



Investing in Sustainable Agricultural Production

IFPRI's work on sustainable agricultural production identifies win-win policies and innovations that limit stress on natural resources, contribute to growth and resilience in agricultural production, and reduce poverty.

Growing populations and rising incomes are increasing the global demand for food. In this era of natural resource scarcity and climate change, policymakers' attention is increasingly focused on the need for sustainable agricultural production that both expands the food supply and reduces environmental degradation. The International Food Policy Research Institute (IFPRI) has been at the forefront of efforts to address agriculture's environmental impacts—including land, water, biodiversity, and climate—while increasing food security. Specifically, IFPRI has been a leader in the integration of biophysical, economic, and social science knowledge and has conducted research on technologies, policies, and institutions for sustainable production, from the local to the global level.

Growth of Sustainability Concerns

From its founding in 1975, IFPRI's primary focus has been on raising agricultural productivity of small farmers through better enabling environments, such as land and water rights, appropriate input and output support policies, and pro-poor technology policies. The Institute's early policy work supported dissemination of Green Revolution technologies that were creating significant productivity gains in Asia and parts of Latin

America. In the 1980s, however, growing recognition of environmental degradation and resource scarcity led IFPRI to incorporate environmental sustainability into its research efforts. In 1991, IFPRI created its Environment and Production Technology Division to lead the Institute's work on sustainable production—that is, agricultural intensification that does not degrade the natural resource base upon which it depends. While early research focused on problems associated with the new technology packages, such as injudicious fertilizer and pesticide use, research over the last two decades has generated an increasingly nuanced understanding of agriculture's relationship with the environment.

The Poverty Triangle

While agricultural intensification under the Green Revolution model created its own set of environmental challenges, more serious degradation was occurring on marginal lands, where many of the world's poorest live. In many developing countries, a cycle of poverty and environmental degradation—driven by limited access to resources and capital, growing populations, and uncertain land tenure, among other constraints—was leading to worsening environmental and economic conditions as poor farmers pursued increasingly unsustainable practices, such as shortening fallow periods and encroaching on forests and hillsides.

In an influential publication in 1997, *Sustainability, Growth, and Poverty Alleviation: A Policy and Agroecological Perspective*, IFPRI researchers examined global and regional impacts of the “triangle” of poverty, low agricultural yields, and environmental degradation and provided the basis for a new research agenda. Seeking win-win policies to address all three sides of this triangle, IFPRI has devoted substantial research to improving the welfare of small farmers on marginal lands through improved agricultural practices that combine sustainability and greater productivity. In a brief published in 2000, *Promoting Sustainable Development in Less-Favored Areas*, IFPRI researchers demonstrated that investment in these areas could not only generate favorable returns but also help the poorest and protect valuable environmental resources. In-depth studies in Ethiopia, Honduras, and Uganda pointed both to the need to develop and disseminate appropriate agricultural technologies and to the need for institutional

reforms, including tenure security and functioning markets for labor, inputs, and credit.

Sustainable Land Management for Productivity

Among the most fruitful research efforts related to the poverty triangle have been those addressing land degradation and sustainable land management, including the role of property rights. IFPRI's work on land and water rights led to the creation of a CGIAR-wide research program on Collective Action and Property Rights (CAPRI) in 1996. CAPRI has worked on ways government policies and customary institutions can improve security of women's and men's rights to farmland and on collective management of rangelands, forests, and fisheries, both important for adoption of sustainable practices. Work with the Food and Agriculture Organization of the United Nations and the Global Forum on Agricultural Research, such as the 2011 publication *Engendering Agricultural Research, Development, and Extension*, has further drawn attention to the importance of addressing the needs of women as well as men for sustainable agricultural production.

Over the last decade, research focused on sustainable intensification has evaluated the potential of a range of agricultural techniques—such as no-till and drip irrigation—at high granularity. For example, the HarvestChoice program, launched in 2006, supports smallholders and their national and regional agricultural research organizations by developing locally specific knowledge and mapping for enhanced agricultural productivity and sustainability. The Bill & Melinda Gates Foundation and the Comprehensive Africa Agriculture Development Programme have used HarvestChoice data and analysis extensively for investment planning. The ongoing Cereal Systems Initiative for South Asia also looks at how to deliver new technologies to small and poor farmers, with important findings on the potential of public-private partnerships. Recent research has highlighted the high costs of inattention to land and soil degradation. Specifically, the Economics of Land Degradation program, launched in 2011 and co-led by IFPRI and the Center for Development Research (ZEF), has increased recognition of the global impacts of inadequate local land management.

