption.

I shall return to the validity question and how to possibly address it shortly, but there is another piece of evidence in the scatterplots reproduced in Figure 3 that is worth highlighting: whatever the FCS may be capturing, it clearly does it with a lot of noise, as shown, for example, by the wide range of FCS values reported by households that would be consuming the

same amounts of foods per capita. This raises a question of reliability, especially if the intention of the analysts were to respond to the call to be able to identify "who the hungry are". Unfortunately, the FCS user manuals and other supporting materials provide no guidance on how to determine the extent and relevance of measurement errors.

The final observation that I make on the FCS, has to do with comparability of the assessments, over time and across space. Even setting aside

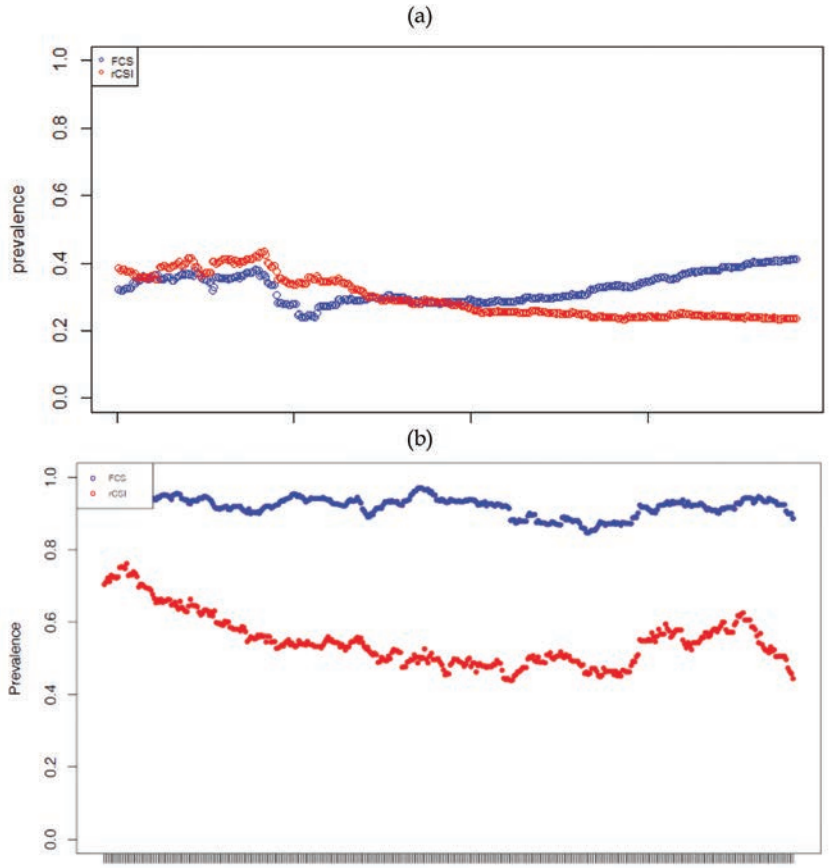

Figure 4. When compared to other indicators of food insecurity, supposedly equivalent FCS-based classifications reveal very different levels and/or time patterns, depending on the where data are collected. The charts above represent daily time series of the percentage of households with either "poor" or "borderline" FCS in the population of two different provinces of Nigeria (panel a) and Afghanistan (panel b) retrieved from the https://static.hungermapdata.org/api-catalog/

the validity question for a moment, and assuming that the FCS might be measuring something, one would hope that such "something" is the same, independently of when and where the FCS data are collected. This is particularly important, for example, when FCS data are used in the context of initiatives that propose assessments involving many countries, over time, and for which comparability of the classifications is of essence.

Consider now the series reported in the charts in Figure 4, which are derived from data currently released under WFP's Hunger Map Live. In the charts, the red dots represent the percentages of households in the population that has "inadequate food consumption", defined as either "poor" or "borderline", based on the reported values of the FCS, while the blue dots represent the percentages of households in the same population reporting having relied to relevant strategies to cope with food shortages, as captured by the so-called reduced Coping Strategy Index (r-CSI), another indicator commonly used in emergency food security assessments. It is evident that two series cannot be representing the same phenomena in the two contexts. In the first case, while the estimated percentages are very similar, at levels of around 30% of the population, from a certain moment in time they clearly show a divergent path. In the second case, however, the two series depict very different levels, with the FCS pointing to percentages around 90%, while the rCSI pointing to levels of around 60%.

Admittedly, these are just two examples (though many more can be found by perusing the rich database made generously available by WFP), and a creative analyst may indeed be able to find explanations to justify these patterns. Moreover, I do not deny that the data behind these statistics may contain very relevant information. That is not my objective, as in a world where information is so strategic, every kind of information is precious.[5]

The points I am making in this paper are different and relate to how these statistics are presented to the general audience and how the information contained in the data collected is processed. The main problem I have is that the very fact that these are presented as "statistics" based on "key

[5] One explanation, for example, may be that the two series represent two distinctly different attributes of the households: "food consumption" and "coping behaviors", as the names of the indicators suggest, and that while in Nigeria households are still able to somehow protect their food consumption levels, in Afghanistan most households may have exhausted their coping abilities. The decreasing trends in the r-CSI coupled with constant or increasing trends in the FCS can thus be interpreted as coherent signs of a continuing deterioration.

indicators" conveys an aura of objectivity and scientific neutrality that, unfortunately, is neither proven nor qualified. Perhaps the behavior of the series is dominated by the noise that inevitably distorts the signal contained in the data, perhaps the arbitrarily set thresholds used for classification are not truly equivalent in different contexts, and therefore reporting "poor" or "borderline" food consumption may have different meanings in terms of what the actual "food insecurity" status of these populations may be. Unfortunately, despite the efforts I have put over the last decade into exploring the literature on food security measurement, I have failed to identify research that addressed these fundamental questions of reliability and validity, which are the only criteria that should be used to define what is being done quantitatively as science.

Measuring the unobservable: the Rasch model

Given the discussion in the preceding section of this paper, I would not be surprised that readers may be skeptical regarding the possibility to find a solution to the problem of scientifically measuring food insecurity. Two things should be clear, that make it a special challenge. First, food insecurity, as a theoretical construct, the way it is probably interpreted by most of us, cannot be taken simply as a synonym of reduced quality and/or quantity of the food consumed. Further, though being one of its most frequent determinants, food insecurity is also not a synonym of malnutrition and therefore is not a physical or biological human attribute. Seen from the social science perspective, it is also not just yet another name given to extreme poverty, to limited resilience or coping ability, or similar constructs. Food insecurity has long been recognized as something complex, that involves all dimensions that, at any moment, contribute to people's inability to access the food they need to conduct active, healthy, and dignified lives, irrespective of their cultural, demographic, or socio-economic status. Second, it should also be clear that simply devising a procedure to attach numbers to cases falls very short from quantifying the magnitude of the attribute of interest, in ways that – as Benjamin D. Wright reminds us in the quote reported in the opening of this paper – "work as well as the ubiquitous physical measures by which [we] manage [our] everyday living".

In this section I argue that, though impossible to observe directly, as a physical or biological attribute, the severity of the food insecurity condition of people can be measured in a scientifically proper sense. This can be done by applying the Rasch model (Rasch 1960; Bond, Yan, and Heene

2020) to measure the severity of the food insecurity condition of individuals or households through data on the self-reported occurrence of behaviors and conditions that are typically associated with a situation of inability to freely access food.

The Rasch model is a general approach to infer the unobservable magnitude of a subject's latent trait (such as, for example, the level of competency on a subject matter possessed by a student) from the observable responses that the subject gives to a number of different "items" (such as the questions included in an evaluation test), via rigorous application of sound statistical principles. This is not the place to enter into a detailed technical discussion of the way in which the Rasch model is applied in practice, referring the reader to the existing voluminous literature on the subject.6 It may be important, however, to underline that the only requirement to consider a problem treatable through the lenses of the Rasch model, is that both the subject and the items used for assessment are located on the same unidimensional scale (say, the one that measures both the student's ability and the test items' difficulty in the example made above), and that the greater the distance between the subject and the item, the more likely it is to observe a certain, definite response. In formal terms, the model postulates that the probability of observing a certain response (say, an affirmative answer), by a respondent (identified by the subscript i) to a question (identified by a subscript j), is a logistic function of the distance, on an underlying scale of severity, between the position of the respondent, a_i, and that of the item, b_j.

$$\text{Prob}\{x_j = 1\} = \frac{\exp(a_i - b_j)}{1 + \exp(a_i - b_j)}$$

where $x_{i,j}$ are modeled as binary variables $x_{i,j} \in \{1,0\}, \forall_j, j$.

[6] Especially useful are the books by Bond et al. (2020), which presents a very complete yet accessible treatment of the Rasch model described as the tool to achieve fundamental measurement in the human sciences, and the one edited by Fischer and Molenaar (1995), which provides a collection of technical contributions on the foundation, extensions and examples of applications, including by introducing statistical estimation algorithms. Of note, in the context of the discussion in this paper, is the very recent book by Engelhard, Jr. and Wang (2021) where the Food Insecurity Experience Scale is used as an extended example throughout the book, to demonstrate points related to scale construction, evaluation, maintenance and use.

Despite its simplicity, this formulation of the relationship between the observable data (the set of x_{ij} responses) and the unobservable measures (the parameters a_i and b_j) is the only one (among many possible alternative, more flexible formulations proposed in the broader field of item-response theory – IRT) that ensures the property that measures be *invariant*.[7] Loosely speaking, invariance of the measures means that the way a measurement tool works is not distorted by the specific object that happens to be measured.[8] I hope my readers will agree that this looks like a very important property of measurement tools to be used in science, and that therefore, unless proven impossible, any creative way of transforming the data collected with the best possible intention to capture something relevant to the policy question should be tested for adherence to the restrictions imposed by the Rasch model.

After all, applying the Rasch model in practice should not be difficult for experienced quantitative analysts versed in statistical inference. The unknown parameters a_i and b_j are estimated by forming the likelihood function of the data set $X = \{x_{i,j}\}$, seen as a function of the unknown parameters $\theta = \{a_i, b_j\}$ and maximizing it. In the end, parameters will be those of main interest and are interpreted as a measure of the magnitude of the latent attribute of interest, as revealed by the evidence provided by the observed (or self-reported) responses to a set of relevant items.

In this sense, the most important message from this section of my paper is that analysts interested in resolving the potential shortcomings of indicators such as the FCS (but a similar proposition can be made for the Household Dietary Diversity Score, the Coping Strategy Index, or some of the very recently proposed indicators of diet quality at https://www.dietquality.org/) that are being used for international assessments, should feel compelled to attempt to construct Rasch-based measures from the data they have collected. This will force them to settle on the premise to the fundamental validity question, by having to provide an operational definition of their measurand (it may be the "adequacy of food consumption levels", for a measure derived from data collected with FCS, HDDS or DQQ questionnaires), and to explore, in rigorous quantitative analytic terms, issues of reliability. If successful, they may finally confidently claim to have established a measure.

[7] For a detailed treatment of measurement invariance, see Engelhard, Jr. (2012).

[8] This is a fundamental aspect of what has been defined stochastic conjoint additive measurement (Perline, Wright, and Wainer 1979).

Experience-based food security measurement and prospects for better food security assessment

My final section turns to the Food Insecurity Experience Scale, as the first example, within the broad field of food security assessment, of successful completion of the entire process I sketched in closing the previous section.

When FAO started exploring ways to respond to the solicitations which emerged from the 2011 meeting of the CFS, to find a way to substantially improve global food security monitoring, it did not have to start from scratch. Analysis of *food insecurity experiences* data, which has its roots in the very pioneering works conducted in the early 1990s at Cornell University (Radimer, Olson, and Campbell 1990; Radimer et al. 1992; see also Kendall, Olson, and Frongillo 1995) and in the context of the Community Childhood Hunger Identification project (Wehler, Scott, and Anderson 1992), had already successfully led to the development of a quantitative food insecurity and hunger measurement scale, thanks to the research conducted by sociologists at the Economic Research Service of the US Department of Agriculture (Hamilton et al. 1997; Nord, Jemison, and Bickel 1999) using the Rasch model. Since 1995, experience-based food security measurement had been successfully applied in many countries and in different contexts, and the approach had been discussed at an International Symposium in 2002 (E. Kennedy 2003). In addition to the US, use of experience-based measures as a way to collect official data to inform national food security assessment had been implemented in Canada, Brazil and Mexico, and successfully tested in several other countries.

By 2012, there was a sufficiently broad interest towards the method, and diffused applications, though questions were raised on the possibility to obtain universally comparable assessments across countries and cultures (Coates et al. 2006; Jensen 2003).

Indeed, one problem was that we were still lacking a proper method to calibrate the food insecurity measures obtained in different contexts, possibly using slightly different survey modules adapted to the local cultural and linguistic conditions, against a common reference standard. It was through the "Voices of the Hungry" project,[9] started in 2012 thanks to generous support to FAO from the Government of Belgium and the United Kingdom, and later by the Bill and Melinda Gates Foundation and the European Commission, that researchers at the Statistics Division of FAO where final-

[9] http://www.fao.org/in-action/voices-of-the-hungry

ly able to develop the methods and tools needed to produce such comparable measures (Cafiero et al. 2016; Cafiero, Viviani, and Nord 2018) and to introduce the Food Insecurity Experience Scale (FIES) to the international community, as a complete food security measurement system, composed of a data collection tool (the FIES survey module), protocols for its field application, procedures to conduct the statistical validation of the data collected and to assess their reliability, to compute food security measures, and, most importantly, to calibrate those measures against a global FIES reference scale, so that assessments conducted in different populations and over time could be considered properly comparable, in a deeply scientific way.

As a result, the FIES has been endorsed as the basis to compute SDG indicator 2.1.2. and since its introduction, the FIES has been extensively validated for use all over the world and in very different contexts. (Frongillo 2022) The relevance of indicator 2.1.2 in the context of the ambitious 2030 Agenda for Sustainable Development should not be underestimated, as it allowed to enrich the prevailing global narrative on food insecurity (which tended to be focusing on hunger) to include moderate food insecurity as an important driver of various forms of malnutrition. In this respect, experience-based food security measures will be a very useful tool to guide policies intended to fight not only hunger, but malnutrition in all its forms (Pérez-Escamilla 2012; Pérez-Escamilla et al. 2017).

