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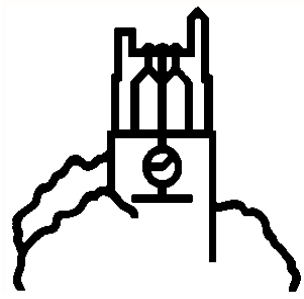
Patterns and Trends in Food Staples Markets in Eastern and Southern Africa:

Toward the Identification of Priority Investments and Strategies for Developing Markets and Promoting Smallholder Productivity Growth

By

T.S. Jayne, Nicole Mason, Robert Myers, Jake Ferris, David Mather, Margaret Beaver, Natalie Lenski, Antony Chapoto, and Duncan Boughton



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PATTERNS AND TRENDS IN FOOD STAPLES MARKETS IN EASTERN AND SOUTHERN AFRICA:

TOWARD THE IDENTIFICATION OF PRIORITY INVESTMENTS AND STRATEGIES FOR DEVELOPING MARKETS AND PROMOTING SMALLHOLDER PRODUCTIVITY GROWTH

by

T.S. Jayne, Nicole Mason, Robert Myers, Jake Ferris, David Mather, Margaret Beaver, Natalie Lenski, Antony Chapoto, and Duncan Boughton

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EXECUTIVE SUMMARY

Accurate information on farmer and consumer behavior is the foundation for identifying public investments and policies that can effectively promote national food security and income growth objectives. This report synthesizes recent findings on smallholder crop marketing behavior and urban consumption patterns in Eastern and Southern Africa, and their implications for public sector investments and policies to promote smallholder incomes and national food security.

The report highlights ten major issues:

1. A smallholder-led agricultural strategy is necessary to rapidly reduce rural poverty, but inadequate access to land is increasingly constraining the potential for a broad-based smallholder-led agricultural development strategy: Farm sizes are declining over time as rural populations grow and families sub-divide their land to the next generation. In the four countries examined in the report (Kenya, Malawi, Mozambique, and Zambia), over 50% of the farms are below one hectare in size. As average farm size falls below one hectare, a staple food-based agricultural system under a primarily rain-fed system with one growing season using low-input technology is in most areas not going to provide a viable pathway out of poverty.

The potential remains for successful smallholder-led agricultural development, and this is indeed necessary to achieve meaningful reductions in rural poverty. There are three ways to address this problem and probably all three will be required. First, support productivity growth of staple food cultivation with improved access to inputs and management knowledge, so smallholders can produce a surplus on farm sizes that are currently too small to do so. However, this strategy is viable only in areas well suited to intensified staple food cultivation where response to fertilizer application is favorable. Second, support crop diversification into higher-return activities, such as fresh fruits and vegetables, dairy, and other activities. To some extent this is already happening naturally, but facilitating it will require supportive government investments in market infrastructure and reliable food retail markets in rural areas so that farm households can trust that staple grain will be available to purchase with the income they earn from cash crops. The third pathway for overcoming the land-related constraints on a successful smallholder-led agricultural development strategy is for governments to invest in infrastructure and services in regions that are currently underutilized to encourage new settlement in productive but currently underexploited areas. There remains ample scope for such a strategy in many, but not all countries in the region. But the recent transfer of massive amounts of land for large-scale commercial investment and the massive amounts of public resources that have in some cases accompanied these commercial land investments may impede needed access to land for future generations of smallholder farmers.

2. Smallholder farmers are less isolated from markets than commonly thought: Smallholders selling maize report improvements in their access to buyers. The number of private traders coming into both accessible and remote villages to buy maize from farmers in the first 4-5 months after the harvest is usually more than 10 and in many cases more than 20. According to national surveys of smallholder farmers, the median distance travelled by farmers to sell their maize in Malawi, Zambia, and Kenya is zero, indicating that most farmers sell their maize to traders who come directly into their villages, even in inaccessible and remote areas. This points to evidence of steady investment in grain assembly and

transport over the 20 years since private grain trade was legalized. These observations call for a re-examination of the meaning of "access to markets", "isolated area" and similar phrases which have been associated with the distance to roads or market towns. We find that smallholders' access to competitive grain buyers is generally not related to either distance to roads or towns, but is more often related to marketing board operations that affect the incentives of private traders to operate in particular areas.

It remains true that a minority of smallholders are able to produce a food surplus to sell. However, their lack of market participation is driven more by inadequate land and productive assets than by isolation from markets. This puts the main burden on the generation of improved farm technology, management practices, and access to land and other productive resources so that more farmers are capable of relating to markets as sellers.

3. Farmers receive about 60% to 90% of the price of maize grain observed in the district retail markets: By matching farm-gate prices received by interviewed farmers with prices observed in regional markets during the same period, it is found that farm prices are roughly 60% to 90% of retail maize grain prices in Zambia, Kenya, and Malawi. Yet farmers in the same villages obtained widely varying prices for their maize in the same month, indicating major differences among farmers in negotiation ability and understanding of their marketing options. These findings indicate potentially high returns to farmer marketing training to raise their incomes from surplus grain production.

4. By contrast, farm-gate maize prices over the period 2000-2008 accounted for only 35% to 45% of the total value of commercial *maize meal* in these countries. Marketing and processing costs account for the lion's share, 55% to 65%, of the cost that consumers pay for commercial maize meal. This implies that new marketing technologies or institutional innovation within the marketing system that would reduce marketing costs by 10%, for example, would benefit consumers more than a 10% reduction in farm production costs brought on by new farm technology. Efforts to improve farm-level productivity are absolutely critical to achieve broad-based rural income growth and food security. Yet the potential for future farm-level income and productivity growth in the region are likely to be intimately tied to future cost-reduction in the marketing system.

5. There is very limited grain storage in rural areas. Traders frequently indicate constraints on availability of storage facilities and disincentives to engage in intra-seasonal storage. There are six main causes of disincentives to store grain and invest in storage facilities:

i) *Staggered harvest seasons in some areas:* In regions with multiple harvests per year, such as Kenya, Uganda, and northern Tanzania, there are relatively small intra-seasonal price rises. Maize production is hitting the market at various times throughout the year. This shifts the emphasis of marketing from intra-seasonal storage to spatial arbitrage, shifting grain from places where the harvest is hitting the market to areas experiencing demand at that time.
ii) *Unpredictable government operations in grain markets:* Highly discretionary government policies create major risks for grain storage. Export bans, sudden modification or removal of import tariff rates, and stock releases from government silos at concessionary prices are examples of how government activity can undermine the returns to intra-seasonal storage. Growing concerns over manipulation of national crop production estimates and food balance sheets also further erodes confidence in publicly provided information that plays an important role in encouraging storage activity in other parts of the world.

iii) *The resulting grain price uncertainty inhibits commercial bank investment in grain storage and makes investing in government instruments relatively attractive:* Most governments in the region are running deficits, which they finance by offering high-interest bills and bonds. Local banks naturally are content to earn a safe return investing in these government bonds rather than make loans to highly risky investments in grain arbitrage. Reducing the policy risk in markets will encourage bank investment in African agriculture.

iv) *Uncertainty over disposition of current marketing board storage facilities:* Most of the silo capacity in countries such as Kenya, Malawi, and Zambia remains in public sector hands. The potential for selling parastatal storage facilities at concessionary prices as part of some future privatization plan acts as a deterrent to new commercial investment in storage. This pattern of bank investment also shifts major investible liquidity in a country into government operations and programs rather than commercial investment.

v) *Threat of grain confiscation:* Recent events in Malawi, Ethiopia, and Kenya demonstrate that there is some risk of stored commodities being confiscated or destroyed.

vi) *Lack of quality standards with respect to moisture content:* Assembly traders and wholesalers make little effort to discourage the buying of wet maize or to separate it from higher quality dry maize. If anything, the tendency is to combine wet and dry maize in order to mask the ability to detect wet maize by the next buyer. The storage of high-moisture content maize results in rotting and high storage losses.

6. Disincentives to store grain also exacerbate the flow of grain out of informal markets and contribute to a circuitous flow of grain from surplus-producing farmers in grain deficit areas to urban areas, only to be milled by large-scale processors and then re-distributed back to the grain-deficit rural areas in the form of expensive commercially milled meal. This problem contributes to redundant transport costs and higher food costs for consumers.

7. Informal grain markets tend to become very thin in the hunger season after the majority of smallholders' surplus production has been bought up and fed into formal marketing channels. Once in the hands of formal sector marketing agents, grain rarely gets back into informal channels. This market segmentation would not necessarily be a problem if it were not for the fact that the formal sector tends to charge much higher marketing margins than informal traders, and hence formal sector retail prices for maize meal and other finished staple products are almost always substantially higher than the retail goods processed and sold by informal traders and millers. The problem of segmented markets – a competitive and agile informal sector which is starved for capital, and a more highly-capitalized formal trading sector which is competitive in some cases and oligopolistic in others – leads to a common situation during the hungry season in which informal markets dry up and are unable to acquire grain due to barriers to regional trade and selective channeling of imports to a few formal trading firms. As a result, consumers pay considerably higher prices for their staple food than would be the case if informal markets were not discriminated against.

8. The staple grains policy environment in many countries in the region is highly unpredictable. It is sometimes assumed that policy reforms were implemented and hence the policy environment poses no special challenges. We strongly disagree with this view. In fact, policy uncertainty, vacillation, and institutional vacuums are the norm in much of the region, which lead to problems of credible commitment with the private sector. Policy reforms have been implemented in a *de jure* sense but the potential benefits of such reforms are eroded by *ad hoc* policy interventions in both external trade and domestic marketing which exposes the private sector to huge risks and financial losses. All this uncertainty stifles private investment in the development of agricultural markets, which in turn continue to

deprive African smallholders of services and markets that would otherwise allow them to raise their crop productivity set in motion a number of virtuous cycles.

9. Staple food marketing systems are characterized by weak coordination among the players in the value chain/marketing system: Transporters are unable to coordinate well with traders in the potential use of cost-reducing marketing and transport technology. Large traders in one country are often prohibited from linking with millers seeking grain in other countries. The SAFEX price discovery process, which could be so useful to governments, marketing firms and contribute to the development of more structured markets throughout the region, is frequently lost due to highly discretionary state operations in markets.

10. Many market failures commonly observed in the region reflect chronic underinvestment in productivity-enhancing public goods. The costs of participation in markets are unusually high in most of Africa due to limited investment in transport infrastructure, ports, rail, road, and electricity. The ports in eastern Africa are in a state of decay and the high costs involved in importing fertilizer and other goods acts as a tax on farmers as well as the entire economy. Farmer participation in staple food markets is also constrained by weak commitments to crop science, especially relevant for semi-arid conditions, and effective extension services for farmers. Ironically, while reviews of the Asian green revolution experience underscore the very high payoffs to public investment in R&D and physical infrastructure in terms of agricultural growth and poverty reduction, these public goods investments account for a very low percentage of national budgets among most African nations and in some cases are crowded out by large-scale input promotion programs with uncertain long-term effects.

Recurrent Patterns in Smallholder Farmer Behavior

The report also highlights a number of recurrent patterns in smallholder farm behavior and urban consumer behavior that appear to be consistently observed in most countries for which survey evidence is available. The report highlights six main findings about smallholder crop production and marketing behavior:

1. Maize is generally the single most important crop in smallholder farm incomes: When adding the value of production and sales, maize accounts for 44%, 41%, 26% and 23% of farm income in Malawi, Zambia, Kenya, and Mozambique, respectively, according to recent national surveys. The importance of maize varies greatly by region. Maize accounts for as much as 70% of farm income in some areas (generally those of relatively high agro-ecological potential), and less than 10% in others (generally the semi-arid areas). In general, maize accounts for a slightly higher share of total income on relatively large farms, except in Malawi.

2. *Fresh fruits and vegetables are becoming more important in smallholder cropping patterns and are now rivaling maize as the highest income-generating crops for smallholder farmers.* While maize is still the dominant crop in terms of area cultivated, high-value food crops such as fruits, vegetables, and legumes account for a greater share of household income (29% of farm household income in Kenya and 28% in Mozambique, compared with 26 and 23% for maize, respectively). In Kenya and Mozambique, the smallest farms have the highest share of farm income from horticultural crops.

3. *Maize will continue to play a crucial role in agricultural productivity growth even if its share of farm income and sales revenue may decline somewhat over time.* Smallholders' ability to diversify into higher valued activities will be influenced by the performance of

staple food markets. If food is reliably available in markets at tolerable prices, smallholder farmers are likely to shift more of their land and labor into crops that provide higher returns and then use the proceeds to buy food from the market. Shifts toward higher-return activities can be a source of major productivity and income growth for smallholder farmers, but such a strategy depends on reliable availability of staple food to buy at tolerable prices.

4. The sale of traditional cash crops is also highly related to landholding size. In Zambia, Malawi, and Mozambique, the farm income share from traditional cash crops are from 7 times to over 20 times higher among households in the top landholding size quintile than in the bottom quintile. In Kenya, the farm income share of traditional cash crops is roughly constant across the landholding size quintiles, but in terms of absolute gross income, the relatively large farms derive 3-4 times more gross income from the sale of these crops than the smallest farm quintile.

5. Livestock products form a large share of farm income only in one of the four countries examined, Kenya, where it comprised 23% of farm income. This reflects the importance of commercialized dairy production among smallholders in Kenya. Livestock product income accounts for less than 10% of farm income in the other countries.

6. Smallholder farmers' participation in grain markets is determined by several factors including their asset position (e.g. land, labor, and capital), agro-ecological conditions, and access to markets. Owing to a highly inegalitarian distribution of land within the smallholder sector, the marketed grain output in the smallholder sector is extremely concentrated. In all the countries in the region for which survey data is available, there is a recurrent pattern in which roughly 2-3% of relatively commercialized smallholder farmers account for half or more of the total quantity of maize sold by the smallholder sector. Rarely do more than 40% of farmers sell grain in any given year, not because buyers cannot be found, but more fundamentally because the combination of limited productive assets and limited access to improved technology precludes them from being able to produce a meaningful farm surplus.

Trends in Urban Food Consumption Patterns

The report highlights three main findings and their implications for food policy:

1. Rising importance of wheat in urban staple food consumption: Urban consumption of wheat is rising rapidly and has become the dominant staple in many cities of East and Southern Africa. Urban consumption surveys consistently attest to the rising importance of wheat products in staple food consumption patterns. However, maize is still the dominant staple among the 30% to 40% of the poorest urban consumers.

The rising importance of wheat products in urban consumption patterns in the region has several underlying causes: i) Urbanization and growing preferences for convenience foods; and ii) the price of wheat products has declined in many cases relative to the price of maize products. We note a strong decline in the inflation-adjusted price of wheat bread over time, compared to a more modest decline (in Zambia and Kenya) or increase (in South Africa, Malawi, and Mozambique) in the real price of maize meal. The gradual decline in the retail price of wheat products compared to maize meal has contributed to the shift in urban consumption patterns over time.

Wheat is currently not well-suited for smallholder production in most of Africa. Wheat production usually requires capital-intensive investment in irrigation and other production technologies. As a result, scale economies in production cannot be achieved unless large

areas can be put under production, which is beyond the means of almost all smallholders. For these reasons, the growth in wheat consumption presents a dilemma. Ideally, economic growth is best achieved by rural-urban synergies in which urban populations create a market for rural producers, while the income received from agriculture is used to meet the demand for goods and services produced by urbanites. To the extent that urban consumers increasingly rely on products produced only by large-scale farmers or procured in international markets, these synergistic growth processes between smallholder farmers and urban consumers will be mitigated, with adverse implications for economic development.

2. Rapid investment in medium- and small-scale staple food processing and retailing are largely responsible for the reductions in marketing margins and retail food prices that have been documented in much of the region: In inflation-adjusted terms, the unit price of commercial maize meal has declined by 30 to 35% in Kenya and Zambia over the 1995-2009 period. Market liberalization has resulted in rapid investment in grain milling, which put pressure on the formerly oligopolistic commercial milling industry to reduce their margins. As long as grain is circulating in informal markets, consumers can buy grain and mill it at a neighborhood hammer mill, of which there are thousands dotted throughout the country. At this time, the structure of the market is highly competitive and milling/retailing margins are low. In any given area, a few large milling firms are competing against scores of small-scale millers and retailers for consumers' business. However, later in the season when maize sales off the farm tend to dwindle, the informal markets become very thinly traded. A scarcity of maize grain in local markets means that the small- and medium-scale processing sector are unable to operate. At this time, the structure of the market becomes more concentrated, and the demand for large-scale commercial millers' products jumps up as consumers now can only procure maize meal from this source. Consumers pay substantially higher prices for staple maize products at this time.

3. Grain is often unavailable to buy at certain times of the year: Even when there are adequate maize supplies nationally, once grain is purchased by the larger traders or by government marketing agencies, it generally cannot be accessed by informal small-scale millers or retailers. Large public and private traders sell mainly to commercial millers and other industrial buyers. These commercial maize products are then distributed through a variety of retail channels, including informal channels, but these products are relatively expensive compared to the less processed and less value-added products distributed through informal channels which are preferred by most low-income consumers. The drying up of informal markets during the hunger season exacerbates low-income consumers' access to food and contributes to food insecurity. During times of regional production shortfalls, these problems are accentuated. In such cases, imports from South Africa or international markets are required. Large-scale imports are usually supplied in large transactions to the large millers only, again effectively sidelining the small and medium-scale processing sector that the poor rely on and which exert competitive pressure on the large-scale processing sector to trim their margins.

Main Implications for Public Investments and Policies toward the Agricultural Sector

History suggests the necessity of productivity increases in smallholder agriculture. Except for a handful of city-states, there are virtually no examples of mass poverty reduction since 1700 that did not start with sharp rises in employment and self-employment income due to higher productivity in small family farms.

Smallholders' ability to respond to crop marketing improvements is fundamentally constrained by farm structure: over half of the small farms in the region are less than one

hectare in size. One-quarter of the farms are less than 0.5 hectares in size. These farms cannot earn a viable livelihood through a maize commercialization strategy unless there is tremendous growth in maize productivity, which will require sustained and dedicated investment in crop science and extension.

While improved performance of staple food markets will support smallholders' participation in food markets, survey data reveal that limited land and capital are often the primary reason why the majority of smallholder farmers do not sell staple foods. Even with major improvements in the performance of food markets, a large percentage of smallholders will continue to be unable to produce a surplus that would enable them to link to markets. An important conclusion appears to be, therefore, that "access to markets" may not be the primary constraint for the bottom 50% of smallholders with inadequate land or productive assets to produce a staple food surplus in the first place. For this bottom 50% of the rural farm population, governments face the double burden of providing the means to put improved farm technology in their hands that is appropriate for their conditions, and ensuring that smallholders have access to markets that minimize marketing costs. This boils down to simultaneous improvements in farm technology (including for semi-arid conditions in which a large fraction of the smallholder populations in the region reside), access to credit, improved rural road, rail and port infrastructure, and hospitable conditions for private investment in rural input retailing and crop assembly. For the top 50% of smallholders ranked by land and productive potential, the main challenges are reducing the transaction costs of marketing output and protection against downside price risk.

Moreover, without the opening up of new land through public investments to encourage new settlement and/or substantial maize productivity growth, the gradual movement toward smaller farm sizes will compel households to adopt more diversified commercialization strategies or opt out of agriculture. In highly land-constrained areas, it should not be surprising to find continued high out-migration to urban areas, with remaining farm households shifting out of relatively low-value maize toward horticulture, tobacco, cotton, and niche crops, and then using the revenue to buy their staple food needs. Thus, the trend toward structural maize deficits is not necessarily a sign of failure for the region if non-farm sectors can grow to absorb labor migrating out of agriculture, and if remaining small farmers can shift into other activities that provide higher incomes. There is evidence to suggest that this is already happening at least for a sub-set of smallholder farmers in the region. Governments may promote more stable farm revenue and consumption patterns through supporting private systems of input delivery, finance, and commodity marketing for a wide range of crops given the increasingly dynamic nature of African and world agriculture. Such investments would represent a shift from the strategy of price stabilization and price support for a dominant staple grain to a portfolio approach that puts greater emphasis on a range of higher-valued commodities while attempting to make the socio-political economy less vulnerable to the effects of food price instability.

Therefore, the finding that the eastern and southern Africa regions are moving into a structural staple food-deficit situation may be a consequence of rapid urbanization borne of population growth and land pressures, and diversification into other crops. Yet maize productivity growth will remain a crucial objective. If it can be achieved, it will reduce import dependence and remain a source of dynamism and growth for many small farmers in the region. However, broad-based improvements in rural livelihoods and incomes will require dynamism and growth in non-farm sectors as well as productivity growth for other crops: oilseed crops, horticulture, animal products, and other food crops such as cassava.

Making markets work for smallholder farmers will require actions from many different actors, both private and public, as well as from international financial and donor organizations. Our premise, however, is that the public sector role is decisive. If public sector policy choices do not reduce the currently high levels of risk and uncertainty in African agricultural markets, and if governments use their scarce resources in ways that do not provide greater investment incentives for the private sector, then there will be limited scope for private investment to provide smallholder farmers with the access to markets that they need. Financial markets will also stay away from African agriculture if the risks of investment remain very high relative to the returns. On the other hand, if African governments define their roles clearly, implement these roles transparently and consistently, and invest their scarce resources in ways that make the greatest contribution to agricultural growth and poverty reduction, then this approach is likely to leverage even greater private investment in support of smallholder agriculture. When the conditions are created for profitable and stable private investment, the private sector has in other parts of the world grown and responded as seen in much of Asia, and there is little reason to believe Africa is different. Hence, private sector investment patterns and the supply of bank financing for private investment, are largely *outcomes* of public sector behavior – its policy choices, integrity of its institutions, and the ways it spends its funds through the treasury.

For these reasons, we conclude that there is no single or deterministic "future" of the small farm in Africa. The decisions made by governments primarily and international organizations secondarily will largely determine the future of smallholder agriculture in the region. Without renewed attention to sustained agricultural productivity growth, most small farms in Africa will become increasingly unviable economic and social units. Sustained agricultural productivity growth and poverty reduction will require progress on a number of fronts, most importantly increased public goods investments to agriculture, a policy environment that supports private investment in input, output and financial markets and provision of key support services, a more level global trade policy environment, supportive donor programs, and improved governance. Subsidies, if they are focused, well conceived and implemented, and temporary, can play a complementary role but should not – based on the Asian evidence presented here – be seen as fundamental to the process. Most of these challenges can be met. Meaningful progress will start when the political will is mobilized to adopt the policies and public investments which substantial evidence shows have the greatest chances of driving sustainable pro-poor agricultural growth.

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ACRONYMS

ACF	Agricultural Consultative Forum, Zambia
ACRE	Average Crop Revenue Election
ADMARC	Agricultural Development and Marketing Corporation
AGMOD	An Econometric model of U.S. agriculture
AISS	Agricultural Inputs Support Survey
CBS	Central Bureau of Statistics
CPI	Consumer Price Index
CRS	Catholic Relief Services
CSA	Census Supervisory Areas
CSO	Central Statistical Office,
DAP	Ministry of Agriculture's Policy Analysis Department
DDG	distillers' dried grain
DOE	U.S. Department of Energy
DRC	Democratic Republic of Congo
EAs	Census Enumeration Areas
ECX	Ethiopia Commodity Exchange
EISA	Energy Independence and Security Act of 2007
EIU	Economist Intelligence Unit
ERS	Economic Research Service
ESA	Eastern and Southern Africa
FAO	Food and Agricultural Organization
FSRP	Food Security Research Project, Zambia
FSU	Former Soviet Union
GDP	Gross Domestic Product
GMB	Zambia's Grain Marketing Board
GTZ	Gesselschaft für Technische Zusammenarbeit
IDRC	International Development Research Centre
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IPD	Implicit Price Deflator
KACE	Kenya Agricultural Commodity Exchange
KMDP	Kenya Market Development Programme
KNBS	Kenya National Bureau of Statistics
MACO	Ministry of Agriculture and Cooperatives, Zambia
MIC	Kenya Market Information Center, Ministry of Agriculture
MINAG	Ministry of Agriculture, Mozambique
MSU	Michigan State University
MT	Metric Ton
MTI	Kenya Ministry of Trade and Industry
NAFTA	North American Free Trade Agreement
NASSEP	National Sample Survey and Evaluation Programme
NCPB	National Cereals and Produce Board
NEPAD	New Partnership for African Development
NGOs	Non-governmental Organizations
NMC	National Milling Corporation
PHS	Central Statistical Office's Post Harvest Survey, Zambia
PSUs	primary sampling units
R&D	Research and Development
RFS	Renewable Fuels Standard
SAFEX	South African Futures Exchange

SEAs	Standard Enumeration Areas
SG-2000	Sasakawa/Global-2000
SIMA	Agricultural Market Information System
SS	Supplementary Surveys
UCS	Urban Consumption Survey
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WTO	World Trade Organization

1. INTRODUCTION

1.1. Description of the Problem

Throughout the world, the major share of staple food costs to the consumer is typically accounted for by marketing costs. The maize-based agricultural economies of eastern and southern Africa are no exception: farm-gate maize prices over the period 2000-2008 accounted for roughly 35% to 45% of the total value of commercial maize meal in Zambia, Kenya, Malawi, and Mozambique (Chapoto and Jayne 2009). Marketing and processing costs account for the lion's share, 50% to 65%, of the cost that consumers pay for commercial maize meal. This implies that new marketing technologies or institutional innovation within the marketing system that would reduce marketing costs by 10%, for example, would benefit consumers more than a 10% reduction in farm production costs brought on by new farm technology. Efforts to improve farm-level productivity are absolutely critical to achieve broad-based rural income growth and food security. Yet, as we conclude below, the potential for future farm-level income and productivity growth in the region is likely to be intimately tied to future cost-reduction in the marketing system.

The development of staple food markets will clearly play an important role in helping Africa to achieve broad-based income growth, poverty reduction, and food security. Yet staple food markets in Africa are performing under severe burdens that impede their ability to contribute to the achievement of these objectives. Consider the following facts:

- The technology to raise farmers' yields substantially in many areas is already on the shelf, as shown by the Sasakawa/Global-2000 (SG-2000) programs of the 1990s, but the means to consistently put these technologies in farmers' hands are not. The SG-2000 experiences demonstrated that African farmers can dramatically improve their yields when supplied with the appropriate technologies and management practices, but their yields quickly reverted to former levels after the withdrawal of the programs. These programs have so far been thwarted by their inability to anticipate and address downstream issues of marketing and governance.
- Staple food markets are very price inelastic. In an environment of large weather-driven changes in production, inelastic demand gives rise to wide price fluctuations. Moreover, supply expansion caused by the uptake of productivity-enhancing technologies tend to be short-lived because they lead to price slumps and hence act as a disincentive for farmers to sustain their use of improved technology.
- Informal grain markets tend to become very thin in the hunger season after the majority of smallholders' surplus production has been bought up and fed into formal marketing channels. Once in the hands of formal sector marketing agents, grain rarely gets back into informal channels. This market segmentation would not necessarily be a problem if it were not for the fact that the formal sector tends to charge much higher marketing margins than informal traders. Therefore formal sector retail prices for maize meal and other finished staple products are almost always substantially higher than the retail goods processed and sold by informal traders and millers. The problem of segmented markets – a competitive and agile informal sector which is starved for capital, and a more highly-capitalized formal trading sector which is competitive in some cases and oligopolistic in others – leads to a common situation during the hungry season in which informal markets dry up and are unable to acquire grain due to barriers to regional trade and selective channeling of imports to a few formal trading firms. As a result, consumers pay considerably higher prices for their staple food than would be the case if informal markets were not discriminated against.

