INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

IFPRI RESEARCH AND ENGAGEMENT:

CLIMATE CHANGE *and* AGRIFOOD SYSTEMS

WHY CLIMATE CHANGE ADAPTATION AND MITIGATION MATTER FOR FOOD SYSTEMS

All people depend on food systems for nourishment, and many rely on them for their livelihoods…

Agrifood systems employ over

1.2 billion people

primarily in low- and middle-income countries, and sustain the livelihoods of a quarter of all households.

Climate change affects food production and livelihoods…

Extreme weather events are now reported

three times more frequently than in the 1980s.

43 million children

have been displaced by droughts, floods, storms, and wildfires since 2016.

Welfare losses from climate change impacts on agriculture are estimated at US$0.5 trillion in sub-Saharan Africa and US$1.1 trillion in South Asia alone over the 2020-2050 period.

But food system transformation is needed to improve diets and livelihoods…

Over 9 percent of the world's population

was undernourished in 2022 and more than 3 billion people could not afford a healthy diet.

Food systems must feed almost

2 billion more people

by 2050 than in 2020, but growth in agricultural production and productivity have slowed.

And food systems must reduce GHG emissions…

Food systems generate

one-third of GHGs,

and more than two-thirds of these GHGs

are from food systems in low- and middle-income countries.

Climate change poses unprecedented challenges to the world's food systems. Rising temperatures, changing rainfall patterns, and more frequent extreme weather events threaten agricultural production and the biodiversity and ecosystem services that underpin agriculture. Within food systems, climate change affects processing, storage, transport, and retailing of food as well as our food environments.

These growing climate risks impact food security, nutrition, and human health, as well as equity and livelihoods, with poor food producers and consumers hit hardest. They make food systems a riskier source of income and reduce the availability of food — worsening poverty and inequity, disrupting livelihoods, and contributing to hunger and malnutrition.

At the same time, food systems are failing to provide healthy diets for all, and are generating one-third of human-caused greenhouse gases. Solutions must address this complex nexus of problems.

Climate change adaptation and resilience-building efforts for food systems must be accelerated to reverse growing malnutrition, ensure that all people can access healthy diets, and provide sustainable livelihoods. At the same time, efforts to transform food systems must work to reduce their environmental footprint. Farmers and small businesses along food value chains in low- and middle-income countries will have to adapt their practices to a climate marked by extreme weather events and changing seasonal patterns in order to meet growing and changing food demand, while also contributing to mitigation. Support for this critical transformation requires not only the development, dissemination, and adoption of appropriate low-emissions, climate-smart technologies and practices but also a focus on the policies, institutions, governance, and behavior change that can promote sustainable, inclusive food systems.

To address these challenges, IFPRI's experts work with partners around the world to identify, assess, improve, and adapt policy, institutional, and governance responses that can drive transformative change. Our research and engagement address the complex threats posed by climate change with a three-pronged approach:

1. **Clarifying and understanding the situation and outlook.** IFPRI provides foresight and policy modeling on the potential impacts of climate change under different climate and policy scenarios, as well as ex ante assessments of potential pathways and investments to lessen these impacts. IFPRI also develops metrics and frameworks to analyze and monitor climate change impacts on the poorest and most marginal populations, as well as adaptation options.

If we don't act now, by 2050 climate change may…

Slow the growth of global food production by **8 percentage points**

Put as many as **72 million** more people at risk of hunger globally

Put **28 million** more people at risk of hunger in East and Southern Africa

Source: IFPRI IMPACT model.

