Food Chain Reaction—
A Global Food Security Game

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Abstract

The Center for American Progress, World Wildlife Fund, Cargill, Mars, and CNA developed and executed a policy decision-making game designed to explore issues arising from, and possible responses to, global food system disruptions. The game took place in November 2015 in Washington, D.C., and included senior officials and subject matter experts on teams representing Brazil, Continental Africa, China, the European Union (EU), India, the United States, Multilateral Institutions, and Business and Investors. During four rounds of game play spanning the decade 2020 to 2030, players confronted food system pressure at the intersection of population growth, urbanization, severe weather, and social unrest. In response, players crafted policies, made decisions, and took actions that dynamically influenced the state of the world as the game advanced. As the chain reaction of impacts tied to their choices became apparent, players experienced first-hand how their decisions and actions influenced global food security. At the conclusion of the game, players highlighted significant lessons learned and expressed increased preparedness to collaboratively address food security.

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Executive Summary

Background

The global food system is heavily networked and complex, making it vulnerable to a variety of risks. In 2007 and 2008, the world watched as a modern-era food crisis arose from the complex interplay of several drivers: droughts in major grain- and cereal-producing regions, increased biofuel production consuming grain supplies, and a range of evolving structural problems in the global food supply chain. Disruptions affected developed and developing countries alike, creating political and economic instability, and contributing to social unrest in certain areas. The crisis highlighted the critical importance of better understanding the interdependencies and cascading effects of decisions made throughout the global food system and how the effects of climate change may exacerbate such challenges.

Recognizing the need to address threats to food security, World Wildlife Fund, the Center for American Progress, Cargill, and Mars (hereafter referred to as the sponsors) came together to develop a game exploring a range of questions including: Will increasing levels of stress on the global food system disrupt markets? Will individual nations become isolationist—or cooperate—to restore stability? Will global leaders identify new and innovative approaches to balance short- and long-run considerations? CNA, in collaboration with the sponsors, designed and conducted a policy decision-making exercise with 65 international thought leaders to better understand the global impacts of and responses to deepening global food system disruptions.

Game Design

Food Chain Reaction—A Global Food Security Game was held November 9–10, 2015 in Washington, DC. Players with considerable influence and deep expertise in agriculture, trade and economics, climate and the environment, diplomacy, and security represented national and international governing bodies and organizations and the private sector. During the game, players encountered a decade marked by food price and supply swings amidst burgeoning population growth, rapid urbanization, severe weather events, and social unrest. Recognizing their influence over global conditions, players took action—and, in the process, shaped the world.

The game's dynamic design allowed players to experience a chain reaction of consequences resulting from their choices.

The game was set between the years 2020 and 2030, a period that was near enough to be familiar, but distant enough to allow players to focus beyond current policy debates. The longitudinal nature of the game presented players with the opportunity to realize the impacts of their choices in the context of the environment-food-stability nexus. The players were organized into eight teams. Six of the teams represented Brazil, China, the European Union (EU), India, the United States, and Continental Africa. The seventh team represented Business and Investors, and the eighth team represented Multilateral Institutions (e.g., World Bank, United Nations, Non-Governmental Organizations). The interests of and events in other key regions, such as the Middle East and Central Asia, were represented within the underlying background scenario and through events that emerged as the game proceeded.

Prior to game conduct, players received background information relevant to each team's unique geographic and climatic situation, national security issues, and economic and political status. Based on this information and the evolving state of the world—driven to a large extent by their own actions—players confronted a variety of significant decisions and tradeoffs. Teams were afforded the ability to employ national, bilateral, and/or broadly cooperative approaches to addressing the world's growing food security challenges. Based on team actions and external stresses, a panel of experts (the "Adjudication Cell"), relying on qualitative and quantitative judgment, updated the state of the world to illustrate for players the results of their combined actions. The game proceeded in this manner over four rounds until the scenario advanced roughly ten years.

Game results

Prior to the start of the game (through 2019), demographic changes, climate pressures, and political crises had combined to threaten food security. The first round spanning 2020 – 2021, included lower than average global foods stocks, rising food prices, weather-related disasters, and instances of social unrest. The cumulative actions of players influenced worldwide conditions in subsequent rounds. In the second round spanning 2022 - 2024, players experienced the game's food security crisis peak, followed by a tempering of global pressures in round three (2025 – 2027). The fourth and final round concluded in 2030 and brought players full circle to increasingly tight global circumstances, similar to those in the first round.

Game play produced insights on governmental, multilateral institutional, and private sector reactions to food system disruption drivers such as extreme weather events, and consequences of disruptions—including global food price volatility, social unrest, environmental pressures, and migration and humanitarian crises. One of the fundamental conclusions that emerged from the game is that stakeholder

cooperation and collaboration are paramount to the development of effective short- and long-term food security initiatives.

The overall game findings follow:

- Institutional inertia pervaded the first round of the game, when global conditions were clearly trending toward crisis but had not yet peaked. Teams did not assume an action-oriented stance until the second round, when they were faced with a crisis situation characterized by multiple extreme weather events, record low food stocks, record high food prices, social unrest, and areas of significant humanitarian need. In direct contrast to the contemplative rather than action-oriented game play in Round 1, when global pressures tapered in Round 3 most teams sustained the momentum gained in the face of crisis (Round 2) and assumed a forward-leaning posture with the goal of building resilience in preparation for future disruptions. In the final round, as dramatic climate stress returned, teams increasingly acted on immediate challenges while maintaining deliberate focus on building resilient structures to systematically face ongoing longer term challenges.

- Teams quickly sought to build an environment of global cooperation and collaboration, although the balance of domestic versus global collaborative decisions varied across teams and throughout the game. As the game progressed, a surprising convergence of ideas allowed teams to agree on common goals and engage in complementary activities. Teams deepened their commitment to global and regional cooperation and collaboration during crisis periods, in large part due to players' open acknowledgement that no one nation, organization, or business could adequately address global food security.

- Many of the teams' actions reflected players' acknowledgment that food system vulnerabilities are exacerbated by the unpredictability of climate effects. Teams sought to develop and implement policies and actions that recognized the link between climate and food security. Similarly, teams acknowledged the relationships between water, energy, and food security; however, these linkages were not operationalized to the same degree as the climate–food security connection.

- A broad consensus developed around the need for timely, relevant, and credible global information on food security drivers and indicators. Players viewed the availability of accurate data from all nations as a strong defense against global food system volatility.

- As the decade unfolded, teams evolved from being immediately reactive to balancing short- and long-term actions. Players sought to maintain a

consistent focus on food vulnerability and security, rather than simply reacting in the face of a crisis.

- Prompted by instances of significant internal and external migration and social unrest, teams identified the contribution of food security to regional stability. Players expressed concern that extreme weather events, food insecurity, and major refugee movements contribute to conflict.

- Many of the teams' specific longer-term domestic and international actions developed as a range of investments and innovative financing approaches. Funding endowments were provided for basic research and development (e.g., seed development, pest management approaches), food production and processing improvements, and infrastructure development and enhancement. It is important to note that players made significant commitments as a result of game design, without the tension of budgetary constraints.

As the game progressed, players developed greater appreciation and understanding of the complexity and importance of achieving and maintaining global food security. Players finished the game excited to use their experiences as a springboard for initiating future conversations about the importance of proactive, cooperative, and balanced approaches to promoting global food security.