More recently, a modified FIES survey module, adapted to report conditions and experiences occurring during the 30 days preceding the interviews, has been used to collect data in several food crisis countries in 2020 and 2021, during the height of the COVID-19 pandemic. Results have led to publishing two consecutive reports on access to food in these countries (Boero et al. 2021; Cafiero et al. 2022) and to inform discussions within IPC Technical Advisory Group, to include the 30-day referenced FIES-based indicators in the reference table for acute food insecurity assessments under the IPC. During the COVID-19 pandemic, FIES has been used to collect food security data in the LSMS-High Frequency Phone Surveys initiative of the World Bank (https://www.worldbank.org/en/programs/lsms/brief/lsms-launches-high-frequency-phone-surveys). Since 2020, the FIES is the chosen questionnaire to be proposed to measure household food insecurity in the DHS Program administered by USAid (https://dhsprogram.com/pubs/pdf/DHSQM/DHS8-Module-FAO-FIES-Qnnaire-EN-16Oct2020-DHSQM.pdf). Since 2022, FIES is used to collect data in the agricultural community of food crisis countries, disseminated through the

Data in Emergency (DIEM) Information System initiative of FAO (https://data-in-emergencies.fao.org/).

Concluding remarks

A series of unprecedented global events such as the COVID-19 pandemic, and heightened attention devoted to traditional drivers of food insecurity and hunger, such as conflicts, extreme weather events linked to climate change, and the continuation of economic downturn and crises caused by distortions in the international commodity and financial markets has caused the attention given by experts, policy makers and the general public on food security measurement issues to reach levels never achieved before. At the same time, with the fundamental revolution that accompanied the emergence of the new Information and Communication Technology era we live in, we see a proliferation of channels through which a continuous flow of data and information reaches the general public, often with no time for the traditional mechanisms that human society has put in place to exercise the fundamental role of separating the information wheat from the chaff.

Science is perhaps the most important of such mechanisms, a reason why this workshop on "Food and Humanitarian Crises: Science and Policies for Their Prevention and Mitigation" convened by the Pontifical Academy of Sciences is of crucial importance at a crucial moment, when decisions must be made quickly to protect the fundamental human right to adequate food and nutrition.

In this context, contrasting the deep scientific theory and practice that underscored the development of the Food Insecurity Experience Scale with the more pragmatic and operationally oriented intent that motivates other popular food security and nutrition assessment tools, this paper has attempted to raise some caution against too simplistic interpretations of published data on "real-time" food security assessments, while offering suggestions on how current practices in this important area of social policy might be substantially improved.

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Perspectives from the International Organization for Migration: Effective Actions for Migrants and Displaced People Dealing with Food Insecurity

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Tmnit Nur
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1. Introduction

The 2022 Working Group II Report of the Sixth Assessment of the Intergovernmental Panel on Climate Change (IPCC) presented a bleak reality; the rise in extreme weather and climate events have exposed millions to acute food insecurity and water insecurity; and will continue to do so at an alarming rate.[1] In parallel, a record number of people are on the move. These drivers of migration are influenced by worsening climate change and environmental degradation and are likely to become even more destructive in the coming decades. Furthermore, these drivers *also* impact food security. Populations' ability to grow food of sufficient quality and quantity is closely connected to climate variability and their capacity to make a decent living by selling food at adequate prices.

Against this backdrop, this paper will highlight some of the key issues pertaining to the migration, climate change and food security nexus, from the perspective of the International Organization of Migration (IOM), the only agency of the UN system that works on all dimensions of the migration, climate change and food security nexus from both policy and operational perspectives.

2. Unpacking the human mobility, climate change, and food security nexus

The migration, climate change and food security nexus is complex. Sudden and slow-onset events and processes linked to climate change shape

[1] IPCC, 2022a.

human mobility and food security. Desertification, sea-level rise, extreme heat, and extreme weather events pose risks to livelihoods, water availability and resilience, all of which jeopardize food security and sustainable development contributing to different types of human mobility.

2.1. Food insecurity as a driver of migration

Food security is one of the many socio-economic and environmental factors that impact the decision to migrate. Furthermore, this migration can take several forms, with some forced into displacement and others migrating – at least to an extent – voluntarily in search of better economic opportunities. People may also cross borders or stay within their own countries, or migrate in a circular way, for various periods of times or forever.

Existing data reveals that millions of people are forced each year into displacement due to the combined impacts of climate change and food insecurity. Food insecurity may also drive people to voluntarily migrate in response to or in anticipation of food insecurity, in search of areas where food security is better assured. For instance, rural-to-urban migration in the Kyrgyz Republic is linked to the devastating impacts of climate change on agriculture and farming livelihoods.[2] The current trends of migration from rural to urban areas are influenced by a multitude of factors, including the uncertainty of income and the risks associated with food insecurity, which often prompts farm households to adopt migration as a coping mechanism.[3] Poor rural households, especially those residing in developing countries, often resort to sending family members to urban areas to pursue non-agricultural employment, as a means of managing the risks associated with seasonal hunger and extreme poverty.[4] Additionally, displacement caused by environmental disasters, such as floods or coastal erosion, has become commonplace in many nations. For communities where livelihoods heavily depend on vulnerable water and marine resources, migration can sometimes be considered a collective strategy.[5] For example, for Small Island Developing States (SIDS), planned relocation or resettlement may be necessary as climate change impacts threaten the physical viability of SIDS and their entire national economies.[6]

[2] WFP and IOM, 2021.
[3] FAO et al., 2018.
[4] FAO, 2015.
[5] Causse et al.,2016.
[6] Ibid.

At the same time, food insecurity might reduce some of the resources necessary to migrate, such as financial means linked to declining agricultural, farming or fishing livelihoods, resulting in trapped populations that are unable to migrate. On the other hand, those with improved food security may have the resources to cope with compounding crises or climatic events, allowing them to remain in their areas of origin. Food insecurity can also aggravate the situation of people already on the move, including displaced populations and migrants in transit who are often food insecure and need humanitarian assistance.

As climate change and food insecurity worsens, regions and communities with existing vulnerabilities and people with pre-existing inequalities will suffer disproportionately. Rural populations, landlocked or import dependent countries, those in fragile and conflict-affected contexts and humanitarian operations will bear the brunt of natural resource scarcity, commodity scarcity and rising food costs. Looking towards the future, it is already clear that millions of people will be on the move due to climate impacts and their spillover effects. If no widespread policy interventions are adopted to step up climate mitigation and adaptation measures in vulnerable regions, the World Bank projects that 216 million people could become internal climate migrants by 2050.[7]

2.2. Key datapoints

Climate change, disasters, and food insecurity have been found to shape migration patterns globally. The combined impacts of climate change and food insecurity are leading to acute crises, that, combined with the lingering effects of pandemic, economic instability, rising food prices, can compound risks for communities already under severe stress, leading to protracted crises. In 2022, disasters alone led to 36.2 million internal displacements.[8] For example, in the East Asia and Pacific region, approximately 10 million people were internally displaced by floods, storms and geophysical hazards in 2022.[9]

Disasters directly linked to food security, such as intense drought, that contribute to famine episodes, also lead to migration and displacement. In 2022, 2.1 million people were displaced because of drought in Somalia, Kenya, and Ethiopia.[10]

[7] Clement et al., 2021.
[8] IDMC, 2023.
[9] Ibid.
[10] Ibid.

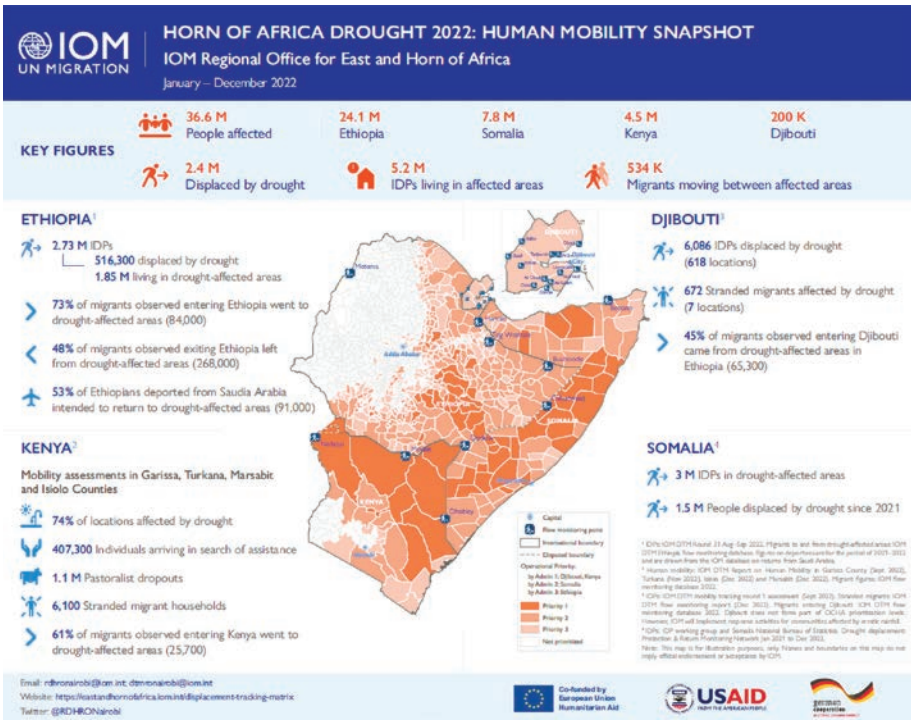

Figure 1. Horn of Africa Drought 2022: Human Mobility Snapshot (January-December 2022).

As of November 2022, IOM's Displacement Tracking Matrix estimates that 1.8 million people have been displaced by drought in the Horn of Africa, with five million people living in drought-affected areas, and 260,000 migrants moving to and from the area (e.g. Fig. 1).[11] Drought-induced displacement is increasing the vulnerability of an already vulnerable population as they move to urban areas in search of assistance. Between 2021 and 2022, the number of internally displaced people in 22 countries that had food crises grew from 45 to 51 million.[12] In the Horn of Africa, more than 1.5 million people have been displaced due to drought – with more than one million displaced in Somalia since January 2021.[13]

[11] IOM, 2022a.
[12] FSIN, 2023.
[13] Terry and Rai, 2023.

According to the 2023 Global Report on Food Crises, nearly 53.2 million people were internally displaced in 25 countries and territories identified as food crises.[14] Nearly 670 million people, or eight per cent of the global population, will be facing hunger in 2030.[15] Sub-Saharan Africa remains one of the most vulnerable regions to the impact of climate change and a region predicted to have the greatest number of internal climate migrants by 2050, an estimated 86 million people.[16]

2.3. Migration – both a challenge and an opportunity

Migration in the context of climate change and food insecurity clearly presents challenges for states and communities. However, migration already represents hope in some contexts. Research shows that migration can boost the capacity of people and communities to adapt to adverse climate impacts.[17]

The IPCC recognizes that increasing adaptative capacities can reduce climate displacement's negative impacts and improve migrants' degree of choice.[18] On one hand, increasing adaptive capacities can help to avert, minimise and address climate-related displacement. At the same time, safe, orderly and regular migration, within and between countries, can support adaptation.

Migration can also act as a powerful driver of development and resilience building in the face of climate change and food insecurity if enabling conditions are in place. Safe, regular, and orderly migration can provide a mean for livelihood diversification, increase household savings via financial remittances, and lead to the acquisition of new adaptive skills, while reducing pressures on natural resources in climate-vulnerable and food-insecure communities of origin.

Furthermore, the role of migrants as key contributors to global food security should be better acknowledged. More than a quarter of the global farm work is done by migrant workers.[19] Food systems in countries of destination rely heavily on migrant workers, who contribute to the global food supply and global food security through their agricultural labor.

[14] FSIN, 2023.
[15] FAO, 2022.
[16] Clement et al., 2021.
[17] IOM, 2017.
[18] IPCC, 2022b.
[19] FAO, n.d.

Key message: The evidence is clear; climate change and food insecurity are shaping contemporary migration patterns at a time when there are more people migrating than at any time in recorded history. Migration is often a challenge to be managed, but it can also provide opportunities to countries, communities and individuals when enabling conditions are in place.

3. Effective actions to respond to the needs of food insecure migrants and displaced people

As food insecurity continues to worsen, it is essential to develop solutions addressing the complexities of the migration, climate change and food security nexus. IOM promotes a comprehensive approach to this nexus, grounded in human rights for the benefit of both migrants and societies. When well-managed migration becomes a safe and accessible choice, it can help people adapt to environmental and climate change.

To this end, supporting inclusive multilateral and cross-sectoral collaboration and developing innovative migration responses is key to make humane and orderly migration part of the solution to address food insecurity. This entails working across the Humanitarian, Development and Peace Nexus (HPDN) to provide solutions in the following areas: 1) addressing the environmental, climate, and security factors that compel people to leave their places of residence; 2) building the resilience of communities through adaptation, preparedness and disaster risk reduction measures; 3) providing effective and timely humanitarian and recovery assistance; and 4) implementing peacebuilding and community stabilization activities to manage risks associated with climate change and unplanned population movements.

In addition, investments in sustainable agriculture, water management, and renewable energy sources can help build resilient and adaptive communities, reduce poverty and inequality, and promote inclusive and sustainable economic growth.

To address the complex relationship between migration, environment, and climate change, the IOM has strengthened its efforts through the Migration, Environment, and Climate Change Strategy 2021-2030. IOM's work in disaster risk reduction, climate change adaptation, and sustainable livelihoods reflects its dedication to supporting communities worldwide and providing durable solutions. Existing programming provides a wealth of knowledge and best practices on how to address different dimensions of the migration, climate change and food security nexus.

Anticipating and identifying needs: As overlapping crises cause forced migration and displacement, innovative approaches are needed to identify emerging needs in displacement contexts to improve preparation and to adequately address the needs of the affected population. For example, in acute humanitarian crises, IOM's Displacement Tracking Matrix (DTM)[20] is used to identify and address data gaps on the food security status of displaced populations to better understand and respond to the food security needs of vulnerable communities. Furthermore, in displacement settings, providing sources of clean water and energy are imperative to ensuring basic needs are met. IOM DTM is piloting an Energy Module to help provide a snapshot of displaced and affected communities' energy needs and guide the development of the humanitarian response across sectors concerned with the clean energy transition including, camp coordination and camp management (CCCM), food security, shelter & non-food items, protection, water, sanitation and hygiene. This data would be useful to identify and prioritize locations with urgent sectoral needs.

