

PROGRAM ON  
FOOD SECURITY AND THE ENVIRONMENT  
STANFORD UNIVERSITY, 2008





The majority of the world's poor work in agriculture, and agriculture dominates human use of environmental resources. Improving agricultural productivity at minimal cost to the environment will thus be central to global efforts at poverty alleviation and environmental improvement.



## Problems and Opportunities

The recent rapid rise in global food prices and the attending food riots and shortages throughout much of the developing world have once again thrust issues of food security to the forefront of the global consciousness. Such developments emphasize both the deep interconnectedness of today's global food markets, and the fragility of past successes in reducing global hunger and poverty. Estimates suggest that the recent food price increases could force an additional hundred million people below the poverty line, adding to the roughly one billion people who already live day in and day out in poverty and chronic hunger.

Recent developments in food markets have also re-emphasized the fundamental links between food and the environment. Although agriculture has long been the dominant user of land and water resources globally, new sources of demand for agricultural products are causing farmers to apply more fertilizer and expand production into environmentally sensitive areas at often-unprecedented rates. At the same time, human-induced global climate change could represent a severe constraint on future agricultural production, perhaps threatening humanity's collective ability to feed itself.

Amidst such dire problems, however, exist remarkable opportunities. After decades of declining attention at the hands of governments and international development institutions, issues of rural development and food security are back at the top the development agenda. But while nearly everyone acknowledges that "something must be done" about the global food situation, there remains substantial uncertainty over the causes and consequences of the crisis, and over how best to improve agricultural productivity and global food security without destroying the environment in the process.

## Mission and goals

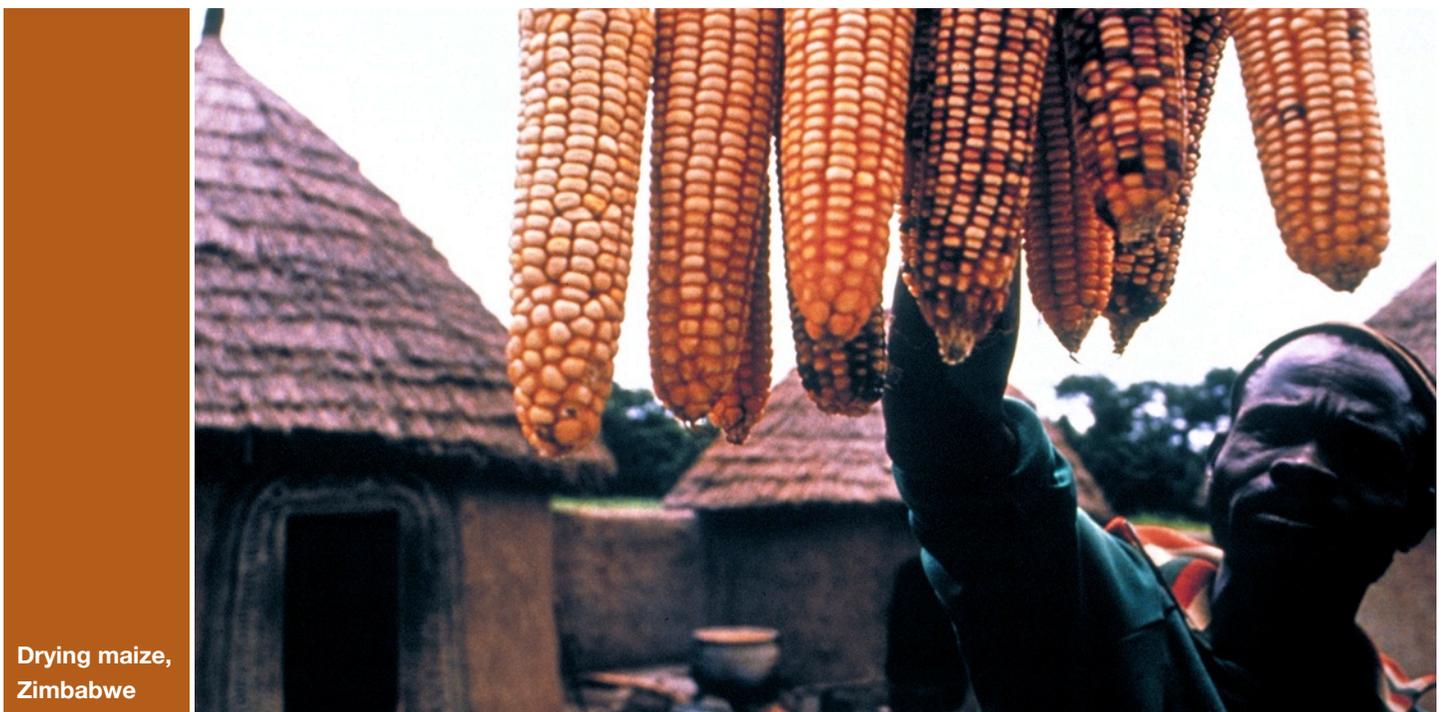
Stanford's Program on Food Security and the Environment (FSE) aims to generate innovative and policy-relevant solutions to the persistent problems of global hunger and environmental damage from agricultural practices worldwide, through a focused research portfolio and an interdisciplinary team of scholars. The program provides the educational foundation for graduate and undergraduate students at Stanford interested in issues of hunger, rural development and poverty alleviation, global resource use and environmental degradation, climate impacts on food security, and agricultural trade and policy. The program also provides direct science and policy outreach through international development institutions, non-profit organizations, foundations, private sector firms, and other groups that play significant roles in the agricultural development and environmental arenas.

