Program on

Food Security and the Environment

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Food Security and the Environment

A joint program of the Freeman-Spogli Institute for International Studies, and the Woods Institute for the Environment, Stanford University

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Problems and Opportunities

Newspapers around the world report daily on the wars and other violent conflicts that typically result in 3,000 deaths per day. These same papers fail to report that 20,000 people die each day of causes related to hunger and extreme poverty. Over a billion people suffer from chronic food insecurity, yet they fail to capture public attention—even though the persistence of hunger and poverty also feeds violent conflict and weakens national and international security. Food insecurity is particularly widespread in agricultural regions where resource scarcity and environmental degradation constrain productivity and income growth. *Hunger is the silent killer and moral outrage of our time, but there are few university programs in the U.S. designed to study and solve the problem of global food insecurity.*

Political, media, and academic attention tends to focus instead on agricultural surpluses in the U.S. and Europe, the billions of dollars paid annually to farmers in these wealthy countries to sustain agricultural livelihoods, and the struggle by Mexico, Brazil, China, India and other developing countries to compete in world food markets. Meanwhile, many of the important questions for these countries are obscured. Can rising food demands be met on the existing agriculture land base, or will more native forests, wetlands, and other valuable ecosystems need to be cleared for future food production? Can technology be harnessed to increase agricultural yields sufficiently to meet income- and population-driven demand for grains and meat? If so, at what cost to regional environments in the form of freshwater depletion, nutrient run-off, "dead zones", pesticide drift, and lost biodiversity? Will the future success of feeding the world be undermined by global climatic change? *These questions lie at the core of human survival and values, yet there are virtually no programs of higher education in the U.S. that directly address them*.

Mission and Goals

Our mission:

Stanford University's new program on Food Security and the Environment aims to generate innovative 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, global resource and environmental degradation, agricultural technology, climate impacts on food security, and agricultural trade and policy. It also links food and resource issues to security issues more traditionally defined. The program provides direct science and policy outreach through international development and aid institutions, the international agricultural research centers (CGIAR), the United Nations Food and Agricultural Organization (FAO), the U.S. Department of Agriculture (USDA), environmental non-profit organizations, private sector firms, and other groups that play significant roles in the agricultural development and environment arenas.

Our goals:

- 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, national 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.
- To establish Stanford as the leader in higher education in these fields.

J. Cendon/FAO

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 three theme areas: Hunger and Food Security, Changing Forces in the World Food Economy, and Aquaculture. A description of these theme areas and the major projects associated with each are discussed below.

Hunger and food 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 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. Roughly 35% of the population in Sub-Saharan Africa remains undernourished, and the number of low-income food-deficit countries throughout the world still hovers around 90. Population growth in poor countries remains high, creating further stresses on the environment.

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

1. *Assessing the impacts of climate variability and climate change on food security in Asia and Africa.* This project combines the expertise of atmospheric scientists, agricultural economists, plant breeders, and policy analysts to understand and mitigate the adverse effects of short-run climate variability and long-run climate change on food security for various crops in developing countries. The project focuses on poor regions where households are particularly vulnerable to climate and related price shocks for both staple and minor crops. Our research also assesses the genetic diversity required for these crops to move outside their traditional production range given projected future changes in climate. The research is being conducted in Indonesia, China, the Philippines, and the Sahel, and involves the direct participation of policy-makers, including Ministers of Trade, Agriculture,

and Planning, as well as regional irrigation and food logistics officials and representatives from international institutions charged with protecting plant genetic diversity.

2. *Unraveling the "deadly connections" between food insecurity, poverty, environmental degradation, and civil conflict.* This project involves primarily political scientists, economists, and medical researchers to address the question of whether hunger, poverty, disease and agricultural resource constraints foster civil conflict and international terrorism. Economists have elucidated the linkages between agricultural stagnation, poverty, and food insecurity, and political scientists have empirically analyzed the role of poverty in facilitating civil conflict. To date there has been virtually no work bringing the two perspectives together, nor in exploring their connection to infectious disease and dwindling environmental resources. This project seeks to establish the empirical and policy linkages between the approaches, with the goal of identifying interventions to reduce poverty, disease, and violent conflict.

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 world have precipitated a global search for alternative fuels, a search which is profoundly affecting food markets in often under-appreciated ways. Our research portfolio in the "Changing Forces" area centers around the following two projects:

1. *Analyzing the effect of rapidly rising meat consumption on the global environment.* Rapidly rising global demand for meat is changing the nature of livestock production and putting increasing pressure on natural resources throughout the world. Much of this growth in demand is being met by an expansion of international trade in both feed and meat, which can obscure the effects of consumption decisions on the environment. This project seeks to develop both analytical tools and policy solutions to understand and mitigate the effects of changing consumption and production on environmental resources. Particular attention is paid to Brazil, where rapidly expanding beef and soy production for export threatens the Amazon rainforest. Research in that country is being carried out by an international team of remote sensing experts, ecologists, agronomists, and economists with the aim of assessing the extent and rate of land clearing for soybean production, its effect on biogeochemical changes and biodiversity loss, the impacts of land clearing on regional hydrology and climate change, and the role of policies to achieve an appropriate balance between agricultural commodity

trade, production practices, and conservation in Brazil's rainforest states.