Encouraging joined-up coherent action: In Latin America and the Caribbean, IOM co-leads the Inter-Agency Coordination Platform for Refugees and Migrants (R4V) with UNHCR. The R4V platform, present in 17 countries and coordinating the response of 192 partners, is an example of how to work jointly and through a coordinated sectoral approach while allowing for a flexible response based on vulnerability that effectively adapts to a crisis context. As part of the R4V Response, the Refugee and Migrant Response Plan (RMRP) ensures close cooperation and coordination with local and national authorities, academia, and the private sector to expand initiatives for immediate and urgent food needs using approaches that factor gender and age considerations.[21]

In Somalia, competition for scarce natural resources, particularly water, is driving violent conflict. Environmentally fragile communities are forced to relocate and compete with other communities for control over declining ecological yields as a result of climate change and environmental deterioration, which further depletes already scarce water resources. Through a

[20] IOM's Displacement Tracking Matrix gathers and analyses data to share timely and critical multi-layered information on the mobility, vulnerabilities, and needs of displaced and mobile population targeting emergency responders and decision makers.

[21] The Inter-Agency Coordination Platform for Refugees and Migrants from Venezuela, accessed 24 May 2023.

multi-sectoral and collaborative approach, IOM, the United Nations Environmental Programme and the Stockholm International Peace Research Institute are working together to reduce environmentally-induced displacement and conflict in Somalia's Galmudug state. Activities include tangible investments in water infrastructure and innovations for water and energy capture, such as construction of a solar-powered borehole, as well as infrastructure support and agro-pastoral livelihood opportunities for women.

Working directly with affected communities: Climate change acts as a 'threat multiplier', not directly causing conflict but interacting with other political, economic, social and factors, including food insecurity, to exacerbate drivers of conflict and fragility.[22] In West and Central Africa, transhumance is an important livelihood and economic activity that drives rural development in the region, but climate change, demographic changes and resource scarcity are exacerbating political insecurity leading to conflict and affecting traditional transhumance routes.[23] IOM developed the DTM Transhumance Tracking Tool (TTT) as a localized approach to conflict resolution. The TTT provides event alerts, due to conflict or disaster, as well as prevention alerts due to unexpected livestock movements to understand existing and potential conflicts.[24] Using a localized alert system, a large network of informants across the region share and receive movement and conflict information that is provided to regional stakeholders for the development of tension reduction interventions.

In Senegal, the Casamance violence has impacted Kolda, one of Senegal's poorest regions. While the region was traditionally fertile and provided many opportunities for farming, climate change and environmental degradation have depleted local soils, endangering the livelihoods of local communities dependent on the agriculture sector. In 2019, IOM implemented a pilot project in partnership with the NGO Trees for the Future (TREES) to train returned migrants in agroforestry and sustainable agricultural practices.[25]

Following the TREES Forest Garden Approach, returnees worked on a demonstration farm where they cultivated fruits and vegetables as well as learned new income-generating practices.

[22] IOM, 2021a.
[23] IOM, 2021b.
[24] IOM, 2023a.
[25] IOM, n.d.

Supporting migrants to be part of the solution: To address food insecurity, durable solutions that focus on prevention, adaptation, and long-term resilience are needed to build the adaptative capacity of affected populations. Financial remittances can contribute to household food security in many ways, including supporting the purchase of consumable goods, diversifying household income, and funding the purchase of production inputs.[26]

Social remittances, such as innovative ideas and practices, can support the acquisition of new adaptive skills such as climate-smart agriculture in communities of origin.

In Tajikistan, IOM is centering women in the solution. Climate change will greatly affect Tajikistan's rural population, which is dependent on the agricultural sector, by intensifying drought and severe water shortage. At the same time, out-migration is a defining characteristic of Tajikistan's so-

Key message: Understanding and addressing the nexus between migration, environment, climate change, and food insecurity through programmatic action across the HDPN is necessary to reduce the negative impacts of these factors on lives and livelihoods. Governments, international organizations, civil society and migrants themselves must work together to develop comprehensive and evidence-based policies that protect human rights and address the root causes of migration in this context.

ciety and the remittances sent home are important to the national economy and support the livelihoods of families staying behind. IOM is supported the women staying behind respond to the impacts of drought and severe water shortage by leveraging savings, predominantly from remittances, for household adaptation planning. To guide future policy and programming on climate change adaptation in Tajikistan, an action research study was conducted to understand the best capacity building initiatives to boost climate change adaptation in their households.

4. Looking ahead

The overlapping crises we are witnessing around the world are undermining the international community's ability to deliver the promises of Agenda 2030 and the Sustainable Development Goals, to reach the climate mitigation and adaptation objectives collectively agreed upon under the Paris Climate Agreement and the advance the implementation of the Glob-

[26] Weldemariam et al., 2021.

al Compact for Safe, Orderly and Regular Migration. Yet, it is a global responsibility to respond to current challenges linked to climate change, food (in)security and migration, and to prepare for future challenges on the horizon, including by promoting the positive role of migration and migrants.

To this end, states will need to prioritize actions across the HDPN based on whole-of-society approaches. This paper identifies five concrete actions, echoed from the report of the 2022 International Dialogue on Migration – *Overlapping Global Crises: The Impacts of Food Insecurity and Climate Change on Migration and Displacement*,[27] that have the potential to create transformational changes for countries and societies.

1. Identify communities-based action to adapt to changing food-related livelihood options, including through skills development, social protection measures, and financial investments including through partnerships with the private sector.

2. Explore the possibilities to expand legal pathways to provide safe and legal migration options to those experiencing the twinned acute impacts of food insecurity and climate crisis.

3. Leverage the added value of existing knowledge to better understand and respond to the interconnections between rural livelihoods, food security and migration.

4. Systematically integrate the voices of migrants in the development and implementation of policy and programmatic responses and ensure that these responses are fully informed by migrants' experiences.

5. Assess the impacts on vulnerable people, especially women, who often bear the brunt of food insecurity but also hold the key to solutions; and young people, who will be forced to take up the legacy we leave behind.

[27] IOM, 2023b.

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Indigenous Peoples and the Making of Resilient Life: Hybridizing the Culture of Maize to Achieve Food Sovereignty

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Abstract

In the face of crises caused by extreme climatic shocks, and sociocultural and political processes, food security continues to be a challenge. Mainstream approaches focussing on crop productivity and high-yielding technologies continue to be promoted worldwide and they are partially the root cause of the climate and food crisis. However, there are other alternative food systems, i.e. Indigenous Peoples' food systems, that could offer alternatives to the current crisis and from which we could learn to make more resilient communities. Despite the fact that Indigenous Peoples' food systems, such as native seeds-based food systems, are still widespread, they remain underestimated by mainstream policies and agricultural research. In this paper, we explore how Indigenous Peoples innovate and play with different elements to make resilient food systems to adapt to a changing world while also keeping elements that are relevant to their self-determination and culture. We argue that it is possible to create resilient communities by reinforcing Indigenous Peoples' food systems rather than displacing or replacing them. This paper describes a case study grounded in the Zapotecan Indigenous community in Oaxaca, Mexico, that continues to cultivate native maize, although they have adopted other technologies such as irrigation. We describe how migration, climate shocks, Mexican agricultural and rural development policies, and changing aspirations have shaped Indigenous Peoples' culture of maize technology and yet, how being self-sufficient is essential for their resilience. We explore how these Indigenous Peoples make resilient communities through their *comunalidad*. *Comunalidad* involves rights to recreate tradition and culture but also protect themselves in the face of threat, as it is the space that allows them to enact their right to self-determination (*usos y costumbres*) and reinvent their social fabric and

community-based work (*tequio*) to find continuity in life (*fiesta*) or be resilient. This hybridization around maize cultivation comes along with a hybridization of food, aspirations, identity, and culture as farmers are adapting to a changing world and expressing their sovereignty. Indigenous Peoples choose to take what suits them best from the pluriverse to create a hybrid life and adapt to a changing world. We use this case to show that we could be learning lessons from Indigenous Peoples and the importance of a rights-based approach to support resilient communities.

Keywords: native maize; Mexico; Indigenous Peoples food systems; climate change; migration; Indigenous Peoples; food sovereignty; resilience.

Indigenous Peoples and the making of resilient life: hybridizing the culture of maize to achieve food sovereignty

1. Introduction: Setting the scene

> *50 years ago, I remember that several events like rains and pests hit my town badly. However, my parents and grandparents back then had many fields cropped, they had lots of maize, beans and crops. Thus, we did not feel it at all, we would manage to survive. All was different in 2010 when we were hit by a hurricane and strong rains blocked the entry to the mountains, and the stores ran out of maize and food. We did not have food and the only solution we found was to go up the mountains to get maize from other Indigenous Peoples that were farming more than us. I was ashamed then: how come I could call myself a farmer if I could not cultivate what I needed to feed my family? I wondered how I let this situation happen and how come, as a child, I never faced a situation like this* (Susana, Interview 2016).

It was a sunny day in March 2016 when we arrived in Yavesía, a tiny village located in the Zapotecan indigenous mountains of the Sierra Juarez in Oaxaca, Mexico, after a three-hour drive from Oaxaca City. We were amazed by the landscape and how the community seemed to be isolated, untouched, and calm. Yavesía can only be accessed by public transportation once a week in the community-managed bus service and has no cellular phone signal. We saw the maize in traditional fields using the *milpa system*, an intercropping system that includes native maize, potatoes, pumpkin, beans, and other crops. We wondered how this seemingly untouched community was able to continue with its way of life as we live in a globalised and changing world. It was like being trapped in time. We wondered, are these Indig-

enous Peoples the "noble savages" (Raymond, 2007) attached to the earth (Verschoor, 2009), mother earth and native seeds protectors as portrayed by many social activist groups?

As we stepped from the car to continue the journey on foot, we spotted one *milpa* field with a sprinkler irrigating the *milpa* and peach trees. Then we wondered, how did this Indigenous farmer get an irrigation system in his *milpa*? Does this mean that these Indigenous Peoples fit the "peasant-is-obsolete" narrative (Nally 2016:572), and their food systems are inefficient and need to be modernised to ensure food security? Does this mean they had to replace their native maize with hybrid maize and other technologies to increase their maize production? We continued our discussion as some of our peers indicated that we needed to ensure food security through increasing maize production and replacing obsolete *milpa* systems, while others argued that we should not pervert or touch the pretty traditional *milpa* systems.

As we continued walking and discussing, we found Sagrario, a 45-year woman, tilling her *milpa*. She was fertilising her *milpa* alone and we offered her some help, to which she agreed. She told us to cover the fertiliser with soil and add soil to the root of the maize plants to prevent the fertiliser from being swept away by the wind or rain and to prevent the plants from falling over. We realised that Sagrario's *milpa* did not look like the traditional *milpas* we know, which commonly have four to five maize plants spaced every 0.90-1.5 m. Sagrario's *milpa* had three maize plants sowed every 40-60 cm. We could also see some peaches hanging from the trees that are not characteristic of the region and some pipes lying on the ground that she was using to irrigate her field.

We praised Sagrario on how pretty and modern her *milpa* field looked and she replied that her *milpa* field had not always looked like that. It was thanks to multiple events that she learned to combine different technologies to cope with extreme events and changing circumstances. She said that the landscape had changed a lot since she was a child, migration and other factors had affected their livelihoods. While migration had allowed them to get better incomes and caused a reduction in farming, they relied on local and national stores to complement their food needs. However, in 2010 they learned that money was not sufficient to ensure food; rather, they needed to ensure their self-sufficiency. They had experienced some challenges after the tortilla crisis in 2007 but in 2010 a hurricane disrupted the local stores which ran out of maize: they had money but no sources to buy food, and roads were blocked to enter their mountains. Their only solution to find food was to go higher

up in the mountains. Indigenous Peoples in Yavesía then recalled that in the past, before migration became central to their lives, they had also had extreme events, but they were always self-sufficient, and they survived. They reflected on the need to innovate more and reclaim their food self-sufficiency which explains the *milpa* systems we saw with different 'modern technologies'. In 2021 with the COVID-19 pandemic their experience was different: now they were self-sufficient and even though the local stores also had food and maize shortages, they managed to be self-sufficient.

As we engaged more with the Indigenous Peoples in Yavesía in 2016 and 2021, we had more questions. We wanted to understand what were the drivers that shaped their *milpa* cultivation and how these drivers affected the resilience and livelihoods of a community like Yavesía. What was the role of policy on their livelihoods? What were their strategies to cope with change? How can these strategies help to cope with the multiple crises we are facing?

1.1. In the name of food security: The problem of the productivity-oriented paradigm in times of crisis

We live in a time of crises caused by conflict, climate shocks, and the threat of a global recession. Thus, policymakers and practitioners continue debating on what is the best approach to solve the current multiple crises as every night around 828 million people go to bed hungry (FAO et al., 2022). For decades, central to the discussions of food insecurity has been the need to produce more, but with the current climate crisis we still think of producing higher yields but also in a more sustainable way. As conflicts have also arisen, particularly with Russia and Ukraine, with the increase in the cost of fertilisers and staple crops, and with the experience of COVID-19, we also see the need to make shorter and more resilient food systems.

For decades, the productivity or modernisation paradigm has promoted intensive agriculture in which food security is equated as a synonym for high crop yields, looking down upon traditional food systems as they have been considered inefficient. The modernisation model was rooted in the Green Revolution that emerged in the 1960s, when high-yielding varieties, monocropping, and intensive chemicals were highly promoted to maximize the yields of specific crops per unit of input (Pingali, 2012). While we cannot deny some of the positive outcomes of this model to feed the world, we cannot also deny that this model led to unsustainable food systems as today, intensive agriculture accounts for 30% of the greenhouse gases contributing to climate change (Fanzo and Downs 2021), uses 70% of the fresh-

water, and is responsible for 80% of the world's deforestation (FAO, 2017).

In a time of crisis, food diversity is essential. This productivity-oriented paradigm has made us dependent on a few crops, i.e., wheat, maize, and rice provide at least 50% of the world's caloric intake (Awika, 2011 and Chivenge et al., 2015) and with 25 other crops make up 90% of it. Relying on a few crops when food chains are disrupted, as we experienced with COVID-19 or the current conflict between Russia and Ukraine (World Bank, 2022), threatens the world's food security (Triphanti, 2016) as food supplies are reduced. Additionally, in an era of climate change threatening life, studies suggest that promoting monocropping has caused the loss of biodiversity (Jacques et al., 2012).