Contents

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A Global Food Security Game

> *"The most daunting aspect of the existing global food system is not only the strong possibility that food crises are an inherent aspect of the global food system ... but also that this system may well be hit hard by several shocks in the future. These include adverse weather shocks and declining productivity related to climate change, and a recurrence of oil price shocks and surging biofuels demand."*
> **—Derek Headley and Shenggen Fan**

Based on their research of the determinants and consequences of the 2007–2008 global food crisis, Headey and Fan's[1] conclusion underscores the complex interplay of factors, including drought, restrictive trade measures, and long-term structural problems responsible for record upward food price movements. The crisis highlighted the need to better understand the interdependencies, cascading effects, and aggregate impact of decisions made throughout the world with regard to the global food system and food security.

Food Chain Reaction—A Global Food Security Game took players beyond what the world has already experienced. Over four rounds representing a decade-long period, players experienced the impacts of cumulative pressures—including those resulting from private sector, organizational, and governmental actions—on the global food system. The longitudinal design provided players with the opportunity to experience linkages between climate and food that would not have been realized if play had not been allowed to proceed over time. Players contributed their expertise and debated the trade-offs of possible policy actions, while interacting with and learning from others. This approach was well suited for an issue as complex as food security, which is tied not only to agriculture and food production, but also to issues of diplomacy, security, the environment, climate change, economics and trade, and development.

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[1] Derek Headey and Shenggen Fan, *Reflections on the Global Food Crisis: How Did It Happen? How Has It Hurt? And How Can We Prevent the Next One?* IFPRI Research Monograph 165 (Washington, DC: International Food Policy Research Institute, 2010).

The Game

An overarching game objective was to identify the ways in which the public and private sector might intervene in responding to climate and global food system disruptions. This meant the game had to have a particularly open-ended design. The remaining game objectives include the following:

- Understand how key players respond to key trigger points in a crisis

- Determine if and how the global food system can be stabilized in a period of crisis and disruption

- Explore through pragmatic and policy responses how to prevent disruptions—but also how to respond to them should they arise

- Explore climate change mitigation and adaptation to understand benefits and trade-offs for both types of climate change responses

- Derive compelling insights to share with food security thought leaders to inform food security thinking and policymaking

- Improve understanding and appreciation of the roles of prices, markets, open trade, and private sector and commercial interests in enabling the global food system to make the world more food secure

- Improve understanding of the impact of government intervention on markets.

The highly networked nature of the global food system did require the game to capture the world's top food producing and consuming populations, as well as vulnerable nations affected by surging global food prices. The end result was eight teams—totaling 65 players—representing teams from Continental Africa, Brazil, China, the European Union, India, the United States, Multilateral Institutions, and Business and Investors. An Adjudication Cell panel comprising subject matter experts with relevant expertise adjudicated the collective outcomes of team decisions and actions, and advanced the game's scenario accordingly.

Game play was subject to several influential artificialities, including the absence of budgetary constraints and specific political regimes, or specific election cycles (i.e., players could not be "voted out"). In addition, teams did not directly mirror the real-world composition of the entities they represented during game play (e.g., the European Union team did not include representatives of all EU members), and teams were limited to players' expertise and experience, and the game materials.

Game Play

The following subsections describe the perspectives and behaviors of the eight teams, highlighting the main areas of discussion and the positions taken within each of the teams.[2]

Brazil

- Faced little internal disagreement due to relatively homogenous team composition that agreed to focus strongly on growth-oriented domestic policies and actions. Appeared to feel somewhat insulated from significant global food security challenges.

- Promoted the position that domestic agricultural production expansion and supply chain improvements (e.g., seed development, infrastructure investment, technology transfer, biofuel policies, insurance programs) benefit the world and help to alleviate global food price pressure.

- Implemented policies (e.g., reclaiming degraded land, honoring the Forest Code) aimed at reducing impacts on climate and the environment. Demonstrated strong support for further development of the bio-economy, including advanced biofuels.

- Invested in domestic research and development promoting long-term agricultural improvements (e.g., improved fertilizer efficiency).

- Expressed a willingness to contribute to global initiatives by avoiding bilateral actions in favor of multilateral agreements.

China

- Encountered minimal internal conflict due to consistent viewpoints represented within the team.

- Focused primarily on domestic issues in keeping with a strong stance toward national self-sufficiency. The team took the position that, given the size of

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[2] It is important to note that the team characterizations reported in this section are specific to the game environment. The game planners identified potential players with the goal of building teams that represented a diverse range of positions and interests. The composition of teams during the game was not necessarily representative of real-world governments, organizations, and/or businesses.

China's population and rapidly growing middle class with greater preferences for protein, Chinese achievement of self-sufficiency could reduce pressure on the global food system and thus be beneficial to the world.

- Focused heavily on water resource strategies (e.g., irrigation, pollution and contamination control, desalination). Most of the approaches taken were focused on domestic approaches and impacts; however, China did agree to consider joint river management approaches with India, using the Mekong Delta model as a framework. Realizing the potential mutual benefits, India and China agreed to continue negotiations regarding joint management of shared water resources, including the Brahmaputra River—a possible testbed for a collaborative approach.

- Expressed a relatively strong willingness to make investments in Africa (although not to the degree requested by the Continental Africa team) and provide funds for humanitarian relief efforts.

- Agreed that enhanced global food security and water information systems are critical.

- Supported global initiatives (e.g., global food stock system) to be undertaken, or overseen by Multilateral Institutions. However, there was reluctance to being fully transparent, particularly with respect to food stock levels.

- Initiated enhanced food cooperation in Southeast Asia through information-sharing, solar and hydroelectric power-source development, emergency assistance measures for climate refugees, and short-term application of artificial rainfall technology.

Continental Africa

- Team comprised players representing a variety of backgrounds and interests. Encountered challenges balancing the interests of countries, regional organizations, and the African continent.

- Embraced the position that the African continent can play a major role in enhancing global food security (i.e., Africa is a major part of the solution). African Union and heads of state committed significant resources to "climate-smart" initiatives designed to close yields gaps and transform Africa into the "breadbasket of the future."

- Pushed for ambitious levels of free trade within the African continent. Recognized the need for intracontinental approaches to improving agricultural productivity, encouraging foreign direct investment and trade, and promoting resilience and stability.

- Promoted continental economic transformation through efforts to raise and mobilize capital. Promoted continental free trade and resource mapping, and entered into negotiations with the Business and Investors team, the U.S. team, the China team, and the India team to secure investments in research and development (to improve agricultural productivity and to enhance infrastructure) and to create a more robust business culture, thereby reducing reliance on other nations' more traditional development and relief approaches. Private sector investment in technology and infrastructure was recognized as the way forward.

- Developed internal safety nets (e.g., stocks, conditional cash transfers), encouraged international partners to develop and invest in a globally coordinated quick response capability to address climate change–related disasters, and called on other nations (e.g., East Asian countries) to avoid implementation of trade restrictions.

European Union

- Faced considerable internal debate due to the politically and geographically heterogeneous composition of the team. Nonetheless, the European Union players agreed to reform Common Agricultural Policy away from direct payments (i.e., income supplements) to a public-funds-for-public-goods approach. For example, the team allocated 40 million Euros for a rewards system providing payments to agricultural producers engaged in good environmental behaviors (the environment being the public good). The team also temporarily suspended environmental regulations while simultaneously implementing a tax on meat when faced with the peak of the food crisis.