Jointly situated within the Woods Institute for the Environment and the Freeman-Spogli Institute for International Studies, FSE is well positioned to

address questions surrounding hunger, poverty, and the environment in a systematic and integrated way.

The three primary goals of FSE are:

- To design new approaches to solving global hunger and environmental problems related to agriculture by creating an interdisciplinary team of scholars inside and outside Stanford who collectively have the relevant scientific, economic, and policy expertise.
- To expand higher education on food security and the environment by enhancing the curriculum at Stanford in the areas of hunger, agricultural development, sustainable agriculture, and related fields such as risk assessment, human security, and policy analysis.
- To develop outreach activities with the private sector, national agencies, international organizations, and the NGO community on critical topics of agricultural technology and development, food security, and environment and climate linkages to agriculture.



Drying maize,  
Zimbabwe

## Research Activities

Productive food systems and their environmental consequences are at the core of the program. Many of these systems are global in character, but they are influenced significantly by differing food objectives and instruments among nations, especially by income level. The program thus seeks to understand the food security issues which are of paramount interest to poor countries, the food diversification challenges that are a focus of middle-income nations, and the food safety, bio-energy, and subsidy concerns prominent in richer nations. The relationships between food security and environmental protection are crosscutting issues at regional, national, and global scales.

To focus research into these questions, FSE projects are organized under two platforms: Food and Nutrition Security, and Changing Forces in the World Food Economy. A description of these platforms and

world who live each day in chronic hunger. Such hunger is most pronounced in rural areas of Africa and Asia, and especially in regions prone to drought or located in fragile or degraded environments.

While all research at FSE deals to some degree with issues of food security, FSE's Food and Nutrition Security theme area is anchored by the following three projects:

1. *Assessing the causes and consequences of the world food crisis.* The recent rise in global food prices has been met with much controversy in both popular and academic circles over its fundamental causes and its implications for the global food insecure. In this project, FSE researchers are attempting to put the causes and consequences of the crisis on both an empirical footing and in the proper policy context, with the goal of helping inform both



**Left:** FSE postdoc Jen Burney conducting price surveys, northern Benin. **Right:** rice harvest, Lombok, Indonesia.

some of the the major projects associated with each are discussed below. A full list of program research activities can be found on our website (<http://fse.stanford.edu>).

### Food and Nutrition Security

Food insecurity deaths during the past 20 years outnumber war deaths by a factor of at least 5 to 1, and there remain roughly 1 billion people around the

short- and long-run interventions that could stabilize prices at levels acceptable to both producers and consumers in poor countries.

2. *Understanding the Agricultural Lives of the Poor.* Good data are fundamental to good policy analysis or fruitful development intervention. Unfortunately, for broad swaths of the developing world, there exist no systematic, comprehensive data describing the basic production and consumption behav-

ior of poor households. This project fills the data void by analyzing existing household datasets throughout the developing world to build a publicly-available database on household economic behavior and agricultural activity.

3. *Assessing novel technology interventions for income generation in rural Africa.* The project involves an economic and environmental assessment of a novel NGO program which uses solar power to pump irrigation and drink-

world have precipitated a global search for alternative fuels, a search which is profoundly affecting food markets in often under-appreciated ways, and which is rapidly changing the climate on which food production depends. Four projects in the “Changing Forces” area are described below:

1. *Adapting agriculture to a warmer world.* There is little disagreement now that the climate is changing, that humans are at fault, and that such changes could fundamentally affect humanity’s collective ability to feed itself. But there is little systematic knowledge of where climate effects will hit hardest and how agriculture might adapt to a rapidly changing climate. This project involves an empirical assessment of potential climate impacts on agriculture in both temperate and tropical countries, and an assessment of the gains from different possible adaptation strategies, with the goal of prioritizing interventions in agricultural adaptation
2. *Making biofuels work for the climate and for the poor.* This set of projects addresses three primary questions: how could rapidly expanding biofuels production in developed countries