There are other alternatives to food security, e.g. Indigenous Peoples' food systems, that are more sustainable. Indigenous Peoples and their practices are responsible for preserving 80% of the world's remaining biodiversity (Sovrevilla, 2008). These systems are largely rich in biodiversity and adapted to broad range of environments. For example, we can find these native maize-based systems in the arid lands of the Arizonan desert with Tohono peoples or in the 'chakras' in the rainforests in the Peruvian Amazonas or in the Mayan peninsula where these *milpas* have been adapted to cope with constant extreme events (Camacho-Villa, et al., 2021). The richness of native maize systems is so large that a Guatemalan Mayan system can contain up 143 different foods (FAO, Bioversity International y CIAT 2021) or the Yucatecan Mayan *milpa* or traditional food systems that contain up to 250 species (Toledo, 2008) and 329 medicinal plants that are recognised by their smell and taste (Ankli et al., 1999). These alternative food systems have remained largely neglected in mainstream research and policy because the dominant assumption has been that Indigenous Peoples need to be lifted out of poverty and food insecurity by increasing their crop yields through the use of modern technologies, e.g. improved seeds, fertilisers, machinery, among others (Byerlee et al., 2009; Johnston & Mellor, 1961; Thompson & Scoones, 2009).

1.2. The case of Mexico: Maize policies and the productivity-oriented paradigm

Mexico has not been an exception to the dominance of the modernisation-productivity paradigm, and the main beneficiaries have been a small group of wealthy farmers who could be incorporated into the market-oriented system (Appendini & Liverman, 1994; Fox & Haight, 2010; Gates, 1988). Thus, national policies discouraged the use of native maize and fa-

voured the use of improved maize varieties to increase productivity. The most prominent intervention as part of this process was the Green Revolution, a ground-breaking international agricultural intervention with the aim of increasing productivity, that took shape with the Mexican Agricultural Programme (MAP) in the 1940s (Harwood, 2009). Some years later, Plan Puebla in 1968 (Cano & Winkelmann, 1972; Felstehausen & Díaz-Cisneros, 1985; Redclift, 1983) and Plan Maíz in 1969 (Maximiliano-Martínez et al., 2011) emerged, which drew on elements of the MAP but applied them in more localised contexts. At the time, these interventions were highly criticized for their focus on productivity and for ignoring local contexts and environmental and equity concerns. In 1963, the Mexican government, attempting to reach self-sufficiency and modernisation of agriculture, implemented the National Company of Popular Subsistence (CONASUPO) that would collect maize and other basic crops from Mexican farmers and allocate them to different regions of the country, including to rural areas to supply local food demands (Appendini et al., 2003; Gates, 1988). The increased reliance of local communities on government stores of grains led to a sharp reduction in local production and self-sufficiency (Appendini, 1992). By the end of 1980s, the era of self-sufficiency was collapsing, and internal debt was increasing, giving rise to a movement away from government intervention and control of grain markets toward the free-market capitalism of neoliberalism (Yunez-Naude, 2015). As a result, the Mexican government signed the North American Free Trade Agreement (NAFTA) (now the Mexico-United States-Canada Agreement [MUSCA]) to reduce state intervention, with the goal that farmers capable of competing in an international market would coexist, while others would adopt more competitive crops or move into other economic activities (Nadal, 2000; Yunez-Naude, 2015). Alongside this move, the Programme for Direct Assistance in Agriculture (PROCAMPO) was launched in 1994 to help maize growers for 15 years as they transitioned to more competitive productivity agriculture (Yunez-Naude & Barceinas, 2002).

At present, Mexico is not self-sufficient on maize: this affects our resilience and the situation has remained like this over the last decades. One of the last shocking moments was in 2007, the tortilla crisis linked to the boom of biofuels in the U.S. (Ogle, 2009; Thomaz & Carvalho, 2011), the catastrophic effects of climate change in Mexico in 2009 (Caballero, 2012; Seager et al., 2009; Tirado & Cotter, 2010), and the dependency of Mexico on foreign sources for at least one third of maize demands (Turrent

Fernández et al., 2012) showed the vulnerability of Mexico as policies continue reinforcing inequality and this dependency on external food sources. Again, in 2021 with COVID19 we witnessed how large-scale farming was more affected than traditional farming as they rely less on external inputs (Lopez-Ridaura et al., 2021).

Then, the question is, should we be looking into traditional food systems or Indigenous Peoples in the building of resilient communities? In the next sections we provide an ethnographic study that relies on how Indigenous Peoples in Yavesía, Oaxaca, Mexico have learned to cope with change and how sovereignty and self-determination is essential for their food and livelihoods security.

1.2.1. Food security or food sovereignty for resilient communities: hybridizing the culture of maize

While we argue that to ensure food security, we need to look at other alternative food paradigms besides the modernisation paradigm, in this paper we explain how Indigenous Peoples in Yavesía hybridize elements of the modern paradigm with their traditional food systems and livelihoods in relation to their maize cultivation to adapt to a changing world and community, i.e., how they hybridize their cultures of technology. When referring to technology we draw on its expansive understanding as "the human capacity to make or unmake" (Richards, 2009:495), which renders technology as a highly social activity that is subject to the norms and of "those who make" and the contexts in which they are embedded (MacKenzie & Wajcman, 1999). We use the concept of cultures of technology from Nowotny (2006) to explain that the same technology can have different meanings based on the cultural elements of the actors interacting with it.

In reflecting on how farmers hybridize their cultures of technology, we go beyond past research which has addressed the concept of agricultural hybridization primarily in terms of material mixing. For example, how indigenous farmers mix different types of maize seeds, i.e. "creolisation", which refers to genetic blending of local maize with modern high-yielding varieties (Bellon et al., 2006; Keleman et al., 2009); or participatory plant breeding, which combines genetic hybridization of the plants, but also involves a hybridization of knowledges (Almekinders & de Boef, 2000; Humphries et al., 2015). However, the hybridization in this research goes further because it explores the hybridization of other components of maize cultivation, such as the socio-cultural elements which form the cultures of technology. Thus,

while for a scientist a maize seed can be a pool of genes, for Indigenous Peoples it can be a sacred spiritual guide that takes care of the community (Nazarea, 2013). For our paper, therefore, hybridization is not simply a matter of mixing genes, seeds, or purely agricultural technologies, but also a matter of hybridizing the cultures in which those technologies are embedded.

While some of these ideas on hybridization have been introduced earlier in the broader concept of development, e.g. the Pluriverse from Escobar (2018) and Kothari et al. (2019), and *El vivir bien* (Gudynas, 2011), these perspectives seldom reveal in detail the mundane practices and decisions of the farmers and do not fully explore how the clash between cultures of technology affects farmers' lives and resilience. In this study, our entry point is maize cultivation in Santa María Yavesía, a Zapotecan indigenous community in Oaxaca, Mexico, and the farmers' collaboration with the MasAgro Programme (Sustainable Modernisation of Traditional Agriculture in Mexico) and led by the International Maize and Wheat Improvement Centre (CIMMYT). We explore here how the farmers decided to hybridize and how hybridization plays out in the daily practices of the farmers from Yavesía as they work to achieve resilience and food sovereignty in times of multiple crises.

2. Methodology

2.1. Approach and data collection

Our study is based in Santa María Yavesía (Figure 1), a Zapotecan indigenous community located in the State of Oaxaca. We follow a case study approach (Gerring, 2007; Suryani, 2008; Yin, 2003) in which we analyse the history of the practices around maize in Yavesía from 1940 until today. While the researchers were collaborating with MasAgro Programme from 2012-2020, the data collection took place between March and September 2016 when the researchers spent several months in the community and involved semi-structured interviews with key-actors and participatory observation to construct a timeline of critical events that affected local farming practices around maize. In 2018 and 2020, the researchers were also in touch remotely with four Indigenous Peoples to get updates on how the situation unfolded in Yavesía.

In this paper we acknowledge that there is no single definition of Indigenous Peoples, but we acknowledge the characterisation of the UN on Indigenous Peoples' Rights (2004:2) as

> *Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed*

> *on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal system.*

In this paper we also acknowledge that Indigenous Peoples can be hunters, gatherers, fishermen, among others, but given the characteristics of the food system and livelihoods we describe in this paper, we refer to them as Indigenous farmers not to use 'Indigenous' as an adjective but instead to indicate that these Indigenous Peoples are right holders and do farming activities. Thus, when reading Indigenous Peoples or Indigenous farmers or Zapotecan farmers, or Zapotecan Indigenous farmer or farmers in this paper, we will be referring to the same group of Zapotecan Indigenous Peoples living in Yavesía.

For the data collection in this paper, we interviewed 25 Indigenous Peoples, using the life-histories method to identify key events in their lives, such as where they were born, if they have migrated or moved into a new location/place (and why), marriage, the birth of children and events that have shaped the community's life (such as natural disasters). In most of the cases we focused on three points in Indigenous Peoples' histories: their childhood, the time following their marriage, and the present day. We performed a systemic mapping (Lopez-Ridaura, 2014) of each of these points to identify what farming was like at these different stages: i.e. the location and number of fields, crops, topology and people engaged in the farming activities. All the farmers were interviewed at least twice.

We also interviewed three technicians working with the farmers in Yavesía, five technicians collaborating with or working on the MasAgro Project, eight researchers linked to the MasAgro Project and seven government officials with positions in agriculture and social development.

We also conducted participatory observation, joining in with some farming activities, and attended six training and field days with technicians and researchers. We also attended a workshop with farmers of the community around the dynamics of their livelihoods and sacred places to better understand their relationship with the nature. The organizer of the workshop was a researcher in a local institution and a member of the community.

Finally, we consulted the academic literature, the grey literature and analysed meteorological data using ERIC II software (IMTA, 2009) (from

Ixtlán de Juárez meteorological station, the closest to Yavesía) and other reports to confirm extreme events cited by farmers, read newspapers to verify specific information shared by farmers and read studies done in the community by students of a local university and the internal reports of MasAgro Programme.

2.2. The study area: Santa María Yavesía, Oaxaca

Santa María Yavesía is Zapotecan community of 448 people, 107 of whom are bilingual, speaking Zapotecan and Spanish, and the rest only speaking Spanish. It is located 1900-2100 masl in the state of Oaxaca, in the southern part of Mexico (Figure 1).

The agricultural land of the community stretches from 1900 to 2500 masl, and the forest is found at 2500-3400 masl. The temperatures range between 10-18°C and annual precipitation is 1000-1500 mm. The total area is 9,147 ha. Only three percent of the land is used for agriculture and one percent is urban. Two main permanent water currents run through the community, later forming the Yavesía river ('Shoo Raa' in Zapotecan) that divides the community into two neighbourhoods: Asunción and San Miguel. The farmers refer to the microclimate along the river as humid and to the area above 2400 m as cold. The social organisation is communal by *usos y costumbres*, meaning that the lands are owned by the community and that they make decisions collectively. Despite the influence of other religions, the elements of nature still play a role in their cosmovision.

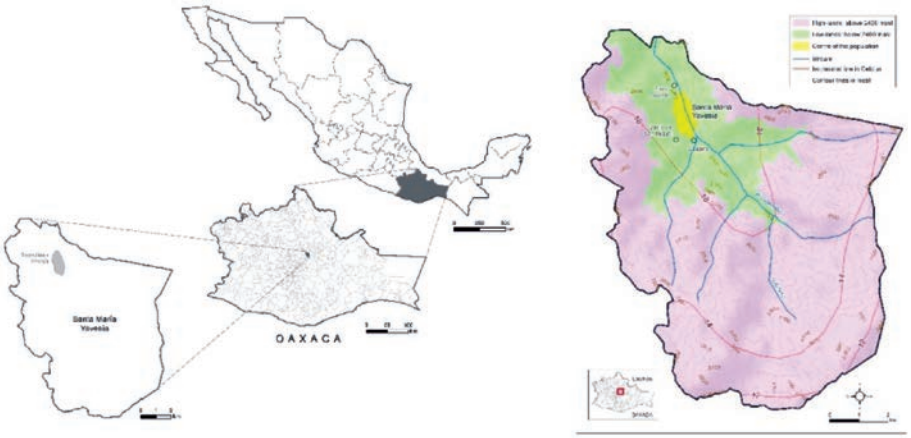

Figure 1. Location of Yavesía and the distribution of fields, lowlands and uplands (Based on INEGI, 2018 maps).

The centre of the community is at 1900 msal and here most of the families have set their homes close to each other along the river. Thus, when referring to the upper lands in this paper, we refer to the lands or fields located at a higher altitude from this reference point.

3. Results

3.1. Making resilience and milpa in Yavesía: hybridization of practices

We talked to Indigenous men, Indigenous women, Indigenous youth and Indigenous elders to learn about their resilience and how their *milpa* systems had changed over the time and why. During these conversations we learned that Indigenous Peoples had adopted many modern practices in cultivating their *milpas*, ranging from planting fruit trees to introducing irrigation. In the following section we describe some of these major changes.

3.1.1. Crop diversity and planting arrangements

According to Indigenous Peoples' recollections, the *milpas* in the upper lands (> 2400 masl) changed the most (Figure 2): they had previously cultivated many crops and varieties there, but now they have largely been abandoned as many Indigenous Peoples have chosen to migrate and houses have been relocated to the central part of the community. A few farmers were still cultivating blue and yellow maize there in 2016. In contrast, the *milpas* in the lower lands (<2400 masl) are still cultivated intensively and the number of crops cultivated regularly in 1960 compared to those cultivated in 2016 increased from 13 to 23 (Figure 3).

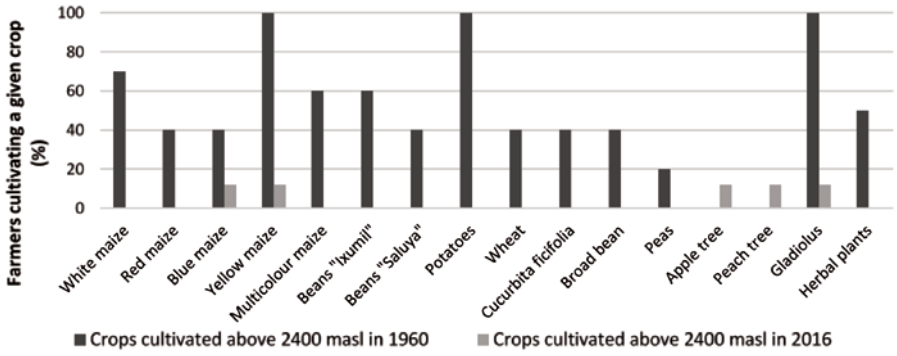

Figure 2. Crops in the milpa fields located above 2400 masl in 1960 and 2016.

