



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

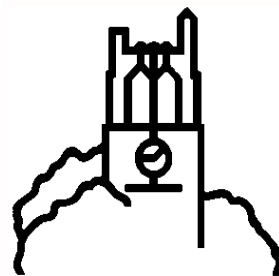
*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

MSU International Development Working Paper

Lessons Learned from 25 Years of Food Security Research, Capacity-Building, and Outreach

by

The MSU Food Security Group



MSU Agricultural Economics Web Site: <http://www.aec.msu.edu>
MSU Food Security Group Web Site: <http://www.aec.msu.edu/fs2/index.htm>

MSU International
Development
Draft Working Paper 101
October 2009

Department of Agricultural, Food, and Resource Economics
Department of Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

MSU is an affirmative-action, equal-opportunity employer

MSU INTERNATIONAL DEVELOPMENT PAPERS

The Michigan State University (MSU) International Development Paper series is designed to further the comparative analysis of international development activities in Africa, Latin America, Asia, and the Near East. The papers report research findings on historical, as well as contemporary, international development problems. The series includes papers on a wide range of topics, such as alternative rural development strategies; nonfarm employment and small scale industry; housing and construction; farming and marketing systems; food and nutrition policy analysis; economics of rice production in West Africa; technological change, employment, and income distribution; computer techniques for farm and marketing surveys; farming systems and food security research.

The papers are aimed at teachers, researchers, policy makers, donor agencies, and international development practitioners. Selected papers will be translated into French, Spanish, or other languages.

Copies of all MSU International Development Papers, Working Papers, and Policy Syntheses are freely downloadable in pdf format from the following Web sites:

MSU International Development Papers

<http://www.aec.msu.edu/fs2/papers/recent.htm#recentidp>
<http://ideas.repec.org/s/msu/idppap.html>

MSU International Development Working Papers

<http://www.aec.msu.edu/fs2/papers/recent.htm>
<http://ideas.repec.org/s/msu/idpwrk.html>

MSU International Development Policy Syntheses

<http://www.aec.msu.edu/fs2/psynindx.htm>
<http://ideas.repec.org/s/msu/polbrf.html>

Copies of all MSU International Development publications are also submitted to the USAID Development Experience Clearing House (DEC) at: <http://dec.usaid.gov/>

LESSONS LEARNED FROM 25 YEARS OF FOOD SECURITY RESEARCH, CAPACITY-BUILDING, AND OUTREACH

by

The MSU Food Security Group

October 2009

This paper was prepared under the Leader Award of the Food Security III Cooperative Agreement (GDG-A-00-02-00021-00), funded by the Economic Growth, Agriculture, and Trade (EGAT) Bureau of the United States Agency for International Development (USAID).

The MSU Food Security Group (MSU FSG) is comprised of faculty members and graduate students of Michigan State University who conduct research, outreach, and training, primarily in countries of Sub-Saharan Africa, with colleagues from these countries. FSG's work is supported primarily through grants and contracts with a wide range of organizations, of which USAID has historically been the largest funder. This document was prepared by Eric Crawford, Duncan Boughton, James Allen IV, and John Staatz, with contributions from Cynthia Donovan, Steven Haggblade, Thomas Jayne, David Mather, David Tschirley, and Michael Weber.

ISSN 0731-3483

© All rights reserved by Michigan State University, 2009

Michigan State University agrees to and does hereby grant to the United States Government a royalty-free, non-exclusive and irrevocable license throughout the world to use, duplicate, disclose, or dispose of this publication in any manner and for any purposes and to permit others to do so.

Published by the Department of Agricultural, Food, and Resource Economics and the Department of Economics, Michigan State University, East Lansing, Michigan 48824-1039, U.S.A.

ACKNOWLEDGMENTS

The authors wish to acknowledge helpful comments from other members of the Food Security Group (FSG), from Philip Steffen (USAID/EGAT/AG), and from Carl Eicher. Thanks also to Patricia Johannes for editorial and document preparation assistance.

The Economic Growth, Agriculture, and Trade (EGAT) Bureau of the United States Agency for International Development provided the funding that made preparation of this working paper possible. We grateful acknowledge the support they have provided under the Leader Award of MSU's Food Security III Cooperative Agreement.

EXECUTIVE SUMMARY

Decades of research have led to substantially improved understanding of the nature of food insecurity. Until the food crisis of 2007/08, a combination of economic growth and targeted programs resulted in a steady fall in the percentage of the world's population suffering from under-nutrition (from 20% in 1990/92 to 16% in 2006). Yet over a billion people still face both chronic and/or transitory food insecurity due to long-standing problems of inadequate income, low-productivity in agricultural production and marketing, and related problems of poor health and absence of clean water. Among regions of the world, the greatest number of the food insecure lives in South Asia, while Sub-Saharan Africa (SSA) has the highest proportion of population that is food insecure. Achieving adequate food security for such a large number of people is increasingly challenging due to a combination of economic, social, political and environmental factors.

This document contains an overview of the past 25 years of research, capacity-building, and outreach by MSU's Food Security Group. The paper describes key elements of the FSG approach and draws lessons regarding the value of that model. It also examines the insights gained from research and outreach, primarily in Africa, and their value to the U.S. Global Food Security Initiative in addressing the major current challenges facing food and agricultural systems.

MSU FSG researchers and their colleagues have been carrying out integrated programs of applied research, capacity building, and policy dialogue focused on food security—largely in Africa—since the early 1980s, building on insights from two decades of earlier projects that addressed agricultural and rural development. Three ten-year food security cooperative agreements—from 1982 through 2012—have been funded by USAID central offices and country and regional missions.

The strategic goal of these cooperative agreements has been to integrate research findings into national, regional, and international policy dialogue and program design to promote rapid and sustainable agricultural growth as a means to cut hunger and poverty. Strategies for achieving food security are analyzed within a structural transformation context that takes into account the role of trade, nonfarm income generation, and the implications of agricultural development for poverty alleviation and sustainable natural resource use.

Major research themes for the 2002-2012 phase of food security research are: (1) improving food systems performance, and (2) understanding household income and livelihood dynamics. Illustrative topics include how the level and distribution of rural assets affect food security, evaluating food emergency response and safety net options, the design of collective actions for financing social and infrastructure investments, and how households respond to rising prime-age mortality as they try to maintain their food security.

Hallmarks of the FSG program include the following: (a) empirical research focused on real-world problems and themes identified in partnership with African colleagues and the funding agencies; (b) integration of research, outreach, capacity building and institutional strengthening; and (c) a strong team orientation among those involved. Specific conceptual and operational guiding principles for MSU's work include:

1. A combination of improved technology, institutions, and policies is required to address complex problems of agricultural development and food security.
2. A collaborative approach is used to design and implement project activities
3. Capacity building is a key objective of MSU project activities.

4. Working papers and presentations are used to communicate research findings to policy makers in a timely way.
5. Household, firm, and market-level data are collected and analyzed to provide new empirical insights into production and marketing systems and policy/program impacts.
6. Administrators at all levels within MSU have been committed to maintaining a critical mass of faculty and graduate students to work on these applied research, capacity-building, and outreach/policy dialogue activities, and to rewarding for that.

Guided by these themes and principles, MSU's research and outreach program has focused on the three major topic areas: (1) farm and household productivity and technology use; (2) marketing and regional trade; and (3) ways to improve the food security of vulnerable groups. Lessons learned from this work over the last 25 years are summarized in the main paper in terms of these three broad topics plus an overarching theme that addresses agricultural growth and food security in a structural transformation context, as follows:

1. Agricultural growth and strategies for limited-resource households.
2. Sustainable increases in smallholder productivity, technology development and transfer (TDT), intensification strategies (including use of fertilizer and improved seed), and cash crop/food crop synergies.
3. Market institutions (including market information systems), market reforms and private sector development.
4. Improving the food security of vulnerable groups, including poverty alleviation, options for responding to situations of food insecurity (including food aid, cash transfers, and coping with high or unstable prices), determinants of nutritional improvement, and impacts of HIV/AIDS on agriculture.

Based on prior work and taking into account likely future challenges, the MSU FSG has identified an agenda for research and policy dialogue that addresses one overarching theme—successful transitions and drivers of change—and six sub-themes:

1. Sustainable increases in productivity.
2. Marketing and supply chain efficiency.
3. Land policy and access.
4. Household-level poverty alleviation and safety nets.
5. Managing food price and supply instability through marketing and trade policies.
6. Agricultural sector information capacity building.

Over the past 25 years, the MSU FSG, with sustained core support from USAID/Washington and country missions, has provided development practitioners at the country, regional and global levels with important insights into how to promote agricultural development and strengthen food security. What makes this model work and what are its payoffs? How can it be leveraged to support the Global Food Security Initiative (GFSI)? In brief:

1. Key features of the FSG approach include the cooperative agreement mechanism, which provides a structure for country buy-ins as well as core funding that supports a coordinated and long-term research program that draws on comparable results across

multiple countries. In-country research creates an empirical basis for policy dialogue that improves the relevance of policy recommendations and helps translate them into action. The integration of the FSG team into the activities of its home academic department provides significant mutual benefits.