- There is a highly inegalitarian distribution of land within the smallholder sector, which leads to a concentrated pattern of smallholder market participation. In all the countries in the region for which survey data is available, there is a recurrent pattern in which roughly 2-3% of relatively commercialized smallholder farmers account for half or more of the total quantity of maize sold by the smallholder sector. Rarely do more than 40% of farmers sell grain in any given year, not because buyers cannot be found, but more fundamentally because the combination of limited productive assets and access to improved technology precludes them from being able to produce a meaningful farm surplus.
- Many "market failures" commonly observed in the region reflect chronic underinvestment in productivity-enhancing public goods. The costs of participation in markets are unusually high in most of Africa due to limited investment in transport infrastructure, ports, rail, road, and electricity. The ports in eastern Africa are in a state of decay and the high costs involved in importing fertilizer and other goods acts as a tax on farmers as well as the entire economy. Farmer participation in staple food markets is also constrained by weak commitments to crop science, especially relevant for semi-arid conditions, and effective extension services for farmers. Ironically, while reviews of the Asian green revolution experience underscore the very high payoffs to public investment in research and development (R&D) and physical infrastructure in terms of agricultural growth and poverty reduction (Rashid, Cummings, and Gulati 2007), these public goods investments account for a very low percentage of national budgets among most African nations. In some cases, these investments are crowded out by large-scale input promotion programs with uncertain long-term effects.
- The staple grains policy environment in many countries in the region is highly unpredictable. It is sometimes assumed that policy reforms were implemented and hence the policy environment poses no special challenges. We strongly disagree with this view. In fact, policy uncertainty, vacillation, and institutional vacuums are the norm in much of the region, which lead to problems of credible commitment with the private sector. Policy reforms have been implemented in a *de jure* sense but the potential benefits of such reforms are eroded by *ad hoc* policy interventions in both external trade and domestic marketing which exposes the private sector to huge risks and financial losses. All this uncertainty stifles private investment in the development of agricultural markets, which in turn continue to deprive African smallholders of services and markets that would otherwise allow them to raise their crop productivity set in motion a number of virtuous cycles.
- More broadly, staple food marketing systems are characterized by weak coordination among the players in the value chain/marketing system: transporters are unable to coordinate well with traders in the potential use of cost-reducing marketing and transport technology. Large traders in one country are often prohibited from linking with millers seeking grain in other countries. The South African Futures Exchange (SAFEX) price discovery process, which could be so useful to governments, marketing firms and the development of more structured markets throughout the region, is frequently lost due to state controls on trade.

These seven broad problems reflect the magnitude of the burden facing those attempting to improve the functioning of staple food markets in the region. However, it is our strong conviction that the knowledge currently exists to overcome these challenges. The main constraints are political and institutional, and hence active engagement with governments will inevitably be a crucial part of the solution.

1.2. Objectives

This study synthesizes available knowledge to date on the problems to be addressed in improving the functioning of staple food markets in the region and identifies priority investments and other actions needed to overcome these challenges. To achieve these objectives, we provide a detailed description of smallholder staple food production, consumption, marketing, and storage behavior, and urban consumption patterns. Given the highly heterogeneous nature of smallholder agriculture, a differentiated micro-level perspective of smallholder production and marketing patterns (stratified by landholding size) is important for understanding the strengths and limitations of alternative options for improving grain market performance.

We also identify the challenges associated with the development of improved marketing institutions such as warehouse receipt systems, commodity exchanges, and various risk management tools. We also use a world food systems model developed at Michigan State University, AGMOD, to project future maize and wheat price conditions to 2014 and consider the implications for staple food systems in the eastern and southern Africa region. Lastly, we identify promising policy options and investments to make staple food markets work to support smallholder income and productivity growth.

1.3. Organization of Report

The rest of the report is structured as follows: The next section presents conceptual issues centering on the elasticity of demand, specifically the potential to make the demand for staples more elastic to stabilize markets and protect farmers against the severe downside price risk that currently plagues these systems. Section 2 also reviews the evidence from Asia's green revolution experiences regarding the payoffs to alternative agricultural investments over the past 50 years and considers the applicability of these findings for eastern and southern Africa.

Section 3 provides a brief historical review of food marketing in the region and highlights the main lessons learned from four decades of experience.

Section 4 turns to the description of the household survey data in Kenya, Malawi, Mozambique and Zambia that constitute the descriptive information on smallholder and urban consumer behavior presented in this report. Section 5 presents the following information for each country: (i) importance of various income sources in smallholder livelihoods; (ii) importance of various crop types in smallholder production and marketing patterns; (iii) smallholders' relationship to markets, i.e., buyers, sellers, net buyers, autarkic, etc.; and (iv) the characteristics of smallholders in these various marketing categories.

Section 6 presents urban household consumption patterns and discusses the dynamic changes taking place in staple food demand. Section 7 presents projections from world agricultural models on future grain price levels. Section 8 discusses the opportunities and challenges associated with various market risk management tools that could potentially improve market performance in the region. In light of price projections and survey evidence on evolving household production, marketing, and consumption patterns, Section 9 concludes by identifying the main policy challenges to be tackled as part of an effective market development strategy. Also identified are *first-order* policies and investments needed to promote a food marketing system in a way that catalyzes smallholder productivity growth and 'green revolutions' in Africa. We use the term "first order" to mean the most critical

interventions needed before which meaningful progress in other areas would be feasible. Obviously, a comprehensive plan for developing markets in Africa will require hundreds of actions from myriad actors. This report does not attempt to be comprehensive but rather aims to identify the strategic and critical actions of first-order importance, which will enable the hundreds of other required investments and actions to reap a payoff.

2. CONCEPTUAL ISSUES AND CURRENT DEBATES

2.1. Making the Demand for Staple Food More Elastic

One of the key characteristics of staple food crops is their low overall elasticity of demand. Inelastic demand means that income growth and price changes generate relatively limited changes in quantity of food staples demanded. When demand is inelastic, technology adoption and productivity growth often lead to declining producer prices without a proportional increase in demand. This may have negative welfare impacts on producers unless farmers are able to reduce their production costs from adoption of new cost-saving farm technology. Crop production expansion is therefore difficult to sustain in the face of highly inelastic product demand, which causes precipitous price plunges when local markets are unable to absorb surplus output. Such price drops are a major cause of subsequent farm dis-adoption of improved technology (Vitale and Sander 2005). This was indeed the experience of the Sasakawa-Global 2000 programs implemented in many African countries in the 1990s (Putterman 1995; Howard et al. 1999.

Figure 1 shows this schematically. If farmers' initial adoption of productivity-enhancing technology causes the food supply curve to shift from S^0 to S^1, prices will drop from P^0 to P^1 if markets are unable to absorb the surplus due to inelastic demand (D^0). The actual quantity supplied increases marginally from Q^0 to Q^1. In this environment, markets are not able to support sustainable farm technology improvements. This could be the case when surplus producing regions are poorly linked to deficit (net importing) areas within a country because of poor market infrastructure or when a country is unable to export the surplus. Thin local markets in many rural areas in Africa become saturated quickly when many farmers attempt to sell their produce right after harvest to meet various financial obligations.

By contrast, Figure 2 shows a situation of elastic demand. When demand is elastic, greater quantities of product can be absorbed by the market without depressing prices. If the demand for grain were more elastic (as shown in Figure 2), the same expansion of the food supply curve from S^0 to S^1 would cause a much smaller reduction in farm prices, and a much greater ability to increase actual quantities supplied by farmers (Q^0 to Q^2). A major challenge of output market development, therefore, is to make the demand for staple food much more elastic. A related challenge is how to expand the demand for grain to maintain strong incentives for farmers, but do it in a way that does not price poor consumers out of the market.

A third scenario, shown in Figure 3, underscores the power of regional and international trade to stabilize food prices and support farm technology adoption. Figure 3 is similar to Figure 2, except that the magnitude of potential price fluctuations is truncated by trade possibilities. If a country's markets can be well integrated with surrounding countries, then a price drop (e.g., to P^3 in Figure 3) would make the country's surplus production competitive in regional or international markets, providing a vent for surplus production at a level equal to the price in international markets minus transport costs (P^3). Likewise, if prices rise to a certain point (P^4), surpluses in other countries can be brought into the country at a cost equivalent to the price of grain in the surplus country plus transport costs (P^4). However, the theoretical price stabilizing effects of trade can only be realized in practice if markets work well, which depends on getting the incentives right for traders to operate.

Figure 1. Supply Expansion with Inelastic Demand

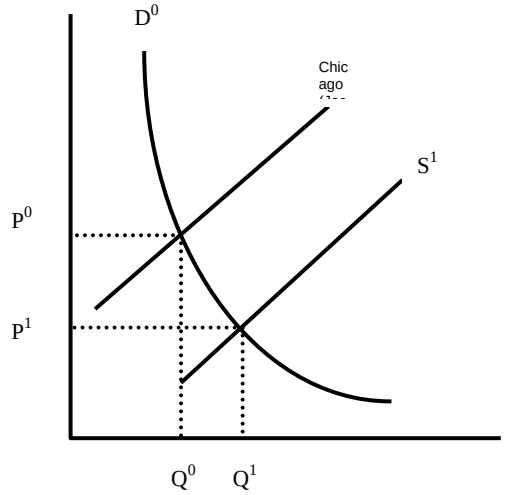


Figure 2. Supply Expansion with Elastic Demand

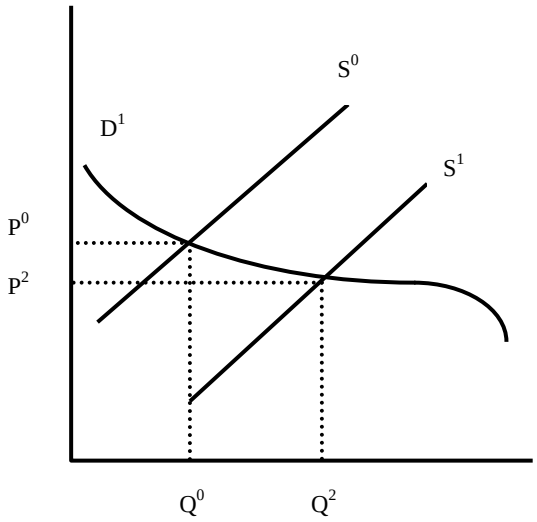
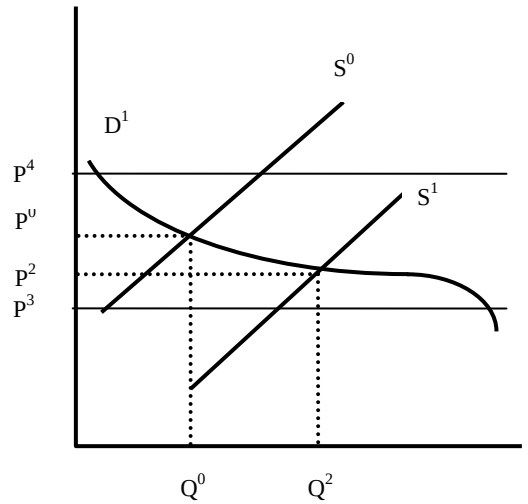


Figure 3. Supply Expansion with Elastic Demand and Trade Linkages



2.2. Factors Affecting the Elasticity and Stability of Demand

Most discussions over strategies to stabilize food prices have to date considered inelastic demand to be more or less given. The general argument is that inelastic demand is determined by consumer behavior, i.e., consumers need to eat regardless of whether prices are high or low. While true, the elasticity of demand for staples are also greatly influenced by the functioning of markets. It is possible to alter the shape of the demand curve that small farmers face. The demand for staple grain crops can be made more elastic, and shifted outward, through market-facilitating public investments and policy choices and by nurturing important marketing institutions. By focusing on making the demand for food more elastic, downside price risk for farmers can be mitigated.

Investments and policies that could potentially achieve these price-stabilizing effects are briefly identified below. The pros, cons, and income distributional effects of these alternative options can be clarified based on a better understanding of smallholder production and marketing patterns and consumer demand patterns. We will return to a discussion of these strategies in Section 9 after a thorough review of the household survey data in Sections 5 and 6. The main potential candidates here:

i) *Investment in physical infrastructure:* The size of the market is determined by marketing costs. Transport costs are generally the largest single component of price differences between surplus and deficit areas (Gebremeskel, Jayne, and Shaffer 1998; Mittendorf 1989). As transport costs decline, grain markets become more integrated and the overall size of the market expands for any particular farmer and demand becomes more elastic. This is analogous to the situation of a small country supplying product to the world market – the huge size of the world market relative to the small country's production makes the demand function that it faces perfectly elastic (flat). More generally, there is strong evidence that a country's level of infrastructural development is associated with its level of agricultural productivity (Antle 1983).

ii) *Regional trade:* Regional trade, in combination with good transport infrastructure between countries, has the potential to expand the size of the market, increase the elasticity of demand facing farmers, and reduce price instability. For non-tradable commodities where price shocks are mainly generated by domestic events such as weather, the magnitude of the shock will largely determine the variability of domestic production. However, local production shocks can be mitigated by regional trade, which tend to stabilize markets by linking together areas with covariate production (Koester 1986). The size of a country matters – larger countries typically have more diverse regional climatic conditions that reduce systemic risks at the country level. Regional trade has a greater potential to stabilize food prices when consumers can easily substitute one food type for another (such as maize and cassava in parts of southern Africa; wheat and rice in other areas), where cropping patterns are diverse, where production in different parts of the region are not highly correlated, and where the costs of transportation a port is low (Delgado and Minot 2000; Byerlee, Jayne, and Myers 2006).

iii) *Streamlining regulations and trade barriers:* Many African countries impose import tariffs on staple foods coming from neighboring countries. In 2008, Malawi, Zambia, and Tanzania banned maize exports. These trade barriers are often put in place unpredictably, which make it risky for trading firms to invest in developing durable marketing networks across regions. Customs clearance procedures are often cumbersome. For example, permits to import grain legally into Kenya are available only in Nairobi (Nyameino, Kagira, and Njukia 2003). Traders wanting to move product from N. Mozambique to southern Malawi need to get export permit in Quelimane at the coast in northeaster Mozambique (Tschirley and Abdula 2007). These regulatory barriers impose transaction

costs on traders, which results in lower demand and lower prices for farmers (and higher prices for consumers). Streamlining the regulatory processes for regional trade can reduce downside price instability that often depresses farmer incentives to sustain their use of productivity-enhancing cash inputs.

iv) *Rural financial markets to improve traders' capacity to absorb surplus production:* While the importance of small farmer credit in promoting the uptake of improved farm technology is well recognized, the role of trader finance is also crucial. A major source of inelastic demand in traditional food markets is the constrained supply of trader finance (Coulter and Shepherd 1995). Market institutions such as warehouse receipt systems can inject needed liquidity into grain marketing systems, and thus allow the system to absorb more easily the surplus production in good years. However, the development of these market institutions will depend on supportive government policies. So far, fledgling attempts to develop warehouse receipt systems and other innovative sources of trader finance in staple food assembly and wholesaling markets (e.g., Ghana and Zambia) have floundered due to direct government operations in markets that have been incompatible with the development of these institutions.

v) *Policies toward subsidized imports and food aid:* While local farmers' are generally well served by regional trade, their interests can be undermined by subsidized food imports, particularly if this alters long run food consumption patterns. For example, large processing companies in urban areas are often able to acquire subsidized wheat and rice from international sources, which over time, influences urban consumption habits. With few exceptions, most smallholder areas are not suited to wheat and rice production. The importation of subsidized wheat and rice undermines long-term demand and prices for the main staple grains, roots and tuber crops that small African farmers produce. For example in India, the demand for sorghum and millets – crops widely grown in drought-prone areas – has declined mainly due to public procurement and distribution systems that subsidize rice and wheat (Ryan and Spencer 2001). In West Africa, the demand for subsidized rice and wheat has also increased, especially in urban areas, in many cases displacing consumption of traditional cereals (Vitale and Sanders 2005). Similarly, inappropriate uses of imported food aid (e.g., the sale of imported food aid by Non-governmental Organizations (NGOs) during periods of local production surplus)[1] are likely to depress small farmers' uptake of improved farm technology over time (Tschirley et al. 2006; Dorosh, Dradri, and Haggblade 2009).[2]

vi) *Diversification of food consumption patterns:* When food consumption patterns become more diversified, markets become more interlinked and stable than in cases where one commodity dominates food consumption patterns. Especially in eastern and southern Africa, food production and consumption patterns have changed markedly over the past decade. The former dominance of white maize has given way to more diversified food systems. In many rural areas of Malawi, Zambia, and Tanzania, cassava cultivation has increased dramatically. The increasing role of cassava, a drought tolerant crop that can be stored in the ground, provides new potential to stabilize food consumption in the face of maize production shortfalls (Nweke, Spencer, and Lynam 2002). The availability of other drought-tolerant crop (e.g. cassava, sorghum, millets, pigeon pea) that are less prone than maize to extreme production fluctuations provides some relief in the degree to which maize supplies can fluctuate from year to year without seriously aggravating food insecurity. While not necessarily affecting the elasticity of demand for any particular food

[1] Many NGOs derive part of their annual operating budget by "monetizing" (selling onto local markets) food aid received from donor countries like the United States. In this way, a certain amount of food assistance to Africa is *un*influenced by weather and local supply conditions, and it is this component that has the greatest potential to disrupt local markets and affect small farmers' incentives.

[2] There is not a clear consensus on this point. Abdulai, Barrett, and Hoddinott (2005), for example, contend that food assistance programs usually have not adversely affected small farmers' production incentives and may actually help them by generating community assets through public works projects.

commodity, diversification of consumption and interdependence of demand for alternative staple foods tends to increase overall food supplies and therefore contribute to stability of food markets and prices over time.

vii) *Generating alternative sources of demand for grain:* Analysis of alternative futures and outlooks for agriculture indicate that the demand for livestock products, fruits and vegetables will increase dramatically as Africa rapidly urbanizes. More than half of Africa's population (projected to reach 1.2 billion) will reside in urban areas by 2020. The resulting high demand for poultry and milk products will induce greater derived demand for use of cereal grain as livestock feed. If supply can be increased, this could expand the total demand for coarse cereals and reduce the upward pressure on prices of other staple crops (e.g. maize). In addition, world food and energy markets are becoming increasingly integrated. These developments are likely to raise world food prices at least somewhat over the next decade (see Section 7). While the bio-fuels revolution is likely to exacerbate future problems of access to food for low-income consumers, the world is less likely to see depressed world food prices over the foreseeable future. These developments, combined with eastern and southern Africa's gradual transition to structural food deficits (see Section 6.1) imply that the region will increasingly be facing a price surface determined by import parity levels, i.e., world price levels plus marketing costs to regional demand centers. In this environment, downside price risk for small farmers may be less of a problem than in previous decades, particularly if the interventions identified above could be promoted.

viii) *Development of world food markets:* Until recently, the world market for white maize was thinly traded and hence small absolute changes in import demand in southern Africa had the potential to influence world prices. The rationale for some level of stockholding is more compelling in such cases. However, in recent years, the white maize market has become much more heavily traded due to the effect of the North American Free Trade Agreement (NAFTA), which, since 1997, has induced a large white maize supply response in the U.S.A. to export to Mexico. These developments have mitigated the potential for white maize prices and supplies to become tight when the southern Africa region experiences a drought, and thus reduces the rationale for keeping large government stockpiles of white maize to stabilize supplies (Tschirley et al. 2006).

2.3. Looking at Food Markets as a Vertical System

The market-strengthening and stabilizing approaches specified above can be achieved through a variety of public and/or private sector approaches to market development. There is widespread agreement in the literature that the state has a crucial role in providing incentives for the private sector to develop strong output markets in Africa. However, there are major controversies as to what exactly these critical government roles are, and how they should be implemented. Identifying promising interventions or programs to defend output prices in the face of output supply expansion must be considered within the overall system-wide value chain, e.g., how can specific interventions be made to function compatibly with other stages of the value chain.

A major insight from commodity value chain analysis (Taylor 2005; Kaplinsky and Morris 2001) and the earlier industrial organization and commodity sub-sector literature of the 1970s, 1980s, and 1990s is that risks, uncertainties and lack of profitability at one stage of the system will impede incentives for investment at other stages of the system, depressing overall

performance of the value chain.[3] Much in the same way as the human spine and central nervous system transmit signals and coordinate the movements of the entire body, the wholesaling stage of the food system plays a similar coordinating role in food value chains. It is at the wholesale level where i) almost all of the seasonal storage takes place downstream from the farm; ii) where long-distance spatial arbitrage opportunities are identified to reallocate supplies from surplus to deficit areas and link farmers and assemblers with processors, retailers and consumers in distant areas; and (iii) where most of the financing for purchasing the crop harvests originates. Maize assemblers, who account for most of the direct purchases from farmers, tend not to start buying until wholesalers come to their region. This is because assemblers generally do not have the funds to buy large quantities of grain and require either loans from wholesalers or assured back-to-back transactions arranged with a wholesaler to buy the maize right after the assembler buys from farmers. As such, the development of the wholesaling stage of the staple food systems are required for successful introduction of structured trading and risk management tools such as warehouse receipt systems, forward contracting, and use of futures and options on regional commodity exchanges.

Moreover, the development of such market institutions can only be functional within a system where the price discovery process is perceived to be based on competitive forces and not easily manipulated by large players in the market such as marketing boards. The most effective safeguard against manipulation is to ensure that sufficient trade volumes are achieved to protect the integrity of the price discovery process (Coulter 2005; Coulter and Onumah 2002).

The literature on food sub-sectors and value chains stresses that efforts to promote performance at either end of the value chain (e.g., assembly or storage investments at village-level, or retail market development) can be stymied by poor performance at the crucial middle stages of the system (Shaffer et al. 1985). Therefore, a major challenge to making food markets function for the benefit of small farmers (and farm technology adoption in particular) is to achieve greater clarity as to the appropriate public and private roles in developing the wholesaling stage of food value chains – the backbone of the staple food marketing systems in almost all countries.

2.4. Lessons from Experience with Asia's Green Revolution

There have been many calls for attempts to learn from Asia's green revolution experience in an attempt to draw important lessons for Africa. Based on India's Green Revolution experience, Fan, Gulati, and Thorat (2007) analyzed the returns to various types of public expenditures over a 40-year period. While the impacts of alternative investments in India may not necessarily be the same throughout eastern and southern Africa, it is instructive to compare the relative importance of these alternative investments in promoting agricultural growth and poverty reduction in India in the achievement of its green revolution (Table 1).

Table 1 details the estimated marginal effects of different types of government expenditure in each decade, in terms of their impact on agricultural gross domestic product (GDP) and poverty reduction. Considering first the estimated returns to agricultural GDP, in the 1960s most investments and subsidies generated returns that were both significantly greater than

[3] For example, see Marion et al. 1979; Shaffer 1980; Shaffer et al. 1985; Mueller 1983; Marion and NC 117 Committee 1986. Even earlier insights from the economics/business management literature (e.g., Drucker 1958) stress the symbiotic relationships between production and marketing.

Table 1. Returns in Agricultural Growth and Poverty Reduction to Investments and Subsidies, India, 1960-2000

	1960s		1970s		1980s		1990s	
	returns	rank	returns	rank	returns	rank	returns	rank
Returns in Agricultural GDP (Rs produced per Rs spent)								
Road investment	8.79	1	3.80	3	3.03	5	3.17	2
Educational investment	5.97	2	7.88	1	3.88	3	1.53	3
Irrigation investment	2.65	5	2.10	5	3.61	4	1.41	4
Irrigation subsidies	2.24	7	1.22	7	2.28	6	na	8
Fertilizer subsidies	2.41	6	3.03	4	0.88	8	0.53	7
Power subsidies	1.18	8	0.95	8	1.66	7	0.58	6
Credit subsidies	3.86	3	1.68	6	5.20	2	0.89	5
Agricultural R&D	3.12	4	5.90	2	6.95	1	6.93	1
Returns in Rural Poverty Reduction (decrease in number of poor per million Rs spent)								
Road investment	1272	1	1346	1	295	3	335	1
Educational investment	411	2	469	2	447	1	109	3
Irrigation investment	182	5	125	5	197	5	67	4
Irrigation subsidies	149	7	68	7	113	6	na	8
Fertilizer subsidies	166	6	181	4	48	8	24	7
Power subsidies	79	8	52	8	83	7	27	6
Credit subsidies	257	3	93	6	259	4	42	5
Agricultural R&D	207	4	326	3	345	2	323	2

Source: Fan, Gulati, and Thorat 2007.

zero and larger than their costs. In particular, road and education investments had estimated benefit-cost ratios of 6 to 9. Agricultural research investments and credit subsidies yielded benefits that were 3 to 4 times the amount spent. This was the period when improved seed varieties, fertilizer, and credit were being promoted as a high payoff technology package. Irrigation and power subsidies yielded the lowest returns in this period, though returns to irrigation investment and subsidies were estimated as more than double spending. In the 1970s and 1980s, the returns to most of these subsidy programs declined though they began to account for an increasingly large share of national budgets. Meanwhile, agricultural R&D, road investments, and education investments provided the greatest payoffs in terms of agricultural growth. By the 1990s, only agricultural R&D and road investments continued to yield estimated returns of more than 300%. Estimated net returns to irrigation investments and education were low but still positive, whereas credit, power, and fertilizer subsidies had negative net returns, and subsidies on irrigation had no significant impact on agricultural production at all (Fan, Gulati, and Thorat 2007).

The ranking of investments in terms of poverty reduction impacts follow the same broad pattern as that for agricultural GDP growth. Across all decades, spending on roads, agricultural R&D, and education provided the greatest poverty reduction impacts. Fertilizer subsidies are estimated to have been effective at reducing poverty in the two earlier decades, but subsequently appear to have been highly ineffective. Credit subsidies were effective in the 1960s and 1980s. As stated by Fan, Gulati, and Thorat 2007.

> "These results have significant policy implications: most importantly, they show that spending government money on investments is surely better than spending on input subsidies. And within different types of investments, spending on agricultural R&D and roads is much more effective at reducing poverty than putting money in, say, irrigation" (p. 18-19).