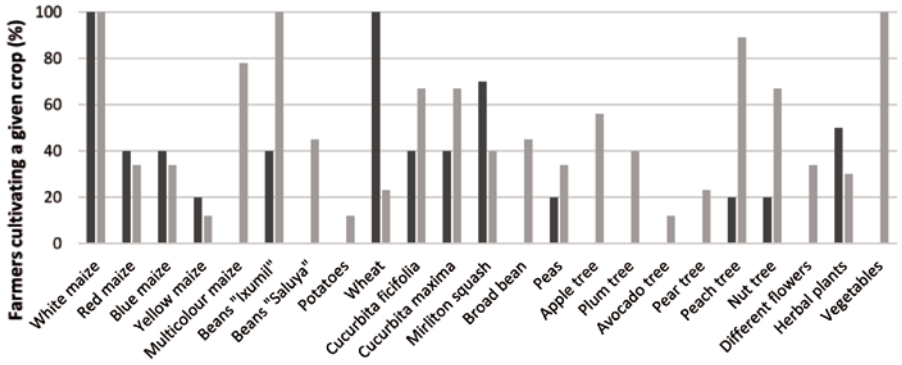

Figure 3. Crops in the milpa fields located below 2400 masl in 1960 and 2016.

Fruit trees have always been part of the *milpa* landscape, although their use has changed and expanded in recent years. In 1991, Eusebio, an Indigenous farmer who had explored several regions of Oaxaca as a rural teacher, learned to graft trees by observing agricultural practices in other places. He took this knowledge to his community and some Zapotecan farmers started grafting local varieties of fruit trees with improved cultivars to generate extra income by selling the fruit. But the real increase in fruit trees came later, in the 2000s and thereafter, when technicians from government programmes promoted the use of MIAF systems (*milpa* systems intercropped with improved varieties of grafted fruit trees of peaches, avocados, apples and nuts). These MIAF systems changed the *milpa* landscape because they used a more efficient topological planting arrangement (Figure 4) and grafting of local fruit trees with improved varieties. Indigenous women learned

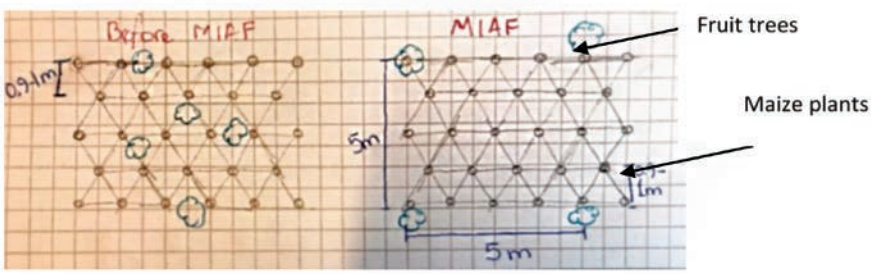

Figure 4. Topology arrangements of the trees in the mipla before and after the introduction of MIAF in the 1990s (left and right, respectively).

to process the fruit into marmalade for a more diversified diet and to sell it locally or in neighbouring communities.

3.1.2. Maize seeds, topology arrangements and harvesting

Although not immediately visible to the casual observer, there has also been a significant change in the planting distances between maize plants. In 2011, a year after hurricane Matthew had destroyed many *milpas* (Section 3.3.2.), Indigenous farmers and Benito Villa, a researcher from Chapingo University, started a farming field school where Indigenous Peoples tried out new techniques to improve their *milpas,* although the idea of "improving" meant different things to the researcher and to the farmers. Benito Villa wanted to increase Indigenous Peoples' maize yields and suggested using improved native seeds from other regions with similar environmental characteristics to Yavesía. The researcher was an expert on participatory maize breeding, and he wanted his farming school to focus only on maize. Yavesía Indigenous farmers told him that mono-cropping was not an option for them. They argued:

> *Uncle Benito* (the Chapingo researcher)*, this is not the way it works, we need our beans, our pumpkins, and other foods to feed us through the year. Change the maize seeds? Are you kidding? No, I have been using those seeds for many years, my land has gotten used to them, no way can I do that. If you want to try your new seeds, let us go there over the hill and there you can show us if your seeds really work. Planting two seeds every 20 cm? Are you kidding me? When am I going to finish sowing? Why not do as we do and plant every 60 cm because that is the length of my steps? This suits me better* (Ines).

Benito and the Indigenous Peoples then developed a hybrid system that is still being used (Figure 5). Farmers plant two or three seeds per hole instead of the traditional five, every 0.4-0.6 m instead of 0.9-1.20 m. They realised that this gave them a larger number of cobs of a good size and still good grain filling, and more maize. Today the farmers and the researcher laugh about the negotiations, and they acknowledge that they both learned from each other and shaped their cultures around maize.

Because farmers are attached to their seeds, which they do not call native or improved maize, but rather simply maize, the researcher only taught them how to improve their seed selection process. Farmers used to select the seeds when the grains and cobs were already drying at home. Benito showed that it is more efficient to select the maize seeds while the maize plants are in the field so they can choose the desired characteristics, e.g.,

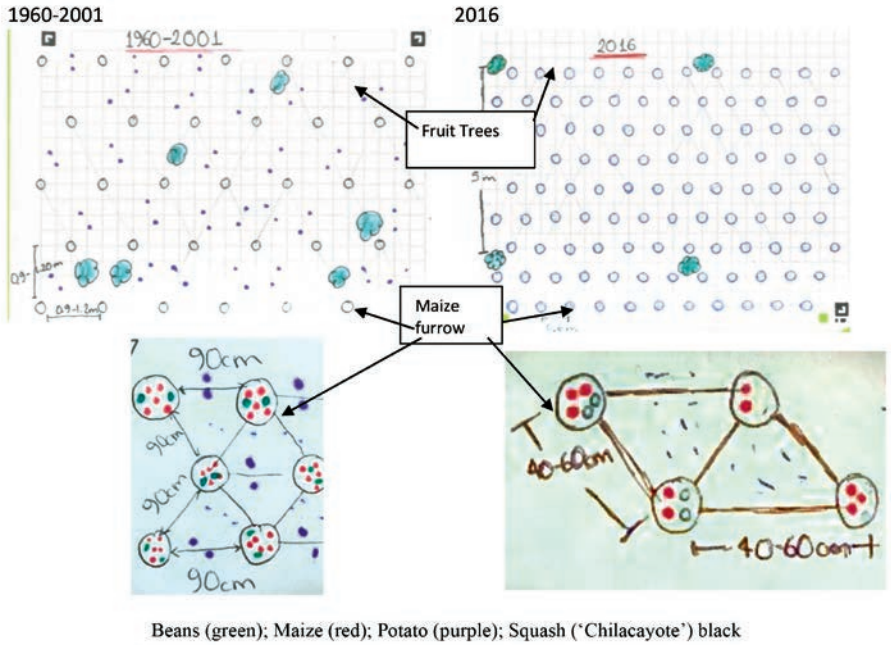

Figure 5. Changes in milpa configuration in 1960/2001 and post 2016.

height of the plant, the diameter of the stalk, propensity to lodging, or the quality of the ears or husk, amongst others. Everardo is considered one of the most successful Indigenous farmers in the community and proudly shows his maize plants. He explained in detail how they learned to prevent undesired pollination.

> *I put a red ribbon on the plants I like. I take off the tassel if I do not like that plant. Do you see my maize? It looks pretty doesn't? Now I have fields with just blue, white, red, or yellow maize, I do not mix them anymore* (Everardo).

When selecting the seeds for the next cropping season, Indigenous farmers choose the maize cobs from the plants they like the most. Once those cobs are dried, the farmer selects again based on the appearance of the cob, the grains, the taste, and the colour. When they shell the maize cobs, they separate the larger grains from the bottom three quarters of the cob which will be used for next year's seeds. Just before planting, the farmers shell off the small grains left on the cob, cook them, and eat them in a ritual to thank *Mother Earth* for last year's seeds, and to ask her for a good cropping season.

Indigenous Peoples have also improved their harvest and grain storage techniques. In the past, Indigenous farmers would let the husks and maize dry on the upright plant, but now they bend the plant so that it dries faster even if it rains, with the added benefit that trapped humidity will not allow the development of diseases or pest attacks. While, in the past, Indigenous farmers would store their grains out in the open where they are susceptible to pests, now some farmers have purchased metal silos to store their grains and even those who have not use three-litre plastic bottles to store their grains to protect against pests. These three-litre bottles also allow farmers to take smaller amounts of maize for their weekly maize supply without exposing the rest of their grains to air and pests whenever they need to take their weekly maize to eat.

3.1.3. Water and soil fertility management practice

A very important change in Indigenous farmer's culture around the *milpa* cultivation relates to water. Water is a main element of the cosmovision of Yavesía Indigenous Peoples, who regard the conservation of the river and forests as essential. Zapotecan people believe that water is sacred and that the rains are also sacred, so the time of maize cultivation was determined by the gods' will. However, Zapotecan farmers realised that relying on rainfall was becoming increasingly challenging because they needed to sow their fields before their six-month migration (Section 3.3.1) and over time the rains started coming later and later. Therefore, they considered irrigating with water from the river. While the older farmers refused to use irrigation because of the sacredness of rainwater, the younger farmers agreed, considering that since the 1990s several farmers had been using the water from the river to irrigate fruit trees: *"why should we not do the same with maize if we can still protect and preserve our forests and our water?"* (Pablo).

The Zapotecan farmers, in collaboration with the researcher, installed two main irrigation lines on both sides of the centre of the community, with the farmers' fields downhill of the main pipelines. The Zapotecan farmers requested a government subsidy in 2012 and added money from their own pockets and used their own labour to reduce costs to install the irrigation lines. Despite this, they still did not have enough funds to install both lines in the same year, so the second pipeline was completed two years after the first. Since installing these pipelines, the Zapotecan farmers adjusted their technology culture around maize and sow their fields before migrating by relying on irrigation if the rainy season has not yet started.

Finally, soil management practices have also changed because of migration. Up to the 1940s, farmers rotated their fields to allow soil fertility to recover:

> *We used to let the soils rest; we sowed them for three years and then gave them a break; some years we planted wheat instead of the milpa, so the soil could recover, but we cannot do that anymore* (Amanda).

Zapotecan farmers are aware of how plants use some soil nutrients and the importance of not exhausting them. They practised crop rotation, but when they relocated their fields to the lower lands, the land pressure there increased. While arable plots were still available in the upper lands, social gender norms did not allow women, who were the primary farmers following the migration of the men, to stay there alone to cultivate the land.

In 1970, the first chemical fertilisers were introduced into the community through several government programmes, although no studies were performed to determine the actual needs of the soil. Farmers did not adopt the fertilisers immediately but did begin using them in 1991 when they thought of them as 'vitamins' for their plants. Zapotecan farmers explained that they thought that the more fertilisers they added to the soil, the better the results would be. With Benito, Zapotecan farmers learned better soil management techniques. For example, they learned that each soil and crop had different requirements and that the fertilisers are more effective if added at specific phenological stages. Also, some Zapotecan farmers had their soils analysed and have reduced their fertilisation dosages from 300 g to 60 g, applying them twice in the cropping cycle. They also learned how to make organic fertilisers which they like because they value self-sufficiency and the cleanliness (as they call it) of the food they produce and eat. The Zapotecan farmers are also adopting the use of mycorrhizas that improve the rooting system and reduce lodging and therefore reduce the need for *arrima*, i.e., adding soil to the roots from five or six times per cropping cycle to only two or three times. This makes it easier for the women to take care of the *milpa* when the men are away.

3.2. Zapotecan Indigenous farmers' culture of maize, food sovereignty and resilience

3.2.1. Native maize seeds as the source of life

Maize seeds are passed from one generation to other to secure a harvest and food supply. In the past, land tenure was linked to the men, who inherited land from their parents. As with the land, maize and other crops' seeds

that were used in the *milpa* were also passed from parents to sons. Because of this generational inheritance, these seeds were already adapted to the soil and environment conditions and increased the chances of a good harvest. As Toledo & Barrera-Bassols (2008) explain, because *milpa* systems are adapted to specific (marginal) environments, they are productive and rely on low inputs, and therefore, farmers adapt the seeds to their needs. Also, as seeds adapt to new environments, they also shape the diets and livelihood of farmers.

Nowadays, Zapotecan women also inherit land and seeds. Since men started to migrate, seed selection and crop management more often fall on women's shoulders. For example, when farmers stopped cropping for a cycle or two and had no seeds to re-start farming again, it was the women who looked for seeds. Farmers believe that preserving their seeds is crucial for their survival (or resilience). They express shame when remembering that they stopped cropping as it made them vulnerable to food insecurity and could have threatened their entire existence (Section 3.3.2). Matilda explained to us:

> *I had to go to another community to get maize seeds. I do not know why but I stopped farming two years in row; it was easier to buy maize than cultivate it. However, when we had the maize shortage in 2010, I knew we needed to do things differently. I got scared, this could not be happening to me. I do not want to ask farmers outside the community to help me out again* (Matilda).

In essence, Matilda's experience reflect how native maize seeds are crucial for resilience.

3.2.2. Native maize and a diverse diet over the year

Maize is also intercropped with other crops as farmers need a range of crops to fulfil their dietary needs through the year and for specific cultural rituals and preferences.

We learned that there are different colours of maize and that each one plays a role in the diet of the farmer's family. For example, Zapotecan Indigenous Peoples love pork *tamales* made with blue maize, but also enjoy a potato soup with local beans and yellow tortillas, whereas *atole* (a beverage) can only be made with white maize and is complemented with black beans. All these crops are part of their *milpa*.

Milpa systems provide a constant source of food throughout the year. Before the *milpa* crops are mature, farmers can take a few immature maize cobs and use them to make soup or a special *elote tamal* (a typical food) and pick the green beans or any other leaves or plants within the *milpa* to supply

their immediate food needs. Finally, at the end of the winter even when the *milpa* fields have been harvested and seem empty, they still contain food. Zapotecan farmers dig the roots of the *chayote* (mirliton) that has turned into a tuber which can be cooked similarly to potatoes and can be made into soups, tamales, or snacks. Falkowski et al. (2019) suggest in a study performed in the Lacandona jungle that *milpas* alone can provide nearly the full caloric nutrients required for a healthy diet and that the combination with other traditional foods provide rich and nutritious diets. Zapotecan farmers in Yavesía balance their diets with other foods such as the chickens, cattle, sheep, pigs, or fish they raise or the wild animals and plants they harvest. And even these systems are not disconnected because the chickens or pigs get fed from the *milpas* too.

