Independent Science for Development Council

Responding to Evolving Megatrends

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Responding to Evolving Megatrends

ISDC Discussion Paper

About the Independent Science for Development Council

The Independent Science for Development Council (ISDC) is a standing panel of impartial, world-class scientific experts who provide rigorous, independent strategic advice to the CGIAR System Council and other stakeholders. Membership was established in October 2019, and 2023 membership consisted of Holger Meinke (chair), Nompumelelo H. Obokoh (vice chair), Fetien Abay Abera, Andrew Ash, David Just, Magali Garcia, Suneetha Kadiyala, and Lesley Torrance. In order to operate, ISDC receives operational support from its secretariat, which is part of CGIAR's Independent Advisory and Evaluation Service (IAES) and hosted at the Rome, Italy, office of the Alliance of Bioversity International and the International Tropical Agricultural Research Center.

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Acronyms

AI	artificial intelligence
Arsht-Rock	Adrienne Arsht-Rockefeller Foundation Resilience Center
AR4D	agricultural research for development
CGT	CGIAR collective global target
CH_4	methane
CO_2	carbon dioxide
EAP	East Asia and Pacific
ECA	Europe and Central Asia
FAO	Food and Agriculture Organization of the United Nations
GHG	greenhouse gas emissions
GRI	Grantham Research Institute
HIC	high-income country
HLPE	High Level Panel of Experts on Food Security and Nutrition
IDAFLW	International Day of Awareness of Food Loss and Waste
IDMC	Internal Displacement Management Centre
IEA	International Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
IEP	Institute for Economics and Peace
ILO	International Labour Office
IMF	International Monetary Fund
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
ISDC	Independent Science for Development Council
JRC	Joint Research Centre
LAC	Latin America and the Caribbean
LIC	low-income country
LMIC	low- and middle-income countries
LSE	London School of Economics and Political Science
MENA	Middle East and North Africa
ML	machine learning
N	nitrogen
NARES	national agricultural research and extension systems
NASEM	National Academies of Sciences, Engineering, and Medicine
NEET	not in education, employment, or training
NCDs	noncommunicable diseases
NGO	nongovernmental organization
N_2O	nitrous oxide
P	phosphorus
PO_4	phosphate
PoU	prevalence of undernourishment
PPP	purchasing power parity
SAS	South Asia
SEA	Southeast Asia
SC	CGIAR System Council
SIS	small indigenous fish species
SO	CGIAR System Office
SMART	specific, measurable, achievable, relevant, and time-bound

SNRD	Sector Network Natural Resources and Rural Development Asia and the Pacific
SSA	Sub-Saharan Africa
Tg	million tonnes
UN	United Nations
UN Climate Change	United Nations Framework Convention on Climate Change
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Program
UN-Habitat	United Nations Human Settlements Programme
UNHCR	United Nations Refugee Agency
UN IAEG-SDGs	United Nations Inter-Agency and Expert Group on SDG Indicators
UNICEF	United Nations Children’s Fund
WEF	World Economic Forum
WFF	World Food Forum
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

Executive Summary

Since the launch of CGIAR's 2030 Research and Innovation Strategy (CGIAR Strategy) in 2021, the trajectory, frequency, and pace of known trends and cycles have changed, and the world has experienced an **increasing array and severity of global shocks**.[1,2] As CGIAR prepares its 2025–2027 research and innovation portfolio, this is an appropriate time to examine the effects of these changes. Accordingly, the Independent Science for Development Council (ISDC) commissioned a 2023 project to answer the following questions:

- What megatrend **dynamics have changed** since the CGIAR Strategy was prepared?[3]
- How do these changes **affect the CGIAR Strategy and its collective global targets?** What are some prime examples of these effects?
- Based on new insights into megatrend dynamics, **how should CGIAR respond?**

This Discussion Paper synthesizes the most recent literature on megatrends affecting agri-food systems. Through the lens of the CGIAR Strategy, it singles out **nine megatrends**, which have heightened interactions and feedback loops among them. In many countries, challenges are increasingly exacerbated by an acute failure of good governance. A few examples highlight the disproportionate impact of the **confluence of these megatrends** in achieving measurable benefits across the five CGIAR Impact Areas.[4]

A set of specific implications for the evolution of the CGIAR research and innovation portfolio concludes this Discussion Paper. They are multidimensional and address **portfolio substance (1–7) and processes (8–9)**:

1. Increasing food diversity and quality
2. Strengthening governance of agri-food value chains
3. Building resilience and fostering inclusion among farmers
4. Focusing on the inclusion of youth
5. Prioritizing technology and education in agri-food systems adaptation efforts
6. Applying climate learning from other sectors
7. Better managing competing demands for water across all sectors of our economies
8. Adopting and using megatrends, foresight, and trade-off frameworks
9. Ensuring specific, measurable, achievable, relevant, and time-bound collective global targets (CGTs)

Ample annexes expand the **evidence basis** for the Discussion Paper. ISDC will incorporate the findings of this commissioned project into tools and rubrics used in ISDC-moderated proposal reviews.

[1] At the time of its writing, the CGIAR 2030 Strategy was based primarily on analyses and data that predated 2020.
[2] Elaborated from OECD (2011), Kosolapova (2023), and Viña & Liu (2023), a global shock is defined as a sudden and largely unanticipated event that has widespread social, economic, and/or environmental impacts that can spill over to other systems and trigger a series of feedback loops.
[3] In general, 2019 is the latest year for which data were available to the architects of the 2030 CGIAR Strategy.
[4] A first ISDC advisory output focusing on the CGIAR Gender Equality, Youth, and Social Inclusion Impact Area was discussed during the 19th CGIAR System Council meeting and presented at the 2023 ISDC Science Forum in Rabat, Morocco, on 19 October 2023.

1 Introduction

1.1 Background

Recognizing the need to accelerate global progress toward the Sustainable Development Goals (SDGs), CGIAR launched its 2030 Research and Innovation Strategy (2021) together with a 2022–24 Investment Prospectus (2021) and a Companion Document (2021). A CGIAR Performance and Results Framework 2022–2030 (2020) was released in January 2021. This pivotal change involved restructuring the research activities of CGIAR and partners into three overarching Action Areas—Genetic Innovation, Systems Transformation, and Resilient Agri-food Systems. Building on 50 years of research and innovation, the aim of the 2030 Research and Innovation Strategy (CGIAR Strategy) is to achieve impact at scale globally and regionally across five Impact Areas: (1) Nutrition, Health, and Food Security; (2) Poverty Reduction, Livelihoods, and Jobs; (3) Gender Equality, Youth, and Social Inclusion; (4) Climate Adaptation and Mitigation; and (5) Environmental Health and Biodiversity. For each of the Impact Areas, CGIAR aims to contribute to a total of 11 collective global targets (CGTs) for the transformation of food, land, and water systems.