2. The payoff to the FSG model of sustained partnerships is threefold: high policy impact, strengthened institutions for continued innovation after project completion, and greater human capacity for the next generation of leadership in analysis, both in host countries and in development agencies in industrialized countries. The threefold impact guarantees greater durability of policy change.
3. Important determinants of success in achieving policy impact include involving local analysts on the research and outreach team, designing research and outreach collaboratively, creating a demand for policy research among decision makers and delivering results to them, and striving for long-term involvement in-country in order to improve research relevance, quality, and credibility.
4. The integration of research and outreach provides two benefits: (a) outreach helps refine the research agenda and provides a better understanding of decision makers' concerns; and (b) integrating research and outreach leads to significant institution-building impacts. FSG has had its strongest impacts in countries where FSG has been able to create or strengthen a cadre of well-trained analysts.
5. In collaboration with USAID/EGAT, the FSG team is taking steps to leverage the program's potential contributions to the GFSI. These steps include:
 - a. Synthesizing and disseminating lessons learned from past FSG work in Africa for potential application in other countries and regions.
 - b. Expanding the number of countries and regions where FSG is active. EGAT has extended the geographical mandate of the FS III Leader Award from Africa to global. FSG has recently initiated discussions regarding potential new project activity in Central America and Asia.

CONTENTS

ACKNOWLEDGMENTS	iii
EXECUTIVE SUMMARY	v
ACRONYMS.....	xi
1. INTRODUCTION	1
2. THE MSU FSG MODEL	2
3. EVOLUTION OF APPLIED RESEARCH AND OUTREACH FOCUS.....	4
4. LESSONS LEARNED.....	5
4.1. Agricultural Growth and Food Security Strategies	5
4.1.1. Agricultural Growth	5
4.1.2. Strategies for Limited-Resource Households.....	5
4.2. Use of Improved Technology	6
4.2.1. Sustainable Increases in Smallholder Productivity	6
4.2.2. Technology Development and Transfer (TDT).....	6
4.2.3. Intensification Strategies: Promoting Improved Soil Fertility and Seed Use ..	6
4.2.4. Cash Crop/Food Crop Synergies.....	8
4.3. Market Institutions, Market Reforms and Private Sector Development.....	8
4.4. Improving the Food Security of Vulnerable Groups	10
4.4.1. Poverty Alleviation	10
4.4.2. Food Insecurity Response Options.....	11
4.4.3. Determinants of Nutritional Improvement	12
4.4.4. Impacts of HIV/AIDS on Agriculture	13
5. RESEARCH AND POLICY DIALOGUE AGENDA FOR THE FUTURE.....	14
5.1. Overall Research Theme: Successful Transitions and Drivers of Change	14
5.1.1. Sub-Theme 1: Sustainable Increases in Productivity	15
5.1.2. Sub-Theme 2: Marketing and Supply Chain Efficiency	16
5.1.3. Sub-Theme 3: Land Policy and Access.....	18
5.1.4. Sub-Theme 4: Household-level Poverty Alleviation and Safety Nets	18
5.1.5. Sub-Theme 5: Managing Food Price and Supply Instability through Marketing and Trade Policies	19
5.1.6. Sub-Theme 6: Agricultural Ssector Information Capacity Building.....	20
6. LEVERAGING THE MSU FSG MODEL IN SUPPORT OF THE GLOBAL FOOD SECURITY INITIATIVE	21
6.1. Key Features of the Approach	21
6.2. Payoffs to the Approach	21
6.3. Leveraging the FSG Model in Support of the Global Food Security Initiative.....	23
REFERENCES	25

ACRONYMS

AGRA	Alliance for a Green Revolution in Africa
CAADP	Comprehensive African Agricultural Development Strategy
CIPE	Center for International Private Enterprise
COMESA	Common Market for Eastern & Southern Africa
ECOFIL	Scientific Directorate and the Research Program in Rural Economy of the Rural Economy Institute (IER) in Mali
ECOWAS	Economic Community of West African States
EGAT	Economic Growth, Agriculture, and Trade Bureau of USAID
GFSI	Global Food Security Initiative
IER	National Agricultural Research Institute in Mali
IIAM	Agricultural Research Institute/Mali
LICNAG	Linkages between Child Nutrition and Agricultural Growth
MIS	Market information system
MSU FSG	MSU Food Security Group
MSU	Michigan State University
NGOs	Non-governmental Organizations
OMA	<i>Observatoire du Marché Agricole</i>
PVOs	Private voluntary organization
ROESAO	A network of regional market information systems and traders' organizations of West Africa
SOM	Soil organic matter
SSA	Sub-Saharan Africa
TDT	Technology Development and Transfer
UNECA	United Nations, Economic Commission on Africa
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

1. INTRODUCTION

Decades of research have led to substantially improved understanding of the nature of food insecurity.¹ Until the food crisis of 2007/08, a combination of economic growth and targeted programs resulted in a steady fall in the percentage of the world's population suffering from under-nutrition (from 20% in 1990/92 to 16% in 2006).² Yet over a billion people still face both chronic and/or transitory food insecurity due to long-standing problems of inadequate income, low-productivity in agricultural production and marketing, and related problems of poor health and absence of clean water. Among regions of the world, the greatest number of the food insecure lives in South Asia, while Sub-Saharan Africa (SSA) has the highest proportion of population that is food insecure. Achieving adequate food security for such a large number of people is increasingly challenging due to:

- Continuing natural resource degradation, driven by a combination of population pressure and outdated agricultural practices;
- Underdeveloped input and rural financial service markets, especially in SSA;
- Structural changes in food supply and demand arising from growing global demand for biofuels, rapid urbanization, and increased foreign direct investment in land and agro-processing;
- Impacts of climate change, including more variable and uncertain agricultural output and prices, negative effects on human and animal health, and flood damage to infrastructure;
- Increased political pressures to make transfers to voters (e.g., cheaper food, fertilizer subsidies) that may compete with long-term investments and/or economic reforms needed to draw small farmers into the structural transformation process;
- Increased costs of regional and international trade due to concerns about food safety (e.g., increased demands for traceability).

This document contains an overview of the past 25 years of research, capacity-building, and outreach by MSU's Food Security Group. The paper describes key elements of the FSG approach and draws lessons regarding the value of that model. It also examines the insights gained from research and outreach, primarily in Africa, and their value to the U.S. Global Food Security Initiative in addressing the major current challenges facing food and agricultural systems.

¹ A common definition of food security is "access by all people at all times to enough nutritious food for an active, healthy life" (USDA 2009). This implies sufficient supplies of food, physical and financial access to those supplies, and nutritional adequacy in terms of dietary needs. Even if enough food exists at the regional, national, or global level, various physical, economic, or policy constraints may affect food distribution, so that food needs are not met at the household (or intra-household) level. Inadequate knowledge about food preparation practices and hygiene, and poor health, can compromise utilization of the nutrients available to a household or individual. The resulting food insecurity may be temporary (e.g., caused by unfavorable weather), or chronic.

² For a more thorough discussion of the concept of food security, see Staatz, Boughton and Donovan (2009).

2. THE MSU FSG MODEL

MSU FSG researchers and their colleagues have been carrying out integrated programs of applied research, capacity building, and policy dialogue focused on food security—largely in Africa—since the early 1980s, building on insights from two decades of earlier projects that addressed agricultural and rural development.³ Three ten-year food security cooperative agreements—from 1982 through 2012—have been funded by USAID central offices and country and regional missions.⁴

The strategic goal of these cooperative agreements has been to integrate research findings into national, regional, and international policy dialogue and program design to promote rapid and sustainable agricultural growth as a means to cut hunger and poverty. The focus on food security ensures that this key dimension of individual welfare is given priority along with economic growth objectives. The orientation of MSU’s food security projects towards improving the performance of agricultural production and marketing systems contributes to both food security and economic growth objectives, given the vital role that the agricultural sector plays in economic growth in Sub-Saharan Africa. Strategies for achieving food security are analyzed within a structural transformation⁵ context that takes into account the role of trade, nonfarm income generation, and the implications of agricultural development for poverty alleviation and sustainable natural resource use.

Major research themes for the 2002-2012 phase of food security research are:

1. Improving food systems performance. Subthemes include analyzing the drivers of agricultural productivity growth and agriculture-environment linkages, and strengthening specific commodity value chains, input/output market performance, and regional trade.
2. Understanding household income and livelihood dynamics. Illustrative topics include how the level and distribution of rural assets affect food security, evaluating food emergency response and safety net options, the design of collective actions for financing social and infrastructure investments, and how households respond to rising prime-age mortality as they try to maintain their food security.

FSG’s success comes from working closely with clients and stakeholders to define research problems jointly in a real-world context. The partnership with stakeholders continues throughout the research process. Initial identification and framing of the research questions are done collaboratively with stakeholders. As results become available, they are shared quickly to enable stakeholders to validate the findings or suggest other interpretations of the results, and apply the results if they find them relevant. The feedback from stakeholders also allows the researchers to adjust their agendas as the work progresses. In addition to this collaborative work with stakeholders, FSG researchers also contribute to the debate about key agricultural issues and solutions through peer-reviewed publications addressed to both academic and practitioner audiences.

³ These include the African Rural Economy/Employment projects, the Alternative Rural Development Strategies project, and the Latin America Marketing Project.

⁴ As of October 2008, the Food Security III Leader Award was given a global rather than an Africa-wide mandate.

⁵ As elaborated below in the Lessons Learned section on agricultural growth, structural transformation is a process by which “the relative contribution of nonagricultural sectors to the overall economy rises as agriculture’s share declines in relative terms” (UNECA 2005, p. 129), an increasing share of agricultural sector value added occurs off the farm, and an increasing share of household production and consumption is exchanged through markets.