Approximately 2.8 million farmers (Eakin et al., 2014) rely on maize cultivation in Mexico. In colonial times, maize was taken to other regions of the world but despite the crop's adaptability to a wide range of environments, it did not provide the same nutritional value as in Mexico (Baker, 2013:20) because the secret of its nutritional value was linked to the diversity of processing. In Mexico, there are more than 600 dishes derived from maize (*El poder del consumidor*, 2017) made up from the 63 different varieties of maize documented in Mexico. Thus, to have a *milpa* is to have a constant food source: a *milpa* is life, as farmers say.

3.2.3. Resilience and milpa *as a social activity: the* comunalidad

Resilience of Indigenous Peoples can be linked to the cultivation of land but also to other social elements tied to the process of *milpa* cultivation. Indigenous Peoples organise themselves around a concept born in the indigenous mountains of Oaxaca and which they call *comunalidad* (Martinez Luna, 2010). In this paper we use *comunalidad* to refer to a farmer's culture of maize and in this section we elaborate on how those elements are intertwined.

Comunalidad is a living paradigm or principle that resembles a Yavesía farmer's life: their *territory or homeland*, their shared work system called *tequio* which is also linked to the community-based organisation; their right to local self-determination through a system called *usos y costumbres,* and *fiesta,* the festivals and celebrations of life which are closely linked to maize as a source of life. When migration began, the practices around *comunalidad* and maize cultivation were reshaped, and new spaces emerged in which the social meaning of maize cultivation was reconfirmed, but in a reconfigured form.

For example, back in the 1950s, maize cultivation was conducted by groups of families through the *tequio* process. The *tequio* process of farm-

ing involved a division of labour within families, with the men responsible for tilling the soil and the women cooking for everyone to celebrate at the end of the day. For example, three Indigenous farming families A, B and C would work together. On day one, these three families worked in the fields of family A, on day two they worked in the field of B and on day three they worked in the fields of family C. The hosting family cooked a good meal for all who helped, but each family had to bring its own maize tortilla. All the tortillas, of different colours, textures and flavours, were placed in a big clay *comal* (pan). Indigenous families joining the sowing shared their tortillas, which also helped them to choose new seeds for the next cropping season with expressions like: "*I like this tortilla, can I have some of your seed?"* (Severino). Indigenous families enjoyed spending time in the fields because they celebrated and asked *Mother Earth* to provide them with a good harvest that fulfilled their food needs. Every time that Indigenous families performed an activity in the fields, they also praised *Mother Earth* pouring some *mezcal or pulque* (traditional alcoholic beverage) and women cooked the best meal they could to share with all the *tequio* participants.

> *We loved coming to the field as children. We did not eat chicken every day but when we were working in the fields, the meals were the best. We had a big feast to celebrate with Mother Earth and request an abundant harvest to provide us food for the rest of the year. The fields were the best places to eat* (Eloisa).

When Zapotecan farmers started to seasonally migrate, this affected the *tequio* and the larger social fabric of the community (Section 3.3.1). By 2016, less than 20% of farming families used *tequio* to cultivate their lands and have had to adapt to other systems of sharing their seeds to maintain the local *comunalidad* culture.

Much of that new system emerged following a maize shortage after hurricane Matthew in 2010 (Section 3.3.2.), when Zapotecan farmers realised how their practices around maize cultivation had changed and how life-threatening it was not to be self-sufficient in maize. Building on the living principle grounded in the *comunalidad*, Zapotecan farmers developed other spaces for exchanging seeds and knowledge, to make their community food sovereign and more resilient again. In 2011, Zapotecan farmers opened a community seed bank, managed by the whole community, and supported by the municipality and Benito, the researcher. Here the Zapotecan farmers can store and exchange their maize and other crops seeds that they cultivate in their *milpas*. It is like an open library of seeds: anyone from Yavesía can access them but should also replace the seeds (s)he takes

Table 1. Summary of key events affecting farmers' livelihoods and farming activities (1944-2016).

Date	Event	Effect in Yavesía (community and farming)
1943	- Drought	- No visual effects, farmers continued farming and being self-sufficient
1944	- Heavy rains and landslides, roads blocked	- The bridge connecting the two neighbourhoods of the community fell. - Farmers still had enough food to feed their families as having different fields allowed them to have sufficient food.
1946	- *Braceros*, policy to recruit labourers to work in the U.S. after WWII	- 1/3 of the male population migrates to the U.S.* - The social fabric of the *tequios* is affected and farming fields are relocated. - Farmers are still self-sufficient
1960	- Migration to the U.S. and other regions continues. - The last mine is shut down.	- Population continued migrating to the U.S. and more fields were relocated in the lower lands. - Farmers were still self-sufficient.
1972	- CONASUPO (** stores are launched in Mexico	- One CONASUPO store is established in Yavesía and people started to buy maize and other basic foods from the store.
1980	- Drought, pests and more migration	- 50% of the fields are now in the lowlands, few people live in or cultivate the upper lands. - Farmers bought more maize from the CONASUPO.
1991	- Migration continues within Mexico and to the U.S., farmers go out and return to Yavesia	- Farmers started grafting local fruit trees with improved fruit varieties. - Farmers use fertilisers more constantly.
1994	- Migration to U.S. to work half of the year - PROCAMPO as a response to NAFTA	- 80% of the fields are now in the lowlands. - Farmers are not self-sufficient but still crop, they complement their dietary needs with foods from the CONASUPO. - 84 farmers got subsidies from PROCAMPO to support their maize farming activities
2000	- Temporarily migrants in the U.S.	- Few farmers are self-sufficient, 80% of the population relies on the CONASUPO and only cultivates for special meals/celebrations
2005	- Hurricane Stan causes landslides and blocks roads	- Many fields along the rivers were lost and some houses relocated, *tequio* practices are now less common
2007	- Boom of biofuels, tortilla crisis and increases in maize prices	- Farmers managed to adjust as they had an income that allowed them to buy maize/food.
2010	- Hurricane Matthew, roads are blocked and food shortage in different regions of Oaxaca	- Farmers were isolated and out of communication. They had money but NO food, maize crisis in the Sierra Norte. - Migrants from Yavesía living abroad sent food aid in trucks to support their village
2011	- Encounter with Chapingo researcher	- Farmers rescued their seeds, started a field farming school and a seed bank based on the principle of "our seeds, our sovereignty"
2012	- Introduction of irrigation	- Cropping calendars changed as farmers use irrigation to water their crops as opposed to the idea of sacred rainfall
2016	- Hybrid *milpa* and maize system	- Farmers adapted their *milpas* and maize practices, combining traditional and modern knowledge

* According to the INEGI, Yavesía had 1012 inhabitants in 1930 and by 1950, the population was 777 (Secretaria de Economia 1950; Secretaria de la Economia Nacional 1948).
**Now referred as SEGALMEX (Mexican Food Security Programme) stores.
Source: https://adnpolitico.com/mexico/2018/08/16/que-es-segalmex-y-como-sustituira-a-diconsa-y-liconsa

and be willing to share his or her own seeds too. Another communal space for seeds and knowledge exchange is the field farming school where farmers try out different seeds. The Zapotecan farmers actively participating in the farming school are not the same every year because of new priorities (such as having a public responsibility with the municipality or taking care of a sick relative), but all farmers still have access to and benefit from the community-based seed bank and related activities, because they are part of the community. In 2014 the village also started a maize fair, alongside the

main festival, creating a competition that gives prizes to the farmers with the most diverse *milpas* (in terms of crops) and the most attractive maize (medium-sized and healthy grains, long and well-filled grains). Zapotecan farmers proudly say that they now harvest more than one ton of maize per hectare whereas in the past they only harvested 300 kg.

3.3. The drivers change in the culture of technology of maize and resilience

We have discussed how the practices and material elements of the maize cultivation have changed over time and elaborated on how those elements are intertwined with Zapotecan farmers' livelihoods. In this section we describe the drivers that shaped Zapotecan farmers' culture of technology around maize cultivation. The drivers can be broadly categorised into three types of events: migration, climatic shocks, and local and international policies. Table 1 summarises these events and the effects they have had on the community.

3.3.1. Migration and the promise of a better life

The changes in *milpa* practices are shaped by migration waves in Yavesía through their effect on the community's social fabric.

According to oral testimonies and Garcia (2008) in 1946 about a third of the men migrated to the U.S. through the "Bracero Programme" (manual labourer programme), expecting to improve their incomes. At the end of WW2 their labour was needed to work in agricultural fields. Zapotecan farmers indicate that their migration was mostly sparked by curiosity about the U.S. This first major migration wave affected the social fabric of the collective *tequio* linked to the maize cultivation. Men were responsible for the tilling and sowing while women were mostly occupied with the cooking to fulfil the *tequio* rituals. With the men temporarily working in the U.S., social norms dictated that women could not stay alone on farms in the hills surrounding the village. And even if they did, without the man to lead the work in the field while the woman led the meal preparation, the traditional practice of *tequio* around maize cultivation could not be maintained in the same way. Thus, when the men started migrating to the U.S. in 1940s the cultivated land decreased, with upland plots and surrounding houses mostly being abandoned and *milpa* cultivation done mainly on individual basis in the lower lands.

A second wave of migration occurred in the 1980 when the last mine in the region, which employed quite a few Yavesía farmers, shut down (Méndez-García, 2017), and more farmers migrated to Mexico City and the

U.S. New opportunities to work temporarily in the U.S. in the mid-1990s fuelled another migration wave. Zapotecan farmers recall that while they still cropped the land, they did not consider being self-sufficient to be very important, as the women were busy taking care of the household and could afford to buy food in the CONASUPO government stores (Section 3.3.3.). Although some farmers got permanent residence in the U.S., the majority continued returning to Yavesía because of their connection to their motherland and cultural identity. By 2008, similar programmes requiring temporary labourers in the U.S. reached the point where at least one member of each family was living outside Yavesía for at least part of the year (Garcia, 2008). The farmers typically migrate for about six months and return in November to celebrate the annual community fest (Section 3.2). With the promise of an income and a better life, migration to the U.S. has continued until today. Switching between these different worlds, their territory in Yavesía, nearby cities and the U.S. is normal for farmers from Yavesía.

At the same time, the exposure to these other worlds can also bring external knowledge into the community and enrich farmers' agricultural practices. For example, in 1991, Eusebio, a local Yavesía farmer, returned with knowledge he had obtained from other farming communities about grafting improved varieties of fruit trees with local varieties and using fertiliser, which he shared with other Yavesía Zapotecan farmers.

4.3.2. Climate shocks and threats to food security

Zapotecan farmers explain that while there had always been climactic shocks that hit their community, they had been resilient and had overcome those shocks. It was not until the 2000s that a series of events persuaded the farmers that their culture needed to adapt to increase their resilience.

The literature suggests that the heavy rains and a severe drought in Oaxaca in the 1940s were linked to food shortage and migration (Leon Santiago, 2015). Yet, Zapotecan farmers in Yavesía learned to deal with climate shocks in different ways. A drought in 1943 and heavy rains the following year (IMTA, 2009) affected the community, and while Zapotecan farmers recall that those events were calamitous as the rains led to the blockage of the few roads leading in and out of the village, they did not result in a serious food shortage. Similarly, although in 1980 their *milpas* were attacked by pests, again the food supply was not seriously affected: the Zapotecan farmers were able to cope by having fields in different places which were not all affected by the pests.

However, in the second half of the 2000s, Zapotecan farmers realised that they had become vulnerable because they were not food self-sufficient anymore. In 2005, Hurricane Stan caused floods in Yavesía and many of the houses and fields along the riverside were destroyed. The effects did not seem to be long lasting: farmers rebuilt the damaged houses, and could meet their food needs by buying from the CONASUPO store. They also managed to cultivate maize in fields that were relocated to higher grounds. The community was then successively hit by a drought and heavy rains in 2008 and 2009. Yet with the few crops that Zapotecan farmers harvested and the CONASUPO store, they managed to satisfy the community's maize needs. However, when in 2010 the storms caused by Hurricane Matthew cut off the roads that connected Yavesía with the rest of the world, there was a shortage of maize and other foodstuffs because CONASUPO stores could not be stocked. This posed a clear threat to the village, *"We had money, but we could not buy maize nor other foods. There was no maize: how could we survive without maize?"* (Irene).

Zapotecan farmers looked for maize in the hills around the village and from neighbouring communities and requested help from relatives living in the cities. This situation challenged farmers to think that they needed to be self-sufficient again, as with their maize and *milpas* they had been more resilient against such climatic shocks in the past. This event hit not only Yavesía but also several neighbouring communities and surrounding regions. In 2010 the regional manager of the CONASUPO stores, Flavio, also an inhabitant of the region and struck by the situation, visited several communities, including Yavesía, to discuss the food crisis. He invited Indigenous Peoples to meetings, and he challenged them as to why they still called themselves *peasants* when they were no longer self-sufficient. He asked them what they needed to become self-sufficient in maize again. The only ones who reacted were the farmers from Yavesía who asked Flavio to find someone who could help them to improve their maize system as they did not want to repeat this situation. This marked the beginning of the collaboration between Benito, the researcher from Chapingo, and the Yavesía Zapotecan farmers, and the encounter and hybridization of two cultures of technology around maize.

3.3.3. The role of national and international policies

Yavesía is not an isolated place: despite its remote location in the mountains of Oaxaca, policy and globalisation affect it. The Bracero Programme

of the Mexican and U.S. governments encouraged men from Yavesía to migrate as early as the 1940s. Also in Yavesía a CONASUPO food store opened in the 1960s (Garcia, 2008), where Zapotecan farmers could buy basic foods such as maize, beans, milk, eggs and sugar. With an easy source for their basic food needs, more Zapotecan farmers migrated to increase their income and fulfil their aspirations.