Table 2. Summary of Analysis of Six Asian Economies' Agricultural Growth Boom Periods

	Agricultural growth effects			Poverty-reduction effects		
	Median share of ag growth attributable to this class of policy or investment	Median rank by total effect	Median rank by benefit/cost ratio	Median share of poverty reduction attributable to this type of policy or investment	Median rank by total effect	Median rank by benefit/cost ratio
Policy / institutional reform	40%	1.0	–	30%	1.0	–
Infrastructure						
Rural roads	10%	3.5	3.0	15%	3.0	3.0
Irrigation	9%	4.5	3.5	8%	5.0	4.0
Electricity/health/ education/communication	9%	4.0	5.5	18%	2.0	4.5
Agricultural inputs delivery						
Fertilizer/seed/chemicals	10%	5.0	5.0	7%	6.0	6.0
Agricultural credit/insurance	2%	6.0	6.0	5%	6.0	2.5
Ag/NRM research/extension						
Ag./NRM research	15%	2.0	1.5	10%	4.0	2.0
Ag/NRM extension	2%	6.0	4.0	5%	6.0	2.5

Source: The Economist Intelligence Unit (2008).

Another summary of Asia's agricultural growth boom was recently carried out by the Economist Intelligence Unit (2008). In this study of six countries (China, India, Indonesia, South Korea, Taiwan, and Vietnam), attempts were made to apportion the agricultural growth and poverty-reduction benefits into various types of interventions and investments specified in Table 2.

The Economist Intelligence Unit (EIU) study highlights the primacy of policy and institutional reform in driving both agricultural growth and poverty reduction benefits. As stated by the report:

> "In places such as Korea and Taiwan, land-to-the tiller reforms created a broad-based agrarian population with ownership over land and strong incentives to increase output. In China and Vietnam, increasing individual farmers' rights over their land and output, combined with agricultural market liberalization, substantially improved farmers' incentives and stimulated rapid growth in output and private investment. Indeed, policy and institutional reforms have been central to (arguably, the main sources of) agricultural growth in China and Vietnam because those countries had to overcome complete state control of the entire economy. But getting institutions and policies right also mattered a great deal in the other four Asian economies as well" (p. 7-8).

> "Appropriate policy reforms not only bring about one-off efficiency gains…more importantly they improve incentives for private investment in resource conservation, technology adoption, innovation, and increased modern inputs application, all of which lead to higher steady-state rates of output growth" (p. 8).

> "Policy and institutional improvements can also improve equity since administrative power over farmer behavior tended to favor the wealthiest and those with the best political connections, rarely poorer individuals or communities" (p. 8).

The EIU (2008) study contends that policy and institutional reform in Africa may not necessarily produce the same magnitude of benefits as they did in Asia because of its view that African nations have already undertaken most of the major sectoral reforms enacted in Asia. We disagree somewhat with this assessment. In much of eastern and southern Africa, food markets continue to be plagued by a high degree of uncertainty and ad hoc government entry into and retreat from markets, despite official policy pronouncements, which are largely inconsistent with actual state behavior. These inconsistencies give rise to problems of credible commitment regarding governments' policy statements, and hence create risks and costs for private traders. The high degree of policy uncertainty impedes private investment to develop access to markets and services for smallholder farmers. Local banks also tend to withdraw from lending to the sector and allocate most of their investment capital to relatively safe and high-interest government bonds. In these ways, there is still a great deal of sectoral reform to be gained in Africa, not necessarily to liberalize private trade but to unencumber it from the risks and high costs posed by unpredictable government actions in food markets.

Other investments found by the EIU study to have high payoffs were similar to those found in Fan, Gulati, and Thorat (2007): crop science R&D and investments in rural roads, electricity, health and education. Resources invested in subsidies and direct distribution of fertilizers and other agri-chemicals showed only modest returns on average.

The findings of these two studies provide some important indications for promoting agricultural growth and poverty reduction in eastern and southern Africa. Although the regions differ in important respects, there are strong reasons to believe that the policy reforms and investments in R&D and infrastructure that generated high payoffs in Asia are likely to be crucial drivers of growth in most of Africa as well. As concluded by EIU (2008):

> "Our assessment is that the interventions that provided most effective in Asia – policy and institutional reforms, an agricultural research revolution, major expansion of rural roads and irrigation, and improved rural financial services delivery – must likewise be the primary targets for new investments…..The specifics of the strategies will vary among countries and even among agro-ecologies within countries, and must be developed internally, albeit with external financial and technical assistance. But the broader patterns are clear" (p. 18).

3. EXPERIENCES WITH ALTERNATIVE APPROACHES TO SYSTEM-WIDE ORGANIZATION OF FOOD MARKETING SYSTEM

This section reviews the broad lessons from experience over the past 30 years with alternative general approaches to organizing food output markets (with a focus on the wholesaling stage) to encourage small farm technology adoption and productivity growth for the basic staples.

3.1. State-led Systems

In recent years, parallels have been drawn between the food marketing systems of Asian countries at the time of their 'green revolutions' and the marketing systems that may best achieve similar farm productivity growth in Africa (Sachs 2005; Dorward et al. 2004). Others have pointed to the fledgling 'green revolutions' experienced in eastern Africa, that appear to have been snuffed out after the state-led marketing boards (which operated mainly at wholesale level) were downsized. The experiences of countries like Kenya, Zimbabwe, Zambia, Malawi, and Tanzania during the 1970s and 1980s demonstrate that a state-led controlled marketing approach can stimulate the adoption of improved grain seed technologies and complementary inputs to achieve impressive production growth (Byerlee and Eicher 1997; Smale and Jayne 2003). These experiences also demonstrate that the main challenge of these state- led approaches is not so much how to initiate farm productivity growth, but how to sustain it if the costs of the programs escalate and lead to fiscal crises (Jayne and Jones 1997; Kherallah et al. 2002; Gulati and Narayanan 2003; Rashid, Cummings, and Gulati 2005; Avalos-Sartorious 2006).

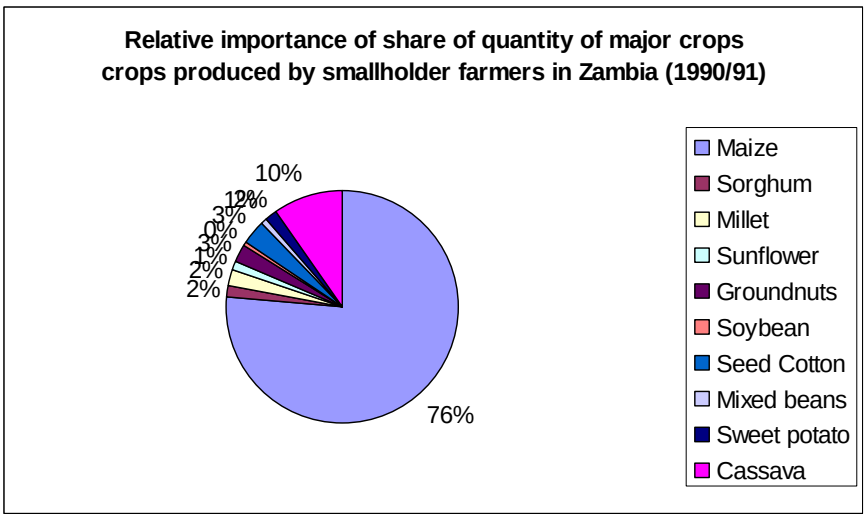
Starting at Independence in the 1960s and 1970s, a prominent goal of government policy in much of eastern and southern Africa was to promote smallholder welfare, using staple food production incentives as the main vehicle. This goal was achieved with great success in the 1970s and 1980s. Two main ingredients drove this production growth: input and crop marketing policies, broadly defined, and improved seed breakthroughs.[4] The key features of the marketing policies were: (a) expansion of state crop buying stations in smallholder areas; (b) direct state control over grain supplies and pricing; (c) heavy subsidization of fertilizer to encourage its use by small farmers; (d) efforts to stabilize and subsidize urban consumer prices without reliance on imports; and (e) shifting the massive costs of these government investments and subsidies onto the Treasury. The expansion of state market infrastructure in smallholder areas facilitated the disbursement of credit and subsidized inputs to smallholders by allied state agencies designed to recoup loans through farmer sales to the marketing boards (Rohrbach 1989; Howard 1994; Putterman 1995). Smallholder maize yields and production grew impressively during the 1970s and 1980s.[5]

The state-led support for smallholder maize intensification during the 1970s and 1980s appears to have shifted production patterns away from other crops to maize, as well as supported an overall increase in cropped area (Smale and Jayne 2003; Zulu et al. 2000). In Zambia, by 1990, maize accounted for 76% of the total value of smallholder crop production (Figure 4).

[4] It is widely agreed that without the advent of new yield-enhancing maize seeds, the state-led marketing investments by themselves would have had a much smaller impact on smallholders' productivity and incomes (e.g., Rohrbach 1989).

[5] The timing of these state investments was as follows: expansion of marketing board buying stations in smallholder areas (Zimbabwe 1980-1986; Zambia 1983-1989; Kenya 1980-1982; Malawi 1974-1985; Tanzania 1974-1979); expansion of state credit disbursed to smallholders (Zimbabwe 1980-86; Zambia 1983-88; Kenya 1975-1983); explicit or implicit subsidies on inputs (Zimbabwe 1980-91; Zambia 1971-1991; Malawi 1980-94). For details, see Jayne and Jones (1997).

Figure 4. Shares of Crop Production Value of Major Crops Produced by Smallholder Farmers in Zambia, 1990/91



Source: Post-Harvest Surveys, 1990/91, Central Statistical Office, Lusaka.

The "smallholder green revolutions" achieved temporarily in the 1980s in parts of the region (see Eicher 1995; Byerlee and Heisey 1997) featured state-led investments in input delivery, credit disbursement, and major expansion of state crop buying stations. Throughout the 1980s and up to the initial reforms, official producer prices exceeded export parity prices in the major production regions of Kenya, South Africa, and Zimbabwe, typically exporters during this period (Jansen and Muir 1994; Wright and Nieuwoudt 1993; Smale and Jayne 2003). In almost all countries, a large proportion of smallholders benefited from the transport subsidies inherent in the boards' pan-territorial pricing structure (Bryceson 1993; Howard 1994; Odhiambo and Wilcock 1990). While currency overvaluation did introduce an often substantial indirect tax on food producers, especially in Tanzania and Zambia (Jansen and Muir 1994), this was largely offset by the package of state investments designed to increase food production incentives (primarily input subsidies, concessional credit, and investments in state crop buying stations, research, and extension).

These pricing and market support policies clearly encouraged the adoption of newly available hybrid maize seeds and stimulated the growth in smallholder grain area and yields during the 1970s in Tanzania and Kenya, and during the 1980s in Zimbabwe and Zambia (Putterman 1995; Jabara 1984; Rohrbach 1989; Howard 1994). Per capita smallholder grain production in Zimbabwe and Zambia increased by 51% and 47% in the 10 years of heavy state intervention between the late 1970s and the late 1980s. In Kenya and Tanzania, per capita grain production rose 30% and 69% between the 1970-74 and 1980-84 periods.[6]

However, herein lay the origins of subsequent unsustainability. As the marketing board floor prices for grain were successful in promoting smallholder input use and production, especially in remote outlying areas, production began to exceed domestic demand requirements, and the costs of accumulating grain in public silos rose dramatically. Often the cost of growing and transporting the grain to urban areas exceeded the economic value of the

[6] Jabara (1984) demonstrates that despite falling real food prices in Kenya during the 1970s, the profitability of grain production actually increased due to farm productivity growth achieved in part through state investments in agriculture. For detailed analyses of the effects of these state interventions on maize technology adoption, see Rohrbach (1989) and Howard (1994).

crop.[7] Strategic stocks sometimes rose to massive levels (especially in Zimbabwe, Malawi, and Kenya), and often had to be exported at a loss to avoid the even greater financing costs of long-term storage and quality deterioration (Buccola and Sukume 1988; Pinckney 1993). Furthermore, marketing board operational inefficiency varied across countries, but adversely affected farmers' incentives to sustain their use of the improved input technologies in many countries (World Bank 1981; Bates 1989; Kaplinski and Morris 2001; Amani and Maro 1992).

Howard (1994) provides a detailed analysis of the rate of return to the maize seed research and marketing policies of the 1970s and 1980s in Zambia. Her analysis explicitly includes the costs of a full range of investments leading to hybrid maize adoption by smallholder farmers. Marketing costs accounted for roughly 59% of the total costs of all investments, in contrast to the seed research investments, which were only 3% of the total. Extension and other service provision programs accounted for the remaining 38%. The rate of return on maize research was favorable when the costs of marketing were not included. After the costs of all related investments (seed and agronomic research, extension, and marketing), however, the average rate of return to maize promotion in Zambia was negative over the 1987-91 period.

As the fiscal costs of state operations in support of smallholder food production mounted, and contributed to overall fiscal crises in these countries, donors changed course and declined to continue underwriting these costs. Continued donor lending and budget support to African governments began to be "conditional" on addressing the major sources of treasury deficits, and in many countries, food marketing policies were indeed one of the main sources of fiscal crisis. After first supporting investments in African marketing boards during the 1960s and 1970s, donors now changed course and argued for their withdrawal. Several factors shaped this change. Donors lost patience with phased and partial reform programs that were seen increasingly as propping up costly and otherwise corrupt and unsustainable pricing and marketing policies rather than facilitating reforms (Jones 1994). In addition, political economy models (e.g., Bates 1981) suggested that state interventions in agricultural markets, while ostensibly designed for rural development, or to correct for market failures, were in fact designed to serve the interests of a dominant elite composed of bureaucrats, urban consumers, and industry. Land allocation was a tool for meting out political patronage and loyalty, and as influential elites acquired big farms, they developed strong individual incentives for a state marketing apparatus that would ensure high prices and subsidized inputs for their farm activities.

By the early 1990s, governments such as Kenya, Zimbabwe, Malawi, Zambia, and Tanzania had no choice other than to cut back on state marketing services. This was because (a) they could no longer sustain these expenditures in the face of mounting budget deficits, and (b) international lenders (mainly the World Bank and International Monetary Fund) were unwilling to provide additional loans without guarantees that governments would address the sources of the deficits – with public maize and fertilizer marketing programs being major sources. In Zimbabwe, even though 17 additional permanent buying stations were established between 1985 and 1992, the number of seasonal rural buying stations declined from 135 in 1985 to 42 in 1989 to 9 in 1991. Disbursement of government credit to smallholders declined steadily from a peak of Z$195 million in 1987 to under Z$40 million in 1994 (in constant 1994 Z$). Fertilizer purchased by smallholders has also stagnated in some countries after

[7] Pan-territorial pricing was particularly burdensome, particularly in Tanzania, Zambia, and Zimbabwe, since it raised the share of grain delivered to the boards by smallholders in remote (but often agronomically high-potential) areas where transport costs were high (Bryceson 1993; GMB 1991).

1993 when major maize policy reforms occurred.[8] In Zambia, grain area, fertilizer use, hybrid seed purchases, and production have all declined since the late 1980s due to a combination of lower real producer prices, higher real fertilizer prices, deteriorating state marketing services, and a reduction in available state credit. Fertilizer nutrient use, which peaked in 1986/87 at 88,000 tons, declined to less than 60,000 in 1994/95. Hybrid maize seed purchases declined from 15,000 tons in 1989/90 to 4,799 in 1994/95. In Malawi, the use of hybrid maize and fertilizer expanded rapidly in the early 1990s, but then plummeted after 1994 due to the collapse of the agricultural credit system.

While the post-independence model of service provision to smallholders appears to have had important successes in boosting grain production and incomes in some rural areas, by the mid-1980s major problems had emerged in all the countries that propelled the grain marketing systems toward reform. Future discussions about state-led marketing approaches to support smallholder input intensification and productivity must address these problems:

1. *Cost containment of marketing board activities*: How can the state-led systems be designed to keep costs within sustainable levels? The major issues are: (a) the more the state directly operates in markets, the more it tends to crowd out potential private sector activity, thus forcing the state to handle most of the entire system; (b) how to defend producer incentives over time, especially if state activity is successful in stimulating farm input and production growth and finds itself accumulating expensive grain stocks; (c) also related, how to absorb and find economically viable uses of surplus crop output; (d) how to minimize the potential for marketing boards to be used in politicized ways that impose additional costs and inefficiencies on the state and often on both farmers and consumers (Sahley et al. 2005; Jayne et al. 2003); and (e) how to avoid the treasury costs of state fertilizer and maize marketing operations that led to their implosion during the 1980s. Maize marketing and input subsidy programs were so large that they contributed to macroeconomic instability and hyperinflation in Zambia (Jansen and Muir 1994), and to a lesser extent Tanzania and Kenya (Amani and Maro 1992; Odhiambo and Wilcock 1990). Zambia's National Agricultural Marketing Board's operating losses were roughly 17% of total government budgets in the late 1980s (Howard and Mungoma 1997).

2. *Credit systems:* While it is sometimes asserted that small farmers' lost considerable access to credit for fertilizer and seed after the transition to "liberalization" and the contraction of state marketing board activities (e.g., Dorward et al. 2004), studies at the time show that state systems of farm input credit were already in serious difficulty due to massive credit non-repayment. In Zimbabwe, almost 80% of smallholder recipients of state credit were in arrears in 1990 (Chimedza 1994). In Zambia, which continued fertilizer and seed credit programs until 1999, repayment rates never exceeded 43% and were generally in the 20-30% range (MACO/ACF/FSRP 2002). The state-led systems for seed and fertilizer delivery and crop payment became increasingly unreliable over time, especially in Zambia, Tanzania, and Kenya, (Howard 1994; Amani and Maro 1992; Westlake 1994). This was one of the major reasons why reform of the grain marketing systems became necessary.

3. *Pan-territorial and pan-seasonal pricing:* Uniform pricing has the effect of depressing the scope for private sector trading, and tends to force the state into performing the totality of marketing functions at wholesale level. Pan-territorial pricing also encourages farmers near urban demand centers (and who are implicitly taxed through pan-territorial pricing) to resort to parallel markets (as occurred in Tanzania, Kenya, and Zambia during

[8] Kenya is a major exception to this (see http://www.aec.msu.edu/agecon/fs2/kenya/pb07.pdf).

the 1980s) and/or switch to other, uncontrolled crops (as in Zimbabwe and South Africa in the late 1980s and early 1990s). Declining volumes through the state marketing channels further exacerbated the boards' trading losses.

4. *Suppression of informal marketing channels:* Empirical evidence from the 1980s and 1990s found that the controlled marketing systems suppressed or imposed additional costs on parallel trading and processing channels that often served the interests of both producers and consumers more effectively than the official state apparatus (Odhiambo and Wilcock 1990; Putterman 1995; Mukumbu 1992; Rubey 1995; Jayne and Chisvo 1991).

3.2. Liberalization: 1990-2000

Despite the conventional perception that food markets have been "liberalized", many African governments in eastern and southern Africa continue to intervene heavily in food markets. The stated purpose of most government operations in markets is to stabilize food prices and supplies and ensure national food security. Governments pursue these objectives through two main routes: (1) marketing board operations, and (2) discretionary trade policy instruments, such as export bans and import tariff rates. A defining feature of the marketing environment in the "liberalization period" in most of eastern and southern Africa has been the tremendous unpredictability and frequent change of direction in governments' role in the market. In this shifting policy environment, the private sector's response has been muted in most countries, especially at the critical wholesaling stage (storage, linkages between farm assembly and wholesaling/processing stages, and long-distance trade, including regional trade).[9]

3.2.1. Marketing Board Operations

Marketing board operations have generally been more modest in recent years than during the pre-control period. However, they continue to be major actors in their countries' maize markets. Using data provided by the national marketing boards between 1995 and 2004, the boards' annual purchases have fluctuated from an estimated 15-57% of the domestic marketed maize output in Kenya, 3-32% in Malawi, and 12-70% in Zambia (Jayne, Zulu, and Nijhoff 2006). These figures understate the boards' full impact on markets because they do not count their often-sizeable maize imports and subsequent release onto domestic markets. Because the boards are typically the largest single player in the market and often behave unpredictably, their operations can create major risks and trading losses for other actors in the market. In countries such as Zambia, Zimbabwe, and Kenya, the marketing boards' involvement appears to have risen in recent years, as budget support from governments has shifted somewhat over the past decade from conditionality agreements to minimally tied, or untied, budget support.[10]

[9] There are unfortunately very few studies that analyze the impacts of staple food market structure and behavior in countries where the state has actually withdrawn from direct operations in the market, which would provide a counterfactual to the mixed state-intervention/private sector situation currently prevailing in most countries. The closest examples are in Mali and Mozambique (and to some extent, Uganda). Unfortunately, there has been no significant "green revolution" seed technology breakthroughs in any of these countries, which further complicates an assessment of the counterfactual situation of how smallholder productivity and input use has been affected within a marketing system where the state has actually withdrawn from direct operations in the market.

[10] Conditionality agreements typically identified specific policy reforms or actions that governments would commit themselves to doing in exchange for receiving loans from international lenders. Untied loans are

3.2.2. Discretionary Use of Trade Policy Instruments

In addition to direct involvement in crop purchasing and sale at controlled prices, governments influence markets and marketing participants' behavior through discretionary trade policy instruments such as export bans, changes in import tariff rates, and government import programs.

Available evidence since 1990 indicates that governments' attempts to stabilize food prices in some cases has made food prices more stable (e.g., for Kenya, see Jayne, Myers, and Nyoro 2008) but in most cases has made food prices more volatile (Rubey 2004; Tschirley et al. 2006; Nijhoff et al. 2003). The latter cases are exemplified by the Government of Malawi's response to an anticipated maize production shortfall in the 2001/02 season. Malawi faced a modest maize production deficit for its 2001 harvest, 8% below the country's 10-year mean. In September 2001, the grain trading parastatal, ADMARC, announced a fixed price for maize to be sold at its distribution centers and announced its intention to import maize from South Africa to defend this price (Rubey 2004). Because ADMARC's selling price was considerably lower than the landed cost of importing maize, private traders had little incentive to import maize in this environment. However, the government imports arrived late and were not sufficient to meet demand. As a result, ADMARC depots began to experience stock-outs, and prices soared (Rubey 2004). When it became clear that ADMARC's supplies were insufficient to last the full season, private traders scrambled to import, but for several months much of rural Malawi experienced grain shortages and prices were reportedly as high as $450 per ton in early 2002. The late-to-arrive ADMARC imports arrived during the good 2002 harvest. For financial reasons, ADMARC had to work down its stocks to free up resources, and these releases onto the market in a good production year produced 16 months of continuously declining maize prices, to the detriment of producers' incentives to intensify their maize production (Tschirley et al. 2006; Rubey 2005). This case illustrates that well-intentioned but poorly implemented government actions can exacerbate food price instability rather than reduce it.

Similar problems arise due to uncertainty about when and whether governments will alter their import duties in response to a short crop. Traders that mobilize imports early face financial losses if the duty is later waived and competing firms (or the government parastatal) can import more cheaply. When governments create uncertainty over import tariff rates during a poor crop season, the result is commonly a temporary under-provision of imports, which can then result in shortages where local prices exceed import parity levels for periods of time (Nijhoff et al. 2003). Analysts not familiar with the details of these situations often erroneously interpret them as evidence that markets fail and that the private sector is weak, leading to a rationale for continued direct government involvement in marketing.

Since the early 1990s when the liberalization process began, the marketing boards in Malawi, Kenya, Zambia, and Zimbabwe have frequently imported maize in volumes that are large compared to the size of the market, and sold at prices considerably below the cost of commercial importation. The expected return to private storage in this policy environment is considerably lower than what it would be if prices were allowed to fluctuate between import and export parity. This has impeded private investment in storage, particularly at the wholesale level. Because governments often attempt to truncate the distribution of food prices at both the upper and lower ends, stockholding is risky and there are no assurances that normal intra-seasonal price rises will occur due to the uncertainty over government action.

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financial injections directly to the Ministry of Finance without specific strings attached as to how the funds are to be spent.

Moreover, most of the silo capacity in countries such as Kenya, Malawi, and Zambia remain in public sector hands. The potential for selling parastatal storage facilities at concessionary prices as part of some future privatization plan acts as a deterrent to new commercial investment in storage (Kopicki 2005). While some analysts point to the large intra-seasonal price variability observed in countries such as Malawi and Zambia as indicators of weak private sector capacity and the limitations of market liberalization, the market environment in most of the region does not provide a meaningful counterfactual to assess the private sector's capacity to engage in inter-seasonal storage.

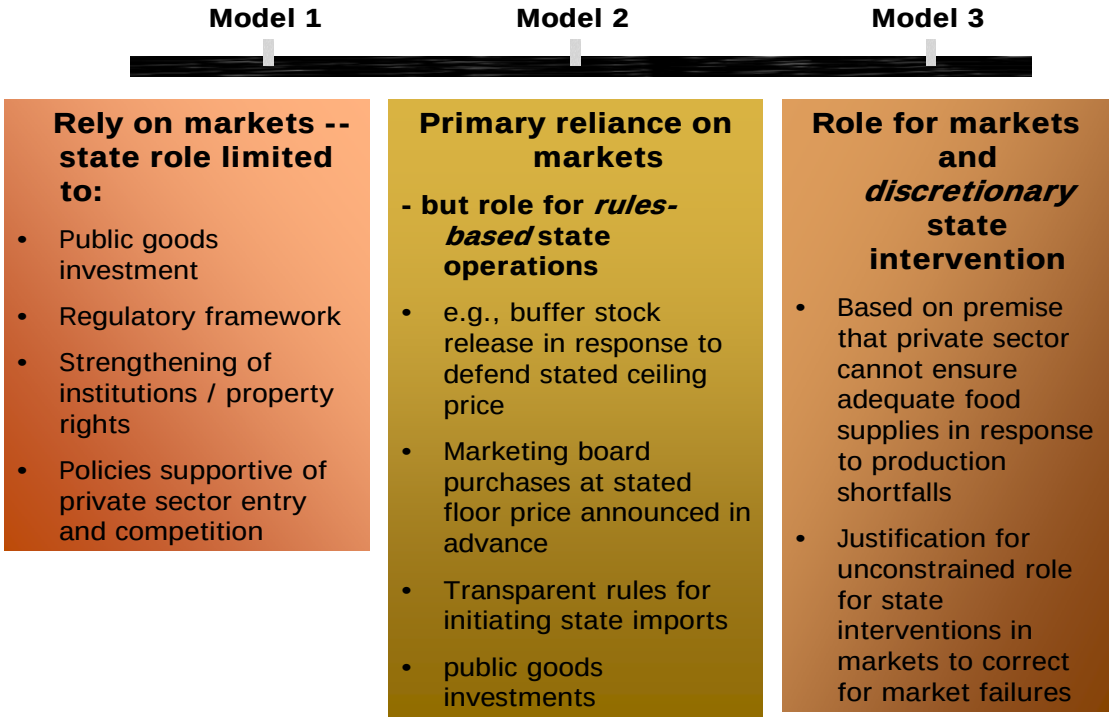
3.3. The Prevailing Grain Wholesaling Systems, Circa 2009

Three competing models currently dominate policy discussions in Africa of the state's appropriate role in staple food markets (Figure 5).