- Supported development of publicly owned stockholding, in addition to private grain stockholding, tied to proportional price movements (e.g., stocks accumulated when prices fall below 150 percent of long-term averages and are released, for humanitarian purposes, when prices rise above 350 percent of long-term averages).

- Invested in research and development initiatives targeted toward increasing sustainable productivity in low income countries through extension services, development financing, locally appropriate improved seed technology (not genetically modified), soil management practices, infrastructure investment, and access improvements.

- Committed to the development and implementation of policies consistent with sustainable food-climate-environment principles. Joined other teams in support of carbon pricing, carbon trading, and a global emissions cap. Sought to address food waste and reflect the costs of negative environmental

externalities in food pricing. Considered criminalizing food waste, but ultimately implemented a food waste best-practices initiative. Implemented a meat tax and tied a carbon tax to agricultural production based on emissions impacts.

- Provided support for conflict-sensitive humanitarian aid, as well as peace-building and resilience efforts in partnership with Multilateral Institutions. Encouraged Multilateral Institution leadership in land tenure rights and contract transparency initiatives.

India

- Team comprised of players representing a variety of positions initially.[3] Early actions required greater internal negotiation.

- Focused on further developing domestic capacity and efficiency by improving infrastructure for India's 4,000 census-designated "market towns"[4] using revenues from expanded coal taxation.

- Agreed to join other teams in support of a global emissions cap consistent with India's prior commitments. Also increased domestic coal sector regulation to reduce associated negative environmental impacts.

- Entered into an agreement with China to explore and address joint approaches to managing shared water resources.

- Promoted the development and implementation of global food security and water information systems, and volunteered information technology expertise and funding to support related efforts. Maintained that India's food stock data is accurate and offered to contribute a portion of domestic food stocks to relieve short-term global food shortages. Encouraged China to be transparent about stock levels and to release a percentage of its stocks for short-term relief purposes.

- Advocated for climate-smart agricultural research and development and technological improvements, including technology transfer of climate-tolerant seed varieties, integrated pest management approaches, and organic fertilizer practices. Agreed that researchers should have the opportunity to

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[3] Some of the India team players were unable to return for the second day of game play, which changed the dynamic of later discussions.

[4] India has approximately 4,000 "market towns" where farmers bring their produce to sell.

research genetically modified seeds, but did not elaborate beyond investigation.

- Noted the underutilized potential in Africa[5] early on and committed to more openly share intellectual property. Committed more broadly to assist Africa as well.

- Proposed creation of a global food bank to address vulnerability due to food price volatility, and the establishment of the Organization for Response to Disaster and Emergency Relief (ORDER). ORDER was characterized as a nonmilitary, humanitarian disaster relief organization that would serve as a coordinating mechanism to address climate change–induced disasters. In developing such a mechanism, the United States suggested the creation of common standards to allow for interoperability across responding nations.

United States

- Encountered minimal internal conflict due to the seemingly homogenous composition of the team.

- Established Global Consortium on Agricultural Research and Development and secured funding commitments from other teams. Promoted the Global Summit on Climate Security and Vulnerability, convened by the United Nations, to address security, diplomacy, and the implications of climate-related disasters on vulnerable nations.

- Supported agricultural productivity research in areas where capacity was underutilized (e.g., Africa). Promoted sector improvements through the application of crop rotation and nitrogen-fixing legume knowledge and practice; shared other agricultural research outcomes; and advocated for initiatives promoting women farmers (according to the Food and Agriculture Organization of the United Nations, women account for 43 percent of the global agricultural labor force, but they are often hindered by laws and culture).

- Committed to domestic emissions-reduction targets. Developed programs to incentivize domestic agroforestry, cover crop practices, complex crop rotations, pulse and perennial cultivation, water resource conservation

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[5] The first round's scenario included information about a report that detailed underutilized agricultural potential in Africa.

practices, and urban agriculture. Funded climate resilience–focused improvements to Mississippi River infrastructure.

- Shifted from the production of first-generation biofuels to programs promoting more sustainable, renewable energy sources. Realigned domestic funding sources to create a single climate-investment fund (the U.S. Infrastructure and Climate-Smart Development Bank) targeting overseas climate-smart agricultural and development initiatives.

- Focused on encouraging ready access to nutritious food while seeking to promote diet shifts (less red meat, more poultry and fish) to simultaneously achieve nutrition and food waste–reduction goals.

Business and Investors

- Encountered minimal internal conflict and was comprised primarily of North American entities.

- Advocated for improved global food security information, including accurate measures of food stocks and flows, and improved forecasts of potential shortages. Considered developing reports that would use, but protect, private industry data. Supported other countries and multilateral institutions' push for information transparency, and sought to contribute analytical interpretation knowledge and skills to data- and information-sharing efforts.

- Focused on the promotion of technological innovation (in particular, genetically modified crop development) and the reduction of barriers to trade. Encouraged nations to avoid crisis implementation of short-term, potentially distortionary policies (e.g., export restrictions, bilateral agreements, etc.) that result in negative long-term impacts.

- Supported investments in global technology transfer and diffusion, and infrastructure (particularly in Africa and Brazil). However, uncertainty with respect to rule of law and governance tempered efforts. Expressed concern about the security of private investments and input markets (e.g., fertilizer) in areas of regional instability.

- Committed to developing a food waste–reduction initiative through investments targeted toward improving production, processing, and distribution efficiency.

- Expressed concern about water availability. Entered into discussions about water scarcity with China and agreed to share technology to improve water efficiency in irrigation. Requested that Multilateral Institutions assist in negotiations with China regarding water flow restrictions.

- Engaged other teams in discussions regarding wider acceptance of genetically modified seeds, particularly in the context of food crisis relief. Expressed concern over water scarcity worldwide and indicated willingness to invest in drought-tolerant seed varieties. Receptiveness by other teams was mixed, with Brazil and the U.S. accepting of the technology; India and Africa willing to consider adoption; Multilateral Institutions not committing to a for-or-against position, but concerned about the politicized nature of the subject; China hesitating due to past experiences (e.g., "Golden Rice"); and the EU unwilling to discuss the matter.

- Recognized that global food insecurity is in large part an issue of access as opposed to insufficient global production. Partnered with Multilateral Institutions to increase capacity for food delivery to targeted hotspots.

Multilateral Institutions

- Encountered challenges achieving internal harmony due to the diversity of players (e.g., nongovernmental organizations, development banks, the United Nations) on the team. Ultimately, assumed role as trusted partner capable of facilitating conversations among nations (e.g., China–U.S. relationship).

- Committed to significant investments (via recapitalization, or restoring balance sheets to financial health) for the development and expansion of climate-smart agriculture and fisheries. Specifically supported investments in food system logistics, land tenure reform, small holder inclusiveness, water management, and research and development on climate-resilient, highly productive, and low–environmental footprint cropping systems.

- Agreed to collaborate with governments to harmonize food policies for more effective distribution and broader access.

- Advocated for the strengthening of existing international institutions while considering the possibility of a new international institution using strengths of existing institutions to engage in long-term approach to the food, water, and climate nexus.

- Proposed testing new approaches to climate change that build from the sustainable development goals and are systematic and sustainable rather than reactive. Suggested the application of whole-system approaches (e.g., river basins, Mekong Delta) with a politically neutral agent (e.g., the United Nations) leading the charge.

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Observations

This section highlights the overarching themes arising from game play.[6] Key observations range from "tipping point" conditions—prompting leaders to move from aspiration to action—to an organically developed environment of international public- and private-sector cooperation focused on countering the influence of climate challenges on the global food system. Investment and financing commitments geared toward longer-term approaches to achieving and maintaining global food security were also discussed at great length during the two days of game play.