Hallmarks of the FSG program include the following: (a) empirical research focused on real-world problems and themes identified in partnership with African colleagues and the funding agencies; (b) integration of research, outreach, capacity building and institutional strengthening; and (c) a strong team orientation among those involved. Specific conceptual and operational guiding principles for MSU's work include:

1. Improved technology, institutions, and policies are required to address complex problems of agricultural development and food security. Single-factor solutions are rarely effective beyond the very short run. All market-based approaches require some form of collective action based on a combination of public and/or club goods and coordination arrangements that evolve over time.⁶ Consequently, institutional design is critical for successful public and private investments.
2. A collaborative approach is used to design and implement project activities, involving MSU, host country organizations and stakeholders, and the donor (USAID and others).
3. Capacity building—at both the individual and institutional levels—has been a key objective of MSU project activities. It is achieved as a joint product of MSU's research and outreach activities through a combination of long-term degree training, short courses, and in-service training in research/outreach skills. Graduate students from host countries and the U.S. play key roles in the research and outreach process.
4. Interim reports (working papers and presentations) are used to communicate research findings as they are being generated, in order to contribute to the policy dialogue process in a timely way.
5. Household, firm, and market-level data are collected and analyzed to provide new empirical insights into the operation of production and marketing systems, and the impacts of various measures taken (or not taken) to stimulate economic growth and foster food security.
6. Historically, all levels within MSU—from President to department chairperson—have been committed to maintaining a critical mass of faculty and graduate students working on these applied research, capacity-building, and outreach/policy dialogue activities, and to rewarding the wide range of contributions to scholarship that they provide.

⁶ The economics literature typically defines “public goods” as goods that are profitable for society as a whole but which no private individual has an incentive to produce, as it is impossible to sell the good because one cannot exclude people from using the good without paying for it. A classic example is national defense. Such goods are often provided by the public sector and financed through taxation. In agricultural development, typical “public goods” include market information, grades and standards, and research on open-pollinated crop varieties. Research has shown, however, that such goods sometimes can be provided by groups of actors working collectively through means other than the state. For example, “club goods” refer to goods that are of value to a group of actors (but not necessarily to all of society) and that are provided by the group as a whole, such as through a professional organization. Thus, in this paper, we refer to “collective goods,” whether they are provided or financed by the public sector or through some other form of collective action. In the context of tightly constrained government budgets, one of the challenges facing food-insecure countries is to examine a whole range of alternatives for providing such collective goods.

3. EVOLUTION OF APPLIED RESEARCH AND OUTREACH FOCUS

Guided by the themes and principles listed above, MSU's research and outreach program has focused on the following three major topic areas:

- **Farm and household productivity and technology use:** (1) Studies of farm productivity, which highlighted the role of technology adoption, such as improved inputs, and underlined the importance of both incentives (profitability) and capacity (resource endowment) in stimulating sustainable technology adoption; (2) evaluation of alternatives for soil fertility improvement (including organic as well as inorganic fertilizer), and economics of improved seed and fertilizer use; (3) economic returns to agricultural research; and (4) synergies between cash crops (such as cotton) and food crops, through improved input and output market access. In all this work, female- as well as male-headed households are identified and studied so that gender dimensions of food security are mainstreamed.
- **Marketing and regional trade:** (1) organization and performance of markets for staple foods (especially maize, rice, and cassava), horticultural crops, and agricultural inputs; (2) the design and impacts of market information systems; (3) the extent and impacts of market reform programs; (4) input/output market linkages, e.g., for cotton and horticultural crops; (5) impacts of government and donor policies on the development of markets to serve small farmers; (6) determinants of household participation in staple food and cash crop markets; and (7) regional trade flows in West and Eastern/Southern Africa, and the use of "food sheds" as a conceptual and empirical framework for studying domestic and regional food security and trade policy.
- **Improving the food security of vulnerable groups:** (1) distribution of household income and assets, including land, and implications for agricultural growth potential; (2) implications of alternative agricultural growth patterns for child nutritional status and income distribution; (3) income and poverty dynamics, including empirical trends and key factors determining positive or negative income changes over time; (4) incidence and impacts of HIV/AIDS on farm households; (5) identification of emergency responses, including food aid, that mitigate food insecurity while avoiding negative consequences on development objectives; (6) design of food aid programs that enhance rather than constrain or damage private sector and regional trade, including local purchase initiatives and market sales of food aid imports; (7) the design of local-level approaches to food security planning; and (8) experience with large-scale fertilizer and seed subsidy programs (Malawi, Zambia), including the difficulties of targeting such programs to the poorest households, displacement of commercial sales by subsidized inputs and other negative impacts on private traders, and magnitude of production and income impacts relative to program costs.

4. LESSONS LEARNED

The following are highlights of lessons learned through implementation of MSU FSG activities regarding key development issues and interventions.

4.1. Agricultural Growth and Food Security Strategies

4.1.1. *Agricultural Growth*

The FSG approach identifies strategies for achieving food security within a structural transformation framework. For most African countries, and often elsewhere, growth in agricultural productivity throughout the food system (from input provision through farm-level production to output marketing and processing) is needed to boost long-run economic growth. Yet over time the proportion of total population in farming and the share of farm-level agriculture in the economy decline and other sectors of the economy expand. Agricultural production becomes increasingly specialized, the proportion of value-added in the food system increasingly shifts to off-farm elements of the system (e.g., processing and retailing), the share of marketed output increases, and rural-to-urban migration occurs. The agricultural and non-agricultural sectors become increasingly integrated and the share of the nonfarm sector in total employment and income grows. International trade offers opportunities for competitive crops/industries to expand production, while offering consumers increased variety of goods and lower prices.

Investment in collective goods and related institutional development is necessary to create the enabling conditions for agricultural growth, including greater human and institutional capacity, agricultural research and technology development, improved infrastructure, and conditions that encourage a transition from state-led to private sector marketing systems, such as a legal framework and stable policy environment conducive to business.

4.1.2. *Strategies for Limited-Resource Households*

About 50% of the rural small farm population cultivates fewer than 0.15 hectares per capita in densely populated countries such as Rwanda and Ethiopia, and fewer than 0.3 hectares per capita in supposedly land-abundant countries such as Zambia and Mozambique. Without major changes in access to land: (1) farm sizes are likely to decline over time; (2) landlessness and near-landlessness will emerge as increasingly important social and economic problems unless growth in the nonfarm sectors can be substantially increased; and (3) given existing agricultural technology and realistic projections of future productivity growth potential, large segments of the rural population will be too asset-poor to climb out of poverty solely through agricultural growth on their own farms (Jayne et al. 2001).

For these households, agricultural growth strategies must be supplemented with development of off-farm wage-earning and service income opportunities. Rural safety net programs may contribute to immediate food security, but can also be designed to encourage households to invest in their children's education and subsequently take advantage of other opportunities, given that off-farm income earnings are correlated with educational attainment.

4.2. Use of Improved Technology

4.2.1. Sustainable Increases in Smallholder Productivity

In contrast to increased production through land expansion, intensification means increasing production through greater productivity of various factors of production (land, labor, water, fertilizer, etc.). Intensification depends on incentives (profitable technology) and capacity (access to production inputs), for which improved input markets are critical. Soil and water conservation investments are an important complement to improved production technology. Non-cropping income is an indirect determinant of productivity via its effect on farm input acquisition and investments (Reardon et al. 1996).

4.2.2. Technology Development and Transfer (TDT)

Investment in agricultural research can bring significant economic returns, although current levels of national investment in agricultural research are often inadequate. The success of TDT programs depends on policies affecting input and output markets and prices; access to input and output markets; agroclimatic conditions (with productivity gains and adoption being lower in marginal zones); stable institutions; and favorable scientific leadership, incentives, and human and financial resources for research (Oehmke and Crawford 1996). Scaling-up of impacts requires improved extension and seed/fertilizer input supply systems. The key challenge is how to organize this in an era of liberalization when state-driven integrated development programs are no longer deemed sustainable. Will integrated value chains driven by outside investment do this? What is the scope for collective action by various actors in the food system, working through task forces (“interprofessions”) that link actors throughout the subsector to provide the “club goods” needed to assure access to improved knowledge and technology?

4.2.3. Intensification Strategies: Promoting Improved Soil Fertility and Seed Use

Soil fertility is critical for crop intensification (Weight and Kelly 1998). Given limited access to land in most African countries, fallow periods are currently too short to remedy low levels of soil fertility and soil organic matter (SOM), and hence alternative recapitalization techniques are needed. Fertilizer combined with recycled crop residues has good potential for recapitalizing high potential land but less so for marginal soils. Regardless of soil type, sustainable recapitalization of SSA soils requires both fertilizer and organic amendments. Fertilizer can serve as a “catalyst” for SOM recapitalization if crop residues are returned to the soil. Crops and cropping patterns can be selected to increase crop residues and SOM. Increased recycling of crop residues depends on farmers’ understanding of technical factors and on the costs and benefits of returning residues to the soil (as opposed, for example, to using them for fuel or fodder). Conservation farming practices involving residue incorporation and minimum tillage can also improve soil organic content and fertility.

Programs to promote the use of fertilizer and improved seed are often used to accelerate crop productivity growth and improve farmers’ incomes. Improved demand incentives, farmer capacity, and strategic investments are needed to improve input use economically:

- Improved demand incentives require (1) stronger and more reliable agronomic response, promoted by investments in the physical environment, technology research, and farmer training; (2) less volatile and higher output prices (relative to input costs),

promoted by public and private investment in market information, transportation, storage, and processing; and (3) lower fertilizer costs, through improved transportation infrastructure, more predictable government policies (to encourage private investment), and improved buying procedures (e.g., bulk ordering).