3.3.1. Model 1. State Role Confined to Provision of Public Goods to Strengthen Markets

This approach relies on the private sector to carry out the main direct marketing functions – purchase / assembly from farmers, wholesaling, storage, transport, milling, and retailing. The role of the state is confined to provision of public goods: market rules and regulations, physical infrastructure, regulatory oversight of finance, market information, investment in new technology, organizing farmers into groups for means of reducing costs and risks of accessing finance, inputs, and marketing. This position is close to the Washington Consensus, which is now generally out of favor.

Figure 5. Competing Visions of Staple Food Market Development



3.3.2. Model 2. Rules-based State Interventions to Stabilize Market Activity

This approach also relies on markets to carry out most of the direct food marketing functions, but the role of the state is expanded to include direct marketing operations, especially in the arrangement of imports, the management of food buffer stocks, and release of stocks onto markets when prices exceed a publicized ceiling price. The rationale for state operations is based on the premise that markets fail in some respects and direct rules-based state operations are necessary maintain food prices within reasonable bounds. The defining feature of Model 2 is that there is pre-commitment: the rules governing state operations are determined in advance, publicized, and followed in a non-discretionary manner. Many technical analysts favor this approach.

3.3.3. Model 3. Discretionary State Intervention to Provide State with Maximum Flexibility to achieve State Policy Objectives

The defining feature of this model compared to model #2 is that state operations are not confined to pre-committed rules that would constrain the state's ability to intervene only when these intervention criteria are met. Most governments in eastern and southern Africa are essentially following Model 3 and have done so from the start of the liberalization process. By the early 2000s, parastatal grain marketing boards have once again become dominant players in the market in Kenya, Malawi, Zambia, and Zimbabwe. Each of these countries have a highly unpredictable and discretionary approach to grain trade policy, commonly imposing export and import bans, variable import tariffs, issuing government tenders for the importation of subsidized grain, and selling their grain stocks to domestic buyers at prices that are unannounced in advance and often far below the costs of procuring it.

Therefore, in spite of the widespread perception that African governments have comprehensively adopted food market liberalization programs, in reality the agricultural performance of many countries since the 1990s reflects not the impacts of unfettered market forces but rather the mixed policy environment of legalized private trade within the context of extensive and highly discretionary government operations in food markets. Markets may be officially liberalized, but their behavior and performance are profoundly affected by discretionary interventions by the state. "Interventionist liberalization" may more accurately describe the food marketing policy environment in many of these countries, e.g., Malawi, Zambia, Kenya, Ethiopia, and Zimbabwe. We now explore the strategic behavioral issues of the private and public sector under each of these three approaches, and the likely performance outcomes – the pros and cons of these three approaches.

Model 1: State Role in Markets Confined to Provision of Public Goods. This model depends on a well functioning private trade to keep prices within export and import parity bands and relies on the proposition that markets are reasonably spatially integrated. The importance of spatial integration studies is that they address the central question how long an initially localized scarcity can be expected to persist, which depends entirely on how well the region is connected by arbitrage to other regions (Ravallion 1986, van Campenhout 2008). Spatial market integration studies for maize in Malawi, Mozambique, Zambia (Goletti and Babu 1994; Chirwa 2000; Tostao and Brorsen 2005; Loy and Wichern 2000; Awudu 2007; Myers 2008) and the broader region (Rashid 2004; van Campenhout 2008) are broadly consistent in their conclusions: maize markets are reasonably well integrated spatially, are becoming more efficient over time, and marketing costs are declining. Some of the studies attribute increased market efficiency to liberalization. Others note that some markets continue to be poorly

integrated mainly due to high transport costs and government activities in the maize market, particularly in Malawi. In fact, most of these studies are likely to understate true spatial market efficiency for two reasons. First, many of these studies do not differentiate between trade regimes and thus measure the degree of market efficiency even during periods when there is no reason for markets to be linked by trade. Second, it is difficult to account for the effects of *ad hoc* government operations in these spatial efficiency models, which introduce differential spatial price shocks in local markets. As a result, there may be a tendency for empirical results to find a lower degree of spatial efficiency because of failure to account for the effects of ad hoc trade policy shocks.

Model 1 has been followed to some extent in countries like Mozambique, Uganda, Burkina, etc. Ironically, Model 1 has never been tested in countries like Kenya, Zambia, Malawi, and Zimbabwe – the very countries where the liberalization model has been widely disparaged and pronounced a failure.

Model 2: State Role Focusing on Rules-Based Interventions and Provision of Public Goods. There are very few examples of this model to examine. The rationale for Model 2 is that well executed parastatal price stabilization operations can in theory put an upper bound on food prices and protect against downside price risk by defending floor and ceiling prices through stock accumulation and release onto markets (Gabre-Madhin, Barrett, and Dorosh. 2003). Successful implementation of Model 2 requires that the marketing boards possess a great deal of technical and management skill.

The weaknesses of Model 2 are that (1) given the long history of ad hoc state intervention in food markets, it is not clear whether Model 2 could be regarded as a credible policy; and (2) given constraints on available government funds for agriculture, spending on expensive government operations in food markets reduces the amount that can be spent on public goods. Research of Evenson and Huffman (2006); Grilliches (1957); Howard (1994); and Antle (1983) shows very high payoffs to investment in these public goods. Therefore, there is potentially a high opportunity cost in terms of foregone public goods expenditures.

Then there is the political science literature contending that government operations in markets are primarily designed to achieve political objectives, not social welfare objectives. According to this literature, the objectives that economic analysis typically give to policy makers, something like maximizing farmer and consumer welfare, is naïve, and that the staying power of marketing boards and other government operations in markets despite economic analysis indicating their relatively low payoffs, is explained due primarily to objectives of maintaining power. Discretionary state intervention, and more explicitly, use of state funds to influence political outcomes using state intervention as the mechanism is an important means by which this is done (see Kanyinga 1994, for an interesting example).

Model 3: State Role Focusing on Discretionary Market Interventions. This is the most common model pursued in the region. It is vulnerable to lack of trust, cooperation, and coordination between the private and public sectors. A discretionary approach to government operations creates great risks for private sector and tends to impede the private sector from performing functions that it would otherwise do more confidently under Models 1 and 2. The poor performance that results from this high degree of uncertainty and lack of coordination is often attributed to market failure, but a strong case can be made that the more central and underlying causes are chronic under-investment in public goods and a lack of credible commitment in the policy environment, leading to low levels of trust and coordination among public and private sector actors in the staple food systems.

Model 3 has been made more feasible for governments to pursue starting in the early 2000s when donors transitioned from aid conditionality to direct budget support. Budget support has eased the fiscal constraints that limited the state's direct role in food markets in the 1990s. Consequently, by the early 2000s, and progressively since then, the maize marketing systems in much of eastern and southern Africa have regained fundamental similarities to the controlled marketing systems of their earlier histories. Some aspects of policy change have been implemented, primarily the legalization of domestic private trading, and marketing board activities have been downsized in response to the unavailability of funds to continue trading at levels during their controlled marketing periods. Instead of purchasing the entire marketed surplus, as was the goal during the former control period, these boards now attempt to influence market prices through their operations in the market, ostensibly for food security and/or price stabilization purposes. Since the reforms began, marketing boards in Kenya, Malawi, Zambia, and Zimbabwe have handled between 10-70% of the marketed maize from domestic production in most years. In countries where marketed surpluses are falling and national food security relies increasingly on imports (e.g., Malawi), the marketing boards' role has shifted more toward importation, stockholding, and release onto markets at subsidized prices. Despite the quite significant role that marketing boards in these countries continue to play up to the present, maize price volatility and its potential effects on production incentives and food security remain critical concerns.

Perhaps the greatest irony of the aid conditionality process in the region is the widespread perception that the World Bank has forced these African governments to implement orthodox agricultural policy reform (Model 1), and that the lack of clear economic turnaround in the region casts doubt on the technical logic of the Bank's model. The weight of the evidence, however, indicates that many countries in eastern and southern Africa have continued highly discretionary market and trade interventions of various types (Model 3), and hence an empirical assessment of these countries' food market performance since the 1990s reflects not the impacts of unfettered market forces but rather the mixed policy environment of legalized private trade within the context of continued strong government operations in food markets. There is widespread agreement that this food marketing policy environment, however it is characterized, has not effectively supported agricultural productivity growth for the millions of small farmers in the region.

Although price stabilization could have important benefits for producers and poor consumers, along the lines of Model 2, these benefits do not appear to have been successfully achieved because they have been pursued more along the lines of Model 3, i.e., unpredictable export and import bans and changes in marketing board operations to influence producer and consumer prices. In fact, price instability appears to be greatest in the countries where governments continue to rely heavily on marketing boards and discretionary trade policies to stabilize prices and supplies (Chapoto and Jayne 2009). Maize price instability in countries like Malawi and Zambia are extremely high despite the persistence of these government operations. By contrast, the operations of Kenya's maize parastatal have reduced price instability (Jayne, Myers, and Nyoro 2008). While it is difficult to estimate the counterfactual – i.e., the level and instability of food prices that would have prevailed over the past 15 years in the absence of these government operations – there are strong indications that at least some aspects of government interventions in food markets have exacerbated rather than reduced price instability for both producers and consumers.

Table 3. Cereal Production Trends in Kenya, Malawi, Zambia, Zimbabwe, and Sub-Saharan Africa overall, 1985 to 2005

	Sub-Saharan Africa	Kenya	Malawi	Zambia	Zimbabwe	Mali	Mozambique	Uganda
	Production indices (1985 = 100)							
1985	100	100	100	100	100	100	100	100
1986	106	115	96	110	90	99	111	90
1987	101	98	88	97	44	94	79	105
1988	119	113	105	172	92	126	78	120
1989	119	110	112	165	75	123	84	138
1990	112	93	99	103	76	102	99	133
1991	122	95	119	104	61	139	72	134
1992	117	97	47	53	13	105	33	148
1993	124	86	153	149	73	126	100	157
1994	129	126	78	102	80	142	108	161
1995	131	113	126	75	27	127	150	169
1996	146	94	139	134	91	134	183	132
1997	139	93	97	99	82	127	206	136
1998	146	102	136	70	55	153	226	174
1999	147	96	189	88	59	168	253	179
2000	140	89	187	91	73	142	211	173
2001	147	113	126	66	55	162	205	189
2002	145	97	124	65	22	152	216	194
2003	161	95	155	114	30	175	242	198
2004	159	95	131	114	35	169	263	217
2005	165	100	132	84	48	191	266	217

Source: FAOStat website: http://faostat.fao.org/, last accessed February 2009, data on this site reported only to 2005.

Before leaving this section, we present trends in staple cereal production (Table 3) for these countries having pursued price support and stabilization objectives (Kenya, Malawi, Zambia, and Zimbabwe) compared to cereal production trends for Sub-Saharan Africa as a whole, and for three countries that are known to have adopted a comparatively non-interventionist approach to grain markets (Mali, Mozambique, and Uganda). One cannot attribute differences in national cereal production performance simply to the manner of government participation in food markets, yet it is perhaps noteworthy that none of the four countries pursuing food price stabilization and food security objectives through direct state operations over the past decade has been able to match production growth for the continent as a whole. While cereal production in the Sub-Saharan Africa region as a whole has increased by roughly 60% over the past two decades, three of the four countries continuing to intervene heavily in their food markets are barely achieving cereal production levels of the 1980s. Ironically, these are the countries where the greatest advances in cereal seed technology have been made, and where green revolutions were believed to have been initiated in the 1970s and 1980s. By contrast, Mali, Mozambique and Uganda have all experienced a 90% or greater increase in cereal production over the past two decades, despite having benefited much less from the technological contribution of improved seeds.

4. DATA AND METHODS

The smallholder farm survey data presented in this report comes from Kenya, Malawi, Mozambique, and Zambia. The choice of countries is based on where MSU has been active over the years to build capacity among national collaborating partners to collect and manage large-sample farm household surveys. In every country, the surveys are confined to smallholder farm households, who were involved in some form of farm production and cropped less than a specific amount of land. "Small-scale" farmers are defined differently in different countries, but in all cases, households farming more than 20 hectares were excluded from the sample (this constituted less than 0.5% of households in all countries). We also excluded pastoral areas from the analyses so as to maintain the focus on the majority of the smallholder population that is primarily engaged in sedentary livelihood strategies.

4.1. Description of Smallholder Farm Household Surveys

4.1.1. Kenya

The Tegemeo Institute of Egerton University and Michigan State University designed and implemented smallholder farm surveys in eight agro-ecological zones where crop cultivation predominates. The sampling frame for the survey was prepared in consultation with the Central Bureau of Statistics but the CBS sampling frame was not made available for this exercise. Households and divisions were selected randomly within purposively chosen districts in the eight agro-ecological zones. Argwings-Kodhek et al. (1998) provides details of sampling; Burke and Jayne (2008) examine and discuss attrition bias issues.

A total of 1,578 small-scale farming households surveyed in 1997. Of these, 121 households were dropped because they were found to be either mainly pastoral farmers or their landholding size exceeded 20 hectares. The 1997 survey therefore constituted 1,457 sedentary households farming less than 20 hectares. Subsequent panel waves were conducted in 2000, 2004, and 2007. The 2007 sample contains 1,256 households of the original 1,457 sampled, an 86.2% re-interview rate. The nationwide survey includes 106 villages in 24 districts in the nation's eight agriculturally oriented provinces.

4.1.2. Mozambique

In 2002a and 2005, the Mozambican Ministry of Agriculture and Rural Development (MADER) in collaboration with the National Institute of Statistics (INE) conducted the *Trabalho do Inquerto Agricola* (TIA) survey. The sampling frame was derived from the Census of Agriculture and Livestock 2000, and was confined to small- and medium-scale farm households. The sample was stratified by province (10 provinces) and agro-ecological zones, and included eighty of the country's 128 districts. A total of 4,908 small and medium-sized farms were interviewed in 559 communities. The sample is nationally representative of rural farm households to the provincial level. A subsequent panel wave was conducted in 2005, with a re-interview rate of 82.7% and replacement of attrited households, to retain a representative sample of the population. Attrition bias is examined in Mather and Donovan (2008).

4.1.3. Zambia

Data is drawn from the Central Statistical Office's Post Harvest Survey (PHS) of 1999/2000, and the linked 2001, 2004, and 2008 Supplementary Surveys (SS) designed and conducted jointly by the government's Central Statistical Office and Michigan State University. A 3-wave panel data set is available for the three agricultural production seasons, 1999/2000, 2002/2003, and 2006/07. This corresponds to the 2000/01, 2003/04 and 2007/08 marketing years. The PHS is a nationally representative survey using a stratified three-stage sampling design. Census Supervisory Areas (CSA) were first selected within each district, next Standard Enumeration Areas (SEA) were sampled from each selected CSA, and in the last stage a sample of households were randomly selected from a listing of households within each sample SEA. The SEA is the most disaggregated geographic unit in the data, which typically includes 2-4 villages of several hundred households.

The 2000, 2004 and 2008 surveys are based on a sample frame of about 7,400 small-scale (0.1 to less than 5 hectares) and medium-scale farm households, defined as those cultivating areas between 5 to less than 20 hectares and/or raising animals. Survey method details and attrition bias are examined in Chapoto and Jayne (2009).

4.1.4. Malawi

Data used in this analysis come from two nationally representative surveys conducted by the Government of Malawi's National Statistical Office. The first survey, the Integrated Household Survey-II, covers two cropping seasons; our panel includes 1,087 households interviewed during the 2002/03 growing season and 1,319 households interviewed during the 2003/04 growing season. Therefore, the first year of the panel, while drawn from the same survey, covers two different years. Each model includes year dummies for both years to control for different year effects. During the first round of data collection there was a relatively small fertilizer subsidy program in operation, but commercial purchases accounted for over 85% of the farmers' total fertilizer use. The second year of the panel was implemented in 2007 and is referred to as the Agricultural Inputs Support Survey (AISS), which covers the 2006/07 growing season. From these two surveys, a balanced panel of 2,406 households is obtained.

4.2. Urban Consumer Surveys

The urban consumption survey data presented in Section 6 is drawn from surveys in Kenya, Mozambique, and Zambia, undertaken by Egerton University's Tegemeo Institute (Kenya), the Ministry of Agriculture (Mozambique), and the Central Statistical Office (Zambia).

4.2.1. Zambia

Zambia's Central Statistical Office with the support of Michigan State University's Food Security Research Project carried out the 2007 /08 Urban Consumption Survey (UCS). The UCS covered the four urban areas of Lusaka, Kitwe, Kasama, and Mansa, which collectively account for roughly 60% of the country's total urban population. The rationale for selecting these four cities is that Lusaka and Kitwe are representative of heavily populated urban areas in Zambia, while Kasama and Mansa are representative of northern urban centers where

Table 4. Number of Urban Households Interviewed, Analytical Sample, and Weighted Number of Urban Households, August 2007 and February 2008 Urban Consumption Surveys

	Number of households				
	Lusaka	Kitwe	Mansa	Kasama	Total
Number of households interviewed in August 2007	720	720	360	360	2,160
Number of households re-interviewed in February 2008	610	632	322	301	1,865
Analytical sample for panel data analysis*	607	627	322	300	1,856
Weighted number of households	225,637	68,153	8,277	17,105	319,171

Source: CSO/MACO/FSRP Urban Consuer Survey.
Note: *Nine households that were interviewed in both August 2007 and February 2008 were dropped from the analytical samples due to data problems related to expenditure on takeaway foods.

cassava is a key staple food. In total, 140 urban Standard Enumeration Areas (SEAs) were enumerated.[11] In each urban area, SEAs were stratified into low-cost residential areas and medium/high cost residential areas, with probability proportional to estimated size from the eight strata (four districts, two strata per district), with the size measure based on the 2000 Zambia Census of Population and Housing. All households in selected SEAs were listed in August 2007, then 18 households were randomly selected and interviewed in each SEA in the same month. Households were re-interviewed in February 2008. Population weights were constructed to correct for the differential representation of the sample at district and sub-district levels. UCS-based estimates are valid at the district and stratum levels. (For additional information on the UCS sample design methodology and information obtained, see the General Report on the Urban Consumption Survey (Hiichambwe et al. 2009). Table 4 summarizes the number of households interviewed in August 2007 and February 2008 as well as the number of weighted households.

4.2.2. Kenya

The data used in this study comes from a cross-sectional random survey of 600 households in Nairobi's urban areas and environs. Tegemeo Institute of Egerton University in cooperation with the Central Bureau of Statistics conducted and implemented the survey in November-December 2003. The survey uses the CBS's National Sample Survey and Evaluation Programme (NASSEP) IV frame established using the 1999 nationwide population and housing census database. Census Enumeration Areas (EAs) were used as the primary sampling units (PSUs). The first step in developing the frame involved allocating the PSUs to the districts considered as the strata. This was followed by selection of the PSUs using probability proportional to size.

Due to socio-economic diversity in the urban centers, the CBS stratified Kenya's urban areas into five income classes (strata): upper, lower-upper, middle, lower-middle and lower. Nairobi was allocated a total of 108 primary sampling units out of the 1800 units in the national frame. These were then allocated to the five strata using optimal allocation and the PSUs selected with probability proportional to population.

[11] SEAs are the lowest geographical sampling unit used by CSO and were the primary sampling units in the UCS. An SEA typically contains 100-200 households.

The allocation of PSUs among the five strata in Nairobi was as follows:

	Income Strata	Primary Sampling Units (PSUs)
1.	Upper	8
2.	Lower Upper	3
3.	Middle	5
4.	Lower Middle	10
5.	Lower	4
	Total	**30**

For each of the 30 primary sampling units, 20 households were then systematically selected, giving a total of 600 households covered in the city. Because of missing information on some surveys and other sources of attrition, the final sample size for analysis was reduced to 541 households.

A weighting procedure was used to take into account the sampling procedures at each stage of selection and non-responses. Weights for each cluster were calculated based on their selection probabilities. Household weights were also calculated based on their probabilities of selection. See Muyanga et al. (2005) for details.

Surveyed households were asked about their purchases and consumption of an array of maize products as well as wheat, rice, and other carbohydrate products that have traditionally constituted the important sources of calories in urban diets. The specific maize products that respondents were asked about include a) highly-refined sifted maize meal (e.g., Hostess brand); the less-refined packaged maize meal brands (e.g., Jogoo, Pembe, Jimbi, etc); the less-refined posho meal (both dehulled and straight run); grain for posho milling (dehulled and straight run); grain for other dishes; and green maize. For wheat, respondents were asked about their consumption of bread, flour, spaghetti, macaroni, and pasta products. Consumption figures exclude food commodities consumed at the urban household premises but produced at households' rural farms and transported to town, as well as the relatively few cases of food commodities grown and consumed from households' urban plots.

4.2.3. Mozambique

The Ministry of Plan and Finance (now Ministry of Plan and Development) carried out its *Inquérito às Familias* in 1996 and 2002 (IAF 1996 and IAF 2002). These expenditure surveys provide nationally and provincially representative data for urban and rural areas on total household expenditure and budget shares for specific items or groups. These data are utilized in section 5 when we examine urban and rural consumption patterns. Because available IAF data do not distinguish between purchases of maize grain and maize meal, nor between various types of meal, the Ministry of Agriculture's Policy Analysis Department (DAP) and Agricultural Market Information System (SIMA) have collaborated on several smaller-scale surveys over the years, including:

- The 2003 Consumer and Small-Scale Miller Survey, a follow-up to the 1994 survey, which randomly selected 305 households in poor neighborhoods of Maputo, Xai-Xai, and Beira;
- The 2005 Maize Trader and Miller surveys which included interviews with the top five millers in the country, and 100 rural traders across the country; and

- Small special purpose surveys of food staple retailers in Maputo during early 2005 and again in early 2007.

Details of these surveys can be found at:
http://www.aec.msu.edu/fs2/mozambique/index.htm

5. SMALLHOLDER PRODUCTION AND MARKETING PATTERNS

The analysis in this section is confined to descriptive information on smallholder income sources, crop production, and marketing patterns, disaggregated by farm size. In each country, the sample of farm households are ranked by farm size and then stratified into five equal groups, or landholding size quintiles. For each of these farm size quintiles, Section 5.1. presents information on the relative importance of farm vs. non-farm activities in the generation of smallholder households' annual incomes. Farm activities are comprised of retained crop production (valued at sales prices), marketed crops, livestock product sales, and agricultural wage labor.

Section 5.2. disaggregates and reports income shares of various types of crop categories within "farm income", e.g., maize; other food staples (primarily cassava, tuber crops, sorghum, millet, rice, and wheat); high-valued food crops (primarily fresh fruits and vegetables, legumes, groundnuts, edible oilseeds); traditional cash crops such as tea, coffee, sugarcane, cotton, and tobacco; animal products; and agricultural labor wages, both cash and in-kind. This section provides an understanding of the relative importance of staple foods in smallholders' incomes, again disaggregated by farm size quintile.

Section 5.3. presents the relative importance of the various crops in smallholders' income derived from the sale of crops.

Section 5.4. reports the percentages of sampled households according to their position in the maize market: sellers only, buyers only, buyers and sellers (net sellers); buyer and sellers (net buyers), and autarkic (no sales or purchases). This analysis is reported for the main agro-ecological zones in each country.

Section 5.5. examines the characteristics of these farm households according to their position in the maize market.

5.1. Landholding Size Distribution in the Smallholder Sector

Relative to other developing regions, Africa has been perceived as a continent of abundant land and scarce labor. While this was true decades ago, rural population density doubled between 1960 and 2000 in Africa, compared to only 20% in the rest of the world (Masters 2005). Access to land has now become a critical problem in much of southern and eastern Africa. One of the most important but underemphasized trends in African agriculture is a steady decline in arable land-to-person ratios. Between 1960 and 2007, according to the Food and Agricultural Organization (FAO) data, the amount of arable land under cultivation (including permanent crops) has risen marginally, but the population of households engaged in agriculture has tripled. This has caused a steady decline in the ratio of arable land to agricultural population (Table 5). In Kenya, Ethiopia, and Zambia, for example, this ratio in the 2000s is about half as large as it was in the 1960s.

Moreover, the distribution of available land is highly inequitable, as the colonial legacy has left much of Africa with severe land inequalities between smallholder, large-scale, and state farms. Redressing inequalities between these sectors is likely to be an important element of an effective rural poverty reduction strategy in countries such as Zimbabwe and Kenya. Perhaps less well acknowledged is that there are major disparities in land distribution within the small farm sector itself. Landholdings within the smallholder farm sector in eastern and

southern Africa are often characterized as small but relatively "unimodal," equitably distributed, and situated within a "bi-modal" distribution of land between large-scale and small-scale farming sectors. However, there are large disparities in land distribution within the small farm sector using national household survey data in Kenya, Malawi, Mozambique, and Zambia (Table 6a to 6d). While average landholding size in the small farm sector range from between 1.1 hectares in Malawi to 2.2 hectares in Kenya, these mean farm size values mask great variation.

After ranking all farms by total household landholdings, and dividing them into five equal quintiles, households in the highest land quintile controlled between 3 to 10 times more land than households in the lowest quintile (Tables 6a to 6d). In Kenya, for example, mean farm size for the top and bottom land quintiles was 6.42 and 0.41 hectares, respectively, including rented land. The range of computed Gini coefficients of rural household land per capita (0.50 to 0.56) from these surveys show land disparities within the smallholder sectors of these countries that are comparable to or higher than those estimated for much of Asia during the 1960s and 1970s (Haggblade and Hazell 1988). If the large-scale and/or state farming sectors in our case countries were included, the inequality of landholdings would rise even further.

Table 5. Ratio of Cultivated Land to Agricultural Population

	1960-69	1970-79	1980-89	1990-99	2000-07
	Cultivated area per agricultural person				
Ethiopia	0.508	0.450	0.363	0.252	0.223
Kenya	0.459	0.350	0.280	0.229	0.207
Mozambique	0.389	0.367	0.298	0.249	0.246
Rwanda	0.215	0.211	0.197	0.161	0.144
Zambia	1.367	1.073	0.896	0.779	0.781
Zimbabwe	0.726	0.664	0.583	0.525	0.480

Note: Land to person ratio = (land cultivated to annual and permanent crops) / (population in agriculture).
Source: FAOStat website: Source: FAO Stat database: www.faostat.fao.org/.