When farmers from Yavesía met Benito in 2010 they clearly sought collaboration. The decision to work collectively with Benito was decided in a community assembly, as part of the *comunalidad* system and the culture of collective self-determination. Benito describes that Zapotecan farmers offered a piece of land to try out several farming techniques and establish the "little farming school", as farmers called it, and they also agreed to provide seeds. However, establishing farm trials and processing seeds for a community seed bank also requires investment, plus the salaries of the technical advisory team. Benito had a long experience working on both participatory plant breeding using native maize and improvement of hybrid maize. He recognised that most of the funds that support native maize initiatives are mainly linked to biodiversity conservation and not to food security, while funds for hybrid or improved maize are more frequently allocated for food security. Thus, the funding is scarce for native maize initiatives that seek to move beyond preserving biodiversity or food sovereignty. Benito nevertheless managed to get funding from different institutions and short funding programmes for 2011, 2012 and 2013. In 2014, the MasAgro Programme expanded its target group to include indigenous farmers cultivating native maize, due to a request by the Mexican government, who was its primary donor, to align with the National Crusade Against Hunger (Martinez-Cruz et al., 2020). The MasAgro programme leaders looked for people who were already running projects on food security and native maize, which led to the encounter between MasAgro programme, the Yavesía famers, and Benito.

3.4. The role of territory and self-determination in enabling resilience

The effects of migration, climate shocks and policies illustrate how native maize farmers hybridize traditional farming with other elements to adapt to a changing world and being resilient. One crucial element that facilitates the co-existence of the culture of native maize is the sense of territory of Yavesía Zapotecan farmers, one of the four core elements of the culture of *comunalidad*. In this section we explain the role of territory in allowing food sovereignty and resilience through hybridization.

First, the territory of Yavesía is the place where Zapotecan People can enact their self-determination. This territory is the ancestral land where their parents and grandparents lived and where their children will live. Because the government has recognised that farmers are the legal owners of this territory and agreed on respecting their internal ways of government and living called *usos y costumbres*, farmers can set rules within this territory and enact their *right to self-determination*. This allows Zapotecam farmers, for example, to welcome, adapt, or reject any intervention, like the collaboration with the researcher Benito, by consulting the community.

The territory is also the space where Zapotecan farmers enact social cohesion and their collective work system of *tequio*. Yavesía has been home to many Zapotecan generations of families and therefore farmers have developed a sense of belonging to a territory and a collectiveness where everyone knows and helps each other. This is why many farmers, despite being part-time migrants, always want to return to the place where they belong and can be resilient as a community. Dukpa et al. (2018) and Loring & Gerlach (2009) have explain how territory plays a key role in social cohesion and how it enables collective action as a living strategy. In the case of Yavesía, we see how communal values like reciprocity and labour and goods exchange, play a crucial role in community resilience, such as with the installation of irrigation systems or the *milpa* cultivation.

Another component linked to resilience and *territory* is the celebration of life*, fiesta*. The Zapotecan farmers work collectively to preserve their forest and their territory because it is home of *Shoo Raa*, their main deity linked to water, who taught them to care for the forest and nature. Farmers know that Yavesía contains the elements that allow them to survive and that they are the custodians of this territory. Many celebrations of life take place in Yavesía. Maize cultivation involves the celebration of life itself because Zapotecan people praise *Mother Earth* for a good harvest. As we discussed, the Zapotecan Peoples of Yavesía have learned that money cannot ensure them life and food sovereignty, thus, maize cultivation is still essential for living. This might help to explain why, despite the dominant modernising paradigm in Mexican agriculture (Fitting, 2006; Martinez-Cruz et al., 2020), native maize has co-existed.

The territory allows farmers to enact their right to self-determination and therefore resilience. In 2020, with the COVID-19 crisis, Indigenous Peoples used their right to self-determination and their system of *usos y costumbres* to enact a "community isolation" (Martinez-Cruz, 2020) to fight the pandemic, by banning entry to anyone who was not from the community or who did

not live there regularly. This strategy protected the community, as Yavesía was part of the so-called "municipalities of hope" because no cases of COVID-19 were registered until December 25th, 2020 (Mexican government official site, 2020). We spoke to Mercedes, a 60-year-old farmer, on July 25th, 2020, and she said in relation to safety and food sovereignty:

> *We are locked down since March. We decided not to let anyone to come in. My son is in another city now, but he should not come. Even my sister living in Oaxaca City cannot come anymore, it is part of taking care of ourselves, we only allow the entry of doctors or any other essential person/service in the community because they could put us at risk. I am not selling food as regularly, but I do not worry. I have seasonal fruits and food in my backyard and fields. Also, my friends and neighbours come and help me, my friend Alicia comes every afternoon to make sure I am doing okay. People are doing okay, we are actually selling our own processed foods and fruits among ourselves, so we share what we have available to eat.*

She also explained that the migrants left before the quarantine was declared in the community and reached their destinations safely, and they hope that by the end of the year, everyone can return to continue their normal life.

Within this context, territorial control, food sovereignty, and the culture of maize technology enables resilience in the face of challenging events. Only within their territory Indigenous Peoples are able to share with and take care of each other, enact their autonomy and right to self-determination, and defend their culture and identity.

4. Conclusions

With this research, we aimed to understand how Indigenous Peoples in Mexico hybridized their culture of technology around maize with the goal of maintaining their resilience. We draw on the daily experiences of the Zapotecan Indigenous People in the village of Yavesía in southern Mexico to understand how and why this hybridization takes place. We showed how the Yavesía maize technology culture embraces intangible elements that are at odds with the modernisation-productivity paradigm, but also that Zapotecan farmers' technology culture of maize is not static. Their maize culture is rather dynamic and resilient, and it has hybridized and adopted elements of modernisation over time to fit changing conditions and preserve autonomy and security linked to a territory and self-determination.

We conclude this paper by reflecting on the need to embrace alternative ways of doing agricultural research and development that recognize the

complexity of resilience related to food systems and that considers rationales other than agricultural productivity but that does not essentialise traditional forms of farming either. With a better understanding of the broader cultural meaning of maize technology and the dynamics of hybridization within it, we argue that Indigenous Peoples and farmers are innovators, but policies have an important role in shaping their livelihoods. We also argue that rather than imposing models on them, in creating resilient communities we should be respecting their right to self-development and become facilitators to allow them to hybridise and come up with the best food systems that fit their changing needs and aspirations.

Historically, modernisation-productivity policies have forced migration in rural and Indigenous Peoples territories; Yavesía, however, is an example of how farmers have hybridized and adapted their livelihoods to become part-time migrants as clearly there is an attachment to land linked to their ways of seeing the world. In a way, Yavesía Indigenous farmers have partly exercised their "right to stay home" (Bartra, 2008) and have also migrated voluntarily. As development practitioners, if our goals are helping to improve people's lives and right to food, we need to embrace alternative ways of understanding the world, respect farmers' and indigenous peoples' right to self-determination to define their "will to improve" (Li, 2007) in the terms they want, whether it is called food security, food sovereignty, *comunalidad* (Martinez Luna, 2010) or something else while they aim to be resilient.

Relevant to the discussions of climate change and resilience is the concept of *Comunalidad* that we developed here. To create resilient communities like Yavesía, we need to respect Indigenous Peoples' territorial rights as their territory enables them to create strategies that protect them like with COVID-19. Also, we need to respect their right to self-determination and self-development as they ought to know better what they need and what fits them, they are innovators by nature and can be resilient if we support them. In the same line, it is their collective action and values that enables them to look after each other and create collective strategies to cope with a changing world.

Indigenous Peoples have a vast knowledge; like the farmers or Indigenous Peoples of Yavesía there are approximately 476 million more around the world, speaking 4,000 of the 7,000 remaining languages (UNDP, 2018). Despite representing only 6% of the world's population, they pose the answers to maintain 80% of the world's remaining biodiversity and inhabit even territories and water than many would call hostile. Unfortunately,

Indigenous Peoples are under constant threat: policies displace them, i.e., every year 25% of Indigenous lands are under pressure of extractive industries (Kennedy et al.,2022) and every year 200 environmentalists are murdered, being 60% of Indigenous Peoples. But also, other policies threaten Indigenous Peoples and the world's resilience, e.g., food and education policies, when native food systems are displaced or monocroppings promoted, when education does not promote the use of language or Indigenous Peoples' seeds and knowledge as food policy are looked down upon.

To conclude, we learned from Susana and Sagrario that money is not sufficient to be resilient, that resilience strategies are linked to self-sufficiency, culture, collective action, territory, i.e. to their *comunalidad*. Also, we learned that policies have an effect on peoples' livelihoods and that Indigenous Peoples have knowledge that can be used and practices that can be scaled up, but first we need to depart from a rights-based approach and allow them to continue combining the best of different worlds and be facilitators of the changes they want to pursue.

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Innovations, Bio-Science, New Foods, Processing, Technology Innovations for De-Risking Agrifood Systems

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Introduction

Throughout history, science and dedicated research have played a pivotal role in shaping the world we live in today. They have brought us improved health, lower mortality rates, better education, abundant food production, and overall well-being. Science, Technology, and Innovation have allowed us to overcome major challenges such as famine, pandemics, conflicts, and industrialization, leading to transformative changes in our lives and the availability of resources.

However, this progress has come at a cost. We've overused our resources and relied on a limited number of inventions and species. As a result, we now face new challenges, including climate change, biodiversity loss, food security issues, water scarcity, and political instability. Addressing these global problems, both locally and globally, requires mobilizing science and harnessing advanced scientific expertise without adverse effects on environment.

Fortunately, we're currently in an era of peak innovation, with a vast knowledge base and a deep understanding of natural phenomena. Science has matured significantly in fields like biology, physics, mathematics, and chemistry. The question now is how we can leverage these scientific advancements in agriculture and food systems to boost productivity while minimizing resource usage.

SDGs and their status

The Sustainable Development Goals (SDGs) are a set of global objectives established by the United Nations to address various social, economic, and environmental challenges by 2030. Progress toward achieving the SDGs has been mixed. At the mid-way point towards 2030, many of the SDGs are moderately to severely off track (Fig.1). A preliminary assessment of the roughly 140 targets with data show only about 12% are on track; close to half, though showing progress, are moderately or severely off track and some 30% have either seen no movement or regressed below the 2015 baseline.

Global situation of food security

The "Zero Hunger" goal, SDG2, aims to eliminate hunger, ensure food security, enhance nutrition, and promote sustainable agriculture by 2030. However, progress toward this goal has been inconsistent, with certain regions and countries falling behind. Projections suggest that as many as 670 million people may still suffer from hunger by 2030. According to the latest FAO SOFI report (The State of Food Security and Nutrition in the World),[1] approximately 821 million people are currently experiencing hunger, an increase of 150 million since before the COVID-19 pandemic.

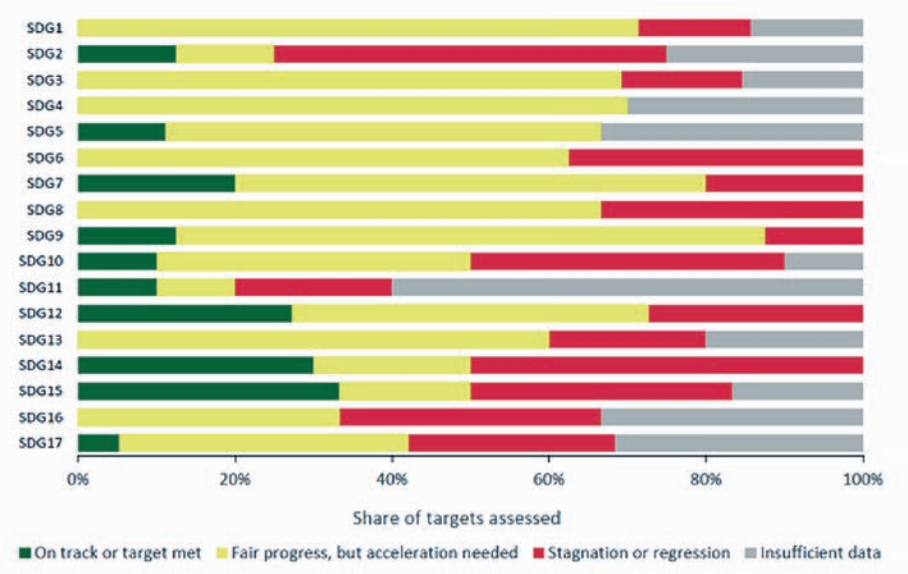

Figure 1. Progress assessment for the 17 goals based on assessed targets, 2023 or latest data.

The primary drivers of poverty and food insecurity include conflicts, persistent inequalities, climate change, and food insecurity itself. Despite commitments made at COP27 to limit global temperature rise to 1.5°C above pre-industrial levels, current national government pledges are insufficient to achieve this target. A concerning report (Climate Plans Remain Insufficient:

[1] https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-security-and-nutrition-in-the-world/en

More Ambitious Action Needed Now | UNFCCC)[2] indicates that if these pledges are implemented as they stand, the world is on a trajectory for a 2.5°C warmer world by the end of the century. This could lead to the expansion of drylands worldwide, exacerbating food security challenges.

Ongoing global efforts are crucial to achieving Sustainable Development Goal 2 (SDG 2), which aims to end hunger and food insecurity by 2030. However, the 2023 Global Report on Food Crises (GRFC) paints a discouraging picture (Global Report on Food Crises 2023 | World Food Programme).[3] It reveals that the challenge of eradicating hunger by 2030 has become even more daunting, as the number of people facing severe food insecurity has risen for the fourth consecutive year. This concerning situation is a result of persistently high levels of food insecurity in some nations, deteriorating conditions in others, and more comprehensive analysis.

Impact of climate change

Climate change presents significant challenges such as shifting weather patterns, crop failures, alterations in pest and disease patterns, water scarcity, land degradation, and changes in suitable crops. Water scarcity has profound adverse impacts on agrifood systems, affecting every stage of food production, from farming and harvesting to distribution and consumption.