Institutional inertia and sustained momentum

> *"The problems are getting worse, the actions remain static, that is as bad as you can get."*   **—Adjudication Cell Member**

Although the 2020–2021 scenario events signaled a looming crisis fraught with weather and climate disturbances in areas of major food production that prompted food stock drawdowns and rising prices, teams dedicated a significant level of effort to domestic actions. Overall, teams exhibited aspirational reactions to the first round, concentrating more on the identification of goals than the execution of actions. As the crisis loomed large, teams generally embraced a "business as usual" mentality.

Round 2 presented a tipping point that launched teams from institutional inertia to more active development and implementation of policies and agreements. Round 2— with its crisis of historical proportions—caused teams to recognize the pitfalls of the status quo, prompting more innovative and aggressive engagement. The degree to which teams transitioned from goals to actions varied, but on the whole, the change in culture was apparent and lasting. By Round 3, the world had entered a period of

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[6] It is important to note that as with any game, the findings from *Food Chain Reaction* are subject to and influenced by the presence of certain artificialities. For discussion of specific artificialities at play, see Appendix B: *Food Chain Reaction* Game Materials.

relaxation during which teams could have opted to relax their behavior. Instead, teams took advantage of the relative calm by leaning forward and focusing on initiatives to build resilience and prepare for future challenges. As a result, in the fourth round, when presented with increasing stress reminiscent of the first round, teams were action-oriented from the onset.

Cooperation and collaboration

> *"International cooperation on these kinds of issues is much more possible than people might think. There is a wide diversity of opinions in all countries and therefore there are always like-minded people with whom you can start the conversation."*　　　　　　　　　　　　　　　　**—India Team player**

Early on, teams began to explore potential relationships with the range of stakeholders represented in the game. Teams were able to pursue similar goals, regardless of their domestic implications, because of the common realization that "everyone was in the same boat." Following the first round of team-to-team briefings, players were surprised by the convergence of ideas across a diverse set of actors. As the severity of the scenario deepened, teams came to the conclusion that no one organization, business, or nation could successfully address global food security, and that the isolated actions of any one actor, or small group of actors, may result in cascading impacts worldwide. This revelation drove more robust international cooperation and collaboration. Most of the teams agreed to avoid bilateral commodity agreements, opting instead to engage in broad multilateral arrangements. There were, however, bilateral agreements on side issues including China's disaster relief agreement, and the U.S.-Brazil agreement on harmonizing accounting rules in the land use sector.

The final round of play culminated in the convening of a Global Summit on Climate Security and Vulnerability,[7] during which representatives of all teams, except the Business and Investors team, which was not invited,[8] expressed the desire for a more robust global coordination mechanism, with greater capacity to respond to climate-related conflict and food system volatility.

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[7] See the "Security and Stability" section for an expanded description of the Global Summit.

[8] The Business and Investors Team was not asked to join the Global Summit, because it was viewed as a government-to-government convening.

It is important to note that although players embraced global cooperation and collaboration as an essential component for adequately addressing food security, sectors (e.g., multilateral institutions and nongovernmental organizations) and geographic regions (e.g., the African continent and the EU) first had to address internal competing priorities and build internal cooperation. A lack of internal agreement tended to challenge the ability of sectors and regions to identify their contributions to, and level of, engagement in global efforts.

Climate, energy, water, and food nexus

The link between climate and food security was well recognized across the wide variety of global leaders who played the game. Many of the teams' actions reflected players' acknowledgment that food system vulnerabilities are further exacerbated by the unpredictability of climate effects. Agricultural production can also contribute to negative environmental outcomes, and yet agriculture is often the first sector to experience the consequences of environmental degradation. Recognizing the potentially destructive nature of this feedback loop, players looked to increase agricultural productivity through sustainable and climate-smart practices. In addition, teams agreed to price environmental services, price carbon, support the development of a market for carbon trading, and cap global emissions levels. Teams entered into negotiations regarding a global carbon cap, carbon taxes, carbon "shadow pricing" through regulations, and carbon trading early in the game, but did not agree on implementation actions.

Although the climate–food security linkage surfaced relatively quickly and remained a focus throughout the game, issues surrounding water and energy—particularly, the climate-energy-water-food nexus—did not clearly rise to the top. Food production exerts a strong influence over water demand and usage, as well as energy demand and extraction. Teams—particularly China and India—dedicated some time to discussing water in the context of irrigation and transboundary water management. However, teams did not directly implement actions addressing the water–food security relationship.

Similarly, discussions regarding energy focused predominately on a transition away from first-generation biofuels[9] to reduce pressure on agricultural commodities needed for food, but did not entail in-depth conversations about uneven availability of electricity across the globe, the dependence of agriculture on energy sources, or the impact of energy generation on the environment and its capacity for food

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[9] First-generation biofuels are generally manufactured from food crops, including sugar cane, corn, soybeans, and even vegetable oils.

production (if degraded by energy generation mechanisms). In this instance, it was interesting to note the prominence of climate in game discussions when many nations will first have to address significant energy considerations to be able to address climate and food security linkages in a meaningful way.

Information systems and transparency

Players across all of the teams called for the collection of more relevant and accurate data by a globally trusted agent. Similarly, players stressed that increased information transparency is a necessary precursor to moderating food system volatility, and improving global data on the levels, geographic distribution, and availability of stocks is of particular concern.

Improved information about not only food production items (e.g., plantings, yields, areas of production), but also a wider range of related variables, including areas of food demand; water availability, usage, and rights; nutrition and food access; and infrastructure will allow global leaders to monitor and track developments related to food security. In turn, improved real-time awareness of food security drivers and indicators will lead to the development of better-informed actions capable of pre-empting or mitigating crises. Players noted that data efforts designed specifically to collect information related to food security will improve leaders' perspectives on current trends and potentially enhance their decision-making positively.

Consistent focus

As the game progressed, players developed the view that vulnerability related to food security requires a consistent focus, and that too often it receives only heightened attention in the face of crisis. Similarly, reactions to food insecurity typically materialize in the form of short-term crisis response measures rather than long-term prevention and mitigation approaches. Players realized the need to change this decision-making culture.

During the "relaxation period" in Round 3, teams seized the opportunity to focus more specifically on longer-term approaches to global food security (e.g., building greater production capacity and resilience in Africa and India). Teams also looked to phase out policies and actions that present the potential to exacerbate food insecurity (e.g., mandated production of first-generation biofuels) and to promote a transition to newer, more sustainable alternatives. Then, when faced with what appeared to be an uptick toward a new crisis in Round 4, teams responded aggressively to immediate humanitarian needs while maintaining their commitment to longer-term, more sustainable approaches.

The concept of global shared stockholding was an interesting development proposed by several teams. Without near-complete transparency and accuracy regarding stock levels, stock accumulation, and release policies, widespread stockholding potentially could be market distorting. Most teams openly decried distortionary approaches (e.g., panic buying, stock hoarding), and yet they were comfortable developing what would amount to a relatively substantial stock volume comprising private, global, and/or domestic reserves.

Food security and stability

As the game advanced, teams confronted a "new normal" characterized to a large degree by volatility and uncertainty. In this environment, players acknowledged the link between food insecurity and instability. Food insecurity and increasing numbers of refugees may give rise to an increase in conflict and even illegal (e.g., human trafficking) and/or terrorist actions.