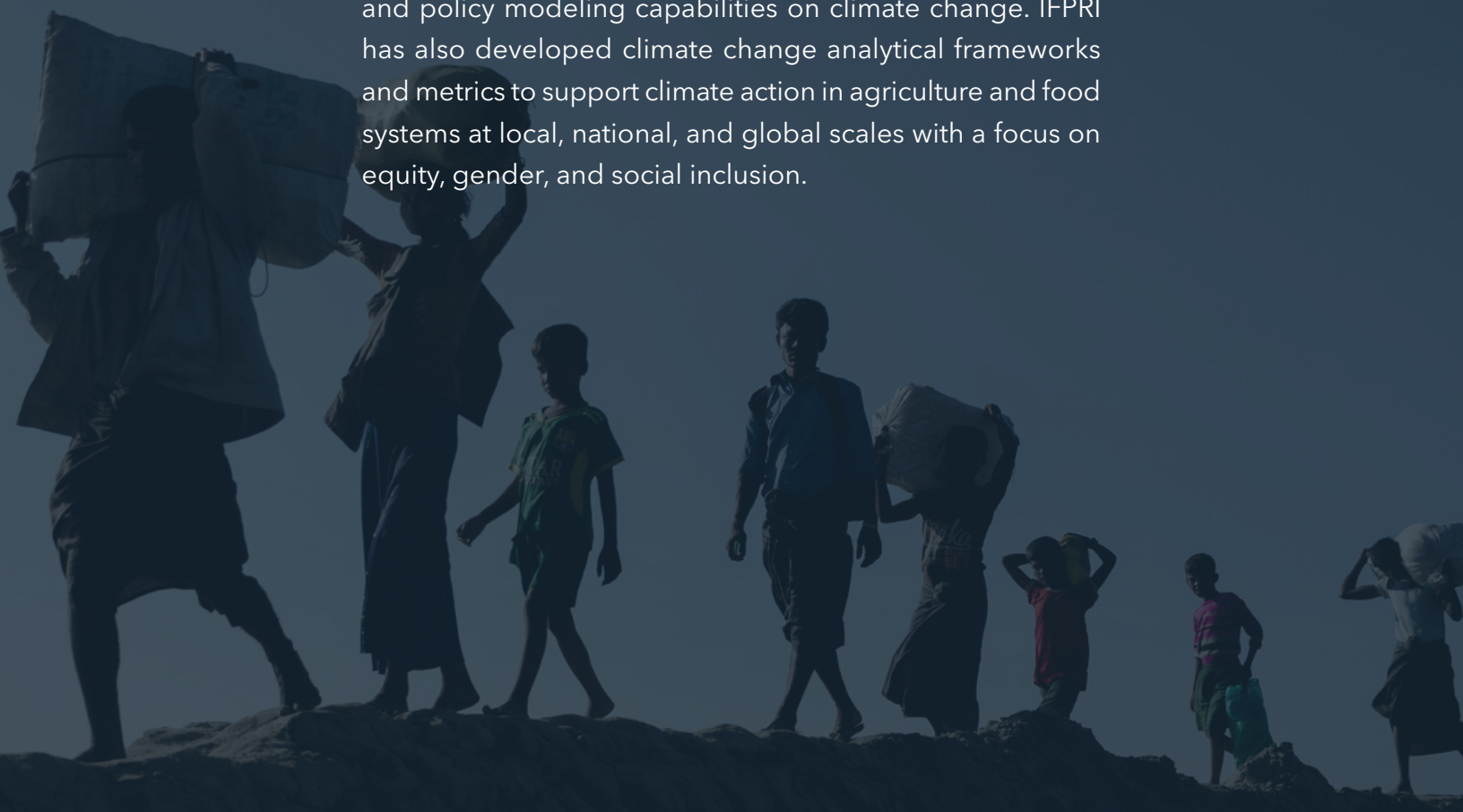
2. **Testing and scaling solutions.** Together with partners, IFPRI identifies, develops, and assesses promising policy, institutional, governance, and behavioral change innovations and technologies for sustainable, equitable food systems transformation. IFPRI also assesses alternative pathways for delivery and scaling up of low-emissions food systems solutions, with a focus on improving livelihoods, equity, and social inclusion and on protecting natural capital.

3. **Shaping enabling environments.** IFPRI explores and advises on enabling environments at the local, national, and international levels to facilitate public and private investments in adaptation, resilience-building, and equitable low-emissions development.

IFPRI implements these workstreams with partners at local, national, and global levels, through its seven units focused on foresight and policy modeling; poverty, gender, and inclusion; nutrition, diets, and health; innovative strategies and scaling; natural resources and resilience; markets, trade, and institutions; and development strategies and governance.

Clarifying and understanding the situation and outlook

IFPRI provides foresight analysis on the potential impacts of climate change under different climate scenarios to anticipate likely effects on agricultural production and food security, as well as policy modeling to assess ex ante the effectiveness of alternative technical and policy interventions for climate change adaptation and mitigation. With a comprehensive suite of data and modeling systems focused on food, land, and water systems, IFPRI serves as the CGIAR hub for foresight and policy modeling capabilities on climate change. IFPRI has also developed climate change analytical frameworks and metrics to support climate action in agriculture and food systems at local, national, and global scales with a focus on equity, gender, and social inclusion.