Africa, a continent with immense potential for global food production, grapples with low agricultural productivity. The current growth in African agriculture primarily stems from expanding land use rather than enhancing productivity (see Fig. 2), which fails to address poverty and malnutrition effectively. This issue arises from insufficient progress in utilizing inputs like seeds, fertilizers, water, and crucially, knowledge for informed decision-making, both on and off the farm. The urgency of the situation is heightened by climate change, demanding increased efforts to provide African farmers and food system stakeholders with improved information, innovative solutions, risk reduction measures, and productivity-boosting innovations through investments in science and technology. To address these challenges, actions should focus on reducing greenhouse gas emissions, fostering climate-resilient agricultural practices, improving water management, investing in crop breeding and genetic diversity, and promoting sus-

[2] https://unfccc.int/news/climate-plans-remain-insufficient-more-ambitious-action-needed-now

[3] https://www.wfp.org/publications/global-report-food-crises-2023

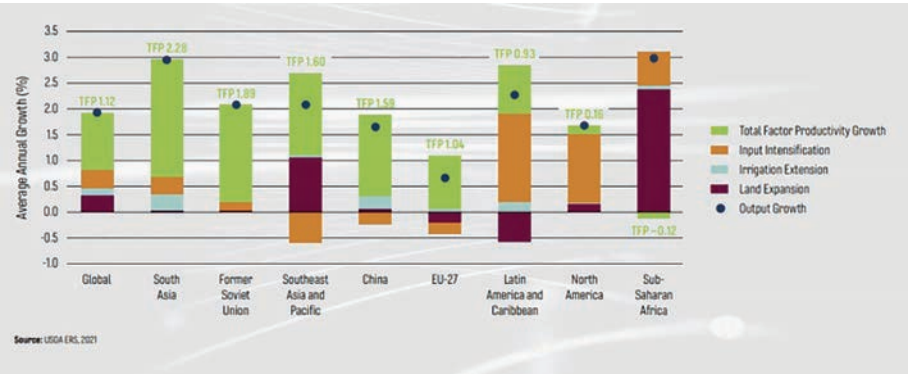

Figure 2. Sources of agricultural output growth by region (2011-2020).

tainable and adaptive agriculture. The development of strategies for adaptation and resilience-building is pivotal to ensuring food security amidst a changing climate in Africa.

System approach for agri-food transformation and role of FAO

Transformation of agrifood systems is a critical topic globally for sustainable agriculture and food security. FAO always uses the term 'agrifood systems' which covers the holistic journey of food from farms to table, and all agriculture sectors, including all food, feed and fibers. The United Nations Food Systems Summit took place in September 2021, where world leaders, stakeholders, and experts convened to discuss and set the agenda for transforming global food systems. It emphasized the need for more sustainable, equitable, and resilient agrifood systems. To transform the world through food and agriculture, FAO is working with its members and partners to promote the transformation of agrifood systems to be more efficient, inclusive, resilient and sustainable for *four-betters*: Better Production, Better Nutrition, a Better Environment and a Better Life for All, leaving no one behind. These *four betters* reflect the interconnected economic, social and environmental dimensions of agri-food systems.

To accelerate impact while minimizing trade-offs, FAO is applying four cross-cutting/cross-sectional "accelerators": (i) technology, (ii) innovation, (iii) data, and (iv) complements (governance, human capital, and institutions) in all its programmatic interventions (Fig. 3). This makes science and innovation as the backbone of the FAO Strategic Framework 2022-31 and are relevant to the key elements of the strategic framework to harness sci-

ence, technology and innovation which are key for the transformation to be more efficient, inclusive, resilient, and sustainable.

The FAO's Science and Innovation Strategy was endorsed by FAO Council in June 2022. The vision of the Strategy is a world free from hunger and malnutrition, where the potential of science and innovation is fully leveraged to overcome complex social, economic and environmental challenges of agrifood systems in a globally equitable, inclusive and sustainable manner. The Strategy covers all sectors and areas of agrifood systems, including crop, livestock, forestry, fisheries and aquaculture; from natural resource management, to production, consumption and food loss and waste; the full range of scientific disciplines (the natural, social, and economic sciences) are considered relevant. It recognizes the need for a diversity of innovations: technological (including digital), social, policy, financial, and institutional, as well as systemic approaches to research. The Strategy gives particular attention to the needs of low- and middle-income countries, with a focus on small-scale producers, family farmers, indigenous peoples, women and youth, as well as micro-, small- and medium-sized enterprises.

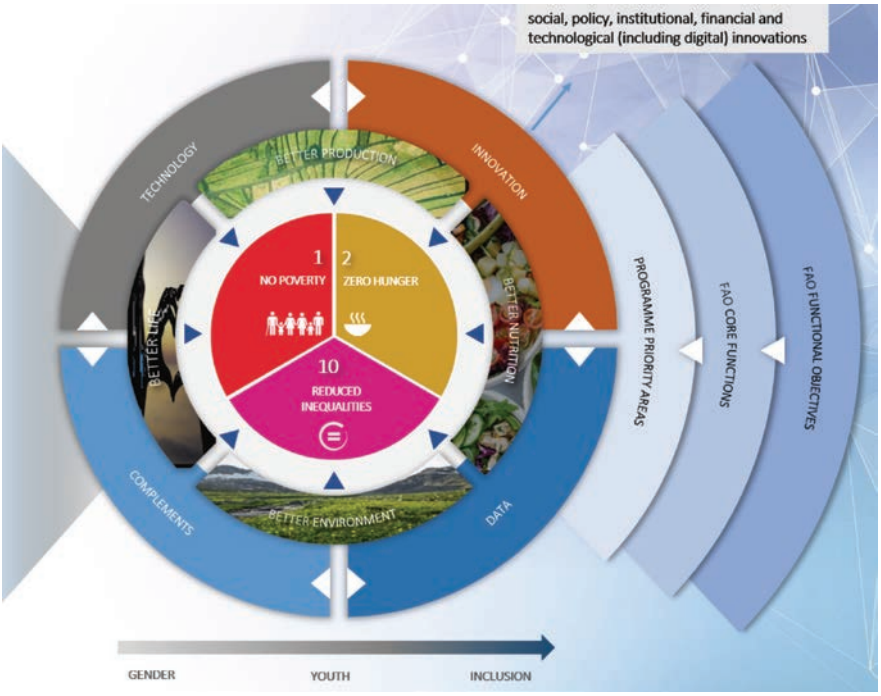

Figure 3. FAO cross cutting accelerators for science and innovation.

Innovation Frontiers for Agri-food Systems

We are currently at the peak of innovation, with our knowledge base expanded significantly. Our ability to understand natural events and to craft new creations is unparalleled. Presently, we can boast on our scientific achievements because scientific outcomes in various fields, including biology, physics, and chemistry, are ready to deliver for the betterment of humanity and planet. We are at our best to improve, innovate and transform our agrifood systems based on science and innovation. FAO plays a crucial role as a neutral platform for discussion of potential benefits and risks of technologies, in terms of consequences for human hunger, human health, animal welfare, food safety, effects on the environment, socioeconomic impact and distribution of benefits.

- **Genetic innovations & Biotechnology:** Genetic innovations in agriculture are advancing rapidly, offering promising solutions to enhance crop yields, improve resistance to pests and diseases, and promote sustainability. Biotechnology has wide-ranging uses and possibilities including, inter alia, crops adapted to biotic and abiotic stresses, nutritionally enhanced and longer lasting foods with reduced losses, reduction of allergens, foodborne disease detection, food safety surveillance, monitoring of genetic diversity and biodiversity, phytoremediation and improved soil health, efficient use of nutrients in feed by animals, rapid diagnosis of diseases and development of vaccines. Some remarkable events in recent pasts could be the drivers of future scenario:

  – **Gene-editing technology**, including CRISPR (clustered regularly interspaced short palindromic repeats), which represents a recent advance in genetics and its application to plant and animal breeding, and is set to contribute to improvements in various aspects of agricultural production. They enhance precision and efficiency over current breeding methods to create crops with desired traits, such as increased pest resistance, drought tolerance, and improved nutritional content for the rapid development of improved plant varieties and animal breeds. In December 2022, FAO published an issue-paper on gene editing techniques and agrifood systems (https://bit.ly/FAOGeneEditing). Developed by a team of authors with oversight from the office of Chief Scientist FAO. This paper is science and evidence-based, forward-looking, and takes a broad and interdisciplinary approach.

- **Regulatory Frameworks:** Regulatory frameworks governing the use of genetic innovations in agriculture are evolving. Some countries have updated their policies to accommodate new technologies like gene editing while ensuring safety and ethical considerations. Since the adoption of genetic innovations in agriculture is subject to regulatory approval and public acceptance, therefore ethical and environmental considerations, as well as concerns about the long-term effects of these innovations, should continue to be part of the discussion on their use in the agri-food system.

- **New food sources and food production systems:** In response to the growing global demand for sustainable, nutritious, and environmentally friendly food, new food sources and production systems are emerging. These innovations represent a shift towards more efficient and eco-friendly approaches to food production, however most of them are still lacking life-cycle analysis to demonstrate these environmental-promises. They are designed to tackle challenges related to population growth, climate change, and limited resources while offering diverse and nutritious food choices for the increasing global population. Some of these innovations are:
  - **Plant-Based Alternatives:** Plant-based foods, such as meat substitutes, dairy alternatives, and plant-based proteins, have gained popularity. These products are designed to mimic the taste and texture of animal-based foods while reducing the environmental footprint and addressing ethical concerns.
  - **Cellular Agriculture:** Cellular agriculture involves the cultivation of animal cells, such as muscle cells, to produce meat, poultry, and seafood without the need for traditional animal farming. This technology offers a more sustainable and cruelty-free way to produce animal-based proteins.
  - **Alternative Protein Sources:** Researchers are exploring alternative protein sources, such as fungi and microorganisms. These innovative approaches can provide protein-rich ingredients for food production. Insects, such as crickets and mealworms, are also considered a potential protein source due to their high nutritional value and lower environmental impact compared to traditional livestock.
  - **Algae and Seaweed:** Algae and seaweed are rich in nutrients and can be used in various food products, including snacks, supplements, and

even meat alternatives. They require minimal land and water resources for cultivation.

- **Vertical Farming:** Vertical farming involves growing crops in stacked layers or vertically inclined surfaces, often indoors or in urban environments. This approach reduces land use, conserves water, and allows for year-round cultivation.
- **Blockchain and Traceability:** Blockchain technology is being used to improve the traceability of food products, ensuring transparency in the supply chain, and allowing consumers to verify the origins and quality of their food.

- Data science and digitalization in Agriculture: Data science and digitalization play a significant role in modern agriculture, often referred to as 'AgTech' or 'Precision Agriculture'. These technologies have transformed the way farming and agricultural processes are managed, leading to increased efficiency, sustainability, and productivity. The effective use of data in agriculture and rural development, and artificial intelligence play a key role in supporting evidence-based policymaking, planning and implementation to improve efficiency and productivity, as well as reducing negative environmental impacts, and it can have a transformational impact by creating opportunities for smallholder farmers and rural communities, through holistic and targeted interventions with concrete impact on the ground.
  Unfortunately, there is a large digital divide, with only 47% of developing countries and 19% of LDCs having access to the internet, with barriers to digital adoption due to a lack of electricity in rural areas, literacy, digital skills, and lack of proper content, and specifically with regard to professionally oriented applications. FAO has a strong focus on "Digital for Impact", with technology, innovation and data as key cross-cutting accelerators across all FAO's work to reach impact at scale, as set out in the FAO Strategic Framework 2022-31. The aim of our "Digital for Impact" is to accelerate action to achieve the SDGS by promoting:
  - better and more timely access to real-time actionable information.
  - sustained engagement with farmers and agrifood systems stakeholders to maximize their benefits from new technologies.
  - improved access to markets, credit and insurance through the application of digital technologies.

- access to digitally enabled climate-smart agriculture solutions; and
- enhancing the digitalization of emergency interventions and social protection mechanisms.

Public-Private Partnerships (PPP)

Collaboration between public research institutions and private companies is driving genetic innovation in agriculture at faster pace than ever. These partnerships facilitate the development and deployment of new crop varieties and technologies. Investments in R&D are inextricably intertwined with growth in agricultural productivity and food supplies. But it takes decades, not months or years, for the consequences of these investments to be fully realized. More investment in public ag R&D needed – Between 1990 and 2014, private spending on agricultural R&D worldwide more than tripled from USD 5.1 billion to USD 15.6 billion surpassing public R&D but concentrated on a relatively small number of commodities. If present trends continue, global AgR&D in the middle of the twenty-first century will look very different from how it looked at the dawn of the century. The rise of AgR&D in the rapidly growing middle-income countries, and the increase in private-sector participation in various regions are encouraging. But the retreat from public AgR&D by rich countries and the continued comparatively low levels of investment in many poorer countries, are concerning. Rapidly regaining lost ground for these parts of the world is an obvious priority if we are to feed the world sustainably to 2050 and beyond. PPP is very important across all platforms because it has capability to disseminate technologies as far as last needy person, leaving no one behind.

Agrifood Systems Technologies & Innovations Outlook (ATIO)

In 2022, FAO launched the new knowledge product 'Introducing the Agrifood Systems Technologies & Innovations Outlook (ATIO)'.[4] The objective of ATIO is to curate existing information on the current, measurable state of STI and upcoming changes, as well as their transformative potential, to inform evidence-based policy dialogue and decisions, including on investments.

Currently data and assessments on STI are scattered, incomplete, unintegrated, while ATIO will gather data and analyze across four distinct stages

[4] https://www.fao.org/documents/card/en/c/cc2506en

of STI development and diffusion. These stages begin with (i) the agrifood systems STI inputs (e.g. R&D financial investments, human, physical and social capital) that generate (ii) pre-emergent STI – i.e. those under active development but not yet in use outside the community of developers – some subset of which gain traction and become (iii) emergent STI observable in use outside researchers' control, and finally become (iv) mature STI before, in many cases, growing obsolescent.

Way Forward for Sustainable Agri-Food System

The way forward for a sustainable agrifood system involves a holistic approach that addresses the complex challenges of food production, distribution, consumption, and waste management. Achieving sustainability in agriculture and the food industry is critical for ensuring food security, reducing environmental impacts, and promoting equitable access to nutritious food. Three key steps and strategies for moving toward a sustainable agrifood system are proposed as:

- Large investment in frontier science and technologies, namely in developing multiple applications and in scaling up innovations, with particular focus on the Global South.
- Science can help provide understanding of the differences of view on contentious issues, for greater policy coherence, shared ownership, and collective action. It is important to nurture debates and contentions to allow space for new ideas and breakthroughs, even when scientific development allows us to close some gaps among contentious issues.
- Strengthening the science-policy interface is critical, to ensure that effective policy decisions are made based upon credible science and evidence.

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This volume brings together new insights of science with the knowledge of frontline actors for addressing humanitarian and food crises. Conclusions of the workshop included:

- A call for redesigned emergency aid interventions with much stronger social protection systems endowed with flexible resources
- Participation of affected local populations
- Comprehensive reform of structures, governance and management of crises
- Strengthening of research on the root causes of humanitarian and food crises
- Research on predicting crises and response options.

As Pope Francis pointed out in his statement to the workshop participants, "…we can and must emerge from a crisis, but under two conditions: we cannot emerge alone from a crisis – either we emerge together or not at all, and secondly, we emerge from a crisis in order to become better, to move ever forward, to make progress."

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