CGIAR delivers its strategy through a three-year research and innovation portfolio of Initiatives supported with pooled funding (see Annex A for a list of all 2022–2024 Initiatives by Action Area). CGIAR is entering a new three-year phase commencing in 2025. Between November 2023 and April 2024, CGIAR is revising its 2025–2027 portfolio. Thus, a response to changing megatrends is timely and crucial. **The purpose of this Discussion Paper is to advise the System Council, the System Board and Management, and the CGIAR scientific community at large on the implications of the changing dynamics of megatrends. This should inform the evolution of the current research and innovation portfolio.**

1.2 Rapidly Changing Global Landscape

The world has entered an era where food, land, and water systems are under serious threat as a result of the confluence of multiple interlinked anthropogenic megatrends (FAO, 2021b; FAO, 2022a).[5] The CGIAR Strategy states that without sustainable long-term solutions, agri-food systems will not be able to meet the demands of the growing global population. Over the past three years, what were previously described as "global challenges" have been reframed as a "global polycrisis." This term emphasizes the existence of multiple interconnected crises that, while seemingly disparate in nature, are interwoven in such a way that the compounding effect is greater than the sum of the individual crises (Lähde, 2023; Lawrence et al., 2023; WEF, 2023a).

The challenges the world faces today may represent a continued, inevitable manifestation of long-run global trajectories. Hence, given that an understanding of megatrends already underpinned the CGIAR Strategy and the 2022–24 Investment Prospectus,[6] some may argue that a reexamination of the megatrends is unnecessary. We disagree but this Discussion Paper is not designed to provide an in-depth megatrend analysis. We refer readers to the growing literature on the use of complexity science[7] to understand interconnected social-ecological systems (Arthur, 2021; Wernli et al., 2023; UNU-EHS, 2023);. We assert that at least two recent tangible events—the COVID-19 pandemic (starting in 2020) and the Russia-Ukraine War (starting in 2022)—presented major shocks to multiple systems, leading to unanticipated global systemic crises that could not be fully foreseen in the CGIAR Strategy.[8] Furthermore, the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) came together for the first time in 2021 to highlight the multiple

[5] Megatrends are large transformative forces that are observable today and will continue to have an impact in the future.
[6] The 2022–24 Investment Prospectus estimates the range of potential future benefits of investing in CGIAR using future scenarios for global and regional food systems versus business as usual. Prager & Kruseman (2022) describe the methods and data. This report includes scientific contributions from many CGIAR Centers. This echoes the Companion Document to the 2022–2024 CGIAR Investment Prospectus, which explicitly mentions the importance of foresight analyses to arrive at a coherent portfolio of best-bet Initiatives, and their use by the Initiative Design Teams in the identification of priority topics, work packages, and countries.
[7] Complexity science is a collection of concepts, theories, and methods, with many insights drawn from the study of physical, biological, and ecological systems (Wernli et al., 2023).
[8] Following Wernli et al., (2023), a global systemic crisis is defined as *"the result of an event originating in one area cascading into a wider macro-shock in areas that are not directly related to the origin of the crisis."*

connections between the climate and biodiversity crises and warned of the emerging risks of an unlivable future (WWF, 2022). Relatedly, new findings from both climatology and earth system science suggest that the number and intensity of environmental threats are rising sooner and to a greater extent than previously anticipated (Steffen et al., 2015; IPCC, 2022; Richardson et al., 2023). Finally, exponential growth in the application of digital technologies, such as artificial intelligence (AI) and machine learning (ML), has a profound impact not only on agri-food systems but also on how research is conducted. See Box 1 for more information on the most recent changes to the global landscape.

Box 1. Recent evidence of a rapidly changing landscape

COVID-19 pandemic. As a result of high levels of global interconnectivity, COVID-19 quickly spread from its place of origin and crossed over national borders, with only two countries remaining COVID-free by October 2023 (WHO, n.d.). COVID-19 was the first disease event since the 1918–20 H1N1 Spanish influenza pandemic to elicit a global health response (Patterson et al., 2021). The pandemic also triggered the largest economic crisis in a century, increased inequalities, and had a negative impact on global education systems (World Bank, 2022c). At the same time, as a result of lockdowns and shutdowns, COVID-19 accelerated the adoption of technologies and innovations in the digital and mechanization spheres and *temporarily* reduced internal and international migration and greenhouse gas (GHG) emissions (Bhanumati et al., 2022).

War in Ukraine. The world is characterized by growing geopolitical tensions and violence. Peacefulness has declined year on year for 13 of the 15 years ending in 2022 (IEP, 2023). While Russia's invasion of Ukraine dominated global headlines in 2022, there were more battle-related deaths in Ethiopia than in the wars in Burkina Faso, Mali, Myanmar, Nigeria, Somalia, Ukraine, and Yemen combined (Obermeier & Rustad, 2023). Yet the effects of the Russia-Ukraine war spread beyond the two warring nations and impacted global agricultural markets and global food security and nutrition (IFPRI, 2023). It remains a major global intra- and inter-systemic crisis.

New evidence from climatology and earth science. Recent research confirmed that record-breaking temperatures and weather extremes are likely or highly likely to occur at lower levels of global warming than previously expected (IPCC, 2022). New results from earth system science also show that six of the nine planetary processes critical for maintaining the stability and resilience of planetary systems as a whole are in a danger zone, with both the number of planetary boundaries transgressed and the degree of transgression higher than that reported in 2015 (Steffen et al., 2015; Richardson et al., 2023).

The world is already experiencing an array of record-breaking weather events. Climate change is rapidly becoming a key driver of natural resource scarcity, land degradation, and biodiversity loss. Combined, these megatrends resulted in 32.6 million internally displaced persons due to disasters in 2022—the highest number in a decade and 41% above the average for the previous decade (IDMC, 2023). Furthermore, there are cyclic causal pathways between ecological threats, conflict, and migration (IEP, 2022a), which further increase the risk of systemic crises across the globe.

Science, technology, and innovation. The pace of advances in science, technology, and innovation is increasing rapidly. As mentioned, pandemic-related lockdowns and labor shortages, as well as snowballing advances in AI and ML, accelerated the adoption of digital and mechanization technologies (De' et al., 2020; Landi, 2020; Takeshima et al., 2021). These and advances in other technologies and innovations could play a critical role in transforming food, land, and water systems to deliver better environmental outcomes, improve human health and food security, and promote more inclusive development. However, they could also be sources of greater inequalities since the Global South does not have the same level of access, education, and potentiality as the Global North. Ensuring that the Global South does not miss out on the latest technologies and innovations, including digital technologies and big data, requires the strategic development and deployment of technologies and innovations that explicitly target the needs of world's most vulnerable populations. *"CGIAR—the world's largest agricultural innovation network—has unique comparative advantages for fostering AI in diverse contexts through its 13 Research Centers in 89 countries and more than 3,000 partners from national governments, academic institutions, private companies, and NGOs"* (CGIAR, 2023). Harnessing the potential of science and innovation for food security and sustainability also requires investment in national agricultural research and extension systems and an enabling institutional environment for sustainable agri-food systems.

1.3 Methods

In line with our objectives to assist CGIAR in its portfolio evolution, we provide examples for at least one of the CGTs to be achieved by 2030 for each of the five Impact Areas, with a focus on the Global South. Further examples can and should be extracted from Annex D.

We synthesized the findings from key megatrend studies purposely selected because of their time frame (from 2019 onward), geographic scope (aligned with CGIAR mandate regions), and focus on agri-food systems.[9] The information extracted from these studies was then updated based on recent literature and data on the social, economic, and environmental impacts of a variety of interconnected megatrends.[10]

Subsequently, we triangulated findings using quantitative data drawn from three databases (World Inequality Report 2022 data; World Population Prospects 2022 data; Ecological Threat Report 2022 data) to provide an additional temporal dimension. In addition, 11 CGIAR senior leads and scientists and 5 external experts participated in a consultation process[11] to inform areas where CGIAR could adjust its research and innovation portfolio to increase its responsiveness to megatrends and thus the likelihood that CGIAR science and innovations will contribute to the CGIAR Impact Areas and CGTs (see Table 1). Insights gathered from the stakeholders were supplemented with qualitative data extracted from the megatrend and associated literature. This Discussion Paper, part of a series of projects commissioned by the Independent Science for Development Council (ISDC), was developed iteratively between ISDC and the lead expert and peer reviewed in its final stages by an external expert.