- Enhanced farmer capacity to use fertilizer requires major improvements in research and extension to equip farmers with the information and skills they need to evaluate technology options and make appropriate adaptations.
- Multiple objectives for fertilizer programs and limited funds will force strategic choices about which farmers and which crop sectors are given priority.
- The desirability of alternative fertilizer investments should be evaluated based on a systematic assessment of financial and economic costs and benefits, also taking into account social and political goals and environmental objectives. Operationalizing this requires establishing implicit or explicit weights on the relative importance of these various objectives.

Unfortunately, fertilizer subsidy programs as typically implemented in Africa have strong short-run political appeal but a questionable longer-run record: (a) there is very little evidence that they have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments; (b) evidence shows that the benefits of subsidies are invariably captured disproportionately by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor; (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have “kick-started” productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end; (d) subsidies can undercut commercial sales and discourage input marketing by private traders; and (e) subsidies are hard to “exit” from once started. Experience with large-scale seed subsidy programs is less well documented. In many countries, the private sector has little incentive to invest in improved seed for open-pollinated crops or varieties because of the lack of repeat sales opportunities, and such investment is often undertaken by NGOs and/or farmer associations. Private companies are more likely to invest in hybrid seed, with hybrid maize having by far the largest share of sales. In Malawi, a flat-rate subsidy was very effective in encouraging private seed companies to promote hybrid varieties using a reduced pack size.

If the decision is taken to implement input subsidies, guidelines for best practice include:

- Instead of direct distribution of inputs by public-sector organizations, use vouchers that can be redeemed at local private retail stores in order not to undermine private-sector agro-dealers.
- Involve a wide range of fertilizer importers, wholesalers, and retailers in the input voucher scheme.
- Before deciding to target the input vouchers, carefully consider the objectives of targeting, take political input, and assess the practical feasibility and costs of implementing a targeted program. If effective targeting does not seem feasible or achievable at an acceptable cost, then a small universal voucher program could be less costly. Pilot programs to test the use of electronic vouchers may identify ways to reduce the costs of targeting in the future.
- Address infrastructure and input supply constraints as well as improving procurement efficiency.

- Facilitate contracts or other private-sector partnerships with farmers in order to reduce the financial burden on government.
- Strengthen farmers' effective demand for fertilizer by making fertilizer and complementary inputs (e.g., improved seed) sufficiently productive to be profitable, and by building input markets and output markets that can absorb the increased output without gluts that depress producer prices.
- Increase fertilizer use efficiency by promoting farmers' use of improved crop management practices, including crop rotation, targeted doses, minimum tillage and other conservation agriculture practices.

4.2.4. Cash Crop/Food Crop Synergies

Industrial crop schemes can help raise incomes and improve food security. For example, integrated credit, input supply, and marketing provides access to inputs that can be used on food crops as well. Perhaps the most widely studied example in Africa is cotton, although recent declines in international cotton prices have weakened potential synergies (Tschirley, Poulton, and Labaste 2009). Profitable cash cropping can attract other investments to the region that provide spillover benefits to farmers growing food crops (Govereh and Jayne 1999).

4.3. Market Institutions, Market Reforms and Private Sector Development

A productive agricultural and food system depends on well-functioning markets for both inputs and outputs. A well-functioning market is predictable and efficient at matching demand and supply for inputs and products over space and time. All markets require some form of collective action and/or collective goods to facilitate their functions and basic performance (e.g., property rights, physical security, exchange facilities, grades and standards). Well-functioning markets can provide opportunities and incentives for growth as well as poverty alleviation. For example, reliable markets for staple food grains reduce the risks to households of specializing in nonfood crops, allowing increased incomes. Well-coordinated input and output marketing systems for high-value cash crops facilitate productivity growth and farmer specialization, also driving income growth. These effective cash crop markets can also indirectly support food crops, through improved incomes and access to inputs for food crops.

Unfortunately, policymakers are sometimes unaware of the many functions that must be assured by an agricultural marketing system, the real costs and risks associated with fulfilling those functions, and the enabling conditions that must be put in place for markets to perform well. Consequently there is often a deep mutual mistrust between the private sector and government that gets in the way of implementing policies and investments to improve market performance. Public sector programs often try to meet short-run objectives by substituting public for private marketing agents, but these public agents have to fulfill the same functions and bear the same costs and risks, and there is no guarantee that they will do so more effectively than private sector agents. History provides many examples of public marketing organizations that are less effective and more costly than private marketing agents would be. On the other hand, experience has also shown that simply dismantling government marketing agencies does not necessarily remove the structural conditions in the markets that lead to market instability (and which often motivated the creation of the government agency to begin with). The critical issue is to identify which market-facilitating roles the state needs to play

and which marketing functions can be more effectively handled by the private and cooperative sectors. Even then, if inappropriately designed, well-intentioned government programs to stimulate agricultural productivity (e.g., through input subsidies), stabilize output markets (e.g., through a public grain reserve), or provide emergency relief (e.g., through distribution of food aid), can undermine the incentives for private marketing activity by increasing uncertainty and reducing opportunities for profitable operation by private traders. This has negative long-run effects on the capacity of marketing systems that are needed to support agricultural growth.

National and regional market information systems (MIS) can improve the functioning of markets as well as guide government assistance when food security is compromised by weather or natural disasters (Diarra, Traoré, and Staatz 2004). Information on prices and availability of staple foods facilitates spatial and temporal arbitrage by reducing transaction costs and uncertainty. Empirical research, including data from market information systems, can play a critical role in informing policy makers about the functioning and performance of agricultural markets (helping to break down the barriers to trust between the public and private sector) as well as to inform the design of public policies and programs, and guide monitoring of their impact. For example, governments across West Africa drew heavily on information from national MIS in monitoring and designing responses to the 2007/08 food crisis. The government of Mozambique maintained its commitment to open maize trade in the mid-2000s despite heavy pressure from millers to stop exports, based on information and insight generated by the country's MIS. Guidelines developed for building sustainable market information systems in Africa point to the importance of political commitment to undertake public/private joint ventures to operate information systems, the importance of regular reassessment of both public and private user information needs, and the need for sustained financial assistance by local, national, and donor participants (Weber et al. 2005). The rapid evolution of agricultural markets and communications technologies in Africa (e.g., spread of cell phones) are opening the door to a wide range of new forms of private as well as public MIS. Recognizing the strengths and weaknesses of the different models will be critical in guiding investments and public policies in this area.

Regional trade can expand the options for economic gains associated with less expensive imports or more lucrative exports where government policies are favorable (absence of export/import restrictions and minimal tariffs or fees). Constructive dialogue among the private sector, public sector, and market information specialists (e.g., West Africa regional market outlook conferences) can have a high payoff through exchange of information about rules and regulations and planned government purchases for food security reserves. This is particularly true when major food sheds transcend national boundaries, making coordinated production and trade policies across neighboring countries critical to capturing economies of scale. Even where government and private sector agree on the rules of the game, however, this information may not be effectively communicated to field staff (e.g., customs officers at border points). Border conferences to facilitate livestock trade between Guinea and Mali are an example of communication and sensitization dialogue with local officials that can be very effective.

Rapid urbanization is placing great stress on the infrastructure and coordination mechanisms to link rural to urban areas, driving a need for major investments in this area. Some of this investment will take place in integrated private supply chains—the supermarket chains, based on foreign direct investment, that have grown so rapidly in other areas of the world. Yet in Africa, although such supermarket chains are present and growing in some countries, the emerging consensus is that across the vast majority of the continent, this growth will be too slow to transform urban marketing systems over a time frame acceptable to policy makers

and donors. Much greater attention thus needs to be paid to modernizing the often dysfunctional system of (largely public) market places that carry the great bulk of food to urban consumers. Crucially, this focus must not be only or even primarily on hard infrastructure but on new definitions of public and private sector roles in the development, ownership, and management of these markets (Tschirley et al. 2009).

4.4. Improving the Food Security of Vulnerable Groups

4.4.1. Poverty Alleviation

Agricultural growth and poverty alleviation are not perfectly correlated. Some patterns of agricultural growth have a higher impact on poverty alleviation than others. To alleviate poverty effectively, agricultural growth must incorporate the following elements:

- Agricultural productivity must be enhanced through the use of region-appropriate technologies, better rural household access to land and rural education, and stronger agricultural input and output markets.
- Land access programs should be given special emphasis, considering the strong direct correlation between land and income in rural areas. A study of five African countries (Jayne et al. 2001) found that the largest part of the variation in per capita farm sizes within the small-farm sectors occurred within villages rather than between villages. At the local level, households in the highest per capita land quartile controlled between 8 and 20 times more land than households in the lowest quartile, which were nearly landless. If no land is available for the severely land-constrained rural poor, the alternative of developing accessible and productive rural off-farm and nonfarm jobs will be essential. Yet the growth employment opportunities in nonfarm sectors in low-income Africa typically requires robust agricultural growth to generate the demand for the goods and services from these sectors.
- Because household income varies considerably even within villages, safety-net assistance to poor farmers cannot be targeted effectively by focusing on “marginal” geographic regions, since even marginal regions will include non-poor farm households, and large numbers of the poor also live in “non-marginal” areas. Instead, geographical targeting—when feasible—must be complemented by targeting at the intra-village level. While intra-village targeting is more challenging and costly than regional targeting, and perhaps more susceptible to leakage, these costs must be evaluated against the benefits of allocating scarce resources more effectively toward poverty alleviation.
- Even where local targeting of agricultural assistance is possible, an exclusive focus on helping the poorest farmers will not be an effective poverty alleviation strategy. Numerous studies suggest that between one-third and two-thirds of all smallholders in Sub-Saharan Africa (depending on the country) lack sufficient land and other resources to “farm their way out of poverty,” particularly if they produce primarily low-value products like cereals. For these people, however, a vibrant agriculture is still needed to generate demand for their labor, in off-farm portions of agricultural value chains, and in other off-farm enterprises that serve farmers as well as to finance the schools and other basic services that will prepare their children for more remunerative jobs outside of agriculture (Staatz and Dembélé 2007; Jayne et al. 2001).