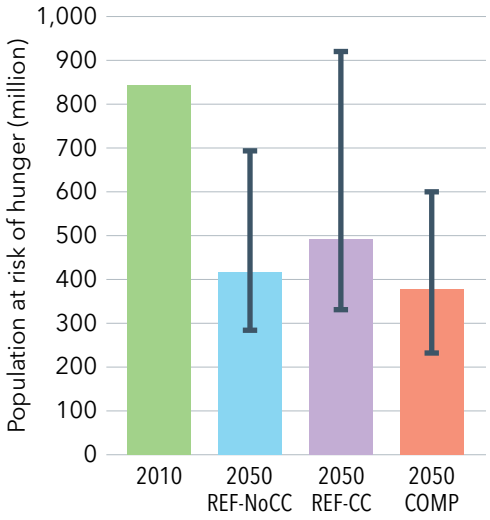


Provide foresight analysis on climate change impacts on agricultural production, food security, and the environment to guide low-emissions food systems transformation

At the global level, IFPRI's IMPACT model focuses on food and agriculture with comprehensive coverage of countries and commodities of importance to low- and middle-income countries. IMPACT is a system of linked economic, climate, water, and agricultural commodity models that supports integrated analysis of changing environmental, biophysical, and socioeconomic trends. This allows us to (1) identify the likely impacts of climate change on agricultural production, food security, and nutrition; and (2) explore the potential effectiveness of climate actions in the context of other important changes in population, incomes, technologies, and diets.

The high-resolution supporting models for IMPACT allow us to assess "pixel-by-pixel" impacts of climate change on food production and identify subnational areas that are potential climate hotspots. With this pixel-based approach, we can assess the risk of localized, high-impact events – such as droughts, floods, and heatwaves – in order to inform targeted interventions and policies.

WORLD POPULATION AT RISK OF HUNGER IN 2010 AND 2050, scenarios with and without climate change and with investment



Source: T.B. Sulser et al. 2021.

Note: World includes all countries. Data shown are a reference estimate (columns) with the minimum and maximum of a plausible interval (whiskers). REF-NoCC = no climate change; REF-CC = climate change; COMP= climate change + investment in agricultural R&D

FINDINGS: Projections from IMPACT model

Analysis using IMPACT estimates that global food production by 2050 could be 8 percentage points lower as a result of climate change.

As part of this analysis, IMPACT modeling shows that, comparing a "no further climate change" baseline with a scenario of strong emissions growth, about 70 million more people will be at risk of hunger globally in 2050 because of climate change, including more than 28 million in East and Southern Africa.

Investment in agricultural research could offset many of these losses. IMPACT analysis for the Commission on Sustainable Agriculture Intensification (CoSAI) found that reducing the agricultural research and innovation investment gap by $15.2 billion annually could achieve key ambitions of the Sustainable Development Goals (SDGs) and climate action, including accelerating the end of hunger, reining in water use and pollution, and making agriculture part of a 2°C climate trajectory.

+ To learn more, see our web pages on IMPACT, Foresight Modeling, Modeling Systems, RIAPA, and Big Data, and CGIAR Research Initiatives on Low-Emission Food Systems (Mitigate+) and Foresight.

Use policy modeling to inform adoption and targeting of technical, policy, and investment innovations for mitigating and adapting to climate change impacts on food systems

IFPRI also maintains the RIAPA suite of more than 30 detailed country-level economywide models that provide policy analysis to inform national decision-making. RIAPA supports assessing the effectiveness of policy and investment packages with multiple goals, including economic growth, employment, poverty reduction, and nutrition and identifying, analyzing, and minimizing trade-offs. These models are particularly useful for the analysis of large shocks, including extreme weather events, and of the implications of climate change adaptation options, such as early warning systems, drought-tolerant varieties, and climate-smart technologies and practices.

Through more than 20 field offices in low- and middle-income countries, IFPRI works closely with local research partners and policymakers to provide policy modeling to inform national climate policies, institutions, and investments. IFPRI work assesses the impacts of climate variability and extremes on national investment strategies and has identified low-carbon futures that support economic growth. The IMPACT model, for example, has been deployed in multiple countries, including in Egypt, to evaluate the likely impacts of climate change on agriculture and adaptation investments. Recent work in Malawi illustrates that investment in agriculture and food systems remains the most effective approach for reducing poverty and hunger despite higher temperatures and greater weather volatility. Other important climate change assessments have been completed in Ethiopia, Latin America, Mozambique, and Zambia.

+ To learn more, see our country office websites, RIAPA, IMPACT, Foresight Modeling, Modeling Systems, and CGIAR Research Initiatives on Low-Emission Food Systems (Mitigate+) and Foresight.

IMPACT: Informing national mitigation efforts

IFPRI research has shown that agriculture, forestry, and other land use (AFOLU) is a promising economic sector for climate change mitigation. Research employing IMPACT prompted the government of Colombia to commit to reducing emissions by 20 percent by 2030.

In Viet Nam, IFPRI partnered with IFAD to analyze various crops and identified rice as having the largest potential to mitigate climate change – rice accounted for 57 percent of the country's agricultural greenhouse gas (GHG) emissions. To incorporate GHG mitigation into the country's rice production growth strategy, IFPRI developed a Low Emissions Development Strategy, which received support from the Vietnamese government.