Table 1. CGIAR Impact Areas and collective global targets

Impact Area	Collective global targets (CGTs)	CGT short form[a]
Nutrition, Health, and Food Security	• End hunger for all, and enable affordable healthy diets for the 3 billion people who currently lack access to safe and nutritious food. • Reduce cases of foodborne illness (600 million annually) and zoonotic disease (1 billion annually) by one-third.	CGT 1. End Hunger CGT 2. Increase Food Safety
Poverty Reduction, Livelihoods, and Jobs	• Lift at least 500 million people living in rural areas above the extreme poverty line of US $1.90 per day (2011 purchasing power parity [PPP]). • Reduce by at least half the proportion of men, women, and children of all ages living in poverty in all its dimensions according to national definitions.	CGT 3. Reduce Extreme Poverty CGT 4. Halve Multidimensional Poverty
Gender Equality, Youth, and Social Inclusion	• Close the gender gap in rights to economic resources, access to ownership, and control over land and natural resources for over 500 million women who work in food, land, and water systems. • Offer rewarding opportunities to 267 million young people who are not in employment, education, or training.[b]	CGT 5. Close Gender Gap CGT 6. Increase Youth Opportunities

[9] Most notably, Serraj & Pingali (2019); UN DESA (2020); Barrett et al. (2021); FAO (2022a); Naughtin et al. (2022); Richardson et al. (2022); Fernandez de Soto & Rugeles (2023); and WEF (2023a).
[10] This Discussion Paper is not meant to be an academic report on megatrends affecting the transformation of food, land, and water systems or to duplicate research on megatrends planned in the Foresight Initiative.
[11] See Annex B for the list of consulted stakeholders, which included CGIAR Impact Area Platform directors, Science Group directors, Portfolio Performance Unit and Foresight Initiative leads, and independent scientific experts (who were diverse in terms of expertise, location, and gender).

Impact Area	Collective global targets (CGTs)	CGT short form[a]
Climate Adaptation and Mitigation	• Implement all National Adaptation Plans and Nationally Determined Contributions to the Paris Agreement. • Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems. • Turn agriculture and forest systems into a net sink for carbon by 2050, with emissions from agriculture decreasing by 1 Gt per year by 2030 and reaching a floor of 5 Gt per year by 2050.	CGT 7. Implement Adaptation Plans and Agreements CGT 8. Increase Climate Resilience and Adaptation CGT 9. Establish Net Carbon Sink
Environmental Health and Biodiversity	• Stay within planetary and regional environmental boundaries: consumptive water use in food production of less than 2,500 km^3 per year (with a focus on the most stressed basins), zero net deforestation, nitrogen application of 90 Tg per year (with a redistribution toward low-input farming systems) and increased use efficiency, and phosphorus application of 10 Tg per year. • Maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed gene banks at national, regional, and international levels.	CGT 10. Maintain Planetary and Environmental Boundaries CGT 11. Maintain Biodiversity

Source: CGIAR Performance and Results Framework 2022–2030.
[a] Short forms of the CGTs are provided for the purpose of this Discussion Paper.
[b] There is no definition for "rewarding" opportunities in the CGIAR Strategy, the CGIAR Performance and Results Framework 2022–2030, or the United Nations 2030 Agenda for Sustainable Development.

1.4 Limitations and Constraints

While examining the **implications of the changing dynamics of megatrends**, we noted two CGIAR process-related issues that should be addressed as part of the evolution of the current research and innovation portfolio:

- **CGIAR CGTs**. CGIAR's CGTs are used as the framing device for analyses in this Discussion Paper. However, the intended level of CGIAR contributions to the CGTs is not stated in the CGIAR Performance and Results Framework 2022–2030, which limits the ability to determine success.[12] Of the 11 CGTs, we examined the 6 CGTs found to be least ambiguous, relatively measurable, and sufficient in terms of data availability—namely, CGT 1: End Hunger; CGT 3: Reduce Extreme Poverty; CGT 5: Close Gender Gap; CGT 6: Increase Youth Opportunities; CGT 8: Increase Climate Resilience and Adaptation; and CGT 10: Maintain Planetary and Environmental Boundaries.
- **Foresight and trade-off analysis**. This paper does not purport to examine all possible future scenarios and potential trade-offs—and synergies—in light of the interlinked megatrends and the resultant cascading and intensifying shocks the world is experiencing. Instead, we direct readers' attention to the recent work undertaken by Barrett et al. (2021), Antle & Valdivia (2021), Wiebe & Prager (2021), Broeze et al. (2023), UNU-EHS (2023), and others on the opportunities that foresight and trade-off analyses offer large organizations such as CGIAR to better prepare for alternative futures. Moreover, we suggest foresight and trade-off analysis should be undertaken in conjunction with a comparative advantage framework (ISDC, 2022a; Meinke et al., 2023).

[12] For example, if CGIAR science and innovations directly contribute to lifting 100 million people out of extreme poverty by 2030, that represents 25% of CGT 3*: Lift at least 500 million people living in rural areas above the extreme poverty line of US $1.90 per day (2011 PPP).* Does achieving 25% of this CGT imply that CGIAR did or did not meet this target in terms of what could be reasonably expected given the level of pooled funding over the nine years leading up to 2030*?*

2 Overview of Globally Evolving Megatrend Dynamics

This section sheds light on what megatrend dynamics have changed since the CGIAR Strategy was prepared. While megatrends are often discussed as individual phenomena, multiple spillovers and feedback loops among the megatrends are well recognized (Antle & Valdivia, 2020). These interlinkages can either intensify or counteract the impact of any individual megatrend. What follows provides a summary of nine recurrent, interconnected megatrends identified by ISDC from a review of the most recent and relevant megatrend and megatrend-related studies (e.g., Serraj & Pingali, 2019; UN DESA, 2020; Barrett et al., 2021; FAO, 2022a; Naughtin et al., 2022; Richardson et al., 2022; Fernandez de Soto & Rugeles, 2023; WEF, 2023a). The summary is based on the consultation and literature review presented in Annex C. Each of the megatrends listed below, individually and in combination, has a direct impact on agri-food systems.

MT 1. Demographic trends. The four key demographic megatrends are population growth, population aging, migration, and urbanization, and they show marked variations within and between regions (UN DESA, 2019). Each trend has interconnected social and economic implications for agri-food systems. While the Global North grapples with the social and economic challenges of population aging (Bloom & Zucker, 2023), rapid population growth in many countries in the Global South brings a different set of challenges. FAO (2022a) noted the **concerns regarding insufficient employment opportunities within and outside agri-food systems to meet the needs of the rapidly growing young population cohorts in Sub-Saharan Africa (SSA) and South Asia (SAS)**. In theory, structured urbanization could provide an opportunity for rural poor people to improve their livelihoods. However, the gender dimension of internal migration, particularly rural-urban migration, is unclear (Pickbourn, 2018; Lentz, 2021). In addition, urbanization is a major contributor to climate change, as cities account for 75% of global CO_2 emissions from global final energy use (UNEP, n.d.a.).