4.4.2. Food Insecurity Response Options

Just as single-factor solutions are rarely effective in solving agricultural development problems, the same is true in regard to strategies to improve access to a decent diet by populations that are food insecure, either chronically or due to short-term supply or income shocks. Different types of intervention will be more or less cost effective depending on the circumstances.

- **Food aid.** For food aid to contribute to, or at least not undermine, long-term food security, it is important to minimize the negative impacts of food aid on private-sector marketing agents. Local procurement of food aid can reduce costs and hence feed more people. Best practices include: (i) replacing commodity assistance with cash assistance in Title II, providing that local food markets are working reasonably well; (ii) including stricter checks and assessments for monetization in Food for Peace program, particularly in different regions; and (iii) improving coordination between USAID and the United States Department of Agriculture (USDA), and between private voluntary organizations (PVOs) and Non-governmental Organizations (NGOs). When food as food is the best option, evidence shows clearly that local procurement of food aid frequently reduces costs and hence feeds significantly more people (Tschirilo and del Castillo 2006).
- **Cash transfers.** Cash transfers can be cheaper than food aid and are a key tool in safety nets to assist the poorest households. Their use is preferable to food aid when: (i) the key problem is not supply of food, but rather ability of households to purchase food; (ii) cash is a useful instrument in obtaining food and administrative and financial systems function well, so that cash can be distributed without extensive fraud or theft and violence; (iii) those most affected are net buyers of food; and (iv) any increase in demand can be met by the markets without causing significant inflation.
- **Coping with high/unstable world prices.** High prices in 2007/08 created a trap by eroding trust between governments and traders and making governments unwilling to rely on private markets to supply food grains and agricultural inputs at reasonable prices. The cereals export restrictions introduced by Asian exporters such as India and Vietnam fundamentally undermined the confidence of many African governments in relying on the international market as an alternative to holding large national food stocks. More effective long-term responses to such crises involve measures to improve domestic, regional, and international market performance. Elements include: (i) introducing or strengthening national and regional market information systems, including crop production forecasting and public/private sector information sharing; (ii) maintaining market access by eliminating export bans and import tariffs, which will only be possible through regional and international accords that allow both importing and exporting countries to deal effectively with domestic food crises;⁷ (iii) government investment in market infrastructure, to reduce trading costs, and in agricultural extension programs; and (iv) enhancing the climate for private investors. In a broader political-economic context, however, increasing the reliance on food

⁷ Possible arrangements being discussed in West Africa include creation of regionally certified private storage agents, who would be allowed to store grain in ECOWAS-certified warehouses and be free to export the grain throughout the region, in exchange for sharing information on their inventory levels; mutualization of national emergency stocks into regional reserves; and linking investment by one country (e.g., Senegal) in another country's agricultural production (e.g., in Mali's irrigated rice zone) with a guaranteed right to export that production to the investing country.

markets to deal with high and unstable prices cannot be dealt with independent of the creation of sustainable food safety nets for the large and increasingly urban population of vulnerable households. A government that ignores the welfare of the poor by simply “letting the market work” risks not being the government for very long, so the design of market-compatible food safety nets has to be part of any market-driven strategy to deal with food price shocks.

4.4.3. *Determinants of Nutritional Improvement*

Adequate nutrition for all requires having enough food available at the national and local levels, as well as ensuring that all households have access to a sufficient quantity and diversity of food for a nutritious diet. While this statement seems self-evident, some strategies for enhancing widespread nutrition have proven ineffective as a result of not incorporating all of these components. For example, Penders, Staatz, and Tefft (2000) have shown:

- Though measures of household income are positively related to better child nutrition, the relationship is frequently weak. Thus, simply raising rural incomes will not cause notable improvements in child nutrition. This conclusion also casts doubt on the accuracy of using household income as a measure of food security.
- While agricultural development can improve the health and nutrition of children, to the extent that it increases production and raises income, neither of these effects is sufficient to bring noticeable improvement. Therefore, agricultural growth is a necessary but insufficient means of improving nutritional status.
- The *pattern* of agricultural growth is critical in determining its impact on child malnutrition. Evidence from Mali suggests that this pattern is a function of, inter alia, family structure, intra-household control of resources, level of nutritional knowledge of the population (particularly of mothers and grandmothers), and the effectiveness of the community in tapping some of the agricultural growth to finance investments in health centers and schools (Tefft and Kelly 2004).

The correlation between income growth and nutrition can be strengthened through improved health and community infrastructure. Community health centers are the focal point for health policy in many developing countries, and there is a strong correlation between improved health infrastructure and child health and nutrition. These centers are the logical entities to sponsor educational programs for each household’s primary caregivers that highlight sanitation, breastfeeding, and general nutritional practices. While health centers can initially be funded by donors, to be sustainable in the long run they must be supported out of the increased rural incomes resulting from agricultural development.

Empowerment of women can also improve nutritional outcomes. Even if households have the means to produce or purchase food, children’s dietary intake is ultimately determined by the primary caregiver’s desire to meet these nutritional needs. Research has shown that women perform this role better than men, who are less likely to spend additional income on increased food consumption for the children (Diskin 1994). In many cases, even income that is directly paid to women ends up in the control of their husbands. Programs that promote gender equality will work to give women a stronger say in the household’s spending habits, and result in a greater share of the household budget devoted to food consumption. Women’s time allocation is a frequently overlooked determinant of their children’s nutritional status. Too often strategies assume that women’s time is abundant, when in fact these plans should strive to conform to household labor needs. For example, programs should encourage activities that

allow women to earn income at home (i.e., cooking, tailoring, gardening) as well as time-saving household technologies (i.e., mechanized grain processing mills).

4.4.4. Impacts of HIV/AIDS on Agriculture

Current mitigation strategies and programs tend to assume labor scarcity among affected households, based upon a homogenous conceptualization of rural households that suffer the death of a prime-age adult. However, various empirical studies based on large-sample household survey data have found that the effects of disease-related adult mortality on rural households in southern and eastern Africa are quite heterogeneous, and conditional on characteristics of the deceased (gender, position in the household) and the household's pre-death wealth. Negative effects of adult mortality tend to be strongest following the death of a male head-of-household and/or among households that were relatively poor prior to the death. For example, male members, especially heads, tend to be the ones who cultivate higher-value cash crops and have the educational background to access higher-wage nonfarm labor markets. Thus, the negative impacts of HIV/AIDS on household labor and income are often overstated since the majority of deceased adults are not the household heads/spouses, and thus are not likely the primary breadwinners (Mather et al. 2005). In addition, mortality effects on income are often not significant among wealthier households, perhaps because they are better able to mitigate the lost labor from the deceased by hiring labor and/or attracting new members.

The existence of heterogeneous mortality impacts on household income raises questions about the usefulness of a homogeneous conceptualization of "affected households," especially within the context of proposals for targeted assistance and technology development. Thus, indicators beyond "adult mortality" are required to identify affected households most in need of immediate assistance (such as households with a male head death—HIV/AIDS widows—or those with low landholding and asset levels) as well as what technology is most appropriate and beneficial for affected households.

While it is important to provide a safety net for the hardest-hit households, investing in pro-poor agricultural productivity growth can help mitigate the consequences of the epidemic. Potential mitigation responses that appear to be appropriate to the needs of hardest-hit households while also benefiting other poor but non-affected households at the same time include improved land tenure; higher yielding and/or more nutritious food crop varieties; labor-saving technologies for water, fuel and food processing; and redressing gender bias in extension and education and, thus, access to cash crop and nonfarm income opportunities.

5. RESEARCH AND POLICY DIALOGUE AGENDA FOR THE FUTURE

The previous section shows that while much has been learned about constraints and opportunities to increase farm and food system productivity, raise incomes, and improve food security, there remain gaps in our understanding. Looking to the future, additional forces of change will add new stresses and opportunities. Given a significant increase in planned public and private investments in agriculture and the rural economy, it will be important to continue empirical research on the food security and poverty impacts of those investments, on how food systems and rural economies are evolving, and on how these changes are affecting opportunities for women to improve their welfare. Especially important will be to use fresh empirical results, through policy dialogue with a range of actors, to design more effective institutions to harness the full potential of markets while providing cost-effective safety nets for those households or individuals that are unable to meet their needs through the market. Based on a review of lessons learned in the past, and an assessment of key drivers of change going forward, we see the following as key research areas to help policymakers plan investments and design policies and institutions to facilitate food system, agricultural and rural economy transformation. We begin with an overall research theme to analyze and understand “big picture” trends, and then identify six sub-themes to address specific areas of concern. While the research needs identified below reflect primarily our experience to date in Sub-Saharan Africa we recognize that there is significant overlap with the needs of food-insecure populations in both Latin and Central America, and South Asia. Hence, learning across continents as well as across countries will increase the payoffs to investments planned through the Global Food Security Initiative (GFSI) and host country partners.