Table 6a. Kenya - Household Mean Income and Income Shares by Quintiles of Total Household Landholding, National, 2007

Quintiles of total HH Landholding	Total HH landholding size (ha)	Total Income	Farm Income	Non-farm Income	Farm income	Retained crop value	Sold crop value	Livestock product sales	Ag wage labor	Non-farm income
		Mean Ksh per adult equivalent.			Mean % share in total households income					
1-Low	.41	31,129	16,799	14,330	57%	26%	17%	13%	0.8%	43%
2	.87	36,001	19,854	16,147	61%	24%	23%	13%	0.8%	39%
3-Mid	1.28	43,511	24,868	18,644	61%	21%	25%	14%	0.9%	39%
4	2.06	48,057	29,056	19,001	63%	22%	27%	14%	0.6%	37%
5-High	6.42	71,648	46,035	25,614	67%	16%	30%	21%	0.5%	33%
Total	2.22	45,998	27,313	18,685	62%	22%	24%	15%	0.7%	38%

Table 6b. Zambia - Household Mean Income and Income Shares by Quintiles of Total Household Landholding, National, 2008

Quintiles of total HH Landholding	Total HH landholding size (ha)	Total Income	Farm Income	Non-farm Income	Farm income	Retained crop value	Sold crop value	Livestock product sales	Ag wage labor	Non-farm income
		Mean '000 Kwacha per adult equiv.			Mean % share in total households income					
1-Low	.16	669	262	407	39%	21%	5%	3%	11%	60%
2	.70	623	280	342	64%	48%	9%	4%	3%	36%
3-Mid	1.18	681	361	320	70%	49%	15%	4%	2%	30%
4	1.87	895	536	359	71%	46%	19%	5%	2%	29%
5-High	4.47	1,207	770	437	76%	42%	26%	7%	1%	24%
Total	1.70	955	446	508	64%	41%	15%	5%	4%	35%

Table 6c. Malawi - Household Mean Income and Income Shares by Quintiles of Total Household Landholding, National, 2007

Quintiles of total HH Landholding	Total HH landholding size (ha)	Total Income	Farm Income	Non-farm Income	Farm income	Retained crop value	Sold crop value	Livestock product sales	Ag wage labor	Non-farm income
	Mean Kwacha per adult equivalent				Mean % share in total households income					
0	0.32	56.1	24.1	32.1	64.7%	41.9%	5.4%	5.8%	11.6%	35.3%
2	0.58	45.4	29.2	16.1	75.9%	50.2%	8.9%	4.2%	12.6%	24.1%
3-Mid	0.86	54.9	38.2	16.7	75.2%	48.2%	11.2%	4.5%	11.3%	24.8%
4	1.24	44.8	32.3	12.5	78.0%	47.0%	17.1%	6.1%	7.7%	22.0%
5-High	2.55	78.0	67.3	10.7	80.9%	40.2%	27.7%	5.5%	7.6%	19.1%
Total	1.11	59.1	38.3	20.8	74.4%	45.1%	14.0%	4.5%	10.1%	25.6%

Table 6d. Mozambique - Household Mean Income and Income Shares by Quintiles of Total Landholding, National, 2005

		Total Income Components			Farm Income Components					
Quintiles of total HH landholding	Total HH landholding (ha)	Total income /AE	Farm income /AE	Non-farm income/AE	Farm income	Retained crop value	Sold crop value	Livestock product sales	Ag wage Labor	Non-farm income
		----- mean values -----			---Mean% share in total household income---					
1-low	0.52	105.9	37.4	69.3	63.3	48.1	7.9	1.6	5.8	36.7
2	1.03	115.4	42.1	70.4	63.7	48.7	9.0	2.0	4.0	36.3
3-mid	1.53	125.4	48.8	75.8	66.4	48.3	11.4	2.4	4.4	33.6
4	2.23	106.2	51.6	53.9	68.4	49.3	12.8	2.9	3.3	31.6
5-high	4.28	153.4	84.1	67.3	72.9	48.1	17.5	4.2	3.1	27.1
total	1.92	121.3	52.8	67.3	66.9	48.5	11.7	2.6	4.1	33.1

Because of rising land pressures and inequitable distribution, semi-landlessness is becoming a major problem. In each country, at least 25% of the small-scale farm households in these nationwide surveys in every country are approaching landlessness, controlling less than a half

hectare of land. In Ethiopia and Rwanda, the bottom 25% of the smallholder population control less than 0.12 and 0.15 hectares (Jayne et al. 2003). In Malawi, where land pressures are particularly severe, 60% of all smallholders possess less than 0.86 hectare of land. While many farms in Asia were similarly very small at the time of their green revolutions, many of them enjoyed irrigation, higher returns to fertilizer that could be achieved with water control, and more than one cropping season. These factors substantially improved Asian land productivity, and partially relieved the severity of the land constraint among small farms. By contrast, the vast majority of African farms are dependent on rain and one crop season per year.

5.2. Sources of Smallholder Household Income and Their Importance

The data in Tables 6a-d also show a strong relationship between access to land, farm income, and total household income in southern and eastern Africa. Farm incomes were roughly three times higher in the top land quintile than in the bottom. Mean non-farm incomes were roughly constant across the five landholding quintiles, indicating that the land-poor were not more successful in generating income off the farm than the other landholding size groups. The exception is Malawi, where the bottom landholding size quintile earned more non-farm income in absolute terms than the other four landholding size quintiles. In all four countries, the share of total income from non-farm sources is much higher for the farm households with the least land.

Household income is positively related to landholding size. Household incomes per capita ranged from 40% to over 100% higher within the top landholding size quintile than among the bottom quintile.

Another observation from Tables 6a-d is that farm incomes account from 60% to 70% of total household income. In Malawi, the share of farm income is slightly higher, owing to the heightened importance of agricultural wage labor there, which is an underlying reflection of semi-landlessness among a substantial portion of the rural population. While agricultural wage labor accounts for less than 4% of total household income in Kenya, Zambia, and Mozambique, it exceeds 10% in Malawi. In all countries, agricultural wage labor constitutes a higher share of total income among the land poor.

Levels of agricultural commercialization vary widely across the countries. Crop sales account for 24% of total household income in Kenya, 15% in Zambia, 14% in Malawi, and 12% in Mozambique. Sales of livestock products (e.g., dairy, eggs, meat) constitute 15% of total household income in Kenya, compared to 6% or less in the other three countries. As expected, agricultural commercialization is much higher in the top landholding size group than in the bottom. In absolute terms, households in the top landholding size group derive between four times more revenue from sale of farm products (in Mozambique) to 11 times more revenue (in Zambia) than households in the bottom landholding quintile.

5.3. Sources of Farm-related Income and Their Importance

Tables 7a to 7d examine the importance of various crop and animal enterprises in household income from farming.

Table 7a. Kenya - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2007

Quintiles of total HH landholding size	Farm income ($US)	Maize retained	Maize sold	Other staple food crops retained	Other staple food crops sold	High-value food crops retained	High-value food crops sold	Traditional cash crops	Livestock products	Ag wage labor
		Mean share (%) in total gross farm income								
1-Low	672	22%	3%	6%	2%	23%	11%	11%	21%	.9%
2	950	20%	5%	6%	3%	19%	12%	14%	20%	1.1%
3-Mid	1,259	18%	5%	5%	3%	17%	12%	17%	22%	1.3%
4	1,465	19%	8%	4%	3%	16%	13%	14%	23%	.9%
5-High	2,711	15%	13%	3%	7%	10%	10%	12%	31%	.7%
Total	1,408	19%	7%	5%	4%	17%	12%	14%	23%	1.0%

Table 7b. Zambia - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2008

Quintiles of total HH landholding size	Farm income ($US)	Maize retained	Maize sold	Other staple food crops retained	Other staple food crops sold	High-value food crops retained	High-value food crops sold	Traditional cash crops	Livestock products	Ag wage labor
		Mean share (%) in total gross farm income								
1-Low	241	35%	3%	18%	1%	14%	4%	0%	12%	13%
2	336	37%	5%	21%	3%	15%	6%	2%	7%	4%
3-Mid	461	33%	7%	20%	3%	16%	7%	5%	8%	2%
4	609	33%	9%	15%	3%	15%	8%	6%	9%	2%
5-High	1,426	30%	15%	12%	4%	12%	9%	6%	12%	2%
Total	615	33%	8%	17%	3%	14%	7%	4%	9%	4%

Table 7c. Malawi - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2007

Quintiles of total HH landholding size	Farm income ($US)	Maize retained	Maize sold	Other staple food crops retained	Other staple food crops sold	High-value food crops retained	High-value food crops sold	Traditional cash crops	Livestock products	Ag wage labor
		Mean share (%) in total gross farm income								
1-Low	75	48.1%	2.5%	9.8%	1.3%	12.5%	2.0%	2.0%	5.8%	16.1%
2	96	44.0%	2.9%	8.7%	2.1%	15.3%	4.2%	2.1%	5.0%	15.5%
3-Mid	108	43.9%	3.0%	8.1%	1.9%	14.9%	4.8%	4.4%	5.5%	13.6%
4	127	39.3%	2.7%	9.1%	2.6%	15.6%	6.2%	8.8%	6.3%	9.4%
5-High	314	30.9%	3.7%	8.4%	2.7%	13.1%	6.7%	18.5%	6.7%	9.3%
Total	144	41.3%	3.0%	8.8%	2.1%	14.2%	4.8%	7.3%	5.9%	12.7%

Table 7d. Mozambique - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2005

Quintiles of total HH landholding size	Farm income ($US)	Maize retained	Maize sold	Other staple food crops retained	Other staple food crops sold	High-value food crops retained	High-value food crops sold	Traditional cash crops	Livestock products	Ag wage labor
		Mean share (%) in total gross farm income								
1-Low	112.5	14.6	1.1	40.6	1.6	23.4	8.0	.4	2.7	4.5
2	138.4	18.3	1.5	39.3	1.2	21.5	8.6	1.3	3.0	3.2
3-Mid	170.6	20.8	2.5	35.0	1.7	18.4	9.2	2.7	4.2	2.6
4	213.9	21.6	2.9	34.3	1.4	17.9	9.1	4.6	3.9	2.4
5-High	382.3	24.1	4.6	28.5	1.5	14.2	8.4	8.8	6.1	1.2
Total	203.5	20.6	2.5	37.5	1.5	19.1	8.6	3.4	4.2	2.6

Maize is generally the single most important crop in smallholder farm incomes. When adding the value of production and sales, maize accounts for 26% of farm income in Kenya, 41% in Zambia, 44% and Malawi, and 23% in Mozambique. There is substantial regional variation in these figures. Maize accounts for as much as 70% of farm income in some areas (generally those of relatively high agro-ecological potential), and less than 10% in others (generally the semi-arid areas).

Perhaps surprisingly, however, maize is not always the most important crop category. The "high value food crops" category (comprising fresh fruits and vegetables, groundnuts and other edible legumes and seeds) provide a greater share of farm income than maize in both Kenya and Mozambique. These crops (primarily fruits and vegetables) account for 29% of farm income in Kenya, 28% in Mozambique, 21% in Zambia, and 19% in Malawi. In Kenya and Mozambique, the share of high-value food crop production and sales income (primarily horticultural crops) are inversely related to landholding size, i.e., the smallest farms have the highest share of farm income from horticultural crops. This category accounts for 31% of farm income among the smallest farms in Mozambique, compared to 22% for the largest farm group. In Kenya, high-value food crops account for 34% of farm income among the land poor, compared to only 20% of farm income among the highest land size group.
The rising importance of cassava production is also seen in Zambia and Mozambique. Cassava is the most important crop contained in the "other staple food crop" category (sorghum, millet, rice, and wheat are the others, but they are generally very minor). This crop category accounts for 39% of farm income in Mozambique, 20% in Zambia, while only 11% and 9% in Malawi and Kenya.[12]

Traditional cash crops such as coffee, tea, sugarcane, and tobacco are relatively important in Kenya (14% of farm income) but less than 10% of farm income in the other three countries. Once again, however, there is substantial regional variation in the importance of these traditional cash crops. It is also noted that the sale of traditional cash crops is highly related to landholding size. In Zambia, Malawi, and Mozambique, the farm income share from traditional cash crops are from 7 times to over 20 times higher among households in the top landholding size quintile than in the bottom quintile. In Kenya, the farm income share of

[12] In Zambia, cassava accounts for 68% of the value of production in the "other staple food" category. Millet/sorghum, potatoes, rice, and wheat account for 16%, 10%, 6%, and 0%, respectively.

traditional cash crops are roughly constant across the landholding size quintiles, but in terms of absolute gross income, the relatively large farms derive 3-4 times more gross income from the sale of these crops than the smallest farm quintile.

Livestock products are relatively important in Kenya, comprising 23% of farm income there. This reflects the importance of commercialized dairy production among smallholders in Kenya. Livestock product income accounts for less than 10% of farm income in the other countries.

Finally, it is noted that the disparities in farm income across the farm size quintiles are much greater when measured in terms of total farm income (as is done in Tables 7a-d) rather than in farm income per adult equivalent (as in Tables 6a-d). This reflects the fact that larger farms have moderately larger family sizes, which reduces the disparities in farm income across the landholding size quintiles when farm incomes are expressed in per adult equivalent units.

5.4. Importance of Crop Types in Smallholder Commercialization

Tables 8a-d present information on the amount of revenue generated from the sale of crops, and the share of this revenue from the various crop categories.

Table 8a. Kenya - Shares in Total Crop Sales Income by Landholding Quintiles, National, 2007

Quintiles of total HH landholdings	Crop sales income ($US)	Maize sales	Sales of other staple food crops	Sales of high-value food crops	Traditional cash crops
1-Low	242	10.2%	8.4%	51.8%	29.5%
2	428	14.9%	7.6%	49.2%	28.3%
3-Mid	622	14.7%	9.2%	46.7%	29.3%
4	735	24.4%	9.4%	43.6%	22.5%
5-High	1,273	33.8%	16.9%	31.8%	17.6%
Total	657	20.1%	10.4%	44.4%	25.1%

Table 8b. Zambia - Household Shares of Components in Total Crop Sales Income by Landholding Quintiles, National, 2008

Quintiles of total HH landholdings	Crop sales income ($US)	Maize sales	Sales of other staple food crops	Sales of high-value food crops	Traditional cash crops
1-Low	24	34.8%	21.6%	42.5%	1.1%
2	76	31.6%	21.9%	38.5%	7.9%
3-Mid	116	28.3%	17.6%	36.5%	17.7%
4	206	32.3%	13.9%	33.7%	20.1%
5-High	673	38.1%	14.2%	30.9%	16.9%
Total	220	33.1%	16.9%	35.3%	14.7%

Table 8c. Malawi - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2007

Quintiles of total HH landholdings	Crop sales income ($US)	Maize sales	Sales of other staple food crops	Sales of high-value food crops	Traditional cash crops
1-Low	51	39.2%	17.0%	34.3%	9.5%
2	54	29.0%	23.5%	39.6%	7.9%
3-Mid	81	30.0%	17.3%	40.1%	12.6%
4	113	17.1%	16.8%	45.5%	20.6%
5-High	347	17.9%	15.5%	31.9%	34.8%
Total	255	24.6%	17.3%	38.1%	20.0%

Table 8d. Mozambique - Household Share of Components in Total Gross Farm Income by Landholding Quintiles, National, 2005

Quintiles of total HH landholdings	Crop sales income ($US)	Maize sales	Sales of other staple food crops	Sales of high-value food crops	Traditional cash crops
1-Low	30.4	9.5	16.9	71.5	2.1
2	52.6	14.4	13.9	66.8	4.9
3-Mid	47.5	17.8	14.7	58.3	9.1
4	65.5	19.0	12.2	54.5	14.3
5-High	166.4	23.5	10.4	43.2	23.0
Total	78.8	17.6	13.3	57.2	11.9

Data in the second columns of Tables 8a-d once again show huge disparities in crop income across the five landholding size groups. Revenues from crop sales among households in the top land quintile are 4 to 10 times higher than households in the bottom land quartile. With the exception of Kenya, for households in the bottom landholding quartile, even a doubling of crop income – resulting for example from use of new technology or additional purchased inputs – would have little impact on households' absolute level of income or absolute poverty rates. These results are especially troubling in light of evidence that "pro-poor" agricultural growth is strongly associated with equitable asset distribution (Ravallion and Datt 2002). To date, surprisingly little attention has been devoted to considering the implications of African land inequality for poverty reduction strategies.

Looking at the shares of crop sales income across farm size category, there are a number of important observations that reflect individual country situations. In Kenya, Zambia, and Mozambique, maize sales income (both absolute income and shares of total crop sales income) are highly correlated with landholding size. The 20% of households with the largest farmers account for more revenue from maize sales than the 80% of the rest of the farms combined. The same is true with the traditional cash crops (coffee, tea, sugarcane, cotton, cashew, tobacco) in Mozambique and Zambia. In Kenya, cash crop production has trickled down more effectively to the smaller farms, and it accounts for a respectable share of crop sales income even among the most land-constrained smallholders.

Sales of high-value food crops (primarily fresh fruits and vegetables) provide a contrasting picture. Here, there is an inverse correlation between landholding size and income shares from crop sales in Kenya, Zambia, and Mozambique. For example, high-value food crops account for 71.5% of crop sales income among the smallest farm size quintile in

Mozambique, compared to 43% among farmers in the largest farm size quintile. A similar inverse correlation between farm size and horticulture sales share is observed in Kenya and Zambia.

This pattern appears to reflect a growing attempt by land constrained households to maximize their returns to their most constrained resource – land – by shifting the composition of cropping from relatively low-valued staples to higher-valued products with relatively low entry barriers such as fresh fruits and vegetables. Apparently, it is less feasible for the smallest farms to engage in traditional cash crops such as sugarcane and cotton because they often require relationship with outgrower companies that have minimum landholding requirements, which the smallest farmers cannot satisfy. By contrast, there appear to be fewer barriers to entry into the production and sale of horticultural products for the domestic market, such as tomatoes, onions, cabbages, and leafy greens. The domestic market for these horticultural products is dominated by small-scale informal buyers, making it relatively easy for small farmers to market these horticultural products even in small quantities.

Another factor may be driving this pattern of an inverse relationship between farm size and crop sales shares from high-valued food crops. With the exception of 2008/09, real retail food prices have been trending downward in much of the region. Rapid investment in medium- and small-scale staple food processing and retailing are largely responsible for the reductions in marketing margins that have been documented in much of the region. Most rural smallholders and urban consumers are major beneficiaries of the reduced real food prices. They now pay less to satisfy their residual food consumption needs than 10-15 years ago. Even more importantly, grain is more reliably available in rural markets. This creates positive conditions for millions of smallholder farmers in the region to greatly raise their incomes by devoting more of their land to crops that earn relatively high returns to scarce land (i.e., move toward more commercialized production and marketing patterns) instead of subsistence-oriented, food self-sufficiency production patterns. For these reasons, there are important interactions between the performance of staple food markets and the potential for smallholder production growth and commercialization involving higher-valued agricultural commodities. More research is needed to test this hypothesis more fully using household survey data from other countries in the region.

The question arises, why not Malawi? Here we do not see any strong tendency for the smaller farms to diversify toward higher-value crops. In fact, maize still holds the largest share of crop sales income among the smallest farms in Malawi. The year in which this survey was undertaken, 2007, was the second year of a large-scale fertilizer and maize seed subsidy program in Malawi. While more detailed research is necessary to corroborate this, there are initial indications that the subsidy program may have encouraged all farmers, even the most land-constrained ones, to continue growing maize in order to feed themselves, rather than moving toward a comparative advantage strategy of growing crops that will maximize crop revenue and using the revenue to purchase needed staples. At this stage, this can only be considered a hypothesis, subject to more detailed analysis.

5.5. Smallholder Households Position in the Maize Market

Several factors determine participation of smallholders in markets including their asset position (e.g. land, labor, and capital), access and proximity to markets, organizational capacity, and their ability to produce a marketable surplus at costs that will make selling at prevailing prices attractive. Available evidence from nationwide farm household surveys for

maize indicates that only a very small proportion of households buy and sell grain in the same year. Small-scale farm households generally fall into one of the following four categories with respect to grain markets (Table 9a-d):

i) *Sellers of staple grains:* Roughly 20 to 35% of the smallholder farms sell maize in a given year. Of course, this figure will rise in good harvest years and fall in a drought year. However, there are two sub-groups within this category:

   - A very small group of relatively large and well-equipped smallholder farmers with 5 to 20 hectares of land, usually in the most favorable agro-ecological areas. These farm households comprise 1 to 3% of the national smallholder farm population in most countries and account for 50% of the marketed output from the smallholder sector. These farms tend to sell between 1 and 50 tons of maize per farm in a given year.
   - A much larger group of smallholder farms (20 to 30% of the total rural farm population) selling much smaller quantities of grain, usually between 50kgs to 200kgs per farm. These households tend to be slightly better off than households that buy grain, but the differences are not very great in absolute terms. Most of these households do not consistently produce a surplus – according to repeat panel survey data, only about 10-15% of smallholder farmers consistently sell grain.

ii) *Buyers of staple grains:* these rural households generally make up 40-60% of the rural population, higher in drought years and lower in good production years. These households are generally poorer and have smaller farm sizes and asset holdings than the median rural household. They are directly hurt by higher mean grain prices.

iii) *Households buying and selling grain within the same year:* In all of the nationwide surveys, relatively few households both buy and sell maize (Tables 9a-d).[13] Only about 5 to 15% of the rural population buys and sells maize in the same year. Many of these are relatively large and food secure farms with a preference for highly refined commercial maize meal; they sell grain and buy back lesser amounts of processed meal. About 3 to 5% of the farm households nationwide are found to sell grain after harvest only to buy back larger quantities later in the season.

iv) *Households neither buying nor selling staples:* these households make from 14% of the smallholder sample in Kenya, to roughly 20 to 30% in Zambia, Mozambique, and Malawi (Tables 8a-d). These households tend to be those residing in the cassava zones, where storing cassava in the ground and digging it up when needed substitutes for maize purchases. There are large portions of the region, especially in Zambia, Mozambique, Malawi, and Tanzania, where cassava is a major staple, and in these areas, a sizable fraction of the rural population at the national level is autarkic with respect to maize.

Grain marketing policies and market development will have differential effects on these different types of small-scale producers. For example, reducing marketing costs will narrow the price band between sale prices and acquisition prices, turning some farmers with relatively low production costs into sellers. A reduction in marketing costs may also reduce the acquisition cost of grain and turn other farmers into buyers of grain staples (Barrett 2008).

[13] It is commonly believed that the majority of smallholder households both sell and buy maize in the same year – distress sales at low prices after harvest, followed by buying back maize later in the season when prices are high. To our knowledge, there is virtually no evidence from household survey data to indicate that this kind of marketing behavior applies to more than 10% of the smallholder farm population.

Table 9a. Kenya - Household Maize Market Participation Status, 2007

	Eastern and Western Lowlands	Western Transitional and Western Highlands	High-potential maize zone	Central Highlands	Coast	Total
Selling maize only	12.4%	30.7%	52.5%	14.9%	4.2%	27.3%
Buying maize only	51.7%	35.8%	19.7%	47.6%	72.2%	39.9%
Buying and selling maize (net maize seller)	13.6%	13.7%	16.6%	22.6%	11.1%	15.9%
Buying and selling maize (net maize buyer)	3.7%	3.4%	1.4%	2.8%	4.2%	2.9%
Autarkic (no maize sales or purchases)	18.6%	16.4%	9.8%	12.1%	8.3%	14.0%

Table 9b. Zambia - Household Maize Market Participation Status, 2008

	Region I: low rainfall (under 800 mm)	Region IIa: moderate rainfall (800-1000 mm), clay soils	Region IIb: moderate rainfall (800-1000 mm), sandy soils	Region III: high rainfall (over 1000 mm)	Total
Selling maize only	14.4%	16.4%	7.3%	21.2%	17.7%
Buying maize only	51.6%	50.7%	61.2%	41.0%	47.2%
Buying and selling maize (net maize seller)	5.8%	11.9%	3.8%	8.1%	9.2%
Buying and selling maize (net maize buyer)	2.7%	2.8%	4.0%	3.0%	3.0%
Autarkic (no maize sales or purchases)	25.5%	18.1%	23.7%	26.8%	22.9%

Table 9c. Malawi - Household Maize Market Participation Status, 2007

	Central	Northern	Southern	Total
Selling maize only	6.8	8.0	5.9	6.5
Buying maize only	47.9	56.9	60.7	55.0
Buying and selling maize (net maize seller)	3.2	3.9	3.2	3.3
Buying and selling maize (net maize buyer)	5.1	3.6	6.9	5.9
Autarkic (no maize sales or purchases)	36.9	27.7	23.3	29.4

Table 9d. Mozambique Household Maize Market Participation Status, 2002, 2005

		Agro-ecological zone				
		Low	Low-Med	Med	High	National
	Year	-------- column % of households by year ----------				
Selling maize only	2002	3.4	7.3	19.7	16.7	10.5
	2005	4.8	8.2	18.7	17.4	11.1
Buying maize only	2002	71.9	57.9	39.4	45.9	55.5
	2005	70.3	53.9	36.3	42.6	52.3
Buying and selling maize (net maize seller)	2002	5.0	2.8	6.6	10.2	5.1
	2005	3.2	2.9	4.3	2.9	3.4
Buying and selling maize (net maize buyer)	2002	2.3	5.1	8.6	6.9	5.5
	2005	2.8	4.6	5.1	5.0	4.3
Autarkic (no maize sales or purchases)	2002	17.4	26.9	25.8	20.4	23.4
	2005	18.9	30.5	35.5	32.2	28.9
		100	100	100	100	100

5.6. Concentration of Household Maize Sales

Staple grain sales can be highly concentrated among a relatively small number of large and commercialized farmers in the smallholder sector. Based on this observation, we categorized the smallholder farm samples in each country into four groups designed to distinguish their purchase and sales relationship to maize markets more meaningfully. These four categories are:

Category 1. Households with "large" net maize sales, i.e., over 100 kgs per adult equivalent (i.e. 400 kgs of maize for the average sized smallholder household). Net maize sales are defined as the quantity of maize grain (and meal/flour equivalent) sold minus the quantity of maize grain (and meal/flour equivalent) purchased, during the previous 12 months. Autarkic household have net maize sales = 0;

Category 2. Households with "small" net maize sales, i.e., between 25 to 100 kgs per adult equivalent;

Category 3: households with negligible maize market involvement, i.e., net maize sales between -25 to 25 kgs per adult equivalent. Autarkic households are also included in this group; and

Category 4: deficit households, i.e., net maize sales less than -25 kgs per adult equivalent.

As shown in Table 10a through 10d, only 2-3% of the farms in Malawi and Mozambique were defined as large sellers (category 1 above), compared to 19% in Zambia and 26.9% in Kenya. Kenya's smallholder population is relatively commercialized and able to take advantage of profitable market opportunities compared to smallholder sectors of Malawi and Mozambique, where 90% of the farms are either not participating meaningfully in maize markets or are actually deficit producers (categories 3 and 4). However, this status also describes 60% of the smallholder population even in Kenya, and over 70% in Zambia.

The relatively large maize-selling households enjoy substantially higher welfare levels, in terms of asset holdings, crop income, and non-farm income, than the rest of the rural population, in all four countries. The smallholder farmers in category 1 had roughly 2-3 times as much land and productive assets as the non-selling and deficit households. The category 1 farmers in Kenya and Zambia also have 2-3 times more gross revenue from the sale of all

crops than the deficit maize households. In Malawi and Mozambique, the large maize sellers have more than 10 times more gross revenue from the sale of all crops than maize deficit households do. Total household income of the category 1 large maize sellers ranges from double that of the maize deficit and autarkic households in Kenya and Zambia, to 3 to 5 times more in Malawi and Mozambique. Considering the relatively small fraction of the smallholder population comprising category 1, these findings reveal a highly concentration of productive resources and marketed crop output among a narrow segment of the rural population.