MT 2. Changing consumption patterns. Healthy diets are often unaffordable. Unhealthy foods, including (but not only) packaged ultra-processed foods, tend to be cheaper and are proliferating in both urban and rural areas, even in low- and middle-income countries (LMICs). Changing consumption patterns can contribute to many forms of **malnutrition**, including undernourishment in mothers, stunting and wasting in children, or micronutrient deficiencies. There is an alarming **lack of availability of the vegetables and fruits** needed to meet healthy diets, and **small farmers are often excluded from formal value chains** (FAO et al., 2023b). Furthermore, increased consumption of ultra-processed foods is causing an obesity epidemic, which disproportionally affects women and children in LMICs (Ameye & Swinnen, 2019). While changes in dietary preferences were primarily urban-led, the **diet transition has spread to rural areas in more recent years**, although to a lagged and lesser extent. While this change in consumption patterns and the resultant health issues are not new, **the food price index has increased by 50%** since the beginning of the COVID-19 pandemic**,** putting a healthy diet beyond the means of more than 3.1 billion people globally. That number is **112 million more people than in 2019** (IEP, 2022a; FAO et al., 2023b). The increased availability and accessibility of processed foods have also resulted in rapid and profound changes in the diets of Indigenous Peoples (Lam et al., 2023). Overall, Indigenous Peoples now face significant health disparities, with undernutrition and food insecurity often coexisting with obesity and chronic diseases (Browne et al., 2020). IPCC (2019) stresses that many indigenous crops supply essential micronutrients and can have medicinal value, but these crops suffer from scarcity and a lack of attention to their adaptation and improvement.

MT 3. Market concentration in the agri-food system. The agri-food sector has been characterized by **increased concentration and consolidation** along the value chain from the provision of agricultural inputs to the distribution of the final outputs (Crespi & MacDonald, 2022). At one end of the scale, global food value chains are governed by a relatively small number of powerful leading organizations, usually with little national or international regulation.[13] At the other end, in LMICs, the agri-food system is characterized by more than 600 million **increasingly fragmented rural and peri-urban smallholdings that coexist with mega-farms** (Erenstein

[13] Global benchmarking and watchdog efforts supply increasingly detailed and frequent analyses of private sector performance; see, for instance, World Benchmarking Alliance, related to human and environmental sustainability.

et al., 2021; Lowder et al., 2021; FAO, 2022b; Hernandez et al., 2023).[14] The knock-on effects of accelerated market concentration on various value chain actors are unclear. Unknown, for instance, are the effects of market concentration on the women who make up 43% of the agri-food system workforce and who already endure poorer pay, worse working conditions, and diminished rights and access to resources and services compared with men (FAO, 2023b). Implications of market concentration in the agri-food system on food security, nutrition, and health are complex, highly context specific, and often opaque. More research is needed to fully understand the effects of increased market concentration on agri-food systems and food consumption patterns and trends, particularly among vulnerable and marginalized producers and consumers (Hernandez et al., 2023).

MT 4. Climate change. Climate change is one of this century's greatest global challenges (Romanello et al., 2022). The world is already experiencing an unprecedented combination of hurricanes, wildfires, floods, droughts, and heat stress, which is not only damaging agricultural production, fisheries, and forest ecosystems but also causing devastating losses to human livelihoods and lives. **The trend is intensifying**. For instance, the WMO (2023) is predicting a **more frequent breaching of the 1.5 degree Celsius (°C) threshold** moving forward. Global warming beyond that threshold *"risks triggering multiple tipping points in the climate system and causing planetary instability"* (UN DESA, 2023b, p. 16). Furthermore, for each 0.5°C above the current level of 1.1°C, IPCC (2022) projects a 200% increase in human displacement across Africa.
Women are more exposed than men to the health and financial impacts of extreme heat (Arsht-Rock, 2023), and women and children are 14 times more likely than men to be killed during a climate-induced disaster (UN Women, n.d.) Social and cultural barriers can exclude women from engaging in climate change coping or mitigation strategies. Slow or failed climate action will further exacerbate gender inequalities in LMICs (CARE International, 2020; UNHCR, 2022; WEF, 2022a). Indigenous Peoples make up 6% of the world's population but safeguard around 80% of the world's biodiversity, and recurrent droughts are displacing them from their territories. Increased extreme weather events and changing climatic conditions have disrupted traditional Indigenous food production and resulted in 34 million people in 25 countries being acutely food insecure (World Bank, 2022b).

MT 5. Environmental degradation.[15] The main driver of environmental degradation is the conversion of land for agriculture, primarily food production, and for resource extraction, especially mining. Associated contamination of ecosystems through nutrients, pesticides, and pollutants undermines subsistence agriculture. "*The contribution of ultra-processed foods to agrobiodiversity loss is significant, but so far has been overlooked in global food systems summits, biodiversity conventions and climate change conferences*" (Leite et al., 2022, p. 1). An in-depth understanding of the impact of increased market concentration of agri-food chains (upstream and downstream) on key agricultural resources such as land and water, energy use, and food loss and waste in the Global North versus the Global South is also lacking (Hernandez et al., 2023). While over 70% of all ice-free land has been altered by human activity, inland water and freshwater ecosystems show the greatest degree of decline because of a range of anthropological pressures such as land-use change, contamination, introduction of invasive species, and infrastructure development. Currently, almost 70% of the world's accessible freshwater withdrawal is used for agriculture. Water scarcity and high levels of violence are also interlinked, with women among the most affected. Water conflicts tripled between 2000 and 2019. "*The countries with the most water-related conflicts over the last two decades were Iraq, Somalia, Yemen and Sudan, all very low peace countries.*" (IEP, 2022a, p. 3). Climate change is playing an increasingly important role in **the decline of terrestrial, freshwater, and marine ecosystems** (UN, n.d.a.)**.**

MT 6. Shifting global health challenges. The key drivers of the new era of infectious and noncommunicable disease include changing demographic trends, increased global connectivity, the rise in conflicts and civil unrest, climate change, pollution, technological advances, and repeated pathogen emergence from wild or domestic animal reservoirs into human populations. Over the past three years, the global pandemic resulted in much-needed **global attention to this megatrend** (WHO, 2022), including the growing multidimensional inequalities between and within

[14] Erenstein et al. (2021) project that by 2030, the average farm size will have declined in SSA, SAS, and the Middle East and North Africa (MENA). Conversely, average farm size will have increased in East Asia and Pacific (EAP), Europe and Central Asia (ECA), Latin America and Caribbean (LAC), and North America. Globally, the size of the average farm is expected to increase by 5.2%.
[15] "*Environmental damage or degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable*" (UNEP, n.d.b.).

countries (DI, 2023). The COVID-19 pandemic triggered the largest global economic crisis in more than a century, with a rise in global poverty for the first time in a generation and disproportionate income losses among disadvantaged groups, especially women and youth (World Bank, 2022c). While higher-income countries are predicted to make a stronger recovery than first anticipated, the economic downturn in LMICs is expected to continue. The mutually reinforcing effects of climate change, COVID-19, and geopolitical instability are felt most acutely by those already living in extreme poverty (DI, 2023).