5.1. Overall Research Theme: Successful Transitions and Drivers of Change

The ability of the *bottom billion* undernourished people in the world to emerge from food insecurity will depend critically on the patterns of food system development and overall economic transformation followed in low-income countries over the next 25 years. It is broadly recognized that agricultural growth is essential to fostering pro-poor growth, especially in Sub-Saharan Africa (World Bank 2007), but that not all types of agricultural growth will necessarily lead to broad-based poverty reduction. The FSG analytic agenda will focus on the impact of different patterns of agricultural growth (investment in small vs. larger farms, or productive vs. more marginal zones) and on linkages between farming and the nonfarm economy in determining the pace and breadth of economic growth and poverty alleviation. In the long run, it is clear that not all smallholders will be able to improve productivity and escape poverty. The ability of different agricultural growth strategies and of local institutions to generate, capture, and reinvest resources that create opportunities for these people to shift from poverty agriculture to something better (often over a generation) will be critical, and FSG will focus on understanding these relationships.

Research on this topic will look broadly at how agricultural policies and investment programs can facilitate agricultural sector transformation that promotes urban and rural food security and help to achieve broad-based poverty reduction. Specifically, it will look at adapting to structural changes in the agricultural sector on both the demand side (e.g., through population growth and urbanization) and the supply side (smallholder and commercial farming) and changes in the off-farm economy. Given the small size of most African economies, and regional complementarities, agricultural growth strategies need to be conceived in a regional (e.g., West African or East African) rather than national context.

Over the next generation, growing trade in food staples appears poised to dwarf all other agricultural markets in Africa. Currently, the market value of Africa's food staples amounts to \$50 billion per year, or nearly three-fourths of the value of all agricultural production. Given growing urbanization and the highest rates of poverty in the world, Africa's market demand for food staples will grow dramatically in coming decades. As a result, production of food staples—for growing urban markets and food-deficit rural areas—represents the largest growth opportunity available to African farmers (Diao and Hazell 2004). Facilitating expansion of these markets will, therefore, be critical for efforts at stimulating agricultural production, broad-based income growth and poverty reduction, and for ensuring food security of vulnerable populations in deficit zones.

A key analytic tool that FSG will use in looking at the potential impacts of regional investment and trade in the food system is that of the food shed. In Africa, production basins for major staples often transcend national boundaries, and consumption centers are frequently across the border from where staples are produced. Fluid cross-border flows, therefore, become critical for maintaining incentives for farmer investment in the surplus zones, for maintaining food security in deficit zones, and for avoiding the extreme price volatility and consequent boom-and-bust production cycles that result when production shocks reverberate within the confines of small individual country boundaries. As a result, organizations interested in accelerating agricultural growth and improving food security in Africa must look at staple food market sheds in a regional perspective. Analyzing production, consumption, and trade within a food shed framework allows one to see more clearly the opportunities for mutually beneficial agricultural investment and trade between countries in Africa.

Within this broad conceptual framework of agricultural and rural economy transition, and using food shed analysis as a spatial framework for analysis and planning, we identify six specific areas of research that need to be addressed to inform the design of investments to overcome chronic and transitory food insecurity.

5.1.1. Sub-Theme 1: Sustainable Increases in Productivity

Agricultural productivity gains depend on a wide range of factors at the farm level and beyond, including technology, production inputs, markets, and information. Farmers must have both the financial *incentive* to increase productivity by adopting improved technology, and *access* to the technology and production resources necessary. Studies by FSG researchers and others have highlighted the persistent obstacles to technology adoption posed by risk (uncertain yields and prices), by lack of physical and financial access to inputs (especially improved seed), and by lack of integration between input and output markets that results in restricted access to inputs or to market outlets at favorable prices.

Factors that affect farmer decision making about on-farm investments are also relatively well understood. Such decisions are made taking into account all household objectives, activities, and resources. Farm investments that appear profitable may, nonetheless, not be implemented either because the necessary resources are not available or because other uses of funds may—for that household—have a higher priority (e.g., education or health expenses) or bring higher financial returns (e.g., nonfarm enterprises).

A stronger emphasis on production-side issues is important for two reasons. First, forces outlined at the beginning of this section, including climate change, are likely to accelerate change in the production environment and in the structure of demand, including both cross-border trade and domestic demand. Information on farm-level production conditions and

costs and returns will need to be monitored and updated as these changes occur, for current crop and animal enterprises as well as new ones that may emerge. Second, data on production costs will be a valuable complement to the increasingly strong body of information being generated by FSG country teams and their local partners about household and trader marketing behavior and market prices. For example, if knowledge of price transmission can be used to predict how changes in world prices will alter prices in regional and local markets, matching this information with knowledge of representative farming systems, and the costs of key crop or animal production enterprises, could allow inferences to be drawn about likely impacts of price changes on farm-level profitability and supply response.

Key topics addressed in this research will include:

- Collection of production cost data on crop or livestock activities that are important for food security and smallholder incomes, or which relate to key issues of national agricultural policy. New varieties with shorter or longer production cycles may be developed or introduced to assist farmers to adapt to climate change, and the cost and returns implications of these new varieties need to be assessed in the context of the overall farm household system. Crops such as cassava and sweet potato are gaining importance as food security insurance crops, yet their production costs are less well understood than those of staple grains such as maize and rice.
- Potential profitability and impact of conservation farming practices, including agroforestry as well as cultivation methods. Climate change is expected to result in drier and more extreme rainfall patterns in many parts of Africa, which will put a premium on effective use of water, including water harvesting techniques and reduced tillage. Replacement of field crops with tree crops or mixed agroforestry enterprises may also become more profitable and more environmentally sustainable.
- Crop yield and price risk and technology adoption. The risks associated with crop and livestock production in much of Africa, and the limited ability of many small farmers to manage risk, are long-standing problems that have resisted solution. New institutions and financial and market instruments now hold promise for mitigating these risks. FSG research will study the feasibility of these innovations at the country level.
- Farm size efficiency. Surveys carried out in FSG country projects have documented the substantial number of farms with land holdings or cultivated areas that seem clearly too small to meet family consumption needs or to provide the basis for successful small-scale commercial production. What size farm and scale of production are needed? Country-specific research is needed to help answer this question, which will depend in part on national objectives regarding food security and poverty alleviation, and on the ability of nonfarm and nonagricultural sectors of the economy to absorb farmers with inadequate land and labor resources who exit agriculture as the process of agricultural transformation evolves.

5.1.2. Sub-Theme 2: Marketing and Supply Chain Efficiency

Linking farmers to reliable and profitable markets is a sine qua non for rapid economic growth. It is also critical to generating the many nonfarm jobs needed to employ the burgeoning labor force. Yet marketing systems in low-income countries, particularly in Sub-Saharan Africa, will be under tremendous strain over the next 25 years. Population growth, rural-to-urban migration, income growth (with its associated shifts in consumption patterns), and increased specialization of farming are leading to exponential growth in the demand for

marketing services at the local, national, and regional level. Most African food marketing systems remain tightly constrained by high unit costs due to poor transportation and processing infrastructure; unreliable power supplies (which greatly increase processing costs); highly variable farm-level production; and high transaction costs due to unpredictable policies, weak systems of contract enforcement, and rent-seeking behavior of both private and public agents. These systems frequently lack the type of “public” or collective goods (e.g., widely accepted grades and standards) necessary to gain the economies of size and reliability needed to make African agricultural products competitive, even in African markets. The FSG research agenda will focus on concrete ways of relaxing these constraints within the framework of the agricultural transformation perspective described earlier. Particular attention will be placed on the role of collective action via stakeholder organizations (such as Zambia’s Task Force on Acceleration of Cassava Utilization) in providing critical “public” or club goods within the context of regional and national food sheds.

Key foci in this research will include:

- What production and marketing programs and policies are required to facilitate more efficient trade within key food sheds? MSU’s Food Security Group is currently assembling empirical information to define and map major staple food market sheds in Africa. This involves identification of key surplus production areas, major deficit markets, and the trade corridors linking the two. We have begun a mapping exercise aimed at displaying this information in an easily understandable, visual format. After mapping key staple food market sheds, and to the extent possible quantifying trade flows, we intend to use these data as the basis for determining the most important staple food market sheds to target with our research, outreach and institution-building efforts.
- Food retail modernization: this process will be much more complex than the widely promoted vision of supermarket takeover popularized in recent years. For SSA, the consensus view is now moving towards the realization that growth of such chains in nearly the entire continent will be too slow to transform food systems over time frames acceptable to most policy makers and donors. What packages of legislative, programmatic, and investment initiatives focused on the modernization of the existing traditional marketing system will be needed to achieve the needed improvements?
- What are the implications of more diversified consumption patterns for policy and investment priorities? In East and southern Africa, maize-focused policies risk becoming increasingly disconnected from the consumption preferences and production opportunities.
- What are the options for improving access to finance for rural and urban traders? As an increasing share of marketable surpluses is purchased by large-scale millers and poultry feed suppliers, it is important to ensure access by rural traders to finance for storage in rural areas and to ensure lean-season food availability for net buyer households. Similarly, in urban areas, the import trade in key commodities (e.g., rice and wheat) is often highly concentrated due to limited access to import credit, which results in higher prices to poor consumers.
- What is the role of collective action? Improved management of public market places, for example, is likely to depend on much greater private sector participation, yet this participation must take place through some kind of collective action. Similarly, farmer and trade access to credit can be greatly enhanced through effective collective action. In many countries, stakeholder strategic alliances (“interprofessions” in

French) are being promoted to help fill the role of providing strategic planning and mobilization of resources for key common investments. What policies, programs, and legislative and regulatory reforms are needed to make such collective action possible?