Toward the end of the game, during the Global Summit on Climate Security and Vulnerability, representatives of each of the teams (except the Businesses and Investors team[10]) came together to address security issues in the new, more volatile world. Convened by the United Nations, the summit highlighted the need for a more systemic capacity to address instabilities that had occurred over the course of the game. Parties focused their discussion on developing better coordination of humanitarian interventions, and improving prediction and prevention of climate-driven security threats.

Although the parties involved in the summit did not finalize an agreement, they did concur on the general framework for a near-future agreement. Key initiatives in the framework included:

- Strengthening existing institutions and authorities under the United Nations (e.g., the World Food Programme, the World Health Organization, the Food and Agriculture Organization, the Department of Peacekeeping Operations, the Office of the High Commissioner for Refugees, and the International Fund for Agricultural Development) and developing better coordination among them.

- Establishing a new coordinating entity under the United Nations/G20 to create the capacity to respond in a more timely way.

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[10] The Business and Investors Team was not asked to join the Global Summit, because it was viewed as a government-to-government convening.

- Creating a new Strategic Headquarters under the United Nations to better coordinate member states' use of military and nonmilitary assets, and to pre-position materials in areas of anticipated need.

In addition to commitments for funding from China, the parties agreed to fund initiatives with a modest transaction fee on global carbon trades in the expanding carbon trading market (initiated in 2025).

Investments toward a more secure future

> *"The world can get it right. The simulation showed that we really need to get ahead of the curve."* —Continental Africa Team player

Teams expressed near-uniform support for making significant investments in crop production research and development, increasing supply chain efficiency with the goal of reducing food waste, and enhancing infrastructure. Research and development programs focused heavily on creating heat-tolerant and climate-resilient seed varieties, developing integrated pest management approaches, enhancing diffusion of production and processing technology, and improving the nutritive value of foodstuffs. Several teams noted that the intellectual property generated from research and development needs to be more open.

Discussions regarding food waste increased over the course of the game. Governments and the private sector took action to reduce waste through investments geared toward supply chain efficiency gains. Further, teams sought to invest in efforts to enhance the nutritive value of individual products. Players noted that food waste is linked to negative environmental consequences and is a major contributor to carbon emissions.

Building capacity and resilience through infrastructure development and enhancement was a central theme across all teams. Food insecurity is often more of an issue of distribution and access rather than overall production. Players generally believed that the capacity to feed the world exists, but that there are regions where people lack sufficient access due, in part, to poor infrastructure. Distribution to the areas of greatest need must evolve from a primary reliance on humanitarian mechanisms (e.g., the World Food Programme) to the development of adequate production and distribution infrastructure and the promotion of local markets. In keeping with this approach, several teams committed funds to smallholder capacity-building initiatives and rural development (e.g., see the "India" section regarding the 4,000 "market town" development approach).

Conclusion

"The 'new normal' is volatility."　　　　　**—Adjudication Cell member**

The game was designed to promote a strategic conversation about global food security among government, private sector, and international organization leaders. Over the course of two days, players developed new insights into realistic challenges during major climate-related food supply disruptions and potential outcomes. The game served not only as the forum for solving global food security challenges, but also as a venue for developing the innovative approaches and relationships necessary to advance a wide dialogue on global food security.

Ultimately, the game elevated food security to a global-level conversation. Players left the game with the realization that policies and actions affecting climate, stability, environment, and trade can cause, or mitigate, food system pressure and volatility worldwide. With each round, teams demonstrated increasingly integrated, coordinated, and systemic responses to the challenges, even as the pressure ratcheted upward. Teams progressed toward longer-term views, more multilateral actions, and an increased focus on global governance issues. The longer-term focus, particularly on long-term investments in research and development in infrastructure and in African agriculture, held even under sustained pressure. As new crises arose, teams moved away from an exclusive focus on short-term approaches, balancing actions with longer-term initiatives that will better enable people to respond to crisis and build greater resilience.

Across the board, teams placed real emphasis on building information-sharing systems, working to open trusted channels of information to allow the world to share data about conditions and locations of global stocks, as well as information about the way the food system works (e.g., choke point locations, points of network convergence). Shared information in a transparent environment is fundamental to building the shared governance system required for future food security. The world will also need ready and sustained collaboration in both the face of global pressure and in times of relaxation. Teams' commitment to a collective path toward systemic treatment of the root causes of the crisis—even as tensions subsided—underpinned their ability to dampen the noise of later crises and concentrate on the fundamental long-term challenges. With resolute focus, teams committed to building a collective

infrastructure targeting the root causes of food instability and its downstream consequences, and to building up a set of responses appropriate to the scale of the problem.

Lessons learned from the game, in combination with future discussions prompted by the game, will enhance decision makers' ability to design proactive policies to mitigate future global food security risks. The question remains: Where do we go from here? Several areas for continued work include:

- *Pursuing more innovative collaborations.* The policies that accumulated over the course of the game weren't radically new and they carried a significant public-sector bias. Public-private partnerships gained less traction than was expected, given their more prevalent use over the past two decades. Next-generation partnerships will need to include innovative combinations of regional actors, citizen groups, and scientists, to name a few.

- *Integrating security problems and food policies.* In the end, teams dedicated relatively little attention to finding effective strategies to deeply integrate the security problems of the world with the food policies of the world. Efforts focused on being ready for conflict rather than changing food system investments and food policies to pre-empt conflicts. The world's ability to relate conflict to food is inadequate, and both the security community and the food security community need to connect the two issues effectively.

- *Changing attitudes from reactionary to visionary.* History has shown that the world tends to make big changes after big catastrophes. Games like *Food Chain Reaction* seek to prompt thinking about big changes before big catastrophes happen. One major challenge to this approach is making future catastrophes as visible, potent, visceral, and motivating as an actual present-day catastrophe. It is hard to motivate people about catastrophes that are distant and more uncertain than real, present-day ones. Hence, the world needs new ways to create scenarios that can be specified with real depth and potency, so that when specific questions relative to the scenario are asked, it is possible to provide answers compatible with plausible evolutions of the world.

- Finally, although *Food Chain Reaction* took place weeks before COP21, it is important to build on the energy from the game, from Paris, and beyond. The motivation is clear: The game saw the world agree to a global price on carbon that, amidst crisis, didn't lose traction. Players stayed the path that would lend the political will to address a key underlying cause of volatility—climate change—and achieve a global emissions cap by 2030.

Appendix A: Game Design

Game design

The design process for *Food Chain Reaction* began in January 2015 with defining game objectives. Through this process, game planners identified several overarching objectives (see "The Game" section) to guide game design, as well as a dozen more detailed learning goals from which to build the scenario that players would encounter. To develop the underlying scenario, the core group of planners representing the game sponsors conducted in-depth research on the determinants of past food crises, consulted numerous subject matter experts across a wide range of disciplines, and conducted a test drill in advance of the game. Through this process, the planners gathered information necessary to construct a "baseline" scenario that included events and conditions, mainly weather and crop production fluctuations, spanning 2020–2030. A majority of the baseline scenario elements were exogenous— in other words, the baseline scenario did not include policy-based decisions and actions of playing entities. The choice of exogenous components was deliberate, and intended to promote policy actions organic to the game (not prompted by policies in the baseline scenario).