Building Models for Water Governance

Sustainable management of water resources, including efficient allocation across water-using sectors and specifically for irrigation, is essential to improving food security for the poor. IFPRI's water research is notable for its interdisciplinary approach and for working across geographic scales. At the global level, IFPRI has taken the lead in developing sophisticated modeling tools linking natural and social systems. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) provides policymakers with an understanding of trends in food and water supply and demand into the future. Results from IMPACT were reported in *World Water and Food to 2025: Dealing with Scarcity* in 2002. That study pointed to a potential water crisis if institutions and policies that support overuse—such as water subsidies, limited cost recovery, and distorted incentives—are not reformed.

IFPRI's research at the river-basin level has advanced understanding of the role of institutions in shaping sustainable water allocation. Through a series of case studies in the Brantas, Dong Nai, Maipo, Mekong, Yellow, and Volta River Basins, IFPRI researchers have built up a comprehensive economic-hydrologic modeling tool for basin-level decision-makers that takes into account biophysical, social, and economic factors. IFPRI's work has also increased knowledge of linkages among poverty, gender, and water allocation disparities and has been used to make the case for markets to allocate scarce water resources and for tradeable water rights. An external review of the Institute's water resource work highlighted IFPRI's widespread influence, highly regarded researchers, and cutting-edge water research. More recent research focuses on the role of irrigation as a climate-smart adaptation strategy and on irrigation's potential for improving health and nutrition outcomes of the poor.

Biodiversity and Biotechnology for Improving Crops

Sustainable production also requires adequate plant genetic resources to support resilience, adaptation, and productivity. Reduced diversity of crops, particularly the loss of traditional cultivars, has raised concerns that the world is losing critical

genetic material that provides valuable insurance against future challenges, such as increased frequency of drought or disease. To protect these resources, IFPRI carried out pioneering policy work in the 1990s on *ex situ* conservation in seed banks and *in situ* conservation in farmers' fields, as well as on intellectual property rights over genetic resources, to ensure that farmers and communities benefited from protecting these resources while providing plant breeders with continued access to the global genetic resource base. IFPRI's work, along with that of Bioversity International, contributed to the establishment of the Global Crop Diversity Trust.

Through the Institute's Program on Biosafety Systems, IFPRI works with countries to develop science-based, nationally appropriate legislation for biotechnology and has supported capacity building, field trials, and biosafety regulations in Africa and Asia.

Climate Change from Local to Global

Climate change impacts, such as from rising temperatures and extreme weather events, are now interwoven with all aspects of sustainability. IFPRI developed its notable climate change program in the early 2000s with a primary focus on adaptation options for Africa south of the Sahara. The Institute also contributed to the development of a CGIAR-wide Challenge Program on Climate Change, Agriculture and Food Security (now one of the CGIAR Research Programs). IFPRI also weighed in on the bioenergy debate with a set of policy briefs on the pros and cons surrounding bioenergy development and an early assessment of the role of biofuels in the 2007/2008 food price crisis.

IFPRI's climate change research program now supports two main areas of analysis: (1) at the country and regional level, joint climate change adaptation and mitigation analysis, dubbed "climate-smart agriculture"; and (2) at the global level, development of a global hydrology model and a detailed crop model incorporating the impacts of climate change on water needs and crop yields. These allow the IMPACT modeling suite to analyze climate change impacts on agriculture and evaluate adaptation and mitigation strategies for global food security.

An influential set of IFPRI publications has examined food security threats related to climate change and potential

responses to support adaptation. These publications include a three-book series on African agriculture and work on Latin America and the Pacific Islands. Finally, taking a global-to-local look, the recent *Food Security in a World of Natural Resource Scarcity: The Role of Agricultural Technologies* provides a groundbreaking approach that integrates crop models and economic models with climate change scenarios to hone in on the potential utility of 11 agricultural technologies and practices. This study makes it clear that policies need to target technologies to specific crops and regions, because of the diversity of local impacts.

Based on this body of work, IFPRI has worked directly with governments on climate-smart agriculture policies and investments for food and environmental security, including the government of the Philippines, and on low-emissions development strategies that enhance yields while mitigating agriculture's carbon footprint, for example, with the government of Colombia.

Meeting the Demand for Sustainability

In the early years, much of the push for sustainability came from the international community. Facing severe hunger and poverty, many developing countries were more concerned with food security than the environmental resources supporting agricultural systems. IFPRI's work, however, helped bring attention to the critical nexus of poverty, sustainability, and growth and increased developing country interest in supporting local investments in sustainable production. The threats of water scarcity, climate change, and land degradation, likewise, are increasing local and regional interest in

addressing issues of sustainability and resilience. In addition, IFPRI's focus on the role that policies and institutions play in shaping resource use has increased attention to sustainability within the CGIAR system and has fostered countries' demand for IFPRI's data and research.

Resources

For IFPRI's research on sustainable production, see <http://www.ifpri.org/topic/agriculture-and-food-production>.

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