Even when a broader set of staples are aggregated together (maize, cassava, sweet potato, millet and sorghum) more than 55% of the sales of staples are still accounted for by 10% of the farmers with the largest sales. This concentration of surplus production and marketing by a relatively few farmers is one of the most important points to be borne in mind when thinking about the effects of policy instruments designed to alter the mean level of food prices.

Perhaps surprisingly, the distribution of female-headed households in these four maize marketing categories is relatively proportional to the overall sample. In Mozambique and Malawi, the proportion of deficit households being female-headed was slightly higher than the overall mean.

These findings hold several important policy implications. First, cereal producer price supports or stabilization policies that involve altering mean price levels over time (as they usually do), can have unanticipated income distributional effects that run counter to stated poverty alleviation goals. To the extent that the poor are net purchasers of staples such as maize, wheat, and rice, they are directly hurt by policies that raise prices of these commodities.[14] Forms of price stabilization that do not raise the average price of food would most likely avoid these adverse distributional effects, and would also help to promote diversification toward higher-valued crops by maize purchasing households (Fafchamps 1992; Jayne 1994).

[14] Of course, a general equilibrium approach, taking into account indirect effects on welfare through labor market effects, would need to be undertaken before the welfare effects of mean-altering price policies could be fully understood.

Table 10a. Kenya - Household Assets, Maize Production and Sales, and Access to Market Public Goods by Maize Market Position Group, National, 2007

HH characteristics	Market Position Group				
	HHs with large net sales	HHs with small net sales	HHs with negligible sales	Deficit HHs	All households
	Mean	Mean	Mean	Mean	Mean
Number of cases (% of total sample)	356 (26.9%)	152 (11.5%)	493 (37.3%)	322 (24.3%)	1323 (100%)
Tropical Livestock Units (TLU)	6.6	3.1	3.5	2.9	4.2
Value of farm equipment ($)	4,032	2,491	2,912	2,094	2,966
Total HH asset value ($US)	5,270	3,054	3,591	2,619	3,744
Total HH landholding (ha)	3.7	1.9	1.8	1.4	2.2
Total Income/AE ($US)	984	488	494	471	620
Adult equivalents, 2007	5	6	5	5	5
Years of education of the most highly educated male	11	10	10	9	10
Years of education of the most highly educated female	10	9	9	8	9
% HH owning animal traction	15	9	11	9	11
% HH using animal traction	27	29	23	23	25
% HH hiring agricultural labor	33	42	31	28	32
% HH renting in land	25	28	21	11	21
% HH renting out land	16	13	10	8	12
Maize cultivated area / AE (ha)	.39	.17	.17	.18	.23
Total cultivated area / AE (ha)	.65	.32	.34	.31	.42
% HHs apply fertilizer to maize	90	80	65	54	71
Kgs of fertilizer used on maize (per ha of maize cultivated area)	184	158	120	109	145
% of maize growing hhs using purchased hybrids	90	80	62	56	70
% HH receiving credit	44	58	53	55	52
% HH receiving extension services	64	64	56	51	58
Distance in kms from HH to extension advice	5.2	3.9	4.5	4.2	4.6
Maize production / AE (kg)	1,046	272	228	191	447
Maize sales / AE (kg)	672	68	6	1	191
Maize sales quantity as % of production quantity	55%	28%	3%	1%	19%
Maize sales quantity as % of production quantity (aggregate)	64%	26%	3%	1%	22%
Maize purchases / AE	7.95	11.29	10.19	64.56	22.95
% HH owning bicycle	55	51	48	41	49
% HH with member of farmer association	69	86	78	74	76
Distance to nearest tarmac road (km)	7.0	6.5	7.8	8.4	7.6
Distance to nearest market place (km)	5.5	4.1	4.4	4.1	4.6
Distance to nearest motorable road (km)	.7	.5	.5	.6	.5
Distance to nearest fertilizer seller (km)	3.4	2.6	3.2	3.6	3.3
Crop sales income ($US)	1,053	728	524	389	657
share of maize sales (%)	51%	26%	5%	2%	20%
share of other staple food crops (%)	13%	8%	10%	9%	10%
share of high-value food crops (%)	25%	37%	53%	60%	44%
share of cash crops (%)	12%	30%	31%	29%	25%
Commercialization index	.64	.53	.39	.34	.46
Value of livestock produce sales ($US)	779	292	313	187	405

Table 10a con't.

Non-farm income ($US)	1,472	945	921	868	1,059
share of salary/wages (%)	28%	28%	25%	22%	26%
share of formal/informal business (%)	53%	58%	56%	60%	56%
share of remittances (%)	19%	14%	19%	18%	18%
% female-headed HHs	24	21	22	28	24
% of single female headed HHs	21	20	20	26	22
% of married female-headed HHs	3	1	2	1	2

Table 10b. Zambia - Household Assets, Maize Production and Sales and Access to Market Public Goods by Maize Market Position Group, National, 2008

HH characteristics	Market Position Group				
	HHs with large net sales	HHs with small net sales	HHs with negligible sales	Deficit HHs	All households
Number of observations (% of total sample) - unweighted	1,492 (19.5%)	571 (7.5%)	3,242 (42.4%)	2,350 (30.7%)	7655
Tropical Livestock Units	5.4	2.5	1.9	2.0	2.5
Value of farm equipment ($)	645	196	109	257	250
Total HH asset value ($)	1,756	642	454	642	737
Total HH landholding (ha)	3.0	2.1	1.6	1.4	1.8
Total Income/AE ($)	488	241	182	252	258
Household size	6	6	6	6	6
Household size (AE)	5	5	5	5	5
No. of prime-age adults (age 15-59)	3	3	3	3	3
Years of education of household head	7	6	5	5	5
Years of education of the most highly educated male	8	7	7	7	7
Years of education of the most highly educated female	7	6	5	6	6
% HH owning animal traction	26	15	9	9	12
% HH using animal traction	43	32	25	30	30
% HH hiring agricultural labor	24	20	11	9	13
% HH renting in land	3	1	1	1	1
% HH renting out land	0	0	0	0	0
Maize cultivated area / AE (ha)	.40	.20	.18	.20	.23
Total cultivated area / AE (ha)	.59	.37	.30	.28	.35
% HH that apply fertilizer to maize	74	49	26	25	37
Kgs of fertilizer used on maize (per ha of maize cultivated area)	309	331	262	246	285
% of maize growing hhs using purchased hybrids	75	47	27	35	41
% HH receiving credit	10	8	9	10	10
% HH receiving extension advice	67	61	51	50	54
Maize production / AE (kg)	924	267	200	180	344
Maize sales / AE (kg)	568	72	3	2	97
Maize sales quantity as % of production quantity	58%	37%	3%	1%	13%
Maize sales quantity as % of production quantity (aggregate)	68%	26%	3%	1%	14%
Maize purchases / AE	12.15	12.70	7.15	90.24	36.54
% HH owning bicycle	77	69	50	50	55

Table 10b con't.					
% HH which received market price information	92	89	76	79	81
Distance to vehicular transport	6.8	8.4	10.7	6.3	8.4
Distance to nearest fertilizer retailer	34.7	40.3	41.5	35.1	38.2
Distance to nearest tarred/main road (km) from center of SEA	22.2	26.0	26.0	25.6	25.3
Distance to nearest district town (km) from center of SEA	34.2	36.0	37.1	31.8	34.8
Value of total crop sales ($)	836	202	90	102	220
share of maize sales (%)	75%	62%	13%	7%	33%
share of other staple food crops (%)	4%	9%	25%	21%	17%
share of high-value food crops (%)	16%	22%	44%	48%	35%
share of cash crops (%)	5%	7%	18%	24%	15%
Commercialization index	.55	.35	.15	.18	.24
Value of livestock produce sales ($US)	194	83	49	83	86
Non-farm income ($US)	882	620	346	596	535
share of salary/wages (%)	16%	10%	9%	14%	12%
share of formal/informal business (%)	43%	46%	41%	45%	43%
share of remittances (%)	42%	44%	50%	40%	45%
% female-headed HHs	17.1	15.6	26.5	25.1	23.8
% of single female-headed HHs	15.1	13.7	22.9	22.0	20.7
% of married female-headed HHs	2.0	1.9	3.6	3.1	3.1

Table 10c. Malawi - Household Assets, Maize Production and Sales and Access to Market Public Goods by Maize Market Position Group, National, 2007

	Market Position Group				
	HHs with large net sales	HHs with small net sales	HHs with negligible sales	Deficit HHs	All households
HH characteristics	Mean	Mean	Mean	Mean	Mean
Number of cases	78	150	1605	1465	3298
% of household population	2.2%	4.7%	48.2%	44.9%	
Assets and Income Levels:					
Tropical Livestock Units (TLU)	4.5	1.3	1.7	0.9	1.0
Value of farm equipment ($)	1013	96	110	56	105
Total HH asset value ($US)	1915	298	248	195	353
Total HH landholding (ha)	1.97	1.81	1.41	1.35	1.41
Total Income/AE ($US)	258	75	60	50	62
Demographic information:					
Total number of members 2007	4.7	5.0	5.4	4.8	5.1
% female-headed HHs	23.3%	22.7%	24.9%	28.9%	26.2%
No. of prime-age Adults (age 15-59)	2.5	2.5	2.6	2.3	2.4
Agricultural practices					
% HH owning animal traction	23.1%	5.5%	4.5%	1.7%	3.7%
% HH hiring agricultural labor	68.6%	40.4%	23.5%	18.4%	23.0%
% HH renting in land	31.9%	22.9%	16.1%	14.3%	16.0%
% HH renting out land	2.2%	9.3%	5.5%	5.6%	5.7%
Maize cultivated area / AE (ha)	0.56	0.34	0.23	0.23	0.24
Total cultivated area / AE (ha)	0.67	0.41	0.28	0.28	0.29
% HH that apply fertilizer to maize	83.4%	73.4%	49.2%	38.6%	46.3%

Table 10c con't.

Kgs of fertilizer used on maize (per ha of fertilized maize area)	215.2	154.5	162.0	154.0	160.7
% of maize growing hhs using purchased hybrids	72.5%	66.0%	47.5%	47.6%	49.0%
Maize production / AE (kg)	1151.4	202.5	100.3	95.0	125.6
Maize sales / AE (kg)	800.4	61.7	2.4	3.3	24.4
Maize sales quantity as % of production quantity (mean across all households)	67.1	55.5	3.9	3.5	7.8
Maize sales quantity as % of production quantity (national level)	53.3	24.0	2.2	3.1	20.6
Maize purchases / AE	26.2	11.5	6.4	96.2	47.4
% HH owning bicycle	74.4%	52.8%	41.9%	34.3%	39.7%
Distance to nearest tarmac road (km)	19.5	19.7	19.4	18.3	18.9
Distance to nearest district town (km)	37.9	38.6	38.8	40.5	39.5
Distance to nearest fertilizer seller (km)	4.5	6.8	7	8.6	7.7
Crop sales income ($US)	588	167	78	31	115
share of maize sales (%)	68.5%	65.2%	15.9%	17.8%	24.6%
share of other staple food crops (%)	6.3%	8.4%	20.9%	16.6%	17.3%
share of high-value food crops (%)	7.7%	14.4%	40.5%	46.4%	38.1%
share of cash crops (%)	17.5%	12.0%	22.7%	19.3%	20.0%
Commercialization index	73.8%	56.2%	31.9%	48.6%	41.4%
Value of livestock produce sales ($US)	14.1	12.2	9.2	23.2	28.4
Non-farm income ($US)	260.8	81.6	94.2	66.1	84.6
share of salary/wages (%)	19.2%	14.9%	14.8%	20.4%	17.4%
share of formal/informal business (%)	61.0%	46.2%	49.2%	44.9%	47.4%
share of remittances (%)	19.8%	39.0%	36.1%	34.8%	35.2%

Table 10d. Mozambique - Household Assets, Maize Production and Sales, and Access to Market Public Goods by Maize Market Position Group, 2005

HH Characteristic	HHs with large net sales	HHs with small net sales	HHs with negligible net sales	Deficit HHs	All HHs
	----- mean values ----				
HH production-related assets					
Tropical Livestock Units (TLU)	1.7	1.2	0.9	1.2	1.0
Value of farm equipment ($)	107	58	31	35	36
Value of Total productive assets ($)	194	120	92	121	106
Total landholding (ha)	3.31	2.74	1.81	1.85	1.92
Total income/AE ($)	312	151	119	103	121
Household size	4.5	5.3	4.9	6.0	5.3
Household size (AE)	3.7	4.3	4.0	4.9	4.3
No. of prime-age adults (age 15-59)	2.2	2.6	2.4	2.8	2.5
Years of education of household head	2.6	2.3	2.0	2.2	2.1
Years of education of the most highly educated male	3.6	3.6	3.1	3.6	3.3
Years of education of the most highly educated female	1.6	1.9	1.7	2.2	1.9
% HH owning animal traction	4.4	3.9	3.0	4.4	3.5
% HH using animal traction	10.2	8.1	8.8	11.1	9.5
% HH hiring agricultural labor	44.7	34.5	18.6	13.5	18.6
% HH renting in land	0.0	0.2	0.6	0.5	0.5
% HH renting out land	0.0	0.2	0.3	0.4	0.3
Maize cultivated area / AE (ha)	.44	.26	.19	.14	.19
Total cultivated area / AE (ha)	1.03	.69	.54	.40	.51
% HH applying fertilizer to maize	10.3	6.0	4.6	2.7	4.2
kgs of fertilizer used on maize (per hectare/maize cultivated area)	374.3	275.3	234.8	337.7	277.3
% of maize-growing hhs using purchased hybrids	2.3	1.7	1.4	2.2	1.8
% HH receiving credit	7.5	6.4	3.1	2.8	3.3
% HH receiving extension services	20.9	19.9	14.5	14.3	14.9
Maize production / AE (kg)	494.1	219.6	94.2	28.9	91.3
Maize sales / AE (kg)	246.5	51.0	16.0	20.3	61.8
HH maize sales quantity as % of production quantity	56.0	34.5	4.8	5.7	9.4
maize sales quantity as % of production quantity (aggregate)	51.8	23.4	3.3	7.2	15.8
Maize purchases / AE (kg)	8.3	1.1	2.7	80.7	30.8
% HH owning bicycle	56.7	50.4	29.4	28.5	31.1
% HH which received market price information	55.2	52.5	40.1	38.1	40.6
% HH with member of farmer association	7.7	8.6	6.6	5.6	6.5
distance to nearest tarmac road (km)	67.1	67.8	58.7	54.0	58.0
distance to district capital (km)	53.8	45.9	42.3	46.4	44.2
distance to nearest fertilizer seller (km)	68.8	73.8	64.6	70.0	67.0
Value of total crop sales ($)	293	112	41	26	48
HH share of crop sales income from: sales of maize (%)	70.4	56.7	9.7	12.1	17.6
sales of other staple food crops (%)	4.9	8.0	14.2	14.6	13.3
sales of high-value food crops (%)	15.1	26.0	64.0	60.4	57.2
sales of cash crops (%)	9.6	9.3	12.1	12.8	11.9
Commercialization index	50.8	33.3	18.6	15.8	19.5
Value of livestock product sales ($US)	24.1	10.6	9.0	13.4	10.9
Non-farm income ($US)	635.1	284.5	251.8	280.7	273.5
HH share of non-farm income from: salary/wages (%)	11.0	10.3	14.9	18.7	15.8
own formal/informal business (%)	73.0	71.6	64.2	64.4	64.9
remittances (%)	16.0	18.0	20.9	16.9	19.3
% female-headed HHs	16.2	13.4	25.9	26.4	25.1
% single female headed HHs	9.6	7.4	17.2	16.6	16.3
% married female-headed HHs	6.6	6.0	8.7	9.8	8.9
% of household population (weighted)	2.8	5.6	60.0	31.6	100.0
Number of cases (unweighted)	217	313	3,225	2,226	5,981

A second implication of the substantial differentiation within the smallholder farm sector is that the benefits of food price stabilization policies that raise mean prices are likely to be extremely concentrated. This was a major outcome of the price support and stabilization policies pursued during the pre-liberalization period. Using data on maize purchases by Zimbabwe's Grain Marketing Board (GMB) between 1985/86 and 1991/92, Jayne and Rukuni (1993) found that 1% of the nation's smallholder households accounted for 44% of all the maize delivered to the Board by smallholder farmers. Of the remaining 99% of the

smallholder farm population (roughly 800,000 households), only 24,000 sold any maize, and those that did so accounted for 4% of the total maize delivered to the GMB by the smallholder sector. Of course, the total smallholder sector received only 54% of the government outlays on maize purchases over this seven-year period, as 4,000 large-scale farmers received the rest.

A final implication of the data presented in this Section 5 is that strategies attempting to link African farmers to markets must take account of how low crop productivity and inequality in productive assets constrain most smallholders' ability to participate in markets. There appears to be a vicious cycle in which low surplus production constrains the development of markets, which in turn constrains smallholders' ability to use productive farm technologies in a sustainable manner, reinforcing semi-subsistence agriculture. Crop production expansion is difficult to sustain in the face of highly inelastic product demand, which causes precipitous price plunges when local markets are unable to absorb surplus output. Such price drops are a major cause of subsequent farm dis-adoption of improved technology. This was the experience of the Sasakawa-Global 2000 programs implemented in many African countries in the 1990s (Putterman 1995; Howard et al. 1999). However, the shape of the demand function is not fixed. The demand function for staple grain crops can be made more elastic, and shifted outward, through market-facilitating public investments and policy choices and by nurturing important marketing institutions. On this list are the crucially important investments in physical infrastructure to increase the size of the market, regional trade to take advantage of covariant production fluctuations within the region, streamlining the numerous regulations and barriers, which inhibit trade, and the development of rural financial markets to finance agricultural trade and inputs. These investments and policies would enable supply expansion due to the uptake of new technology to be better absorbed by the market without a dramatic effect on prices. We will return to these points later.

5.7. Summary

Smallholder supply response is constrained by farm structure: over half of the small farms in the region are less than one hectare in size. One-quarter of the farms are less than 0.5 hectares in size (Jayne et al. 2003). These farms cannot earn a viable livelihood through a maize commercialization strategy unless there is tremendous growth in maize productivity, which will require sustained and dedicated investment in crop science and extension.

There is limited potential for area expansion in most of the region, especially in the fertile zones. Hence, without land redistribution and/or substantial maize productivity growth, the gradual movement toward smaller farm sizes will compel households to adopt more diversified commercialization strategies capable of maximizing the value of output per scarce unit of land. In highly land-constrained areas, it should not be surprising to find households shifting out of relatively low-value maize toward horticulture, tobacco, cotton, and niche crops, and then using the revenue to buy their staple food needs. Thus, the trend toward structural maize deficits (Section 6.1) is not necessarily a bad omen for the region if small farmers can shift into other activities that provide higher incomes. There is evidence to suggest that this is already happening at least for a sub-set of smallholder farmers in the region. Governments may promote more stable farm revenue and consumption patterns through supporting private systems of input delivery, finance, and commodity marketing for a range of crops that offer relatively high returns to farming in the changing environment of Africa's rural areas. Such investments would represent a shift from the strategy of price stabilization and price support for a dominant staple grain to a portfolio approach that puts

greater emphasis on a range of higher-valued commodities. This approach would shift the emphasis from direct approaches to stabilize and/or support the price for a dominant staple grain to one of minimizing the impact of food price instability by making the socio-political economy less vulnerable to the effects of food price instability.

Rising land constraints will progressively encourage farmers to shift toward crops providing high returns to scarce land. Because much of Africa is experiencing increased land pressure and limited potential for area expansion, population growth is causing a decline in land/labor ratios and farm sizes are declining. Maize is a relatively low value-to-bulk crop that currently provides high returns to fertilizer application and land in a limited number of areas (e.g., Kenya's North Rift, parts of southern and central Provinces in Zambia, and Zimbabwe's Mashonaland maize belt). Given reasonable assumptions about the potential for future productivity gains, it is unlikely that maize will provide the net revenue on the millions of farms that are 0.5-1.0 hectares or smaller to generate substantial income growth, especially in the semi-arid areas. Increasingly, the national maize surpluses in these countries are being produced by a very small minority of relatively large farms.

Therefore, the finding that the eastern and southern Africa regions are moving into a structural maize deficit situation may be a logical consequence of population growth, land pressure, and diversification into other crops. Yet maize productivity growth will remain a crucial objective. If it can be achieved, it will reduce import dependence and remain a source of dynamism and growth for many small farmers in the region. However, broad-based improvements in rural livelihoods and incomes will require productivity growth for other crops: oilseed crops, horticulture, animal products, and other food crops such as cassava.

6. URBAN FOOD CONSUMPTION PATTERNS

6.1. Eastern and Southern Africa's Gradual Transition to Structural Food Deficits

Over the next decade, the majority of Sub-Saharan Africa's people will be living in urban centers. Rural land pressures and other demographic forces have transformed the region over the past three decades from a predominantly agrarian work force in which the majority of people fed themselves from their own farm production, to a work force that depends primarily on markets for their food. An increasingly small minority of the population produces a food surplus to feed the growing urban populations. Because of these trends, both the eastern and southern Africa regions are increasingly dependent on imports of staple foods and are gradually becoming structurally food deficit.

This conclusion of widening structural food deficits is based on trend analysis of net export data (the difference between total exports and imports) of maize grain and meal. Although FAO trade data do not capture unrecorded trade flows between countries, the net impact on regional trade on net exports is virtually zero, since each bag of unrecorded cross-border exports from one country in the region is imported by another country in the region. For the purposes of this paper, the southern Africa region consists of Zambia, Zimbabwe, Mozambique, South Africa, Botswana, Namibia, Lesotho, Swaziland, and Malawi. East Africa includes Kenya, Uganda, Tanzania, Rwanda, Democratic Republic of Congo, and Ethiopia.

We regressed regional and country-specific net export data on linear time trends, and on models allowing for shifts in the slope of the trend between the 1960-1981 and 1982-2005 periods. Net exports regressed on a linear time trend in both regions show statistically significant downward slopes. Net maize (grain plus meal) exports in the southern Africa region declined at a rate of -72,201 metric tons per year for the period 1960-2005. Net maize exports over the same period in east Africa declined at the rate of -9,798 metric tons per year (Figure 6). There is no significant difference in the trend in net exports in eastern

Figure 6. Net Exports of Maize Grain and Maize Meal in East Africa

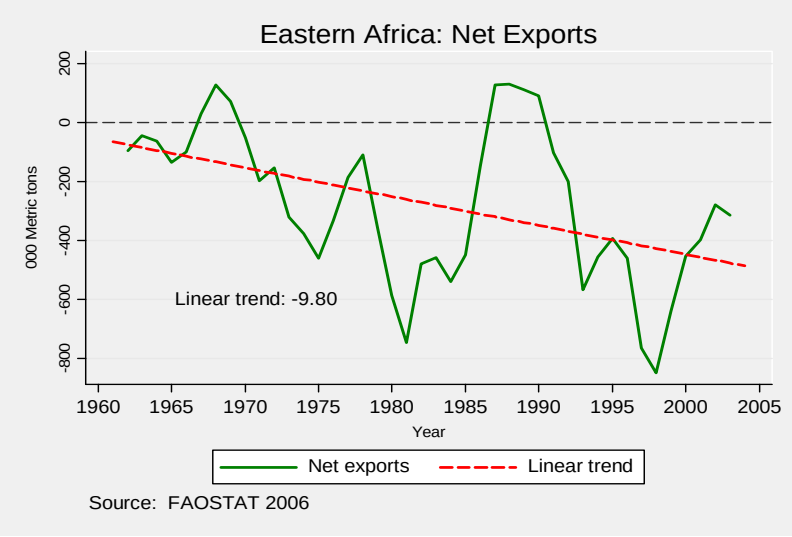
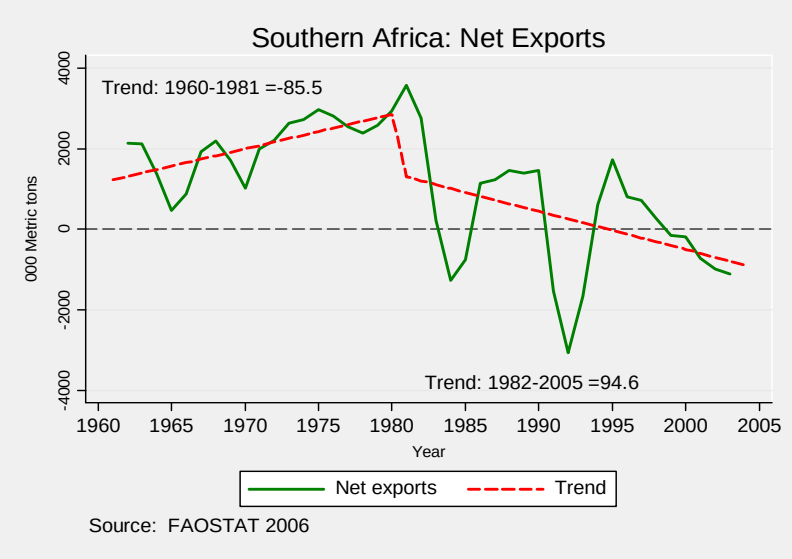


Figure 7. Net Exports of Maize Grain and Maize Meal in Southern Africa



Africa between 1960-1981 and 1982-2005. Net exports in southern Africa increased by 85,544 metric tons per year for the period 1960-1980 and then declined by 94,586 metric tons per year during the period 1981-2005 (Figure 7).At the country-level, there was a downward trend in net maize exports in all countries of southern Africa, with all of these being statistically significant at the 5% level. In east Africa, there was a significant downward trend in net maize exports for 2 of 6 of the east African countries (Kenya and Rwanda); while for Ethiopia, the trend is positive and significant. The trend is weakly negative in Tanzania and weakly positive in the Democratic Republic of Congo (DRC). Kenya, Malawi, and Zimbabwe, all net exporters of maize in the 1970s and 1980s, are now chronic importers. The reduction of maize production subsidies in South Africa has also reduced the exportable surplus in that country, although it remains a reliable exporter.

In recent years, and especially after the inception of political turmoil in Zimbabwe in the late 1990s, South Africa has become the only reliable exporter of white maize in the region. Areas of Mozambique, Zambia, and Malawi typically produce maize surpluses, but these surpluses are usually depleted halfway through the marketing year. Informal trade flows from Zambia to the DRC, and from northern Mozambique into Malawi, appear to be substantial in some years, despite frequent official efforts to suppress these flows or tax them heavily.

A recent study by the FAO (2006) determined that of the $3.7 billion of cereals imported annually by African countries, only 5% of it is produced by African farmers. Between 1990/92 and 2002/04, cereal imports by Sub-Saharan Africa have been rising at 3.6% per year. Almost all of the growing demand in the region is due to rising urban populations, which are growing at over 4% per year compared to less than 1% per year for rural populations.