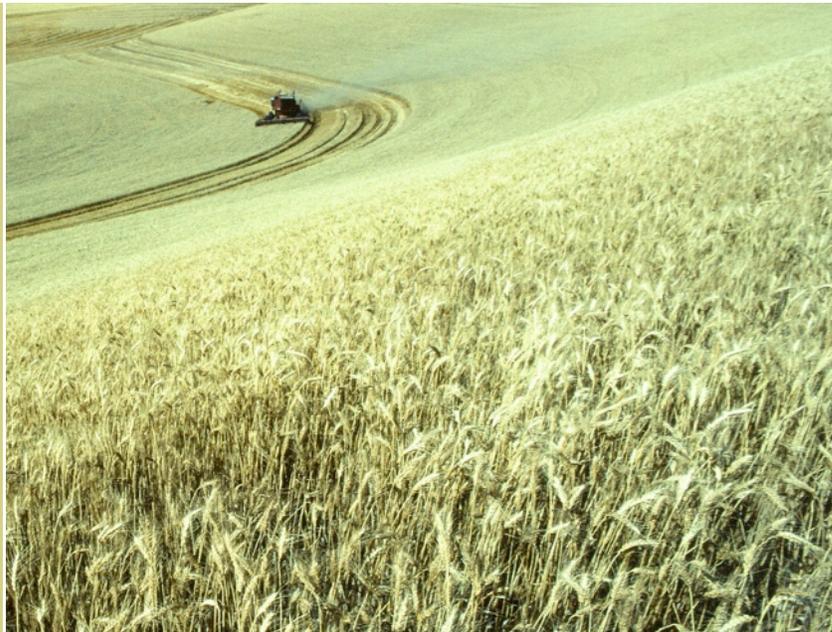
such as the U.S. affect global commodity markets, either through direct price effects or longer-run changes in agricultural policy? Will local or global food security be enhanced or harmed under various biofuels expansion scenarios? And what will changing commodity markets and policy mean for land use decisions in both rich and poor countries, and are there identifiable biofuels expansion pathways that are both food security enhancing and climate protective? To quantify these effects, our work is globally oriented, with models of world commodity markets as well as country models and case studies in China, India, Indonesia, Brazil, Senegal, and Mozambique. The work is a collaboration with numerous international institutions.

3. *Analyzing the effect of animal protein production on commodity markets and the environment.* Rapidly rising global demand for meat and fish is changing the nature of

ing water in a set of rural villages in northern Benin. This study will help shed light on the success of novel technological interventions such as solar electrification in improving rural livelihoods relative to other possible interventions, in the context of the poor, agriculturally dependent communities that define rural Africa.

### Changing forces in the world food economy

Rapid income growth in developing economies typically results in the diversification of agricultural production and consumption, and an increase in energy consumption by the economy as a whole. A shift toward meat consumption, feed grain production, and livestock and feed trade is pronounced in many middle income countries, with direct environmental consequences related to land use, water quantity and quality, and nutrient pollution. Furthermore, rapidly expanding energy needs throughout much of the



Wheat production in the US Great Plains.

Photo: USDA

food production and putting increasing pressure on natural resources throughout the world. This project seeks to develop both analytical tools and policy solutions to understand and mitigate the effects of intensive livestock and aquaculture systems on environmental resources. Current project attention focuses on sustainable feed use in the aquaculture sector, where growing competition for feed resources with the livestock industry is putting increasing pressure on the environment and on already tight commodity markets.

4. *Shaping the rural transition in China.* This broad set of projects addresses various issues related to rural development in the world's most populous country. Ongoing studies include an assessment of the effects of new agricultural technology on rural incomes and the environment, experiment-based research on improving the effectiveness of rural education programs, and the causes and consequences of land use change in China.



## New program developments

FSE enjoyed a very successful 2007/08 Academic Year, its second full year of operation. The Program expanded existing projects, developed numerous new activities, and secured important sources of both programmatic and project funding. The Program built and strengthened new collaborations around the globe, and attracted a growing number of undergraduates and graduates students at Stanford to the field and to its projects. FSE researchers also conducted key policy work on issues of food price and food trade policy in Asia, on issues of biofuels expansion on global food security, and on prioritizing investments in agricultural adaptation to climate change.

### New projects, new funding

The 2007/08 year was a banner year for FSE in terms of securing funding for the program as a whole and for some of the Program's flagship projects. In June 2008, FSE was very happy to announce a five-year, \$3 million gift from Cargill to establish an FSE Visiting Fellows Program, as well as to fund other program activities. This new source of funding will be instrumental in helping FSE

attract top international talent to Stanford in the fields of food security and the environment, and will help FSE build and maintain new, long-run collaborations with scholars and institutions around the world.