5.1.3. Sub-Theme 3: Land Policy and Access

In the coming years, secure access to land will be critical in creating incentives to invest in land-enhancing technologies and infrastructure and in accessing capital to do so (through creating collateral). Who has access to land will continue to strongly influence the distributional outcomes of future agricultural growth. In light of the recent rise in world food prices and growing demand for quality agricultural land in SSA and Latin and Central America, there is an emerging demand by policy makers in these regions for analysis of the impacts of alternative policies toward land. A coherent analysis of this topic involves answering the following questions:

- When governments wrest control of land from traditional authorities for development purposes, what impacts does that have on the availability of land for a smallholder-led agricultural growth strategy?
- What are the implications of foreign investment in agricultural land in Africa, both positive and negative, for rural employment, national food supplies, infrastructural development, and the potential for area expansion by future generations of smallholder farmers?
- What are the options for addressing the growing crisis of access to land within the smallholder sector and the implications of severe land constraints for rural poverty reduction strategies?

An analysis of these questions in an integrated manner would offer valuable guidance to policy makers in the region considering the sale or long-term leasing of land to foreign and domestic investors, the viability of a public investment-led strategy to overcome current land constraints within the smallholder sector, the opportunities and limits of addressing land constraints through rental markets, and the design of rural poverty reduction programs.

5.1.4. Sub-Theme 4: Household-level Poverty Alleviation and Safety Nets

Because of their low asset holdings, the poorest two-thirds of rural households present a particular challenge when designing broad-based poverty alleviation strategies. A high level of vulnerability to food shortages and/or high food prices makes it risky for resource-poor households to specialize in the production of high-value cash crops. In the long run, many households will migrate out of agriculture as a primary income source, but this depends on accumulation of human capital through education. The purpose of this research theme is to identify optimal strategies for increasing the resilience of vulnerable households with low assets and ensuring that children in those households can access the education they need to engage successfully in nonfarm activities. Two sets of questions will be addressed under this sub-theme:

- What are the trade-offs for different farm types between income diversification and specialization? In particular, how can livestock be used more effectively to increase household resilience to food price shocks? How can cash and food crop synergies be maximized and/or financial risks (associated with higher purchased input use)

reduced? What types of off-farm employment contribute most to resilience and school retention?

- How can safety nets used be more effectively to contribute to sustainable reductions in chronic poverty? Linking agricultural development strategies with safety nets is important not only for limited-resource farm households that are unable to escape poverty. Given the growing number of urban food insecure, it will be increasingly impossible politically to focus just on long-term agricultural productivity growth strategies, some of which require short-term increases in food prices, if there is not simultaneously a successful effort to create safety nets for the concentrated and politically vocal urban poor.

5.1.5. Sub-Theme 5: Managing Food Price and Supply Instability through Marketing and Trade Policies

Especially in light of recent world food price gyrations, African governments are extremely concerned with ensuring broad and reliable access to basic staple foods at tolerable prices. There are many alternative approaches to managing instability of food supplies and prices, with concerns that some of the approaches taken by African governments in recent years have been either counterproductive or excessively costly relative to the benefits achieved, discouraging investment in food system modernization. Yet those promoting more trade-based policies to deal with market instability have frequently not been able to provide credible advice to political leaders about how to handle the short-term political risks of price spikes. The challenge is to implement credible government policies that set the rules under which the state will manage markets, and to develop an approach that simultaneously allows the private sector to play a productive role in helping deal with market instability *and* provides the safety nets necessary to ensure political stability. Dealing with any of these issues independently is neither politically feasible nor economically sustainable. Managing down-side price risk has its own set of challenges. Protecting farmers against severe price plunges has been recognized as potentially important for supporting the expansion and sustained use of productivity-enhancing farm technologies. Regional organizations like COMESA and ECOWAS are promoting open regional trade and marketing but require compelling analytical evidence and outreach in order to address the concerns of politicians.

This sub-theme will feature a combination of empirical and political analysis to understand:

- What are the impacts of alternative trade policy regimes and risk management tools (such as futures and options markets) on food availability and food price volatility for strategic food sheds?
- What are the political economy challenges to adopting more open trade policies?
- Can well-designed safety net programs make it easier for governments to accept the perceived risks of adopting policy reforms?
- How can the private sector be more effectively integrated into policy dialogue on trade and food policy?

Proposed work under this sub-theme will explore these interactions and their potential implications for government programs and for efforts by regional organizations to achieve more open regional trade.

5.1.6. Sub-Theme 6: Agricultural Sector Information Capacity Building

Unreliable information on the agricultural sector (basic agricultural statistics, market information, outlook information) greatly constrains private- and public-sector investment and improved public policies to govern African food systems. Private traders in Mali, for example, report that because the government lacks reliable information on agricultural production and (especially) grain stocks, it often blocks trade out of fear that the country will be caught short of grain. Developing improved agricultural information, broadly conceived, is critical to fostering rapid agricultural growth, and is incorporated as a central element in emerging national and regional CAADP agendas.⁸

The FSG research agenda in this area will focus on:

- Analysis of the strengths and weaknesses of alternative models of market information provision (public, private, cooperative, and mixed systems);
- Agricultural statistics: organization and methods;
- Use of agricultural statistics: analysis and outreach for policymakers;
- Cost of production under different cropping scenarios;
- Production forecasts versus post-harvest production estimates and production trends;
- Cost-effective approaches to estimating sources and levels of household rural income, both agricultural and non-agricultural; and
- Market outlook and food balance monitoring.

⁸ CAADP is the African Union's Comprehensive African Agricultural Development Strategy, under which all Sub-Saharan African countries and the main Regional Economic Communities (e.g., ECOWAS and COMESA) are developing comprehensive agricultural investment programs and the policies to implement them.

6. LEVERAGING THE MSU FSG MODEL IN SUPPORT OF THE GLOBAL FOOD SECURITY INITIATIVE

Over the past 25 years, the MSU FSG, with sustained core support from USAID/Washington and country missions, has provided development practitioners at the country, regional and global levels with important insights into how to promote agricultural development and strengthen food security. In countries where the program has operated for a significant period of time, national decision makers and USAID country mission personnel can now interact with a trained cadre of host country analysts. What makes this model work? What are the payoffs from this model? How can it be leveraged to support the Global Food Security Initiative (GFSI)? In this concluding section we briefly address these questions.

6.1. Key Features of the Approach

The USAID cooperative agreement mechanism (Leader With Associate Award), by providing core funding as well as a structure for specific country buy-ins (Associate Awards), allowed the development of a model that would have been impossible under the traditional contract mechanism—especially the ability to develop core research themes and use them to derive comparable results across multiple countries. The FSG and its predecessor programs in Africa have been joint FSG and host country programs with a common vision, collaboratively determined agendas and well-coordinated activities. Local project teams consist of talented in-country staff who gain experience on the job and who benefit from short-term training or, in some cases, long-term degree training. The MSU FSG team consists of tenure-stream and fixed-term faculty members and numerous graduate students, many of whom are from countries with current or past FSG project activities.

FSG activities combine empirically based policy-oriented research with sustained policy dialogue with local decision makers to sharpen the relevance of the research to policy makers and translate applied research and policy analysis findings into action. While campus-based faculty members play an active supportive role in the policy dialogue process, it depends critically on contributions from in-country project team members (e.g., in Mali, Mozambique, Zambia). The ability to sustain country programs over a decade or more has strengthened understanding of local circumstances and built relationships with key institutions and decision-makers that greatly improve the effectiveness of new initiatives and reduce their start-up and transactions costs.

An important organizational feature is that the FSG is integrated into the Department of Agricultural, Food, and Resource Economics at MSU, rather than operating as a self-contained center. FSG faculty members contribute to teaching, graduate student advising, service, and other aspects of the department mission. This strengthens the sense of ownership of the program by the department and university, makes teaching programs more connected and relevant to students interested in development—many from Africa—and allows the program to benefit more from linkages to department faculty, students, and financial resources.

6.2. Payoffs to the Approach

The payoff to the FSG model of sustained partnerships is threefold: high policy impact, strengthened institutions for continued innovation after project completion, and greater

human capacity for the next generation of leadership in analysis, both in host countries and in development agencies in industrialized countries. The threefold impact guarantees greater durability of policy change. Important determinants of success in achieving policy impact include:

- Involving local analysts on the research and outreach team, to benefit from their local knowledge and to increase the credibility of results obtained.
- Designing research and outreach collaboratively and orienting them to key policy issues.
- Creating a demand among decision makers for policy-relevant research, in addition to supplying policy-relevant research and outreach products.
- Ensuring that data collected are analyzed and results are communicated to decision-makers.
- Striving for long-term involvement in-country in order to improve research relevance, quality, and credibility with decision makers.