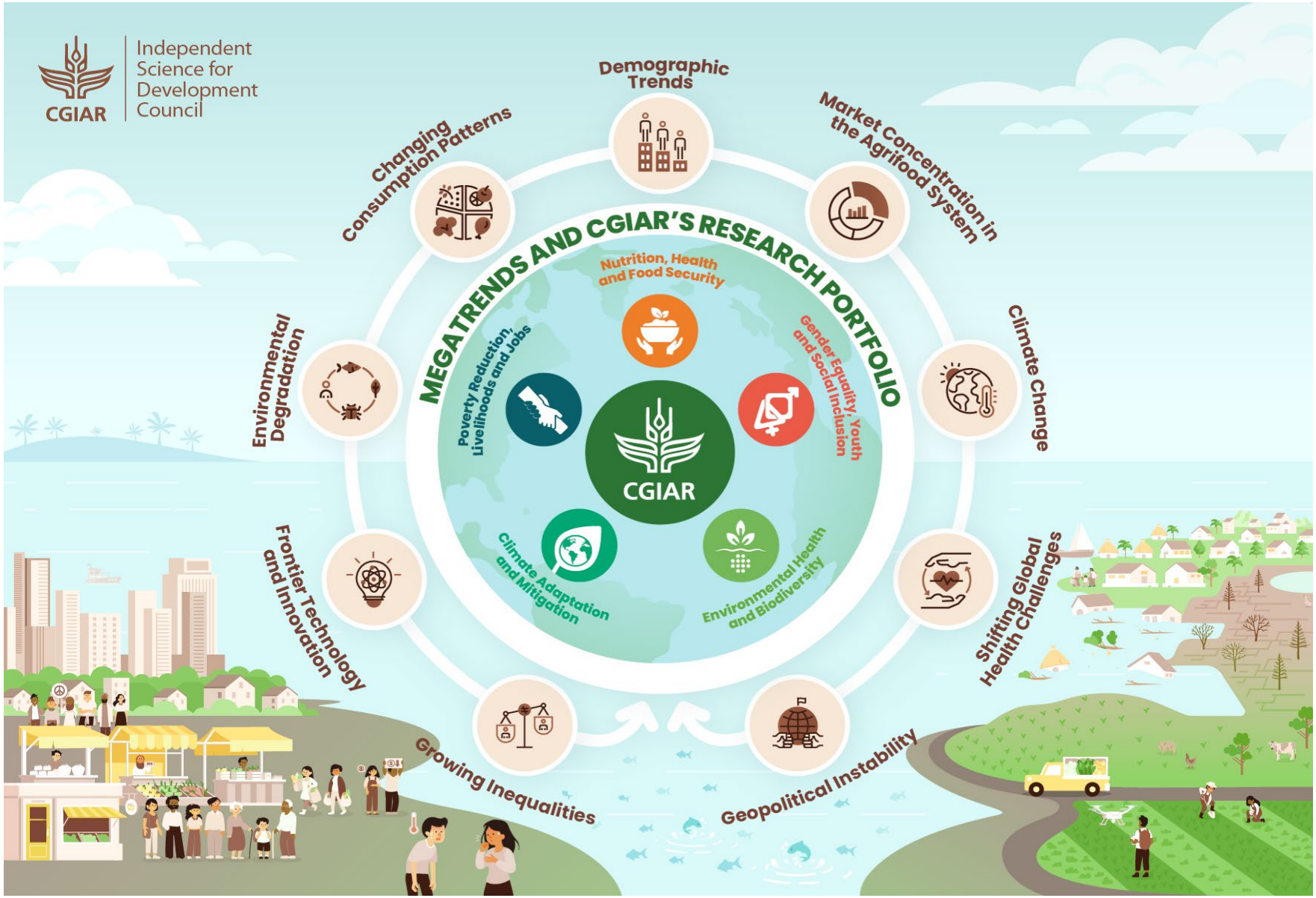
MT 7. Geopolitical instability. The world is currently facing the **highest number of violent conflicts since World War II** (UN, 2023b) such as in Ethiopia, Palestine, Sudan, and Ukraine. In 2018, around 60% of the chronically food-insecure and malnourished people lived in countries affected by conflict. By 2022, this share had **increased to 70%** (WFP, 2018; UN Human Rights, 2023). There is growing recognition of the links between climate change, ecological threats, migration, and conflict. Dependence on food imports from fragile and conflict-affected countries can also represent a risk to food security because geopolitical instability leads to increased food prices (IEP, 2022a). In addition to reducing food and fuel security, geopolitical tensions increase inequalities. For example, the economic, health, and social impacts of conflict and forced migration are gendered. Women and children living in, or fleeing, war or persecution face an increased risk of sexual violence, exploitation, and trafficking (CARE International, 2020; Klugman, 2022). Indigenous Peoples have also been displaced as a result of discriminatory policies, persecution, and armed conflict (UN, n.d.b.).

MT 8. Growing inequalities. Deep-rooted and widespread multidimensional inequalities, which affect women more than men, could increase and become even more entrenched because of the slow and uneven pandemic recovery, climate change, increased levels of conflict, rising food prices, and other global trends (Menon, 2023; Martin-Brehm et al., 2023; World Bank, 2023a). Recovering from multiple cascading crises is especially difficult for LMICs because they have limited financial capacities to fund economic recovery (DI, 2023). **The pandemic caused the largest rise in between-country income inequalities in three decades and contributed to a rise in the unequal distribution of wealth** (DI, 2023; UN DESA, 2023b). Between-country inequalities are likely to increase because climate change will disproportionately affect LMICs. Although these countries are the least responsible for climate change, their geo-climatic conditions, high dependence on natural resources, vulnerability to rising food and energy prices, and limited capacity to adapt make them susceptible to the damaging effects of a changing climate (DI, 2023).

MT 9. Frontier technology and innovation. **New technologies and innovations, including digital technologies and big data, artificial intelligence, solar photovoltaics, genome editing, and nanotechnology, have the power to transform agri-food systems in both positive and negative ways** (FAO, 2022a; UNCTAD, 2023). To ensure no one is left behind, LMICs need access to fit-for-purpose solutions and investment to establish a supportive, enabling environment. For example, low public expenditures on agricultural research for development (AR4D) and extension continues to slow the pace of agricultural productivity growth in Africa compared with other regions (Richardson et al., 2022). Further, if technology-focused research does not consider the myriad barriers that women, youth, and ethnic minorities face in adopting frontier technologies, it runs the risk of promoting technologies that exacerbate inequality (Barrett et al., 2021; Lentz, 2021; FAO et al., 2023b).[16] Despite the benefits that digital technologies can generate for smallholder farmers in developing countries, uptake of these technologies is limited because of low levels of digital literacy, gender gaps, limited access to digital connectivity, and the high cost of devices and services (UN DESA, 2021; UN Women, 2023).

[16] ISDC (2020) emphasizes, "*Ongoing foresight and trade-off analyses should prioritize attention to key barriers to adoption, adaptation, and diffusion of innovations for impact within AFS. Such barriers include poor access, lack of affordability, poor governance and policy implementation, prevailing inequities, and lack of suitability to context, including adequate risk assessments.*"

Figure 1. Nine interconnected anthropogenic megatrends and CGIAR Impact Areas



3 CGIAR's Potential for Making a Difference in an Increasingly Complex and Challenging World

This section deals with how recent megatrend dynamics affect CGIAR's ability to address its collective global targets by 2030 as outlined in the CGIAR Strategy.