If the region continues to slide increasingly into a structurally food deficit situation, this would affect the kinds of future investment we would expect to see in the staple food value chains. As an increasingly large share of African cities' food requirements is met from international imports, future investment by global firms is increasingly likely to be aimed at the milling and retailing stages – supplying mostly urban markets with internationally sourced grain, processing the grain into meal, flour, or bread, and distributing these staple

products through retail channels, including small kiosks, local shops, open markets, and supermarkets. There is already strong evidence that global capital is investing rapidly in integrated milling and retailing of the main staple grain products. We would also expect new foreign direct investment in large-scale farming in the region to minimize transfer costs to supplying the large commercial mills. This scenario would largely marginalize small-scale agriculture and evolve into the Latin American *latafundia* model.[15] However, the objectives of broad-based rural income growth and poverty reduction are best achieved by promoting marketing investments in rural assembly, wholesaling, finance, and input supply to encourage surplus production from the small-scale farming sector.

For these reasons, there is no single or deterministic future for small-scale agriculture in Africa. The decisions made by governments primarily and international organizations secondarily will largely determine the future viability of smallholder agriculture. A major theme of this report is that the public sector has a crucial role in determining the rate and stage of future private investment in the staple food value chains. Public policies and investments geared toward achieving smallholder agricultural productivity growth will raise the returns to private capital investment in procuring food from smallholders relative to international markets. As shown in Section 2, public goods investments in rural infrastructure, crop science, health, extension, and a supportive policy environment tend to have very high payoffs in terms of agricultural productivity growth. The rate of public investment in these areas will influence the relative cost of procuring supplies from smallholder areas compared to international markets to meet national demand. The extent of barriers to regional trade will determine whether needed supplies are more cheaply procured from smallholders in neighboring countries or international markets. In these ways, the state's behavior will affect the relative emphasis of private investment in the staple food value chains, i.e., to strengthen the production and procurement of food surpluses from smallholder areas and link them to urban markets, or to focus more on integrated large-scale urban processing and retailing of staple commodities largely procured from international markets.

6.2. Rising Importance of Wheat in Urban Staple Food Consumption

Based on the urban surveys described in Section 4, Table 11 presents the importance of the main staples – maize, wheat, rice, and cassava, in urban consumers' diets. These surveys consistently attest to the rising importance of wheat products in food consumption patterns (Muyanga et al. 2005; Tschirley and Abdula 2007; Mason et al. 2009).

[15] In the past several years, southern and eastern Africa has witnessed substantial foreign direct investment in large-scale food production. Many of the major milling firms in the region have also invested in large-scale farming. In Zambia alone, Olympia Milling, National Milling Corporation, Chimsoro Milling, and Mkushi Milling all have vertically integrated backward into large-scale food production. Large trading companies have also integrated into production. Export Trading Corporation, for example, acquired a 51% share in the former Commonwealth Development Corporation farm at Mpongwe, which is capable of producing 30,000 mt of maize per year. These moves reflect a bet that future food demand will outstrip available supplies in the region, and that local investment in large-scale food production can minimize landed costs of maize to the major urban mills compared to imports.

Table 11. Staple Food Budget Shares, Urban Centers in Kenya, Mozambique, and Zambia

Urban center	Year	% share of food group in total value of consumption of main staples[a]				% share of the 4 main staples in total food consumption
		Maize	Wheat	Rice	Cassava	
Nairobi, Kenya	1995	42.4	35.3	22.4	0.0	–
	2003	36.3	39.0	24.7	0.0	28.4
Urban Maputo Province	1996	2.6	50.7	35.0	11.7	42.8
	2002	8.9	57.4	28.9	4.8	27.0
Urban Northern Mozambique (includes Nampula city)[b]	2002	32.6	8.2	14.7	44.4	47.5
Lusaka, Zambia[c]	2007/8	39.0	49.4	10.7	0.9	19.5
Kitwe, Zambia[c]	2007/8	42.5	45.3	10.3	2.0	23.2
Mansa, Zambia[c]	2007/8	45.8	28.2	10.0	16.0	23.8

Sources: Mason and Jayne (2009) derived from data in Tschirley et al. (2006), Muyanga et al. (2005), Mason et al. (2009), Barslund (2007), Ayieko et al. (2005).
Notes: [a]Main staples refers to maize, wheat, rice, and cassava. Budget shares of these four staple foods sum to 100% +/- 0.1%. Shares for Nairobi and northern Mozambique are the percentage of total food purchases. [b]Cassava category also includes potatoes for urban northern Mozambique (separate figures for cassava only not available). [c]Excludes foods purchased and consumed away from home – information not available.

In all three surveys, wheat was the main staple expenditure item of urban consumers, except in Maputo where it was rice. Traub (2005) in a study of urban consumption patterns in the Eastern Cape of South Africa also found wheat to be the dominant staple commodity.

The rising importance of wheat products in urban consumption patterns in the region has several underlying causes:

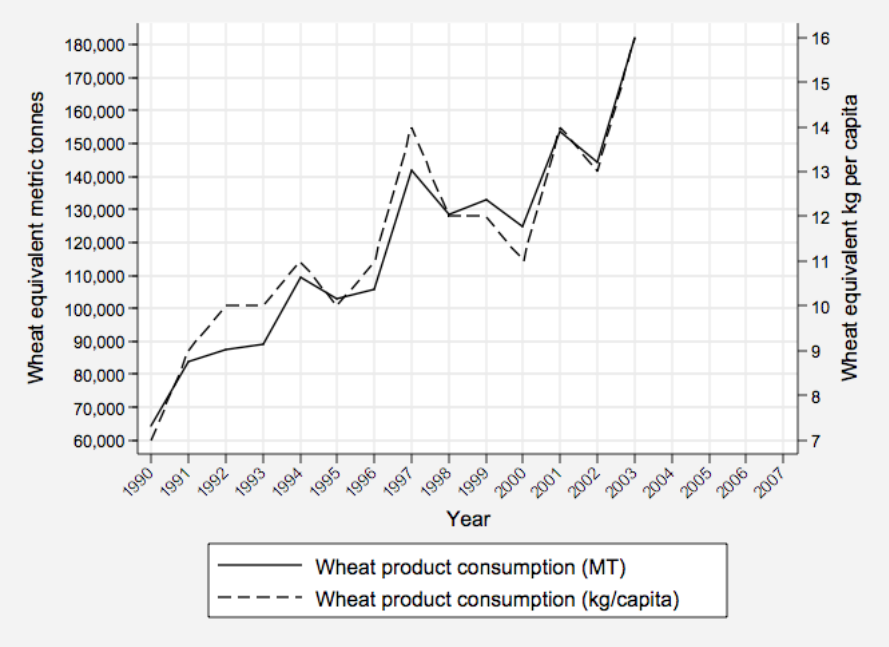
1. Urbanization and growing preferences for convenience foods. Many urban households are composed of men or groups of men. There is some resistance to men cooking maize meal in the kitchen; buying bread or chipatis is considerably more convenient.

2. The price of wheat products has declined in many cases relative to the price of maize products. We note a strong decline in the inflation-adjusted price of wheat bread over time, compared to a more modest decline (in Zambia and Kenya) or increase (in South Africa and Mozambique) in the real price of maize meal. The greater affordability of wheat products over time compared to maize meal has shifted urban consumption patterns over time.

The rapid rise in wheat consumption is shown for the case of Zambia in Figure 8. Per capita wheat consumption has virtually tripled within a 15-year period.

The rising importance of staples such as wheat and rice, which are widely traded on world markets and consistently available at import parity levels, will increasingly contribute to more stable food prices over time. During the 1970s and 1980s, white maize featured much more prominently in regional consumption patterns. During this time, white maize was very thinly traded on world markets. Hence, drought conditions in the region could have substantial impacts on availability and price levels, without the ability to rely on the world market for supplies if needed. Fortunately, staple food consumption trends are moving toward increased diversification, which is also likely to dilute the “wage-good” effects of maize price fluctuations on the overall economy.

Figure 8. Wheat Product Consumption in Wheat Equivalent Terms – Total (MT) and Per Capita (kg), 1990-2003



Source: FAOSTAT.
Note: Wheat product consumption data not available after 2003.

On the downside, however, the rising importance of wheat and rice are at least partially a reflection of African governments' inability to stoke smallholder farmers' potential to produce enough surplus maize and cassava to feed the rapidly growing urban populations. Wheat is currently not well suited for smallholder production. Wheat production usually requires capital-intensive investment in irrigation and other production technologies; as a result, scale economies in production cannot be achieved unless large areas can be put under production, which is beyond the means of almost all smallholders. For these reasons, the growth in wheat consumption presents a dilemma. Ideally, economic growth is best achieved by rural-urban synergies in which urban populations create a market for rural producers, while the income received from agricultural is spent on products made by urbanites. To the extent that urban consumption patterns increasingly reflect products produced only by large-scale farmers or procured in international markets, the growth in demand for staple products produced by smallholder farmers will be mitigated.

6.3. Maize Is Still Dominant among the Poor

Food makes up 60-70% of total expenditures among the urban poor (bottom 20%). Across all urban consumers, food accounts for 45-55% of total annual household expenditure. Table 12 disaggregates food consumption patterns in urban Zambia by city and by income quintile. Urban households were ranked by income level and then categorized into five income quintiles. Results in Table 12 show that maize appears to be an "inferior good" in the sense that the poor spend a greater share of their income on maize than the wealthy. For example, in Kitwe, the lowest-income quintile spends 18.8% of their total food expenditures on maize, compared to only 5.2% among the highest income quintile. Among the lowest income groups in all cities, maize is the most important staple, even in heart of the northern cassava-producing regions.

Table 12. Food Consumption Shares, Average of 30 Day Periods in July/August 2007 and January/February 2008 (Percentage of Total Value of Food Consumption over the Two 30-Day Periods, Rows Sum Horizontally To 100%)

Consumption quintile		Maize	Rice	Wheat	Cassava	Other staples	Sugar & oil	Dairy	Meat & eggs	Fish	Vege-tables	Fruit	Legumes	Other food prepared at home	Food away from home
Kitwe	1 lowest	18.8	1.8	7.7	0.7	2.1	9.9	1.5	11.4	9.1	19.7	3.2	3.7	7.0	3.2
	2	13.0	2.6	11.9	0.6	2.3	9.3	3.0	14.7	8.8	14.8	3.7	3.2	7.9	4.2
	3	11.1	2.7	10.4	0.5	2.3	8.6	3.9	17.0	9.2	13.8	3.4	3.0	7.9	6.2
	4	9.0	2.4	11.1	0.5	2.0	8.0	4.3	18.0	7.7	12.1	4.9	3.0	10.2	6.8
	5 highest	5.2	2.2	10.4	0.3	2.0	6.1	6.0	19.8	7.0	8.9	4.9	2.6	12.7	11.9
	Total	9.8	2.4	10.5	0.5	2.1	7.9	4.3	17.2	8.1	12.6	4.2	3.0	9.8	7.6
Mansa	1 lowest	16.5	1.8	1.5	11.1	3.7	7.8	0.2	7.2	14.4	12.4	4.9	4.2	7.1	7.3
	2	14.0	2.3	3.1	6.4	3.1	8.3	0.5	10.2	13.1	12.2	3.8	4.2	8.6	10.2
	3	13.1	2.7	5.0	4.5	2.8	8.7	1.5	14.7	13.6	11.3	2.9	3.5	8.4	7.1
	4	10.1	2.3	7.3	2.2	2.1	8.4	2.8	16.6	10.7	9.3	2.7	2.9	11.4	11.2
	5 highest	7.4	2.4	10.0	1.5	2.0	8.1	4.0	17.0	9.5	8.5	3.5	2.7	12.2	11.2
	Total	10.9	2.4	6.7	3.8	2.5	8.3	2.4	14.6	11.5	10.1	3.3	3.3	10.3	9.9
Lusaka	1 lowest	16.1	1.7	9.0	0.1	2.4	10.6	3.7	11.6	8.3	18.3	2.2	4.5	5.3	6.2
	2	10.5	2.2	10.1	0.2	2.5	8.2	4.1	17.7	8.7	14.5	4.2	4.5	7.1	5.4
	3	8.3	2.3	10.2	0.2	2.1	7.2	5.8	18.4	7.0	12.2	3.3	3.3	10.5	9.1
	4	6.2	2.3	11.1	0.3	2.4	6.4	6.2	18.4	7.6	10.8	4.6	3.1	10.3	10.4
	5 highest	3.7	1.9	8.2	0.1	2.0	4.5	6.5	18.7	5.5	8.4	3.9	2.4	13.2	21.0
	Total	7.6	2.1	9.6	0.2	2.2	6.7	5.6	17.6	7.1	11.7	3.8	3.3	10.2	12.3
Kasama	1 lowest	17.1	3.7	1.5	7.5	4.2	8.6	0.3	10.7	12.4	16.6	4.6	4.7	7.0	1.2
	2	14.1	3.7	3.3	3.9	3.6	8.5	1.0	13.5	13.5	14.5	4.3	4.1	8.2	3.6
	3	12.2	3.5	4.8	2.6	2.8	8.6	1.9	15.9	11.8	13.7	4.0	3.9	8.9	5.4
	4	10.0	3.1	7.0	1.6	2.5	8.6	3.1	18.2	12.4	12.0	3.5	3.0	10.0	5.1
	5 highest	7.9	2.4	8.4	0.7	2.4	8.0	4.6	18.7	9.8	10.0	4.0	2.5	12.1	8.5
	Total	11.1	3.1	5.9	2.5	2.9	8.4	2.7	16.5	11.6	12.5	4.0	3.3	9.9	5.6

Source: CSO/MACO/FSRP Urban Consumer Survey.

Note: Maize includes maize meal, samp, and green maize. Wheat includes flour, bread, spaghetti/macaroni/pasta, and biscuits. Cassava includes fresh cassava, cassava flour and cassava chips. Other staples include millet, sorghum, Irish potatoes, and sweet potatoes. Other foods prepared at home are mushrooms, caterpillars, honey, coffee/tea, other non-alcoholic and alcoholic beverages, tobacco products, and beer/wine/spirits. Rows sum to 100% +/- 0.2%.

Table 13. Expenditures on Primary Staple Commodities (Ksh Per Adult Equivalent Per Month and Percentage of Total Staple Food Expenditures), Nairobi, Kenya

Income Quintile	Maize Products		Wheat Products		Rice		Cooking Bananas		Total
	KShs/ae	% of total	KShs/ae	% of total	KShs/ae	% of total	KShs/ae	% of total	
1 (lowest)	128.21	43.79	98.47	33.63	58.10	19.84	7.99	2.73	292.77
2	136.30	37.95	132.85	36.99	77.30	21.52	12.69	3.53	359.14
3	131.29	35.45	150.14	40.54	68.82	18.58	20.11	5.43	370.36
4	130.78	29.01	211.06	46.81	89.66	19.89	19.36	4.29	450.86
5 (highest)	104.79	21.98	255.47	53.57	100.34	21.04	16.26	3.41	476.86
Total	126.30	32.39	169.57	43.48	78.84	20.22	15.28	3.92	389.99

Percentages add to 100% across the rows. Source: Tegemeo/MSU Urban Consumer Survey 2003.

By contrast, wheat dominates maize among the top 40% of urban consumers, who have a more important influence on overall national consumption patterns because their total food expenditures are substantially higher than among the poor. A very consistent story is evident in Nairobi, Kenya, as shown in Table 13.

6.4. Greater Affordability of Both Maize Meal and Bread

After rising dramatically in 2007 and 2008, world commodity prices declined sharply beginning in mid-2008. In contrast, nominal staple food prices in eastern and southern Africa (ESA) have remained at unprecedentedly high levels well into 2009. But just how 'high' are these food prices in urban ESA, and were staple foods becoming more or less expensive for urban consumers up until the recent food price crisis? We address these questions by examining trends in wage rates relative to retail staple food prices between 1993 and 2009 for urban consumers in Kenya, Zambia, and Mozambique (see Mason et al. 2009 for details).

Table 14 divides mean annual wage rates by the price of various staple food commodities for each marketing year to compute the kilograms of food affordable on a daily wage over the period 1994/95 to 2008/09. Average formal sector wages rose at a faster rate than retail maize meal and bread prices in urban Kenya and Zambia between the mid-1990s and 2007. (Figures 9 and 10 graphically show the data in Table 14.) Although the recent food price crisis partially reversed this trend, the quantities of staple foods affordable per daily wage in urban Kenya and Zambia during the 2008/9 marketing season were still roughly double their levels of the mid-1990s.

The national minimum wage in Mozambique also grew more rapidly than rice and wheat flour prices in Maputo from the mid-1990s through the 2004/5 and 2006/7 marketing seasons (Figure 11). During the 2008/9 marketing season, Maputo minimum wage earners' rice and wheat flour purchasing power was still higher than in the mid-1990s and roughly similar to levels at the millennium.

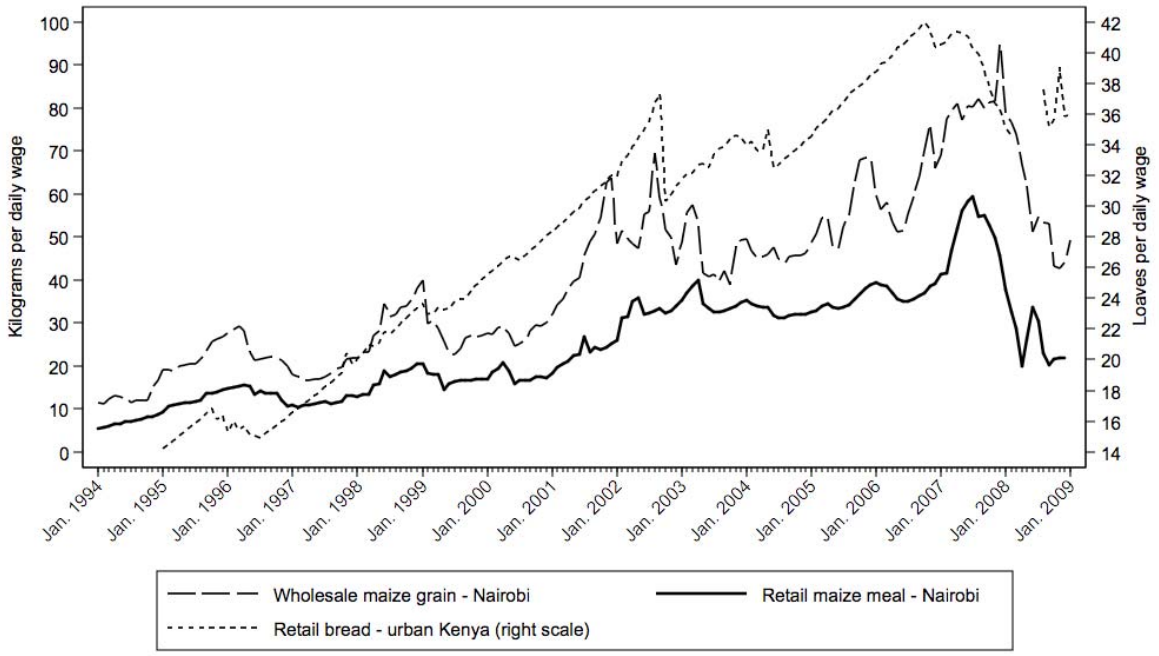
However, the majority of the urban labor force in Kenya, Zambia, and Mozambique is employed in the informal sector and consistent time series information on informal wage rates is not available. Therefore, the general conclusion of improved staple food purchasing power over the past 15 years may not hold for a significant proportion of the urban labor force. Cuts in formal sector employment as a result of the global economic crisis may also be adversely affecting a large number of urban consumers.

Table 14. Quantities of Staple Foods Affordable Per Daily Wage – Marketing Season Averages

Urban center	Quantity affordable per daily wage (units)	Marketing season average[a] 94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09[b]	Ratio of 06/07 to 95/96
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
Nairobi	Maize grain (kg)	16.3	25.2	19.3	23.0	31.9	26.6	32.3	52.2	52.3	45.0	47.9	58.7	71.3	75.8	48.6	2.8
	Maize meal (kg)	9.3	14.1	11.9	13.5	18.1	17.5	18.8	28.2	34.6	33.6	32.5	36.8	43.2	41.4	23.1	3.1
Urban Kenya	Bread (loaves)	14.9	15.9	16.4	20.0	22.9	25.3	28.2	32.4	33.0	34.0	34.5	38.7	41.1	37.4	36.6	2.6
Maputo	Maize grain (kg)	2.9	2.2	3.3	4.1	4.7	6.3	6.9	5.4	5.5	6.0	7.8	6.1	7.9	7.6	5.9	3.6
	Maize meal (kg)	1.6	1.4	2.2	2.1	2.5	3.5	4.0	3.6	3.1	3.2	3.1	3.2	3.3	3.2	3.2	2.4
	Wheat flour (kg)	1.5	1.2	1.2	1.6	1.9	2.4	2.7	2.8	3.0	3.3	3.4	3.7	3.9	3.2	2.7	3.3
	Rice (kg)	1.5	1.2	1.7	2.1	2.3	3.1	3.7	3.8	4.6	4.7	5.0	4.2	4.1	4.2	3.3	3.4
Nampula	Maize grain (kg)	4.9	4.3	6.1	7.5	5.7	10.2	13.5	8.3	7.6	9.2	11.4	8.2	12.2	10.4	7.4	2.8
	Maize meal (kg)	–	–	1.6	–	1.6	–	5.4	3.7	3.3	3.7	5.5	5.0	4.6	4.8	4.2	–
	Wheat flour (kg)	1.1	1.1	1.1	1.3	1.7	2.4	3.1	3.1	3.1	3.5	3.9	4.0	4.2	3.7	3.6	3.8
	Rice (kg)	1.3	1.1	1.2	1.5	1.9	2.6	3.1	3.3	4.0	4.6	4.4	4.3	4.4	3.9	2.7	4.0
	Cassava flour (kg)	2.1	2.4	2.2	2.5	2.6	3.7	4.8	4.6	4.8	6.9	8.7	8.1	7.0	8.1	7.9	2.9
Lusaka	Maize grain (kg)	18.9	20.0	27.5	22.4	19.7	25.2	33.2	29.0	19.3	31.3	41.2	37.5	50.0	67.7	61.4	2.5
	Breakfast meal (kg)	10.9	10.0	13.1	11.3	10.7	13.5	17.2	16.4	13.2	21.5	26.4	25.0	32.7	43.3	36.5	3.3
	Roller meal (kg)	13.6	11.9	17.6	14.6	13.5	17.1	23.0	20.4	15.8	29.4	34.7	31.9	48.7	58.7	48.2	4.1
	Bread (loaves)	6.0	6.8	5.9	6.2	7.4	8.7	9.2	10.7	11.0	11.6	12.7	15.1	17.3	22.5	22.0	2.5
Kitwe	Maize grain (kg)	18.1	23.1	26.9	22.4	18.3	26.6	33.0	25.0	22.8	37.0	45.0	41.9	64.9	74.3	64.0	2.8
	Breakfast meal (kg)	10.6	9.7	12.9	11.8	10.4	13.3	17.4	16.0	13.5	21.1	24.0	25.8	34.3	42.8	35.5	3.5
	Roller meal (kg)	13.1	11.2	16.7	14.4	12.6	16.9	21.2	18.9	15.3	26.0	30.7	32.4	49.3	60.2	48.5	4.4
Mansa	Maize grain (kg)	29.0	26.2	27.6	24.2	18.6	26.3	37.4	25.7	24.9	39.3	54.1	48.9	64.1	67.6	69.6	2.4
	Breakfast meal (kg)	10.8	9.7	12.1	11.2	10.4	13.3	17.2	16.8	12.9	20.0	23.9	24.6	29.9	39.4	34.4	3.1
	Roller meal (kg)	12.5	11.8	13.6	12.9	11.5	15.6	19.4	16.3	15.3	26.2	30.8	31.3	40.7	53.9	47.8	3.4
	Cassava flour (kg)	–	–	15.9	–	–	–	11.3	20.4	21.5	16.5	26.6	21.8	42.4	37.2	45.6	–

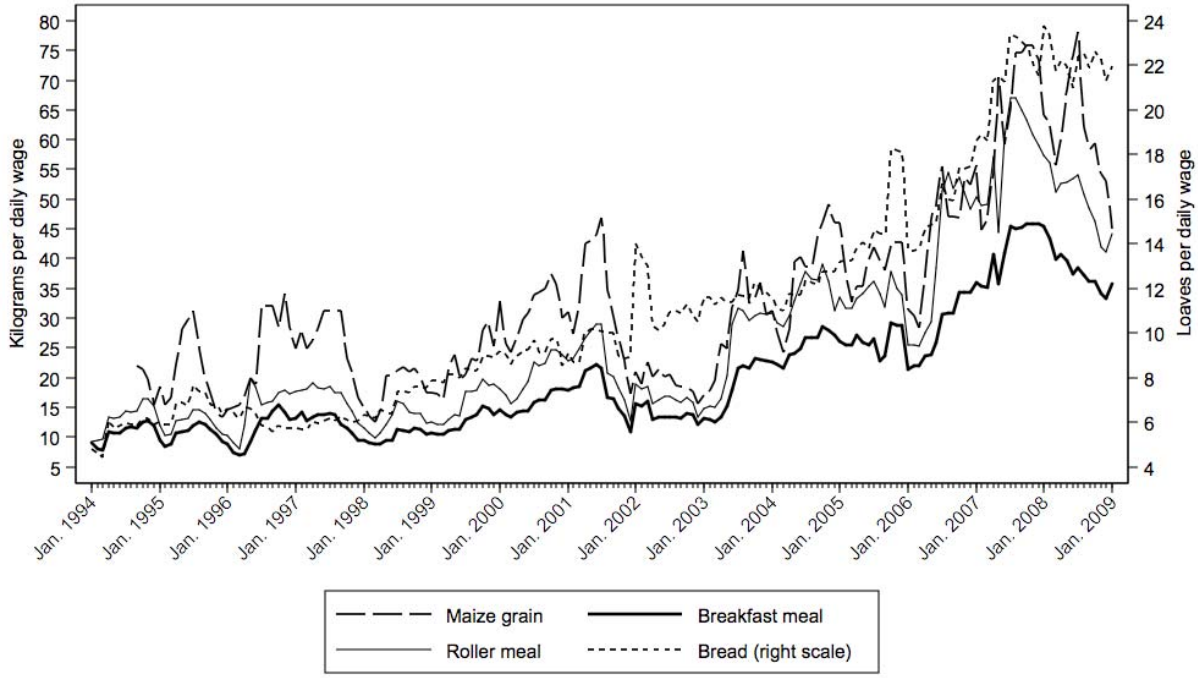
Source: Authors' calculations. *Notes:* [a]July-June for Kenya; May-April for Mozambique and Zambia. [b]Through November/December 2008 or January 2009. – No observations.