Develop frameworks and indicators for low-emissions food systems

IFPRI is a leader in the development of climate change analytical frameworks and metrics for assessing climate action in agriculture and food systems at local, national, and global scales with a focus on equity and social inclusion. In addition, IFPRI research is filling evidence gaps on the gender-differentiated impacts of climate change, gender differences in resilience capacities of men and women, and the gendered implications of climate change adaptation interventions in food systems. Key among these frameworks are the climate change–gender–nutrition framework and associated metrics developed for the Gender, Climate Change and Nutrition Integration Initiative (GCAN). IFPRI is also developing a climate change metric to track the gendered progress of climate action at project and national levels, as well as a tool for mapping climate change–agriculture–gender inequality hotspots – geographic areas where women engaging in agrifood systems are particularly vulnerable to the adverse impacts of climate change – that can inform targeted investments.

+ To learn more, see our web pages on GCAN, WEAI, and Gender.

Design and implement participatory approaches to system mapping

Moving toward low-emissions food systems and implementing adaptation action requires buy-in from a wide range of stakeholders. IFPRI works with a set of tools including net-mapping, group model building, fuzzy cognitive mapping (semi-quantitative mental or actor landscapes), and Knowledge, Attitudes, and Practices surveys to identify key food systems actors, their authority, information, and financial linkages, as well as their individual and collective mental models regarding barriers and conditions for developing low-emissions food systems and other climate action to inform the development of appropriate policies. These tools are also used to identify capacity-building needs for more effective and equitable climate action, including in Bangladesh, Ethiopia, Kenya, Mali, and Viet Nam.

Testing and scaling solutions

In close collaboration with partners, IFPRI evaluates the effectiveness of technological, policy, institutional, governance, and behavioral change innovations (including those developed by CGIAR colleagues and other partners) in addressing climate change and supporting improved food security and nutrition. This research guides evidence-based investment and policy choices for climate-smart innovations; better governance of food, land, and water systems; effective social safety nets and nutrition policies to support the climate resilience of vulnerable populations; climate risk reduction throughout value chains; and women's empowerment and resilience in a climate crisis. With the right policy tools to produce more nutritious food sustainably and access consistent sources of income to meet basic needs under climate change, all smallholder farmers and others who depend on the food system for their livelihoods have a chance to thrive.

Develop and assess technologies and innovations, including digital options, to address climate-related risks to food security, nutrition, and livelihoods along food value chains

IFPRI evaluates the effectiveness of a wide range of promising innovations to increase the use of climate-smart agricultural practices and improvements in value chains, with a focus on vulnerable groups and regions. Assessments evaluate the climate change adaptation and mitigation potential of watershed management practices; solar-powered groundwater irrigation and other clean energy technologies; conservation agriculture; bio-innovations, including biofortification and heat-, drought-, salinity-, and submergence-tolerant varieties; and improved livestock management. IFPRI research tests ways to effectively disseminate and promote the adoption of more sustainable, low-emissions practices, including digital technologies. These include the use of smart phones to facilitate farmers' access to the latest weather, marketing, and extension information that can improve farm production and incomes. IFPRI researchers also investigate how innovations can be used all along food value chains to improve efficiency of irrigation, cold storage, and logistics to prevent food loss and waste and lower emissions both in the field and further along the value chain.

HarvestPlus
Better Crops • Better Nutrition

Research has shown that climate change not only threatens agricultural productivity but also the nutritional content of food plants (including protein, iron, and zinc). IFPRI's HarvestPlus program, a global leader in bio-innovation, has driven development, testing, and dissemination of biofortified varieties that are high in scarce micronutrients. Biofortification is an innovative approach that uses breeding practices and agronomic techniques to provide farmers with varieties that are both more nutritious and stress- tested for local environments. These improvements in micronutrient density and resilience can offset climate-related declines in agricultural productivity and nutrition.

+ To learn more, visit the HarvestPlus website and read about our work on Agricultural Production, Agricultural Extension, Biofortification, and Food Loss and Waste.

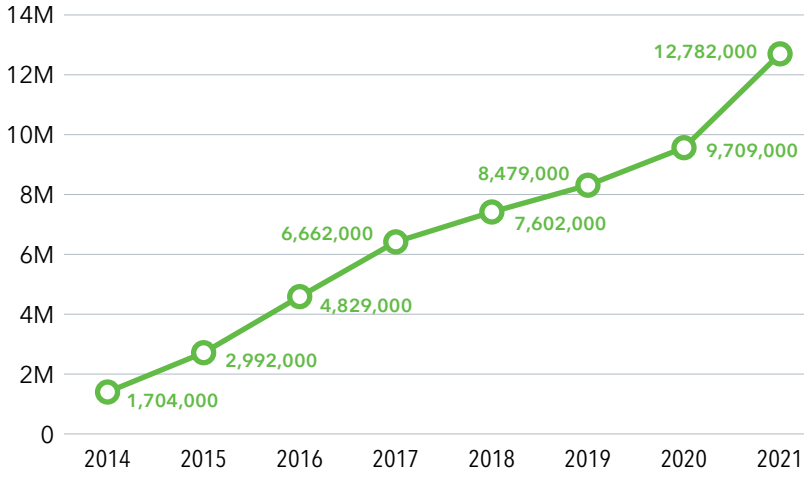
IMPACT: Climate-smart agriculture in Kenya