2. *Understanding the effects of expanding biofuels production on global food security and environmental resources.* The search for alternative energy sources such as biofuels to meet exploding global energy demand is an intense topic of discussion in both academic circles and the popular press. However, much of the debate surrounding biofuels in particular has focused on narrow issues of energy efficiency to the exclusion of broader questions concerning the dynamics of commodity markets, changes in land use, and effects on the global poor. This project address 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 small agricultural producers in developing countries be able to participate in the biofuels revolution, or could the global poor be harmed on the whole by shifts in global commodity prices? What will changing commodity markets and policy mean for land use decisions in both rich and poor countries? To quantify these effects, our biofuels work involves economists, agronomists, and ecologists, with particular attention paid to China, the U.S., Brazil, and Indonesia.

Aquaculture

Aquaculture is one of the fastest growing sectors of the world food economy, and in the context of diminishing supplies for many important wild commercial fish species, aquaculture has an important role to play in meeting current and future demand for seafood. Nevertheless, much of the world's marine aquaculture production is characterized by practices that often harm local aquatic resources or put pressure on global marine food webs. Furthermore, changes in aquaculture technology and policy in countries such as the U.S. are encouraging new types of production practices that could affect marine resources in poorly understood ways. To address these concerns, the Aquaculture theme area focuses on two main projects:

1. *Developing economic incentives and regulatory frameworks for sustainable aquaculture production.* Intensive aquaculture production is characterized by a vast array of production practices and governed by widely disparate set of policy architectures throughout the world. Determining how to move aquaculture production forward will require a careful assessment of the past successes and failures of these practices and policies, and creative thinking about how best to provide incentives for producers to act in environmentally friendly ways. This project brings together various representatives from academia, the private sector, and the environmental NGO community to identify past successes and chart future paths for sustainable aquaculture development – particularly as policy and production shifts into increasingly offshore environments.

2. *Modeling of waste dispersal associated with marine aquaculture production.* The loss of organic and inorganic wastes from net-pen aquaculture production is now a well-recognized environmental problem, but there remains little scientific understanding of the true nature of waste dispersal in marine environments, and no way to systematically predict or track where wastes might go. This project, led by engineers and hydrological modelers, will assess the dispersal and fate of wastes emanating from open net-pens in the marine environment through the development of fluid dynamic models.

Organization and Funding

The Program on Food Security and the Environment is a joint program between the international and environment initiatives at Stanford, with food security research organized mainly under the international initiative and environment research organized primarily under the environment initiative. Scholars centrally involved with the program have senior fellow appointments within the Freeman Spogli Institute for International Studies (FSI), the Woods Institute for the Environment (Woods), and/or professorial positions within university departments. They work as a team on a set of overlapping projects.

An advisory committee of eight distinguished individuals from a cross-section of academic, NGO, and private and public sector backgrounds is being established to advise the program on research, fundraising, and outreach strategies.

Funding strategy

The Program on Food Security and the Environment is built around strong and continuous leadership, a team of scholars from a variety of policy and science backgrounds, innovative research projects, the training of young scholars, several formal courses, and core administrative support.

The funding priorities for the program include funds for:

- Two new senior fellow appointments in related science and policy fields ($3 million in endowment for each)
- A visiting fellows program, with visits ranging from 3 months to two years in duration, to bring new insights and skills to Stanford ($2 million in term endowment)
- Research funds to initiate innovative interdisciplinary projects ($1 million in term endowment)
- Two FSE fellows to assist in program initiatives ($1 million in term endowment)
- Graduate and undergraduate student support for research directly related to the program ($1 million in term endowment)
- Unrestricted program support ($1 million in term endowment)

A core faculty group from within and outside Stanford is committed to launching the program. The faculty members include:

- Rosamond Naylor (Director), FSI, Woods, and Economics (by courtesy)
- Walter Falcon, FSI, Woods, and Economics
- Scott Rozelle, FSI and Economics (by courtesy)
- Donald Kennedy, FSI, Woods, and Biology
- Stephen Stedman, FSI and Political Science
- Peter Vitousek, Biology, Woods, and FSI (by courtesy)
- Gary Schoolnik, School of Medicine and FSI (by courtesy)
- Harold Mooney, Biology, Woods, and FSI (by courtesy)
- Pamela Matson, Earth Sciences, Woods, and FSI
- Jeffrey Koseff, Civil/Environmental Engineering, Woods, and FSI (by courtesy)
- Christopher Field, Biology and Carnegie Institute for Plant Research
- Oliver Fringer, Civil/Environmental Engineering and Woods
- Kenneth Cassman, Agronomy, University of Nebraska
- David Battisti, Atmospheric Sciences, University of Washington
- David Lobell, Lawrence Livermore National Laboratory

FSE Contacts:
Rosamond Naylor, Director
(roz@stanford.edu)
Walter Falcon, Deputy Director
(wpfalcon@stanford.edu)
Marshall Burke, Program Manager
(mburke@stanford.edu)