Early on, the game designers recognized that if players were to be given the freedom of developing strategies and negotiating agreements, it would be impossible to develop quantitative models that would accurately account for all possible player decisions. Instead, the game designers designed the game with a human simulation cell (the Adjudication Cell), comprising numerous subject matter experts, which adjudicated the collective outcomes of team decisions and actions. Although the Adjudication Cell members had access to research documents, aids, and price-forecasting tools, they ultimately relied on their expertise to modify the baseline scenario and determine outcomes over the course of the game. This element facilitated robust gameplay and allowed players to better realize the potential consequences of their behavior.

In advance of the game, all players received a *Food Chain Reaction Situation Manual—Player Briefing Book.* The information in the Situation Manual prepared players for game play by moving the world from the year 2015 to the year 2020— providing necessary context for the year 2020—the starting period of the game. The

Situation Manual also contained a detailed game schedule and information disclosure rules. Players were not privy to scenario details beyond 2020 prior to game conduct.

Over a two-day period, players participated in four rounds spanning the decade 2020–2030. The rounds were segmented in the following manner.

- Round 1: 2020–2021

- Round 2: 2022–2024

- Round 3: 2025–2027

- Round 4: 2028–2030

The first round began with a plenary session that included a "State of the World in 2020" scene-setting video and a briefing on events in the years 2020 and 2021. Following the plenary session, teams proceeded to separate into designated rooms and began to deliberate on and respond to the first round's events. Teams were encouraged to confer with one another to share information and to coordinate and pursue joint actions and/or agreements.

At the conclusion of the first round of deliberations, each team recorded its key decisions and actions in a briefing presentation template. Teams provided a copy of the completed briefing template to the Adjudication Cell for review. Members of the Adjudication Cell analyzed the decisions and actions submitted by each team and determined their combined impact. The Adjudication Cell used this information to develop an update of conditions around the world. Concurrent to the adjudication process, teams briefed one another on the same decisions and actions under consideration by the Adjudication Cell. This process was repeated at the end of all four rounds. Rounds 2 through 4 commenced with the Adjudication Cell's determination of the "new normal"—in other words, the updated state of the world.

Similar to the first round, players deliberated and negotiated within and among the teams in response to updated global conditions and new events during the second, third, and fourth rounds. Following the fourth round, the Adjudication Cell weighed the teams' final decisions and actions, as well as the cumulative impacts of the teams' decisions and actions throughout the game. The game concluded with a moderated panel presentation of the short- and long-term implications of game play.

Participant roles

The term "participant" encompassed many groups of people, not just those designated as players. Groups of participants involved in the game, and their respective roles and responsibilities, included:

- **Players.**   Players were organized into one of eight teams representing governments, the private sector, and multilateral organizations. Players performed their assigned roles (e.g., member of a national government) and discussed and initiated decisions and actions in response to the scenario and game "injects" (i.e., pieces of information inserted into game play to prompt additional player discussion of specific issues—see the expanded description and inject examples later in this section).

- **Control Cell.** The Control Cell planned and managed game play, set up and operated the game site, and acted in the roles of organizations or individuals that did not play in the game (e.g., Russia). The Control Cell monitored the pace of game play, provided key data to players, and prompted certain player actions to ensure game continuity. In addition, the Control Cell issued game material to players, ensured adherence to the game timeline, and collected data. *The Control Cell comprised the Game Directors, the Senior Controllers, and members of the Adjudication Cell.*

- **Game Directors.** The Game Directors monitored overall game flow, troubleshot design and gameplay issues, coordinated with other Control Cell members to carry out necessary adjustments, and facilitated the "new normal" scenario presentations.

- **Adjudication Cell.** Members of the Adjudication Cell were responsible for several functions, including role playing nonparticipating organizations and nations. Adjudication Cell members inserted (or "injected") information into the game, as necessary, to moderate game play and ensure achievement of game objectives.   Members of the Adjudication Cell functioned semi-independently under the supervision of the Game Directors. The Adjudication Cell discussed and analyzed team decisions and actions following each round of play, and determined the parameters of the "new normal" scenario that stimulated subsequent rounds of play. The Adjudication Cell also served as an expert panel that concluded the game with an overview of short- and long-term implications of game play.

- **Senior Controllers.** Senior Controllers possessed subject matter expertise in one or more of the game's topical areas (e.g., agriculture, trade, security). Senior Controllers were assigned, one each, to every team room. Senior Controllers monitored game play and reported to the Game Directors when teams had questions about the scenario or game rules, and/or when they determined that team play was not moving beyond a specific issue or was otherwise stagnating.

- **Recorders/Junior Controllers.** Recorders were assigned, one each, to every team room. Recorders documented player discussions during the scheduled

team deliberation periods, and recorded the team decisions and actions (as dictated by the teams) into the briefing presentation template.

- **Role Actors.** Role Actors simulated specific roles during game play and were not players. For example, a former leader within the U.S. Congress assumed the role of narrator at the start of two rounds, and team mentor during the rounds.

- **Media Personnel.** A very limited number of media were present, playing during the game and documenting the deliberations. Media included staff members from the sponsoring organizations who were cast in media roles, and an embedded journalist playing the role of print reporter. Media players worked directly with the Game Directors to ensure game integrity.

- **Host and Support Staff.** Game host and support staff performed event planning and management, administrative, and logistical support tasks (e.g., registration, venue management, accommodations, transportation, catering).

Game play was generally allowed to proceed unimpeded; however, the Senior Controllers informed the Game Directors of issues that required intervention. Game Directors either took action immediately or conferred with the Adjudication Cell to identify an appropriate intervention and mechanism for the intervention's delivery (e.g., delivery of a diplomatic cable or media news report with prompting details).

During the game, the Adjudication Cell and Game Directors used injects to introduce players to events or situations that had not been fully discussed. For example, the Adjudication Cell and Game Directors injected one news story covering unrest and a humanitarian crisis in Bangladesh to prompt additional player discussion about humanitarian needs, and another news story covering a military coup and government overthrow in Pakistan to prompt further player discussion about regional instability stemming from increasing food scarcity.

Scenario

The game's opening mock newscast challenged players to imagine a global food system under stress due to extreme weather and other environmental factors, urbanization and other demographic pressures, rising global food prices, and falling food stock levels. As this scenario unfolded before players' eyes, signals of a looming potential shock to global food security became increasingly apparent. Players negotiated, collaborated, and deployed policy tools in response to the evolving scenario details. Teams received information regarding the impact of their decisions and actions during the Adjudication Cell Chairperson "scorecard" briefing following Rounds 1, 2, and 3.

After receiving scorecard information, teams were provided with a narrative description[11] of updated global conditions, the "New Normal." The game flowed from a period of mounting global food system pressure in Round 1 to a period of acute crisis characterized by record high food prices, record low food stock levels, and increasing social tension in Round 2. In Round 3, global pressures from weather and other factors eased, allowing for a period of relative calm. In the final round of play, Round 4, players once again encountered increasing global pressures on food prices, food stocks, the environment, and regional stability.

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[11] For the full text of the narratives for each of the rounds, see Appendix B: *Food Chain Reaction* Game Materials.

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Appendix B: Food Chain Reaction Game Materials

Round 1 Narrative: 2020–2021

- *Weather disruptions from El Nino and La Nina*
- *Major droughts across North America*
- *Social unrest in Southeast Asia and Africa*
- *Food prices rise from 158 to 262 percent of long-term averages*

We begin the decade in 2020 with a growing global economy and oil prices at $75 a barrel. Food stocks are tighter than average. Global food commodity prices—while below the record highs of nearly a decade ago—remain at nearly 1.5 times long-term averages.