Changed megatrend dynamics indicate that rapid population growth in low- and middle-income countries (LMICs) combined with other multiple interlinked megatrends, particularly climate change, environmental degradation, geopolitical instability, and growing inequality, will make it increasingly difficult to deliver healthy and affordable diets (CGT 1), lift millions out of poverty (CGT 3), reduce social inequality (CGT 5–6), and support small-scale producers to be more resilient to climate shocks (CGT 8) in the world's most vulnerable regions, staying within environmental boundaries and maintaining biodiversity (CGT 10). According to recent projections, an estimated 575 million people will still be living in extreme poverty in 2030 (Mahler et al., 2022) and almost 600 million people will still be facing hunger—119 million more people than in a scenario without the COVID-19 pandemic or the war in Ukraine.[17] Paradoxically, around 1.6 billion people (20% of the global population) will be affected with obesity (BMI ≥ 30kg/m²) by 2030 (Lobstein et al., 2023).

Given this grim outlook, it is clear that "*[w]e need to do things differently than in the past, not only to address the pressing problems of today but to identify potential threats, opportunities, and appropriate strategies for tomorrow*" (Serraj & Pingali, 2019, p. 6).

Table 2 presents examples of the effects of recent changes in megatrend dynamics across the five CGIAR Impact Areas and their CGTs. For each Impact Area, Table 2 identifies progress toward respective CGTs and prevailing megatrend forces. These examples are illustrative only and should not be treated as comprehensive. Annex D presents an in-depth analysis providing additional information as well as supporting Table 2.

Weak and fragmented governance and declining public investment in food and agriculture inhibit progress toward sustainable agri-food systems (HLPE, 2020; Cobban, 2023). In an increasingly interconnected and complex world, a whole-of-society approach is needed to develop sustainable, equitable, and inclusive solutions (Romanello et al., 2022; WWF, 2022; Fernandez de Soto & Rugeles, 2023).

The challenge for both national and international research organizations is "*to contribute to the global process of creating the science to meet critical agricultural and food system challenges in ways consistent with diverse private and public interests*" (Antle & Valdivia, 2021, p. 2). Despite the enormous challenges, advanced agricultural innovations and technologies[18] have the potential to produce more food using fewer resources while staying within planetary boundaries and maintaining biodiversity (WEF, 2022b). In addition to having the capacity to provide contextual scientific evidence and develop advanced climate-smart solutions, CGIAR holds a significant comparative advantage in its existing global networks and its capacity to broaden those networks. Its global networks and bespoke resources (i.e., human, biophysical, and social capital), coupled with a 50-year history, give CGIAR a unique convening power. As such, CGIAR is well placed not only to deliver solutions that decouple agricultural production from GHG emissions and environmental degradation but to also champion change across government agencies, national agricultural research and extension systems (NARES), universities, businesses, and civil societies.

[17] While progress in reducing food insecurity is expected in Asia, no progress is forecast for Latin America and the Caribbean (LAC), and hunger is projected to *increase* significantly in Africa (FAO et al., 2023b).
[18] This refers to technologies beyond the traditional technological and productivity-focused perspective.

Table 2. Prevailing megatrend dynamics driving CGIAR Impact Areas and progress toward collective global targets (CGTs)
(examples in this table are illustrative only and not comprehensive; more detailed evidence and analysis is provided in Annex D)

Progress toward CGTs	Prevailing megatrends	Examples
Impact Area: Nutrition, Health, and Food Security		
End Hunger: Progress toward ending hunger for all and enabling affordable healthy diets not only is off track but has reversed. The confluence of the intensifying climate crisis, growing geopolitical tensions, continued population growth, rapid urbanization, and changing consumption patterns is making it increasingly difficult to reduce, let alone end, hunger and malnutrition in many LMICs. Of particular concern is the fact that food insecurity is projected to continue to increase in SSA—one of CGIAR's key mandate regions—over the coming decades.	MT 1. Demographic trends MT 2. Changing consumption patterns MT 3. Market concentration MT 4. Climate change MT 7. Geopolitical instability MT 8. Growing inequalities	In Eastern and Southern Africa, 29% of total food expenditure is spent on processed food, of which more than one-third constitutes highly processed food. Recent studies of food consumption in three African countries also show that consumption of processed foods is high among the poor, and even the ultra-poor, in both rural and urban areas. Similarly, in LAC, the shift from traditional biodiverse high-fiber, low-fat foods toward energy-dense, low-nutritional-value foods (e.g., sweetened beverages) is spreading to rural areas and Indigenous Peoples (FAO et al., 2023b). The affordability of nutritious and well-balanced diets might warrant further research. Hunger is significantly worse in countries where agri-food systems are highly sensitive to climate variability and change and where a high proportion of the population depends on agri-food systems for their livelihoods (FAO et al., 2018), is experiencing a high level of conflict, or relies on agricultural imports from conflict-affected countries (IEP, 2023). For example, Africa has the world's fastest-growing population, is experiencing rapid urbanization, and faces a disproportionally high level of complex and compounding weather-related, geophysical, and biological threats (Richardson et al., 2022). Around half the world's fragile and conflict-affected countries are located in SSA (IEP, 2023).
Impact Area: Poverty Reduction, Livelihoods, and Jobs		
Exit Poverty: After a spike in 2020, extreme poverty once again started to trend downward in 2021, and by 2022 an estimated 667 million people were living in extreme poverty (UN DESA, n.d.a). But poverty reduction is unlikely to get back on track to pre-2020 levels soon, and, given the intensifying interactions between multiple megatrends, it is unlikely that at least 500 million of the world's poorest people will be lifted out of poverty by 2030.	MT 4. Climate change MT 6. Shifting global health challenges MT 7. Geopolitical instability	In SSA, home to 60% of the world's extreme poor, per capita income growth over 2023–24 is expected to average only 1.2%, which could cause poverty rates to rise (World Bank, 2023d). Poverty is particularly entrenched in SSA because of the high level of dependence on agri-food systems for food security and employment, limited livelihood opportunities, and gender inequalities. Poor governance, climatic shocks, conflict, and inadequate access to essential services are further exacerbating poverty. Climate change has a particularly fraught relationship with poverty: many proposed mitigation strategies are likely to increase poverty (Soergel et al., 2021) and might be insufficient, given that climate change impacts are exceeding earlier projections.