The Kenya Agricultural Carbon Project has provided carbon payments to smallholder farmers since 2009 in return for their storing carbon through agroforestry and sustainable land management practices. To ensure that these interventions also support climate adaptation and productivity gains, IFPRI was asked to identify "triple-win" crop and livestock management practices across various agroecological zones in the country. Triple-win practices simultaneously address climate change mitigation; increase food production; and improve smallholder livelihoods. Enhanced soil nutrient management (combinations of inorganic fertilizer, mulching, and manure) emerged as a key triple-win strategy in the Kenyan context, while the need to provide better extension services, credit, and climate information was also recognized.

IMPACT: Rapid adoption of biofortification

Some 2 billion people are lacking essential micronutrients in their diets, and climate change exacerbates this severe "hidden hunger" problem. Biofortified varieties developed and scaled up through HarvestPlus, including zinc maize, iron beans and lentils, and vitamin A orange sweet potatoes, may offset the decline in nutrient content caused by climate change. These crops have been widely adopted, and now benefit more than 86 million people in farming households. Globally, 63 countries are growing 13 biofortified crops, and 24 countries have included biofortification in national agricultural and/or nutrition strategies.

Smallholder farming households growing CGIAR/HarvestPlus-facilitated biofortified crops



Support food system actors at different levels to improve inclusive multi-actor governance and innovation development processes for transformation toward low-emissions food systems

IFPRI pilots and analyzes social innovations to support communities in improving natural resource governance and environmental stewardship. Our research on fostering effective natural resource management at the community, landscape, and river basin levels contributes to both climate change adaptation and mitigation by identifying policies and institutional arrangements that contribute to better water management, soil conservation, forest cover, and biodiversity. These, in turn, contribute to food system resilience while also supporting community empowerment. At the landscape level, IFPRI engages in research on integrated landscape approaches to offer methods and tools that empower local communities and resource users in responding to climate crises and building sustainable and resilient socioecological systems, and complement public and private investments.

IMPACT: Games to improve resource governance

Coordinated collective action has been shown to facilitate more sustainable management of communities' natural resources that are under threat from climate change impacts. Working with the Foundation for Ecological Security (FES) in India, IFPRI conducted experimental games simulating links between farmers' crop choices and groundwater resources that communities increasingly depend on due to climate-induced water scarcity. Follow-on research found that villages that played the game were more likely to conduct inventories of their water sources and adopt rules limiting irrigation in the dry season. With this success, FES adopted experimental games for much wider use and is developing new games for other commons.

This work includes testing approaches for bringing together different types of stakeholders for governance of natural resources, such as land, water, and forests; evaluating the dissemination of small-scale irrigation technologies such as solar irrigation pumps; and using games to increase understanding of trade-offs across productivity, equity, and sustainability. IFPRI's field work has tested the use of games as a means to improve collective action and governance of common-pool resources, such as surface and groundwater and forests. Games allow community members to experience and discuss complex resource use problems, for example, overuse of groundwater, and to experiment with rulemaking, in a low-risk forum. This experiential knowledge can then be shared with the larger community, and may help to build social cohesion around addressing trade-offs and supporting more sustainable commons management.

Assessment of these trade-offs is also a key component of IFPRI's work in the CGIAR Research Initiative on NEXUS Gains, which examines the linkages between water, energy, food, and ecosystems. For example, the dissemination of solar pumps may reduce carbon emissions and help farmers overcome short-term droughts, but can deplete water tables over the longer term if not accompanied by community-supported rules for how groundwater is to be shared. NEXUS Gains works at the local level with communities and natural resource management organizations to build better governance of natural resources.

IFPRI's participatory action research as part of the CGIAR Research Initiative on Low-Emission Food Systems (Mitigate+) contributes to decoupling food system development from greenhouse gas emissions.

+ To learn more, read about our work on Environment and Natural Resources, Governance, Resilience, and Water.