Food prices in 2020 and 2021 are climbing, the result of weather-related disruptions to agricultural production. Scientists believe there is a strong link to El Nino and La Nina events that have occurred in successive years. In 2020, El Nino causes warm and dry conditions in South and Southeast Asia and Australia. India and Australia are impacted, with Australia losing almost half of its wheat harvest.

In the Western Hemisphere, warm winters and moist conditions highlight how climate change is spreading pests and plant pathogens. Asian soybean rust expands in the United States, Brazil, and Argentina, but it is effectively treated, adding some cost but avoiding most yield loss. The largest stressor on global food markets is the North American drought of 2021. Intense summer heat from La Nina stresses crops and water supplies, obliging the United States Department of Agriculture to declare disaster status for more than half the counties of the United States. Corn and soybean yields decline significantly.

Overall, with supply stimulated by rising prices but held back by crop problems, global crop production falls 1 percent short of expectations in 2020 and 2021. Stocks decrease from 20.5 percent to 19 percent of annual use, increasing prices by

65 percent from the beginning of 2020, from 158 percent to 262 percent of long-term averages.

Rising food prices add stress worldwide, especially in the poorest food importing countries of Southeast Asia and Africa, where instances of social unrest are reported. Price increases compound other social and economic challenges. Africans migrate, seeking refuge and better conditions. Bangladesh experiences flooding in early 2021 and the resulting migration strains border areas, prompting social disturbances. Related flooding in Pakistan further stresses the region. Countries seeking emergency help further strain the budget of the World Food Programme.

The price increases also lead several agencies and international organizations to examine ways to address short-term and long-term food security challenges. One such study, sponsored by the Food and Agriculture Organization of the United Nations, comes from the International Institute of Applied Systems Analysis. The study authors reiterate the barely tapped potential for increasing yields in sub-Saharan Africa, echoing other organizations that emphasize the need for infrastructure development to strengthen Africa's connectivity to global input and output markets.

Other effects remain to be seen. Brazil, for example, tries to divert acreage expansion interest to degraded, previously disturbed ground, but with limited success. Time will tell whether those efforts or new deforestation will shape land use trends. Meanwhile, the 6th Intergovernmental Panel on Climate Change (IPCC) Assessment Report presents additional evidence and increasing confidence that climate change is reducing food security.

Round 1 Scorecard

Round One Scorecard of Team Decision and Actions

Topic	Short-Term	Long-Term	Key Drivers
Agriculture and Food Production	▬	▲	US and EU biofuels mandates phase out India investments to reduce food spoilage
Economics and Trade	▬	▲	Africa regional trade agreements Increase discussion about sharing stock info
Security and Diplomacy	▲	▼	Shared aspirations and indications of near term cooperation Aspirations need to be followed with actions/budgets/plans
Climate Change, Energy, and Environmental Impact	▼	▼	Aspirations need to be followed with actions/budgets/plans

Negative Influence ▼ ▼ ▬ ▲ ▲ Positive Influence
Neutral
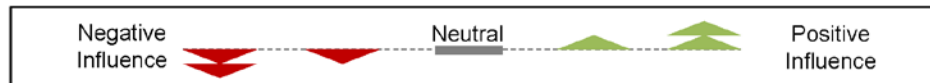
Round 2 Narrative: 2022–2024

> - *Significant droughts scattered across major production areas*
> - *Oil prices rise dramatically, reinforcing biofuels production*
> - *Unrest and migration intensify, panic buying in the face of uncertainty*
> - *Relief organization budgets are strained*
> - *Food prices increase from 262 to 395 percent of long-term averages*

Stress continues to mount in the global food system. While 2022 starts without crop problems, food is still expensive, and normal crop harvests are only large enough to slow the continuing rise in food prices. Public dissent continues and migration within and from food-importing Africa persists, in spite of progress on regional free trade agreements, exerting pressure on the African continent and Europe. Despite an intended increased focus on social protection by multilateral organizations, a lack of clear fundraising means that relief agencies are running low on cash and are challenged to address rising hunger stress.

Things turn worse in 2023. In the Northern Hemisphere, heavy spring rains flood the Mississippi River, disrupting orderly export flow. Later that year, contract disputes between labor union members and their employers result in a strike at shipping ports in the Pacific Northwest. Both events temporarily disrupt U.S. exports, highlighting the sensitivity of supply chains in the global food system. World prices rise, awaiting supply relief, but more problems loom. China and India experience drought. Chinese scientists report that declines in underground water are disrupting irrigation, exacerbated by policies focused on achieving self-sufficiency in rice and wheat. Heat and dryness in India damage crop yields, cause heat stroke in the population, and affect power production. Russia and Ukraine experience heat stress that reduces grain supplies.

By the end of 2023, tight global stocks push food prices upward even further, beyond the 2007–2012 peaks of 280 percent. The impacts register in many dimensions. Urban poor in the most vulnerable geographies become increasingly food insecure. Relief agencies issue urgent pleas for contributions. Organization of Petroleum Exporting Countries (OPEC) members, prompted by food import budget stress, organize strict production controls driving petroleum above $100 per barrel. Despite United States and European Union actions to reduce biofuels mandates, biofuels production remains steady, continuing to aggravate the food balance. High crop prices accelerate land clearing in South America outside of Brazil, due to strict adherence to its Forest Code, and tropical Asia, causing climate experts to warn that new CO_2 release will contribute to long-term warming.

In 2024, crop yields approach normal across the globe, except in the European Union, Russia, and the Ukraine, where heat and drought negatively impact production. Panic buying and stockpiling by some importers prevents relief in stock levels and prices. Concerned about its future food supply, South Korea quietly negotiates a long-term food access agreement with Ukraine. Russia is asked by others to consider similar arrangements. Russia's people are agitated by higher prices, spreading rumors of a possible export embargo.

The only relief comes from livestock systems, which plateau in most places and contract in in a few.

Overall, from 2022 through 2024, though high prices stimulate crop production slightly more than the weather-induced 2 percent average annual crop losses, global demand outperforms expectations. Stocks decrease from 19 percent to 18 percent of annual use. Farmers work very hard to keep up with demand, but do not overtake it. Despite increased international discussion about sharing food stock information to improve food security, anxiety about food security increases prices by another 51 percent from the beginning of 2022, rising to new records, reaching 395 percent of long-term averages.

With stress felt across much of the world, the global economy slows, signaling the possibility of recession.

Round 2 Scorecard

Round Two Scorecard of Team Decision and Actions

Topic	Short -Term	Long -Term	Key Drivers
Agriculture and Food Production	▲▲	▲	Temporary EU waiver of production restraints Infrastructure in Africa and India Managed expansion and intensification in Brazil Doubling of R&D investments
Economics and Trade	▲	▲	Agreements to keep trade open Investments in infrastructure-focused development
Security and Diplomacy	▲	▼	Assistance to Ukraine and WFP New blocs of cooperation forming No response to Pakistan Unilateral actions often didn't account for negative repercussions on their neighbors
Climate Change, Energy, and Environmental Impact	▲	▲	China's water pricing/conserving efforts Taxing carbon and GHGs Brazil enforcing the Forest Code
Implications for Non-playing and Vulnerable Nations	▼	▼	Negative water impacts for downstream neighbors Lack of attention to fragile import-dependent geographies

Negative Influence ▼▼ ▼ — Neutral ▲ ▲ Positive Influence

Round 3 Narrative: 2025–2027

- *Widespread crop production recoveries ease market pressures*
- *Isolated drought causing unrest in the Sahel region of Africa*
- *World Food Programme refunded*
- *Renewed global focus on climate change, focus on longer-term food security*
- *Global food prices ease from 395 to 141 percent of long-term averages*

The period 2025–2027, sees a significant easing of global market pressures. Earlier high food prices have slowed economic growth, diminishing demand. Likewise, high prices have stimulated food production. Farmers nearly everywhere enjoy a respite from weather-related disruptions. For three successive years, global food production exceeds consumption. As food stocks build, crop prices steadily decline.