Impact Area: Gender Equality, Youth, and Social Inclusion		
Close Gender Gap: Social, environmental, and economic crises that disproportionately affect women are becoming more frequent and intense. In particular, multiple and overlapping megatrends—demographic trends, changing consumption patterns, shifting global health challenges, climate change and environmental degradation, and geopolitical instability—are likely exacerbating women's disproportionate food and economic insecurity and lower levels of personal safety. Further, gendered income inequality worsened during the pandemic.	MT 1. Demographic trends MT 4. Climate change MT 7. Geopolitical instability	22% of women working in off-farm agri-food system roles lost their jobs, compared with 2% of men (FAO, 2023b). The ongoing and intensifying climate crisis and conflict also exacerbate gender inequalities and have a negative impact on the livelihoods, health, and safety of rural women in LMICs (CARE International, 2020; Botreau & Cohen, 2019; UNHCR, 2022; WEF, 2022b).
Increase Youth Opportunities: The COVID-19 crisis reversed 15 years of progress in increasing the number of young people in education, employment, or training; more than one in four people aged 15–24 in LMICs risks being stuck in a poverty cycle because of skills-based barriers.	MT 1. Demographic trends MT 3. Market concentration MT 8. Growing inequalities	Around one in five young people is not in employment, education, or training (NEET); a large majority are young women. Over the past four years, the number of NEET youth has been rising, particularly in LMICs, even as adult employment levels returned to, or exceeded, pre-pandemic levels (Elder & O'Higgins, 2023). The upward trend in NEET youth is particularly worrying in the case of SSA because the youth cohort is projected to be 20.3% of the total population in 2030. That is equivalent to 234 million youth (UN DESA, 2022).
Impact Area: Climate Adaptation and Mitigation		
Increase Climate Resilience and Adaptation: Adoption of climate-smart solutions is crucial to ensure food security and build the resilience of small-scale farmers, but the low rate of technology adoption is a continued key constraint in LMICs. Extreme weather events, natural disasters, and pest and disease outbreaks driven by climate change are becoming more frequent and intense, so adaptation strategies will need to be rapidly adjusted. GHG emissions from agri-food systems are expected to increase by 7.6% over the next decade under a business-as-usual scenario, with the climate impacts expected to fall disproportionately on smallholder farmers. However, there is recent progress in developing innovative approaches to developing climate-smart crops that are both better adapted to changing climate conditions and require less GHG-intensive inputs.	MT 4. Climate change MT 5. Environmental degradation MT 7. Geopolitical instability	Climate change is a trigger for migration and conflict. More frequent and extreme weather events, combined with increasing levels of conflict, are displacing record numbers of people. By the end of 2023, the number of displaced persons is projected to be 117.2 million (UNHCR, 2023a); by 2050, 216 million people worldwide are projected to be internally displaced as a result of climate change (UN DESA, 2023b). Forced displacement, driven by climate change and conflict, impacts agri-food systems in both home and host countries (Vos & Wilson, 2020; Anzellini, 2022). Frontier innovations offer strategies to decrease agricultural GHG emissions. For example, genome editing could be applied to develop improved climate-ready varieties and species that require less GHG-intensive inputs or to develop higher-yielding, climate-smart traditional food crops. Adoption of climate-smart solutions is crucial for food security. These can include, for example, farming practices and technologies that decrease soil disturbance and increase water- and nutrient-use efficiency, early-warning weather systems, and crop pest and disease models to help target control methods.

Impact Area: Environmental Health and Biodiversity		
Maintain Planetary and Environmental Boundaries[19]: Around half the global population will live in areas that are water stressed by 2050 (FOLU, 2019). Severe water stress is being experienced by 1.4 billion people in 83 countries, an increase of 200 million since 2020. Ongoing agricultural practices are contributing to increased environmental degradation, with the poor and marginalized bearing the brunt of degraded ecosystems.	MT 1. Demographic trends MT 4. Climate change MT 9. Frontier technologies and innovation	While the rate of increase in consumptive water use in food production is less than the rate of population growth, growing enough food to feed 8.5 million people in 2030 while using less water than in 2010 will be challenging. This is a particular challenge in the MENA region, which is the most water-stressed region in the world; it receives less rainfall than any other region while facing persistent conflict and growing urbanization (IEP, 2022a). Climate change will exacerbate this challenge through more intense and longer-lasting drought conditions and widespread flooding, often within one season, with devastating effects on agriculture and human well-being. Policies that support responsible water management and use across multiple sectors are often lacking or inappropriate.

[19] The target bundles freshwater, deforestation, nitrogen, and phosphorus application. In this table, water is the focus.

4 Implications and In Closing

This Discussion Paper provides a critical examination of how recent shifts in megatrends significantly influence the CGIAR research and innovation portfolio. Our analysis centers on the five Impact Areas through their associated CGTs. We have synthesized the latest literature on megatrends impacting agri-food systems, drawing insights from a consultation process with key stakeholders and supplementing our findings with both quantitative and qualitative data.

We identified nine key megatrends pertinent to CGIAR's mandate and revealed their heightened interactions and feedback loops. Megatrend complexity is further compounded by a notable breakdown in good governance in many countries, exacerbating the challenges. CGIAR research and innovation have limited scope to mitigate some of these effects, but the megatrend dynamics fundamentally affect the course of CGIAR impact pathways. Through concrete examples, we underscore the disproportionate impact of the confluence of these megatrends on achieving measurable benefits across CGIAR's five Impact Areas.

This Discussion Paper not only distills a wealth of insights from the literature but also draws out nine implications for the 2025–2027 CGIAR research and innovation portfolio. While some implications may have longer time horizons, it is imperative to recognize that some of the dynamics of recent megatrends necessitate immediate actions, prompting the need for an evolved portfolio. The initial seven implications primarily address portfolio substance, emphasizing strategic shifts, while the final two focus on crucial process adjustments:

1. Increasing food diversity and quality
2. Strengthening governance of agri-food value chains
3. Building resilience and fostering inclusion among farmers
4. Focusing on the inclusion of youth
5. Prioritizing technology and education in agri-food systems adaptation efforts
6. Applying climate learning from other sectors
7. Better managing competing demands for water across all sectors of our economies
8. Adopting and using megatrends, foresight, and trade-off frameworks
9. Ensuring specific, measurable, achievable, relevant, and time-bound collective global targets (CGTs)

To further many of the implications listed below, CGIAR should continue to embed research and innovation that expand its knowledge of barriers to adoption and increase its ability to contribute to intended outcomes with scaling partners. This lesson is strengthened by the learnings from a decade of CGIAR research programs (IAES, 2021). Impact assessment embedded in CGIAR research and innovation could help implementers (researchers, scaling partners) and shed light on assumptions related to access and scaling. The Standing Panel on Impact Assessment (SPIA) already contributes to this effort.

Implication 1. Increasing Food Diversity and Quality

Sustainable agri-food systems and healthy diets are characterized by diversity. Agricultural diversity within the food value chain could have positive environmental impacts across food, land, and water systems, contributing to climate mitigation. Dietary diversity is one key component of healthy diets. The shift in consumption patterns toward more ultra-processed foods accentuates the need to strengthen high-quality food supply systems worldwide. CGIAR could consider exploring and investing in a broader range of plant and animal food species as part of diversification, including but not limited to small indigenous fish species and traditional food plants. CGIAR's participation in the Vision for Adapted Crops and Soils program, led by the African Union and partners, is just one example.

Implication 2. Strengthening Governance of Agri-food Value Chains

The transformation of agri-food systems hinges on a foundation of good governance. As these systems undergo a progressive shift toward commercialization, there is a concurrent trend toward concentration and consolidation along the value chain, from the supply and subsidization of agricultural inputs (such as fertilizers and pesticides) to the distribution of final outputs (facilitated, for instance, by large supermarkets). A significant gap exists in the availability of comprehensive, up-to-date national and regional data that accurately capture the diverse array of actors within these value chains.

Recognizing this deficiency, CGIAR could contribute significantly through research on the effects of concentration and consolidation of agri-food systems on the livelihoods of women, youth, and Indigenous People who are small-scale farmers. An inclusive approach, involving a wide range of public and private actors along the impact pathway, has the potential to develop and support structures that are urgently needed for the appropriate governance of agri-food value chains.

Furthermore, it is imperative to acknowledge and proactively manage potential trade-offs and spillover effects associated with value chain concentration and consolidation. CGIAR can shed light on these dynamics, facilitating informed decision-making and contributing to policy formulation. In essence, addressing the governance challenges within evolving agri-food systems requires a concerted effort to bridge data gaps, involve diverse stakeholders, and anticipate and manage the multifaceted repercussions of concentration and consolidation.