In the biofuels domain, FSE attracted three sources of funding for its research on making biofuels work for the climate and for the poor. The Bill and Melinda Gates Foundation awarded FSE and a host of international collaborators \$3.8 million over three years to study the effects of biofuels expansion on global commodity markets and global food security. Stanford's Global Climate and Energy Program awarded FSE researchers and other Stanford collaborators \$1.2 million over four years for the study of the effect of biofuels expansion on climate change. Finally, FSE was pleased to announce a private gift from Lawrence Kemp to help build FSE research on the transmission of the global price effects of biofuels expansion to local markets.

Building on previous FSE work on the effects of climate variability and climate change on food security, the Rockefeller and Kendall Foundations funded FSE to con-

vene a meeting in September 2007 of international experts to discuss the potential effects of climate change on plant genetic resources, in particular the implications for global efforts to collect and conserve crop genetic diversity. Results from the meeting led to discussion of further collaboration among FSE, Rockefeller, and the Global Crop Diversity Trust, with the Rockefeller Foundation awarding FSE researchers an additional \$350,000 over three years for the study of climate effects and adaptation options in African agriculture.

Finally, FSE received two seed grants from the Woods Institute's Environmental Ventures Fund. The first grant supports aforementioned work on assessing the feasibility of solar-powered irrigation in the Sahel region of Africa. The second supports an investigation of the linkages between agricultural intensification and cholera outbreaks in Bangladesh. FSE researchers are also playing a key role in a third EVP-funded project, an assessment of the environmental and social consequences of salmon aquaculture in Chile.

### Teaching and personnel

Expanding the curriculum related to food security and the environment at Stanford is a primary goal of the FSE program. Demand for such courses appears to be at an all time high among both undergraduate and graduate students. FSE researches offered three

new courses in the 2007/08 year. Peter Timmer's course "Pathways out of Rural Poverty" explored the past, present, and future of agricultural in the development process. Roz Naylor and David Lobell's course on "Climate and Food Security" combined atmospheric science, agronomy, and economics to give students a holistic look at one of the main constraints facing future agricultural productivity. Finally, Scott Rozelle's course "Economic Development of Greater China" offered insights into the history and trajectory of development in China.

As noted above, FSE added two important staff members during the 2007/08 year. The first is the arrival of Peter Timmer as a Visiting Professor for the next several years. Timmer, one of the world's leading experts on agricultural development, will contribute greatly to FSE's outreach activities as well as its research. Second, FSE hired David Lobell as Senior Research Scholar. Lobell is an expert on interactions between climate and agriculture, and on the application of spatial analysis to the study of agricultural decision-making.

Finally, FSE is very pleased to report generous gifts from Julie A. Wrigley, Alison Wrigley Rusack, and Geoffrey C. Rusack, creating the newly endowed William Wrigley Senior Fellowship position for FSE Director Roz Naylor.

#### *Illustrative FSE publications in the 2007/08 academic year*

- Lobell, D., Burke, M., Tebaldi, C., Mastrandrea, M, Falcon, W., Naylor, R. "Prioritizing climate change adaptation needs for food security in 2030". *Science* 319, 2008.
- Naylor, R., Liska, A., Burke, M., Falcon, W., Gaskell, J., Rozelle, S., and K. Cassman. "Ripple effects of crop-based biofuels on global food security and the environment", *Environment*, November 2007.
- Galloway, J., Burke, M., Bradford, E., Falcon, W., et al "International trade in meat: the tip of the pork chop", *AMBIO* 37, 2007.
- Huang, J., Hu, R., Rozelle, S., Pray, C. "Genetically modified rice, yields, and pesticides: Assessing farm-level productivity in China". *Economic Development and Cultural Change* 56, 2008.
- Naylor, R., Falcon, W. "When we allow cars to compete with people for food." *San Francisco Chronicle*, May 18, 2008.
- Timmer, C.P. et al. "Pathways Out of Poverty During an Economic Crisis: An Empirical Assessment of Rural Indonesia". Center on Global Development Working Paper, 2007.
- Rozelle, S. et al. "Conservation Payments, Liquidity Constraints, and Off-farm Labor: Impact of the Grain for Green Program on Rural Households in China". *American Journal of Agricultural Economics*, forthcoming.

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A JOINT PROGRAM OF THE WOODS INSTITUTE FOR THE ENVIRONMENT, AND THE  
FREEMAN-SPOGLI INSTITUTE FOR INTERNATIONAL STUDIES

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