Identify and assess promising alternative policy, institutional, and governance pathways for climate-resilient food systems transformation that build resilience of women and men producers and consumers, especially among vulnerable populations

Risk reduction throughout the value chain. To limit the impacts of climate change shocks on poverty, food insecurity, and malnutrition, IFPRI research evaluates policy and innovation options for all parts of the food value chain to support incomes, resilience, and healthy diets. These include tools to reduce risks to farmers and other

value chain players, address food loss and waste, and improve crisis responses, all with the overarching goal of transforming food systems for sustainability and well-being.

Options for reducing financial risk for producers from climate change impacts, including new approaches to crop insurance and better access to credit, are being evaluated in diverse contexts. Digital technologies are proving valuable for providing new insurance options for small farmers, and the dissemination, uptake, and use of risk management tools can be improved based on evidence from IFPRI's impact assessment work. For example, IFPRI analyzed weather index insurance schemes in Bangladesh, Ethiopia, and India and found that these systems were highly effective at increasing farmer resilience to droughts, leading to significantly better welfare outcomes. Picture-based crop insurance, tested in Ethiopia, Kenya, and India, makes it easier for small farmers to obtain insurance and to make claims when weather or disease impacts their production. The pictures, taken by the farmers themselves, can also be used to provide personalized advisories to farmers, providing low-cost, targeted extension. Bundling of insurance with other products that can reduce risk, including seeds for drought resistant varieties or other financial products, has been found to improve uptake and outcomes.

FINDINGS: Bundling products to reduce farmers' risk

IFPRI has piloted a market-based, innovative risk management solution in the form of risk-contingent credit (RCC) in Kenya and Ethiopia. RCC is a financial product that embeds insurance protection within its structure. When triggered, this protection offsets loan payments owed to the lender. By substantially reducing the risks of credit for farmers, the RCC product not only mitigates drought-related agricultural risks but also provides access to credit for smallholder farmers, requiring minimal collateral.

+ To learn more, see IFPRI's work on Agricultural Extension, Risk and Insurance, Water, and Seed Systems.

Crisis response. IFPRI's research is also geared toward reducing the vulnerability of downstream value chain actors to climate change and other threats to low- and middle-income country food systems. For example, the Institute's analysis on the impacts of two recent crises – COVID-19 and the Russia-Ukraine war – includes concrete recommendations for making value chains more resilient in times of crisis. Evidence points to the importance of diversification of both input and output markets as well as enhanced flexibility of firms to adapt to changing conditions. Government policy can play a critical role in keeping markets open and transport moving, and ensuring a social safety net that protects vulnerable populations as food prices rise.

Increasingly, communities and countries are facing the combined impacts of climate change and conflict. IFPRI's work in conflict-affected areas such as Yemen and around migration issues considers the linkages between these crises and ways to address the disastrous combination effectively and sustainably, in ways that build social cohesion as well as improving natural resource conditions. IFPRI researchers contributed to recent studies in Burkina Faso, Niger, Pakistan, and Sudan – countries severely affected by both environmental degradation and violence – which assessed the contribution of policies to social cohesion and hence to cooperation in rebuilding resources.

+ To learn more, see Forced Migration, and our work on Migration and Remittances, and the CGIAR Research Initiative on Fragility, Conflict, and Migration.

Effective social safety nets to protect vulnerable populations. Shocks to food systems, such as those caused by extreme weather events and conflict, can drastically reduce incomes and access to food. IFPRI's evaluations of social safety net responses in times of crisis show that designing adaptive social safety nets, including cash and in-kind transfers, that are flexible and can move quickly to expand benefits to newly affected people and reduce both the short- and long-term impact of these crises. IFPRI's extensive work on social safety nets has informed the adoption of programs that enable vulnerable households to weather climate shocks and demonstrated that such programs can also contribute to environmental sustainability. IFPRI's Bangladesh Policy Research and Strategy Program carried out an evaluation of Bangladesh's social protection system that led to important increases in resilience and food security in a country that suffers extreme weather events. IFPRI research also informed the

design of Ethiopia's Productive Safety Net Program (PSNP), which has been highly effective in protecting household food security.

+ To learn more, see IFPRI's work on Social Protection, Nutrition, and GFPR 2022.

Conduct field research to build understanding of gendered impacts and responses to climate change shocks and risks

IFPRI has been at the forefront of assessing gendered climate change impacts and adaptation options, and women's empowerment and resilience. Because women and men are differently affected by climate change, they face specific constraints in responding effectively to climate challenges, have different preferences, and have different contributions to make to climate change responses. Women and other marginalized groups tend to be disproportionally affected by the negative impacts of climate change and often have lower adaptive capacities, given persistent structural inequalities in agrifood systems, which include greater barriers to accessing resources and services and social norms that limit economic opportunities.

Innovations for climate adaptation, mitigation, and resilience must be designed with attention to the differential needs of both men and women and disseminated in ways that promote more inclusive uptake and improved productivity. For example, a study conducted in Malawi, Nigeria, Tanzania, and Uganda found that agricultural extension and advisory services translate into higher agricultural performance of farm households, and can mitigate the negative effects of climate extreme events, when women also receive extension services.