The integration of research and outreach provides two benefits: (1) outreach helps refine the research agenda and provides a better understanding of decision makers' concerns; and (2) integrating research and outreach leads to significant institution-building impacts. For example, impacts in West Africa include: the creation and strengthening of market information systems throughout West Africa; the assistance to local communities in developing local food security plans in Mali; the creation of the subsector economics unit (ECOFIL) within the national agricultural research institute (IER) in Mali; the strengthening of the Food Security Commissariat in Mali; and fostering the creation of a regional traders' organization (ROESAO). In East and Southern Africa, reports and outreach have generated demand among policy-makers for empirical analysis and greater analytical rigor, as seen in the public policy debates in Zambian newspapers. In Mozambique, FSG designed and continues to support the market information system and the Socio-Economics Studies Center of the Agricultural Research Institute (IIAM).

FSG has had its strongest impacts in countries where FSG has been able to create or strengthen a cadre of well-trained analysts. Training researchers and policy analysts and sustaining this capacity within government and academic institutions is challenging because of the under-supply of African professionals with graduate training and the strong effective demand to hire them away, coming from international organizations, donors, NGOs, and the private sector.⁹ Long-term projects that partner closely with local institutions can build more sustainable capacity by offering in-service and graduate degree training opportunities to junior project staff, and then continued employment in the same institution or project upon completion of training.¹⁰ Returning staff can be engaged professionally in a rewarding and positive environment, in which they can build their skills and see the value of their work.

⁹ One could argue that movement of trained junior staff to other national or regional positions should also be seen as a capacity-building success.

¹⁰ Examples include the Bureau d'Analyses Macroéconomiques of the Institut Sénégalais de Recherches Agricoles (Senegal); the Departamento de Análise de Políticas and the Center for Socio-Economic Studies (Mozambique); the Agricultural Consultative Forum (Zambia); the Observatoire du Marché Agricole (OMA) in Mali; the Department of Agricultural Economics, University of Zimbabwe; and the Tegemeo Institute (for agricultural policy), Egerton University, Kenya.

6.3. Leveraging the FSG Model in Support of the Global Food Security Initiative

In collaboration with USAID/EGAT, the FSG team is taking steps to leverage the program's potential contributions to the GFSI. These steps include:

1. Expanding the number of countries and regions where FSG is active. EGAT has extended the geographical mandate of the FS III Leader Award from Africa to global. As a first response to this global mandate, FSG is currently in discussion with USAID/LAC and mission personnel from four countries in Central America regarding potential involvement of FSG in that region. A field visit to these countries is tentatively planned for early 2010.
2. Synthesizing and disseminating lessons learned from past FSG work in Africa for potential application in other countries and regions. Collating lessons on agricultural development in this document is a first step in this direction. In conjunction with USAID/EGAT staff, FSG will also review its Web sites and other dissemination methods (including quarterly e-mail updates on all applied research and outreach outputs) to see whether changes would improve their effectiveness in reaching the broad range of individuals and agencies involved in implementing the GFSI. FSG team members can also, when time permits, provide reviews and suggestions on selected mission proposals for GFSI funding.

To be successful, expansion of FSG activity will require a larger team with a greater diversity of skills, experience, and disciplinary background. The FSG co-directors are working with MSU administrators to secure approval to hire additional faculty members who would have the skills, experience, and interest to devote part or all of their time to collaborating with the FSG team. Efforts will also be made to identify ways to extend the FSG team by including faculty members with relevant skills in food security who are located in other units within MSU, or at other U.S. universities, as well as non-U.S. researchers. As new country- or regional-level activities are initiated, local research and policy-analysis partners will also be identified, and modes of collaboration with them sought that will have the greatest institution-building impact.

In addition, a larger and more stable level of core funding will be needed. With this in mind, FSG co-directors have proposed to MSU administrators that they endorse the creation of an endowment for the FSG program that would be funded 50% by private individuals and organizations, and 50% by matching contributions from the university. Even if this proposal is approved, however, it will not be possible to build a large enough endowment soon enough—in terms of the timetable of the GFSI—to substitute for the core funding from USAID bureaus that has been the mainstay of FSG over the last 25 years.

REFERENCES

- Diao, Xinshen and Peter Hazell. 2004. *Exploring Market Opportunities for African Smallholders*. 2020 Africa Conference Brief No. 6. Washington, DC: International Food Policy Research Institute.
On line at <http://www.ifpri.org/sites/default/files/publications/ib22.pdf>
- Diarra, Salifou, Abdramane Traoré, and John Staatz. 2004. Developing Sustainable Agricultural Information Services: Lessons from Mali. Presented at the Center for International Private Enterprise (CIPE) Workshop on Developing Sustainable Market Information Systems in Africa with Strong Public-Private Partnerships, 15-16 November. Maputo, Mozambique.
- Diskin, Patrick. 1994. *Understanding Linkages among Food Availability, Access, Consumption, and Nutrition in Africa: Empirical Findings and Issues from the Literature*. MSU International Development Working Paper No. 46. East Lansing: Michigan State University.
- Govere, Jones and T. S. Jayne. 1999. *Effects of Cash Crop Production on Food Crop Productivity in Zimbabwe: Synergies or Trade-offs?* MSU International Development Working Paper No. 74. East Lansing: Michigan State University.
- Jayne, T. S., Takashi Yamano, Michael Weber, David Tschirley, Rui Benfica, David Neven, Anthony Chapoto, and Ballard Zulu. 2001. *Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies*. MSU International Development Paper No. 24. East Lansing: Michigan State University.
- Mather, David, Cynthia Donovan, Thomas Jayne, and Michael Weber. 2005. *Using Empirical Information in the Era of HIV/AIDS to Inform Mitigation and Rural Development Strategies: Selected Results from African Country Studies*. MSU Policy Synthesis No. 75. East Lansing: Michigan State University.
- Oehmke, J. F. and E. W. Crawford. 1996. *Payoffs to Investments in Agricultural Technology in Sub-Saharan Africa*. MSU Policy Synthesis No. 20. East Lansing: Michigan State University.
- Penders, Christopher L., John M. Staatz, and James F. Tefft. 2000. *Agricultural Development and Child Nutrition: What Do We Know?* MSU Policy Synthesis No. 52. East Lansing: Michigan State University.
- Reardon, Thomas, Valerie Kelly, Eric Crawford, Thomas Jayne, Kimseyinga Savadogo, and Daniel Clay. 1996. *Determinants of Farm Productivity in Africa: A Synthesis of Four Case Studies*. MSU International Development Paper No. 22. East Lansing: Michigan State University.
- Staatz, John M., Duncan H. Boughton, and Cynthia Donovan. 2009. Food Security in Developing Countries. In *Critical Food Issues: Problems and State-of-the-Art Solutions Worldwide*, ed. Laurel Phoenix and Lynn Walter. Westport, CT: Praeger Publishers.
- Staatz, John and Niama Nango Dembélé. 2007. *Agriculture for Development in Sub-Saharan Africa*. Background paper for the World Bank's *World Development Report 2008: Agriculture for Development*. Washington, D.C.: World Bank. On line at

http://siteresources.worldbank.org/INTWDR2008/Resources/2795087-1191427986785/StaatzJ&DembeleN_AgriForDevInSSA_ve19.pdf

- Tefft, James and Valerie Kelly. 2004. *Understanding and Reducing Child Malnutrition in Mali: Interim Research Findings for the Project on Linkages between Child Nutrition and Agricultural Growth (LICNAG)*. MSU Staff Paper No. 04-27. East Lansing: Michigan State University.
- Tschirley, David, Colin Poulton, and Patrick Labaste (Eds.). 2009. *Organization and Performance of Cotton Subsectors in Africa: Learning from Reform Experience*. Washington, D.C.: World Bank.
- Tschirley, David, Milton Ayieko, Munguzwe Hichaambwa, Joey Goeb, and Wayne Loescher. 2009. Modernizing Africa's Fresh Produce Supply Chains without Rapid Supermarket Takeover: Towards a Definition of Research and Investment Priorities. Paper prepared for the conference Towards Priority Actions for Market Development for African Farmers, 15-17 May. Sponsored by the Alliance for a Green Revolution in Africa (AGRA) and International Livestock Research Institute. Nairobi.
- Tschirley, David and Anne Marie del Castillo. 2006. *Local and Regional Food Aid Procurement: An Assessment of Experience in Africa and Elements of Good Donor Practice*. MSU International Development Working Paper No. 91. East Lansing: Michigan State University.
- United Nations Economic Commission on Africa. 2005. *Economic Report on Africa 2005: Meeting the Challenges of Unemployment and Poverty in Africa*. New York: UNECA.
- USDA. 2009. *Food Security Resources*. U.S. Department of Agriculture, Food and Nutrition Service. Washington D.C.: USDA. On line at <http://www.fns.usda.gov/fsec/>
- Weber, Michael T., Cynthia Donovan, John M. Staatz, and Niama Nango Dembélé. 2005. *Guidelines for Building Sustainable Market Information Systems in Africa with Strong Public-Private Partnerships*. MSU Policy Synthesis No. 78. East Lansing: Michigan State University.
- Weight, David and Valerie Kelly. 1998. *Restoring Soil Fertility in Sub-Saharan Africa: Technical and Economic Issues*. MSU Policy Synthesis No. 37. East Lansing: Michigan State University.
- World Bank. 2007. *World Development Report 2008: Agriculture for Development*. Washington, D.C.: World Bank. On line at <http://go.worldbank.org/ZJIAOSUFU0>