Isolated parts of Africa are the exception to this period of easing stress. In 2027, severe drought affects the Sahel region, causing unrest and pockets of starvation. Global Information and Early Warning System (GIEWS) alerts indicate the possibility of famine, but the warnings are weaker than the reality and arrive a bit late. Regions that have implemented food-system reforms and emphasized food security largely avoid the worst impact, while areas that have not, notably Sudan and Chad, suffer disproportionately. In those countries, internal displacement is creating strain on the United Nations High Commissioner for Refugees (UNHCR), and in Sudan, terror groups complicate food aid delivery by destroying infrastructure and restricting movement.

In Pakistan, political leadership is struggling to maintain food security as internal unrest leads to volatile food prices and continued tension with neighbors. China's water infrastructure programs lead to statements of concerns from Vietnam and other Association of Southeast Asian Nations (ASEAN) countries that their water supplies may be depleted, leading to public protests.

Media across the world cover the developments, causing viewers and listeners to lobby their governments for action. Generous donations to the World Food Programme in 2024–2025, combined with lower food prices, leave the world well prepared to handle the catastrophe in areas humanitarian groups can reach. Also, measures such as the U.S. carbon tax and India's coal tax put climate change higher on the global agenda in the aftermath of the mid-decade price spike, leading to renewed attention.

Meanwhile, the global economy begins to recover. Decreasing food prices are decreasing pressure on land clearing. Poultry and livestock production increases in the face of declining feed prices. Biofuels producers accelerate as crop prices drop. These forces point to a future shift from stock-building to eventual balance and then possibly stocks drawdown.

Overall, from 2025 through 2027, strong prices and good weather cause farmers to strongly overpower recovering demand. Stocks are restored from 18 percent to 21 percent of annual use. Anxiety over food security relaxes, and prices drop by 64 percent from the beginning of 2025, from 395 percent to 141 percent of long-term averages.

Even with the relaxation, the IPPC again highlights the risks of deforestation, particularly in areas such as Bolivia and Paraguay, in its 7th IPCC Assessment Report in 2027. The report emphasizes the critical nexus between climate, energy, water, and food production, and commends Brazil for its efforts against deforestation.

With much less immediate stress, many countries outside of Africa look for ways to enhance longer-term food security, including long-term supply agreements, although larger exporters such as the U.S., EU, and Brazil shy away from such arrangements. Ukraine, which saw its government toppled after its agreement with South Korea, recovers quickly with EU assistance, exceeding previous records in production by 2027. Direct overseas investment in agriculture is also under consideration, particularly focused on Africa.

Round 3 Scorecard

Round Three Scorecard of Team Decision and Actions

Topic	Short-Term	Long-Term	Key Drivers
Agriculture and Food Production	▬	▲	EU imposes production restraints Gains in land-tenure rights globally US investment in ag resilience
Economics and Trade	▼	▬	Stockpiling removes food from global trade
Security and Diplomacy	▲	▬	Assistance for immediate crises Increased international cooperation
Climate Change, Energy, and Environmental Impact	▲	▲	Actions taken on carbon taxation and emissions cap Reintroduction of environmental policies in the EU Pricing environmental services
Implications for Non-playing and Vulnerable Nations	▲	▬	Assistance given to non-playing countries More systems approaches to nexus issues

Negative Influence ▼ ▼ ▬ ▲ ▲ Positive Influence   Neutral
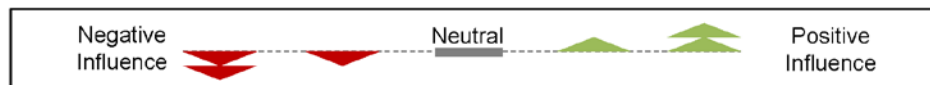
Round 4 Narrative: 2028–2030

> - *Drought in Brazil, China, and the U.S.*
> - *Weak monsoon and social unrest in India*
> - *Protests in West African cities*
> - *Food prices surge again from 141% to 387% of long-term averages*

Scientists report that 2028 and 2029 are two of the hottest years on record, and they serve as reminders of the degrading impact of higher temperatures on food production. Drought in Brazil in 2028 significantly reduces crop production, which falls 15 percent, or 39 million tons, short of normal. Due to the existence of a domestic stock buildup, the price pressure on domestic food business is somewhat reduced.

Then in 2029, El Nino negatively impacts numerous regions. A weak monsoon in India delivers insufficient moisture to crops, resulting in a 10 percent crop loss of 32 million tons. Desperate Indian farmers are showing their dissatisfaction, blocking highways and demanding relief. Government food stocks and the food security program are under severe pressure.

China suffers a moisture deficit, damaging wheat and corn, which drop 6 percent, or 46 million tons. Corn imports rise. Chinese scientists again report falling water tables and new groundwater pollution.

El Nino further damages crops in Indonesia, Philippines, Australia, northeastern Brazil, and in southern parts of Africa, causing a negative impact of 2 percent, or 33 million tons. In all, crops fall 3 percent, or 110 million tons, short of normal. Because of the thinness in the world rice trade, unexpected demand in Indonesia and the Philippines has sent prices soaring. Increased rice prices spark protests in West African cities and present key Asian exporting countries with political decisions on whether to keep their markets open or not.

Once again, global food prices are on the rise. Energy demand and petroleum prices also remain high. With prices rapidly rising, the Gulf Cooperation Council (GCC) countries go on a buying spree across food commodities. Expansion of agriculture into degraded lands in Brazil, African production increases, and increased use of seed varieties raise the appetite for fertilizer, driving prices and volatility up, limiting farmers' ability both to purchase fertilizer and produce affordable food. With 95 percent of the world's phosphorous reserves, Morocco's importance to global fertilizer markets is increased.

To complicate matters more, agronomists observe increasing pest pressure due to overwintering from gradual warming.

In 2030, although the El Nino weakens, moderate drought returns to the United States. Despite new efforts to increase resilience to effects like drought, the country experiences an 18 percent loss in major grains and oilseeds equating to 108 million tons.

Increased prices globally draw down the financial reserves of the World Food Programme.

In sum, from 2028 through 2030, with prices on the rise again stimulating farm activity, offset by several weather problems, production falls just barely short of original expectations. Demand however, is strong, exceeding expectations after recent years of favorable economic growth. Food stocks tighten again from 21 percent to 17.5 percent, which is the tightest stock level in a decade. Although prices rise strongly, from the beginning of 2028 to the end of 2030, at 387 percent of long-term averages, they fall just short of the 395 percent peak in 2024.

Organizations and media are closely monitoring events to see if governments learned from the food price surge earlier this decade and are wondering what may lie ahead.

CNA

This report was written by CNA's Safety and Security (SAS) division.

SAS's work helps improve decision-making during crisis operations and fosters innovative answers to challenges in the areas of first response; emergency management; public health and agriculture; homeland security; risk-management policy development and operations; and response and recovery capabilities at a national level.

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