IMPACT: Reaching women with climate-smart agriculture extension

To ensure women receive the information they need, IFPRI's project on Reaching Smallholder Women with Information Services and Strategies to Respond to Climate Change worked with grassroots women's organizations and extension services in India, Kenya, and Uganda to provide video-based extension messages to women farmers on climate-smart agricultural practices. These messages, tailored to local needs and preferences, reached over 30,000 women in smallholder farm households. The information provided increased awareness of climate-smart agricultural practices among women and facilitated uptake of several beneficial practices.

A key area of this research is understanding the gendered implications of extreme weather events and developing gender-responsive coping strategies. In one example from Bangladesh, IFPRI research found that exposure to flooding is associated with decreased consumption overall, including decreased consumption of nutritious animal-source foods (ASFs); however, women's empowerment appears to be an important pathway toward increased consumption of ASFs, particularly in households that do not own livestock, and has other potential benefits related to climate change resilience. For example, in Bangladesh, women's involvement in agricultural decisions and participation in community groups facilitates diversification of production away from rice, with potential implications for both improved diets and resilience.

FINDINGS: Gendered impacts of extreme weather

Empirical evidence on gender-specific impacts of weather extremes on agricultural labor in Tanzania shows that following a heat stress episode, men are likely to reduce their family labor supply while female family labor supply shows little change. Further, households with only adult women increase their family labor. This may be because women's lower access to key assets and productive resources in agriculture, as well as their limited mobility, leaves agricultural labor as one of their key productive resources. As a result, women persevere in providing labor despite higher temperatures. These results are supported by a broader study using labor force survey data from 30 African countries, which shows that women's labor contribution is increasing relative to men's under heat stress.

+ To learn more, read about our work on Gender and GCAN.

Shaping enabling environments

Climate change impacts vary across countries and regions, but climate change is also very much a global crisis. Governments, institutions, and research organizations from the local to the global level must play a central role in creating an enabling environment that facilitates and incentivizes innovative solutions from the private sector, civil society organizations, and individuals. International institutions and national governments also have a critical role to play in setting climate goals and funding the R&D needed to confront climate change.

Research organizations can provide the evidence needed for setting priorities and selecting among policy options and investments to best meet national and global climate-related goals. Within and among countries, trade and investment regimes should foster development of sustainable, innovative supply chains for agricultural inputs, such as fertilizer, and for food products from farm to consumer to enhance food security and build resilience to food system shocks. At the local level, creating an environment that promotes innovation, resilience, and flexibility in food and livelihood systems and development of new practices and technologies will be critical. Secure property rights, especially for women, are important in providing incentives and ability to invest in soil conservation, tree planting, and other climate-smart agricultural practices.

IFPRI works at the international, national, and local levels to help build an environment that facilitates investments for sustainability, adaptation, and mitigation by providing evidence-based innovations, information, and recommendations.

Contribute to international discourse on climate policy and investments by providing evidence on food systems-based solutions

At the global level, IFPRI helps to shape the international discourse on climate policy and investments through active participation in the UNFCCC COP meetings, and many other global climate-related events on agriculture, food security, and nutrition, such as meetings of the G20 and G7 and the recent UN Food Systems Summit. IFPRI also contributes to dialogue on climate change and food systems through numerous online public seminars, its blog series, and open-access data sets and publications aimed at a range of stakeholder and decision-making audiences. IFPRI's flagship Global Food Policy Report has recently addressed Climate Change and Food Systems (2022) and Rethinking Food Crisis Responses (2023).

Provide evidence for reform of global and national trade and investment regimes to ensure food security, nutrition, and sustainability under climate change

IFPRI has a strong research program on the relationship between international trade and climate change and sustainability. Our research and modeling work show the important role of trade — and trade reforms — in ensuring that food can reach regions impacted by extreme weather events and rising temperatures. IFPRI examines the growing trend of trade measures, such as carbon tax border adjustments, and multiple standards imposed by countries keen to speed up climate change mitigation efforts, with a view to developing policy recommendations that support sustainability without distorting trade, and to clarifying international trade rules.

The Food Security Portal, maintained by IFPRI, provides an early warning system for changes in markets, such as price spikes due to weather events, and policies that could affect food security.

IFPRI also analyzes and proposes innovative approaches to financing food systems transformation under climate change from multiple funding flows.

FINDING: Repurposing agricultural support

IFPRI's experts have proposed repurposing domestic agricultural support payments, which amount to US$600 billion annually in spending on agricultural subsidies, to support farmers' investments that boost climate change adaptation and mitigation. IFPRI's analysis finds that allocating just a fraction of this support to green innovations for crops and livestock could reduce overall agricultural emissions by more than 40 percent.