Implication 3. Building Resilience and Fostering Inclusion among Farmers

Gender equity, social inclusion, and resilience are key factors for reducing inequality. Research that investigates the drivers of deep-rooted and widespread inequalities in agri-food systems, as well as the interconnected and reinforcing feedback loops with other negative outcomes, would increase the effectiveness of CGIAR's contribution to the inclusion of women and vulnerable groups—which may include youth, Indigenous Peoples, and migrant workers. Such research could help remove the barriers that prevent women and vulnerable groups from taking up interventions that enhance the welfare of agri-food system workers and increase gender equality.

Farmers should be included in research for development from the outset. This is already reflected in some of CGIAR's theories of change. Ultimately this will lead to improved resilience and greater equity across the agri-food system.

Implication 4. Focusing on the Inclusion of Youth

Although youth are key contributors to system transformation, few global programs target their inclusion in the agri-food sector. Youth require opportunities for a rewarding and profitable career path in agri-food systems. A stronger focus on youth would fill a gap in the research and innovation portfolio. A comparative advantage analysis should be conducted to assess CGIAR's potential role in this research.

If comparative advantage exists, CGIAR could engage youth (ages 15–24 years) in the design, development, and implementation of research for development work packages that specifically study the key challenges youth face within agri-food systems.

CGIAR could also prioritize work packages addressing youth access in the Regional Integrated Initiatives that focus on scaling technologies and innovations in regions with the fastest-growing young populations. A promising area for youth participation is digital AR4D, which could be further explored in CGIAR's Initiatives.

Implication 5. Prioritizing Technology and Education in Agri-food Systems Adaptation Efforts

Climate-smart innovations help build resilience in agri-food systems. As climate change continues, current adaptation options will become less feasible and effective. Innovations in agri-food systems have been increasingly influenced by innovations in other sectors. Technology to accelerate innovation to meet the rapidly evolving climate challenges is necessary. An obvious question is what role AI could play in this space.

CGIAR could pursue technological investments that both accelerate agri-food innovation and fight poverty. A critical decision for CGIAR investments is between research that targets actual, immediate climate challenges and research designed to address likely future climate challenges—a difficult balancing of resource allocation that leadership will need to confront. Within this context it is important to emphasize adaptation that is conscious of impacts on poverty to avoid exploiting or excluding any vulnerable groups.

With technological advancements comes a need for regulatory progresses that are fit-for-purpose and socially just and appropriate. Policy development is often influenced by public perception of biotechnology. CGIAR could work with its partners to develop strategies for improving public and policymaker understanding of the underpinning science. A multisectoral approach would include partners from the scientific community, regulatory bodies, and educational institutions.

Implication 6. Applying Climate Learning from Other Sectors

Following alarming evidence of accelerated climate change in 2023, GHG emissions of agri-food systems are under increased scrutiny. Agriculture accounts for approximately one-third of all GHG emissions and the agri-food sector is lagging others in its progress towards net zero. The energy and transport sectors have made considerable progress toward net zero, in part because they have served as attractive sectors for sustainable investments from public and private sources.

What can the agri-food sector learn from other sectors that could be incorporated into the research and innovation portfolio? It may be helpful to seek input from subject matter experts and partners from other sectors when investigating how to overcome the investment shortfall. Mitigating climate change is a cross-disciplinary and cross-sectoral challenge, and the agri-food sector may benefit from broader learnings.

Implication 7. Better Managing Competing Demands for Water across all Sectors of our Economies

Water scarcity is a growing area of concern and increasingly conflict. Continued population growth, changing consumption patterns, increased urbanization and industrialization, and competition for water between sectors (e.g., agri-food, transportation, energy, and fashion) lead to additional pressure on this already scarce resource.

CGIAR could consider using their resources for more cross-sectoral research into best management practices of freshwater systems.

Implication 8. Adopting and Using Megatrends, Foresight, and Trade-Off Frameworks

Addressing contemporary challenges requires a comprehensive grasp of the immediate and long-term ramifications of interconnected megatrends on food, land, and water systems. This understanding must include the interplay between climate change mitigation and adaptation strategies, environmental health, biodiversity, and the productivity of agri-food systems, encompassing critical aspects like food security, nutrition, health, poverty reduction, and equity. To systematically navigate these complexities, foresight and trade-off analyses emerge as indispensable tools, offering an explicit exploration of impacts, potential synergies, and trade-offs, while assessing multiple scenarios to achieve diverse outcomes.

To further strengthen the foundations of CGIAR's Initiatives and Science Groups, there is a distinct advantage in adopting a user-friendly megatrend framework that seamlessly integrates foresight and trade-off analyses; one such framework has been illustrated in past ISDC advising to CGIAR (Antle & Valdivia, 2021). Implementing this framework in tandem with comparative advantage analysis could lay the groundwork for robust, mutually beneficial partnerships and ensure the optimal allocation of limited resources toward CGIAR's inherent strengths. CGIAR's existing foresight and trade-off capacities, supported through pooled funding, provide a solid foundation that can be further developed and internally deployed.

Furthermore, the continuous and iterative nature of megatrend, foresight, and trade-off analyses form an integral part of ongoing design and delivery processes. An iterative approach ensures that CGIAR decision-making remains informed and adaptable, facilitating agility in response to evolving challenges and opportunities. In essence, the use of a dynamic framework integrating foresight, trade-off analyses, and comparative advantage not only enhances the resilience of CGIAR's strategies but also positions the organization to proactively shape future outcomes in alignment with its mission and strengths.

Implication 9. Ensuring Specific, Measurable, Achievable, Relevant, and Time-bound Collective Global Targets (CGTs)

Not all CGIAR CGTs are directly aligned with the CGIAR research and innovation portfolio or comparative advantage, nor are they all unambiguous or measurable. In addition, two CGIAR Impact Areas do not have specific CGTs: Poverty Reduction, Livelihoods, and Jobs does not have specific global targets for livelihoods and jobs, and Gender Equality, Youth, and Social Inclusion does not have a specific global target for social inclusion.

Targets are benchmarks against which success can be measured. In its evolved portfolio, CGIAR could review the 11 CGTs to ensure that they are specific, measurable, achievable, relevant, and timebound (SMART). More consideration may be needed to identify what remedial actions to take when CGTs are not being achieved. Currently, some CGTs are too ambitious and aspirational, making them neither “achievable” nor “measurable.”

In Closing

This Discussion Paper aims to guide CGIAR through its next iteration of portfolio evolution by documenting and analyzing recent shifts in megatrend dynamics. As the 2025 research and innovation portfolio takes shape, ISDC strongly encourages CGIAR's leadership and management to thoughtfully contemplate and address the implications arising from the insights presented in this Discussion Paper. Additionally, the literature review and implications serve as a call to action, urging CGIAR to remain agile, innovative, and responsive to the complex interplay of megatrends that affect agri-food systems. As CGIAR continues to be a leader in agri-food research for development, awareness and integration of megatrend considerations will be paramount in ensuring its evolved portfolio is fit for purpose and feasible.

Annexes (in a separate file)

Annex A. CGIAR Initiatives 2022-2024

Annex B. Stakeholder Consultations

Annex C. Megatrends Overview

Annex D. In-depth Analysis of the Effects of Interconnected Megatrends—Their Recent Development and Interactions—across the Five CGIAR Impact Areas

Annex E. References

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