Inform the work of national policymakers to create an enabling environment that incentivizes innovative solutions from the private sector, civil society organizations, and individuals

IFPRI informs the work of national climate negotiators and policymakers on climate resilience and low-emissions strategies. In Asia and Latin America and the Caribbean, for example, IFPRI is leading climate action under the Comprehensive Action for Climate Change Initiative (CACCI). IFPRI supports CACCI's work with national policy systems to implement nationally determined contributions (NDCs) and national adaptation plans (NAPs) through technical and analytical support, capacity development, and inclusive and evidence-based policy dialogue. CACCI aims to help achieve a critical mass of countries meeting their commitments under the Paris Agreement, thus promoting household- and community-level resilience and robust, inclusive growth. In China, IFPRI works with research partners to actively contribute to the country's effort to comply with its Paris Agreement commitments to reduce GHG emissions by 2030 and achieve carbon neutrality by 2060; this work uses CGE modeling and other value chain analysis both through the CGIAR Research Initiative on Low-Emission Food Systems (Mitigate+) and across multiple bilateral projects. Other work examines how carbon financing arrangements such as carbon mar-

kets and payment for ecosystem services can be mobilized to benefit, rather than displace, smallholder farmers and pastoralists.

Also at the national level, IFPRI analyzes government policies for the agriculture sector, market development, energy and water sectors, and food systems transformation that can create an appropriate environment for building resilience, productivity, and equity, and for reducing food systems' climate footprint. IFPRI's 2022 Global Food Policy Report: Climate Change and Food Systems sets out a broad range of opportunities for accelerated action that should be considered in policy and investment decision-making for climate change adaptation, mitigation, and resilience, many of which are mentioned here.

IFPRI also supports capacity building for addressing climate change in low- and middle-income countries. For example, IFPRI participates in the Consortium for Scaling-Up Climate Smart Agriculture in South Asia project, which seeks to ensure food, nutrition, and livelihood security. The project will identify strategies for scaling up climate-smart agriculture interventions and setting up effective mechanisms for cooperation in research and development in this area.

+ To learn more, see IFPRI's work on Governance, Trade, and Environment and Natural Resources.

Facilitate the incorporation of nutrition and gender considerations into climate policies

IFPRI's work on gender and climate as well as nutrition informs our analysis of climate policies and recommendations, based on the understanding that women and men are affected differently by climate change, and will respond differently to impacts and interventions.

Creating an enabling environment that reduces climate risks for women and men and allows them to adapt to climate change is essential for increasing access to sustainable, healthy diets. Supporting women's empowerment and ensuring women have a greater voice in decisions related to low-emissions food systems and climate change can improve outcomes for all. Use of the Women's Empowerment in Agriculture Index (WEAI), developed by IFPRI, as well as greater collection of data disaggregated by gender can make an important contribution to drawing attention to gender differences in impacts and responses to climate change, tracking progress, and increasing inclusion in decision-making and in access to technologies and information that can increase resilience to climate change for women and men. IFPRI is currently developing a WEAI for climate change metric.

+ See our work on Gender, WEAI, and GCAN.

IMPACT: Understanding climate-gender-nutrition linkages

The GCAN Initiative works with partners to increase understanding of climate-gender-nutrition linkages and to integrate gender and nutrition objectives in climate programs. GCAN is identifying approaches for more widespread and equitable uptake of nutrition-sensitive climate innovations in food systems through policy development and programming. This work examines climate change implications for nutrition along food value chains – including at the farm level and in food transport, processing, and storage, as well as marketing, retail, and consumption – in light of the adaptation opportunities and constraints affecting women and men.

Conclusion

Climate change is an unprecedented crisis for all humankind, and many of its greatest impacts will be felt through our food systems — affecting food security, livelihoods, nutrition, and poverty — especially for the world's most vulnerable people. CGIAR has made climate change adaptation and mitigation one of its core impact areas. IFPRI's strategy likewise emphasizes the need to address sustainability, and climate change in particular, in all our efforts to end poverty and malnutrition.

Transforming our food systems for adaptation and mitigation is imperative, but there are few simple solutions. Preparing for and responding to climate change requires a multifaceted approach combining foresight, technologies, policies, institutions, and behavioral change. IFPRI recognizes that bringing about change from the local to the global level requires strong collaboration with multiple partners. Thus, IFPRI brings to bear the wide range of its research capacities to work with partners at all levels, from grassroots women's organizations to the private sector, governments, CGIAR Centers, and intergovernmental organizations, to find equitable and sustainable ways to mitigate and adapt to climate change.

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A world free of hunger and malnutrition

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