Figure 9. Kilograms of Maize Meal and Maize Grain Affordable Per Daily Wage in Nairobi, and Loaves of Bread Affordable Per Daily Wage in Urban Kenya: January 1994-January 2009



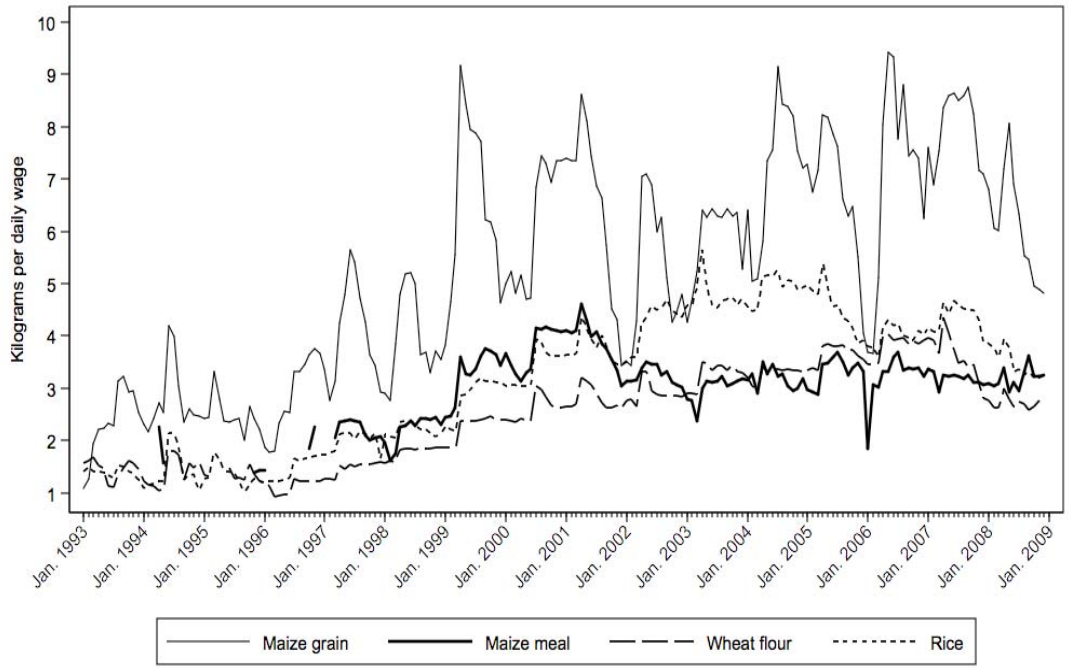
Sources: Kenya Market Information Center (MIC), Kenya Ministry of Trade and Industry (MTI), Kenya National Bureau of Statistics (KNBS).

Figure 10. Kilograms of Maize Grain and Maize Meal and Loaves of Bread Affordable Per Daily Wage: Lusaka, Zambia, January 1994-January 2009



Source*:* CSO 2009.

Figure 11. Kilograms of Maize Meal, Maize Grain, Wheat Flour, and Rice Affordable Per Daily Wage: Maputo, Mozambique, January 1993-December 2008



Source: SIMA.

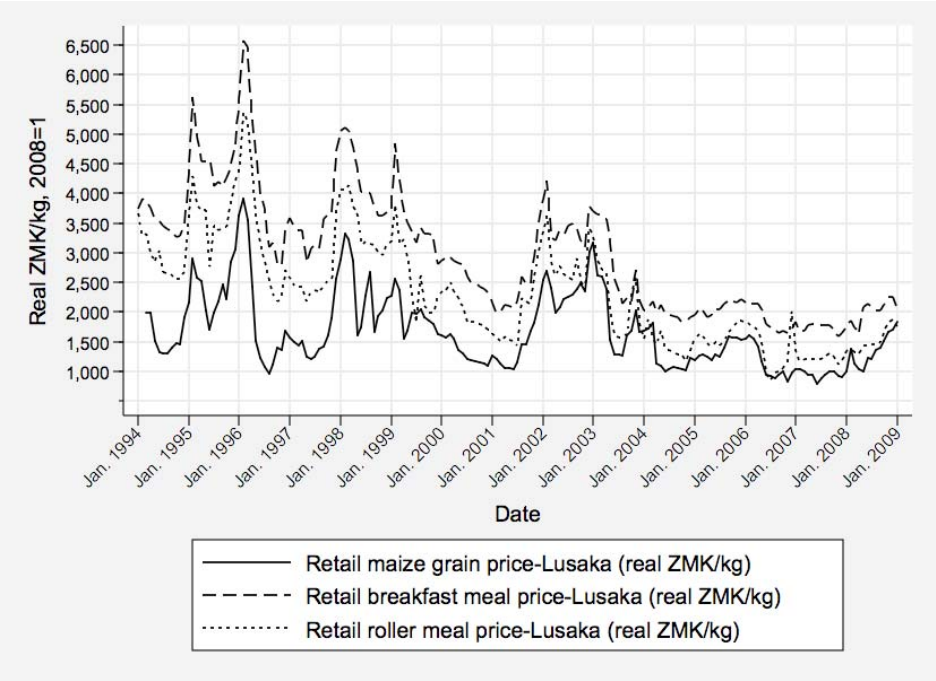
Efforts to establish a system for collecting and disseminating informal wage rate movements over time would be an important step in improving governments' ability to monitor trends and potential abrupt changes in food affordability among low-income households. An area for further research is to determine the extent to which other major components of household expenditures, such as housing and transportation, are correlated over time with food prices.

6.5. Maize Meal and Bread Milling Margins Show a Major Decline

In most countries in the region (and with two notable exceptions), maize and wheat milling margins have declined. This is due to the greater availability of grain in local markets after the decontrol of maize movement that accompanied market liberalization. The greater availability of grain in local markets has encouraged rapid investment in small-scale milling, which has exerted competitive pressures on the large commercial mills to reduce their margins.

Real retail maize meal prices and marketing margins between maize grain and maize meal have fallen substantially in Zambia and Kenya since the market reforms were implemented in the early 1990s (Jayne and Chapoto 2006). Trend-line maize meal prices fell about 30% from 1994 through 2005 while marketing margins fell by roughly 50%. These declines are driven by the informal maize processing and trading systems that arose after the liberalization of markets, which have proven less costly than the industrial milling sector and which compete effectively against it for low- and middle income consumers. The decline in these marketing margins was mainly due to market liberalization. It has conferred major benefits to the millions of consumers in these countries. In Zambia, for example, the decline in maize milling and retailing margins as shown in Figure 12 have saved urban consumers roughly US$ 11 million per year for the past 14 years (Nijhoff et al. 2003).

Figure 12. Lusaka Monthly Retail Maize Grain, Breakfast Meal, and Roller Meal Prices (Real), January 1994-January 2009



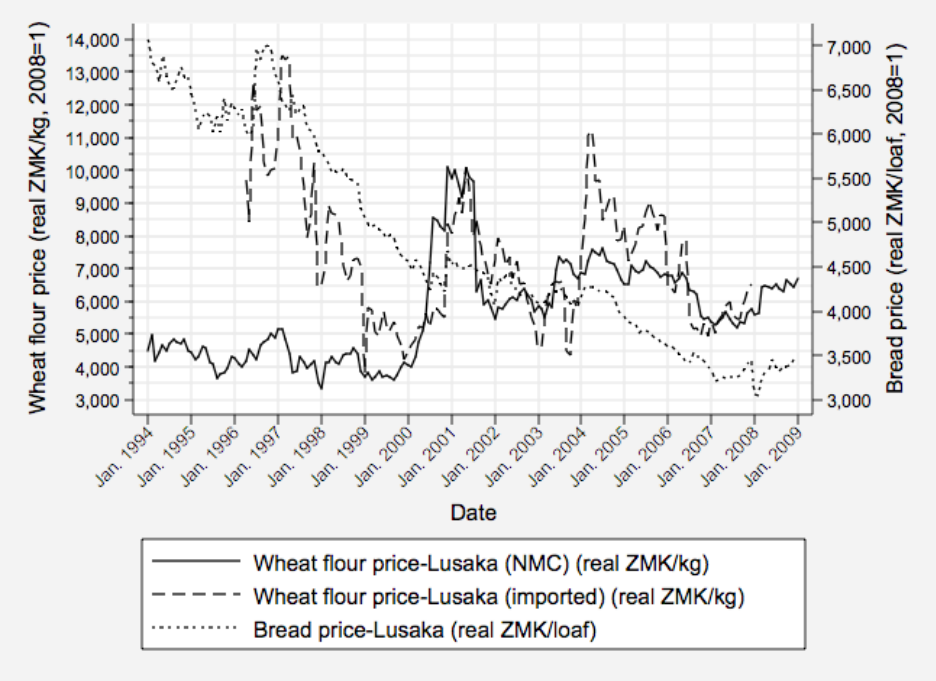
Source: Agricultural Marketing Information Centre and Central Statistical Office, Zambia.

Over the same period, real margins have increased in southern Mozambique and South Africa (about a 50% rise in margins in each country). In both countries, the rising margins appear related to highly concentrated maize milling sectors and to regulatory barriers that limit the availability of grain for milling in hammer mills during the hungry season (Tschirley and Abdula 2007; Traub and Jayne 2008).

However, there are two areas of eastern and southern Africa where grain remains scarce in local markets, South Africa and southern Mozambique, and not surprisingly the margins of the large millers in these two areas have actually risen over the past decade (Tschirley and Abdula 2007; Traub and Jayne 2008). In both countries, the rising margins appear related to highly concentrated maize milling sectors and to regulatory barriers that limit the availability of grain for milling in hammer mills during the hungry season.

While inflation-adjusted wheat prices in Zambia have shown no clear trend since the early 2000s, bread prices have declined dramatically. Consumers in 2009 paid roughly half of the price they paid for bread in the 1990s. (See Figure 13).

Figure 13. Lusaka Monthly Bread and Wheat Flour Prices (Real), January 1994-January 2009



Source: Central Statistical Office, Zambia 2009.
Note: NMC = National Milling Corporation.

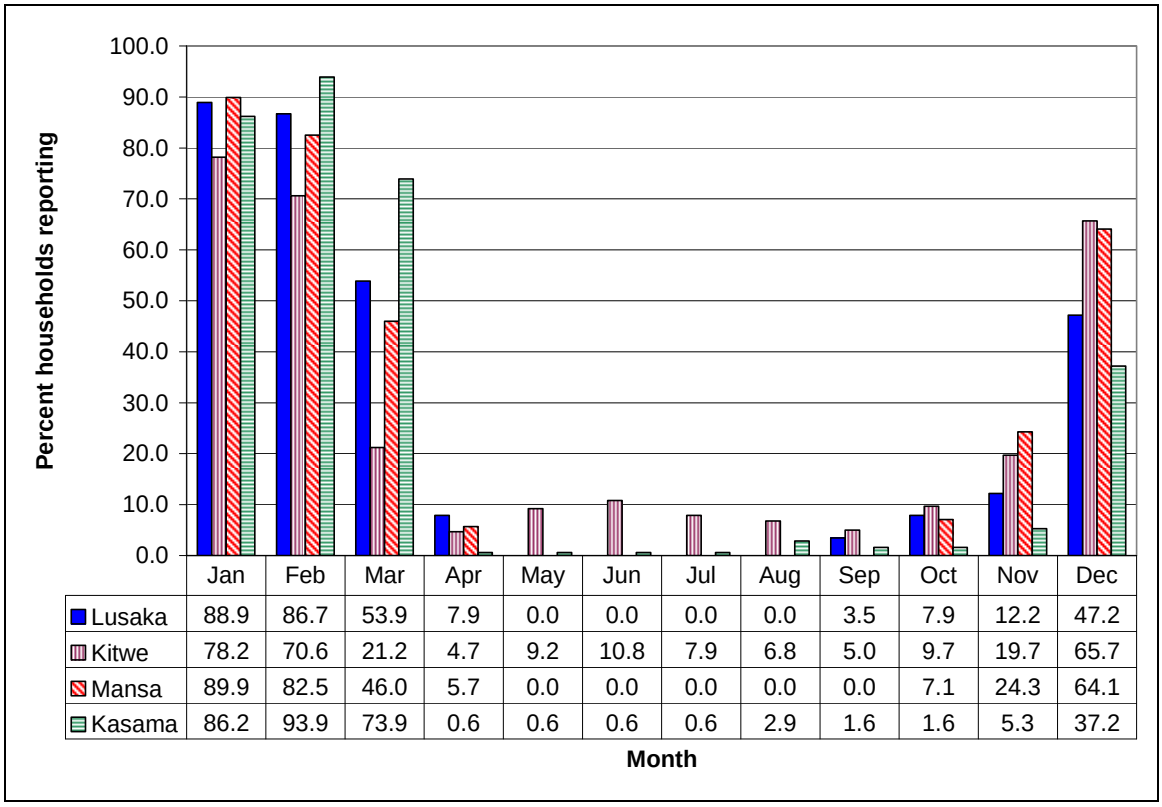
6.6. Major Food Insecurity Problem Associated with Maize Grain Supplies Being Depleted in Traditional Markets Late in the Season

Rapid investment in medium- and small-scale staple food processing and retailing are largely responsible for the reductions in marketing margins and retail food prices that have been documented in much of the region (Jayne and Chapoto 2006). However, available grain surpluses from the smallholder sector are mostly purchased by traders within the first 4-6 months after harvest. As long as grain is circulating in informal markets, consumers can buy grain and mill it at a neighborhood hammer mill, of which there are thousands dotted throughout the country. At this time, the structure of the market is highly competitive and milling/retailing margins are low. In any given area, a few large milling firms are competing against scores of small-scale millers and retailers for consumers' business.

However, later in the season when maize sales off the farm tend to dwindle, the informal markets become very thinly traded. A scarcity of maize grain in local markets means that the small- and medium-scale processing sector are unable to operate. At this time, the structure of the market becomes more concentrated, and the demand for large-scale commercial millers' products jumps up as consumers now can only procure maize meal from this source. Consumers end up paying substantially higher prices for staple maize products at this time.

Figure 14 shows the responses of urban consumers to the question "are there times of the year in which you would want to buy maize grain in the market but it is not available? Yes/no. If yes, what are the most frequent months in which maize grain is unavailable to buy?" The harvest in Zambia comes in April/May, and it is evident from Figure 14 that local maize supplies in informal markets tend to dry up in the 3-4 months prior to the harvest.

Figure 14. Percentage of Urban Consumers Indicating That Maize Grain Is Unavailable to Buy in Local Markets, Four Cities in Zambia, 2007/08



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lusaka	88.9	86.7	53.9	7.9	0.0	0.0	0.0	0.0	3.5	7.9	12.2	47.2
Kitwe	78.2	70.6	21.2	4.7	9.2	10.8	7.9	6.8	5.0	9.7	19.7	65.7
Mansa	89.9	82.5	46.0	5.7	0.0	0.0	0.0	0.0	0.0	7.1	24.3	64.1
Kasama	86.2	93.9	73.9	0.6	0.6	0.6	0.6	2.9	1.6	1.6	5.3	37.2

Why does this occur? Even when there are adequate maize supplies nationally, once grain is purchased by the larger traders or by the Food Reserve Agency, it generally cannot be accessed by informal small-scale millers or retailers. Instead, the grain is sold in large transaction quantities to commercial millers and other industrial buyers. These commercial maize products are then distributed through a variety of retail channels, including informal channels, but the products are the relatively expensive ones produced by the large-scale milling industry. The less expensive products preferred by most low-income consumers are unavailable.

During times of regional production shortfalls, these problems are accentuated. In such cases, imports from South Africa or international markets are required. The informal trading sector cannot engage in such contracts. The larger firms that engage in importation from international markets or from South Africa tend to distribute the imported supplies in large transaction sales to the large millers only, again effectively sidelining the small and medium-scale processing sector that the poor rely on and which exert competitive pressure on the large-scale processing sector to keep their margins down.

There are major opportunities to improve low-income rural and urban households' access to staple food by facilitating the development of informal marketing channels, specifically by ensuring informal traders' access to imported supplies, not just selectively channeling them to the large-scale millers. This will ensure greater competition in the milling and retailing stages of the food system and drive down the cost of staple food to urban consumers as well as the large majority of rural farm households that are buyers of maize.

Constraints on rural storage also exacerbate the flow of grain out of informal markets and contribute to a circuitous flow of grain from surplus-producing farmers in grain deficit areas to urban areas, only to be milled by large-scale processors and then re-distributed back to the grain-deficit rural areas in the form of expensive commercially milled meal. Because of the risks and costs of storage in many areas, grain surpluses tend to be sold and quickly distributed to urban areas for milling by large-scale firms instead of stored for later sale locally. This reflects a variety of disincentives to investment in grain storage, which are explored later. But the main point to be made here is that the disincentives for storage accentuates the outflow of grain from deficit rural areas early in the season and subsequent backflow later in the season, which leads to redundant transport costs and higher food costs for consumers.

6.7. The Continued Dominance of Traditional Food Retailing Channels[16]

The rapid rise of supermarkets in Africa has received great attention in recent years. Several recurring themes in this literature concern the difficulties of traditional food distribution channels to compete with supermarket-driven supply chains, and fears over the marginalization of smallholders from participating in them. If supermarkets were able to capture a significant portion of consumers' food expenditures in Sub-Saharan Africa, and develop procurement channels back to the wholesale or farm level requiring exacting crop quality standards, then this would indeed raise major challenges for the viability of smallholder agriculture.[17]

However, the empirical evidence of supermarket penetration in Africa shows, so far, a very negligible influence. There is now a relative consensus that earlier warnings were probably overstated. Humphrey (2007) concludes that "the extent of transformation of retailing…as a consequence of (supermarket expansion) is overestimated." In Kenya, where supermarkets had penetrated more than in any SSA country outside South Africa, Tschirley et al. (2006) show that supermarket chains held less than 2% of the national urban fresh produce market in late 2003. Also nearly all fresh produce purchases in these supermarkets were made by consumers in the top 20% of the income distribution. They calculate that, to reach a 10% market share in 10 years, supermarket sales of fresh produce would have to grow 22% per year in real terms. In a cross-country econometric analysis, Traill (2006) estimates that Kenyan supermarkets will hold at most a 16% share of total food sales by 2013; this would correspond to a 4%-5% share of fresh produce. Reardon and Timmer (2006) also indicate that there is "considerable uncertainty about the rate at which the supermarket sector will grow" even in Kenya. In most of the rest of SSA, they deemed it "unlikely that…we will see supermarket growth for several decades."

A certain fear over export horticultural channels being captured by firms preferring to deal with larger farms (to the exclusion of smallholders) is also put into context by considering the fact that less than 10% of total horticultural production goes into export markets (even in relatively commercialized Kenya). Domestic demand constitutes by far the largest share of

[16] This section draws from the work of David Tschirley of Michigan State University and colleagues working on retail food modernization.

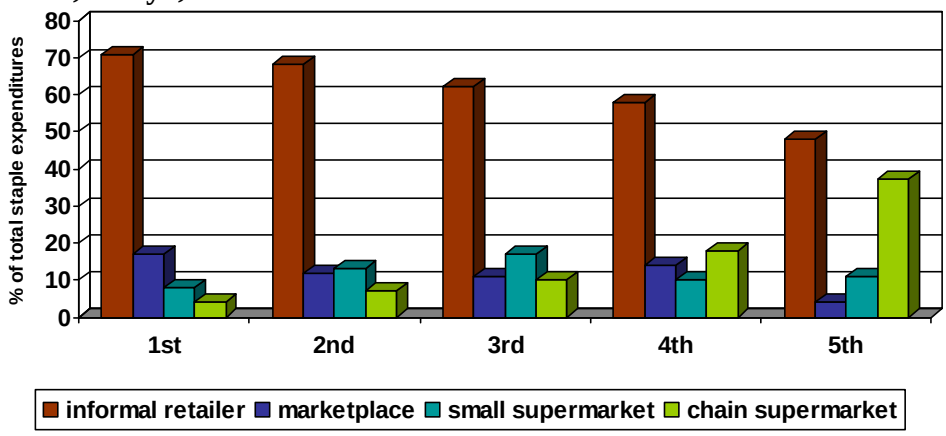
[17] The following quote encapsulates this view: "Our premise is that supermarkets will continue to spread over the (African) region … and thus their requirements will either gradually or rapidly, depending on the country, become those faced by the majority of farmers … Understanding those procurement systems … is thus a way of predicting what will be the challenges and opportunities facing farmers … *in the next 5-10 years"* (Weatherspoon and Reardon 2003; parentheses and emphasis added).

horticultural production and sales, and the domestic market accounted for over 90% of the total growth in Kenya's horticultural production between 1995 and 2004 (Tschirley et al. 2006). As shown earlier, fresh fruits and vegetables now account for a larger share of smallholder revenue from crop sales than maize. Most of this growth in horticultural sales is due to expansion of the domestic market, not export demand. Clearly, the horticultural success story in Kenya is driven by rapid growth in local demand and the ability of smallholders to supply this market.

The situation is largely the same regarding the major food staples. Again even in the relatively modernized capital of Kenya, Nairobi, small kiosks, informal shops, and small independent stores accounted for 71% of consumers' expenditures of food staples (Muyanga et al. 2005).[18] Local open markets and small millers account for another 13%. The big supermarket chains accounted for 17% (Figure 15). Throughout the country, across all retail consumer food expenditures, the share of supermarkets is estimated to be roughly 3%.

In four urban centers of Zambia surveyed in 2007 and 2008, supermarkets were found to have only 5-17% market share for staple foods and are frequented mainly by households in the upper consumption quintiles Figure 16). Retail grocers/general dealers and market stands/stalls account for ~60% of total value of staple purchases and are commonly used by households across all consumption quintiles (→ this shows the staying power of small-scale, more 'traditional' retailers and that urban consumers are heavily dependent on non-supermarket/informal retail outlets. Could be because these informal retails outlets are able to keep their prices lower because they are mainly family-owned and so have lower labor costs, have lower overhead; also intense competition. Policies to help/support these retailers to improve efficiency/lower costs/be more competitive may be preferable to policies aimed at promoting supermarkets and other more formal retail channels).

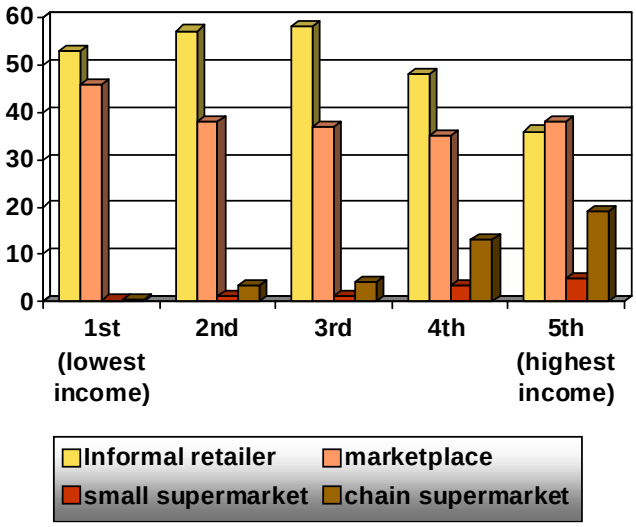
Figure 15. Shares of Consumers' Expenditures on Staple Food Products by Retailer Type, Nairobi, Kenya, 2003



Source: Tegemeo/MSU Urban Consumer Survey 2003.

[18] The data used in this study comes from a survey of 542 households in Nairobi's urban areas and environs. The Tegemeo Institute in collaboration with the Central Bureau of Statistics using the CBS's NASSEP IV frame implemented the survey in November/December 2003 to ensure statistical representativeness.

Figure 16. Shares of Consumers' Expenditures on Staple Food Products by Retailer Type, Four Cities of Zambia, 2008



There are several important reasons why supermarkets' share of African consumer food expenditures will not grow much for the foreseeable future. Although urban Africa is growing rapidly, it is fueled by land constraints and low labor productivity in rural areas, leading to poverty-driven urbanization. The rapid rise of huge slums in many African cities attests to this. Given that at least half of the urban populations are below the poverty line, and another 40% are not far above it, the vast majority of urban African households will, for the foreseeable future, have relatively low disposable incomes. Shopping patterns of the poor follow distinct patterns all over the developing world (Shaffer et al. 1985). They buy low value-added goods, in small units, with minimal processing and packaging. They lack easy access to transportation and hence tend to make most of their food expenditures within walking distance of their homes and work. An unrecognized large share of the urban poor's food expenditures is in the form of street food eaten purchased at small kiosks and from street vendors. For these reasons, informal corner stores in high-density neighborhoods, open markets, street kiosks, other traditional retail outlets – and the marketing chains that supply them – will remain the dominant food supply systems in almost all of Sub-Saharan Africa for the foreseeable future.

These findings put into context the fears over smallholder exclusion from supermarket supply channels. While issued warnings indicate that medium- and large-scale farmers supply the overwhelming majority of produce moving through preferred supplier programs in Africa, these programs account for an infinitesimal fraction of the food trade in African countries. In Kenya, this share was less than two-tenths of one percent of all food purchased in urban areas (Tschirley 2007, based on information in Neven and Reardon, 2004). Thus, as stated by Tschirley (2007), "while smallholder exclusion from large supermarket supply chains is a reality, it cannot now be considered among the top tier of rural policy concerns in this area of the world; nor is it likely to become a top tier concern over the next 10-20 years, given projected market shares of supermarkets over this time" (p. 3).

In light of this situation, a much greater priority should focus on upgrading the performance of urban wholesale and retail marketing systems and facilities on which the vast majority of smallholder farmers and consumers are likely to depend for the foreseeable future. Currently,

traditional wholesale markets are congested, unsanitary, sometimes unsafe, and difficult for trucks to move in and out smoothly. Squalid conditions add transaction costs and reduce consumer demand for products sold in these markets. More sanitary conditions with a modicum of amenities like clean water and toilets would help to solidify their position in the future development of the value chain, and with it, a greater chance that strong multiplier effects would benefit local farmers, traders, and associated local commerce. Public policy and investment to upgrading traditional wholesale markets will be a major determinant of how the sector evolves, and whether it promotes smallholder interests.

For these reasons, the more salient issues of wholesale and retail food modernization revolve around whether growing food demands of an increasingly urbanized continent will be met by local production or by imports, not whether it will be met by supermarkets or traditional channels. If smallholders are made more competitive by public goods investments (R&D, extension, farmer organization, physical infrastructure for regional trade, etc.), then many more smallholders will remain commercially viable in grain staples and other food crops, and will provide growth linkage effects that support overall economic development and poverty reduction. However, if governments continue to under-invest in these productivity-enhancing public goods, then international imports are likely to continue to penetrate local urban markets.

7. FUTURE WORLD STAPLE FOOD PRICE PROJECTIONS

Events of the past three years in the global food, energy, and financial sectors have raised legitimate concerns about food security in the developing world. This has related not only to the dramatic rise in commodity and food prices along with energy into mid 2008 but also to the subsequent sharp declines. This has rendered the outlook for farm and food prices much more uncertain than in the past. Key to this uncertainty is the price of energy as indicated by the price of crude oil.

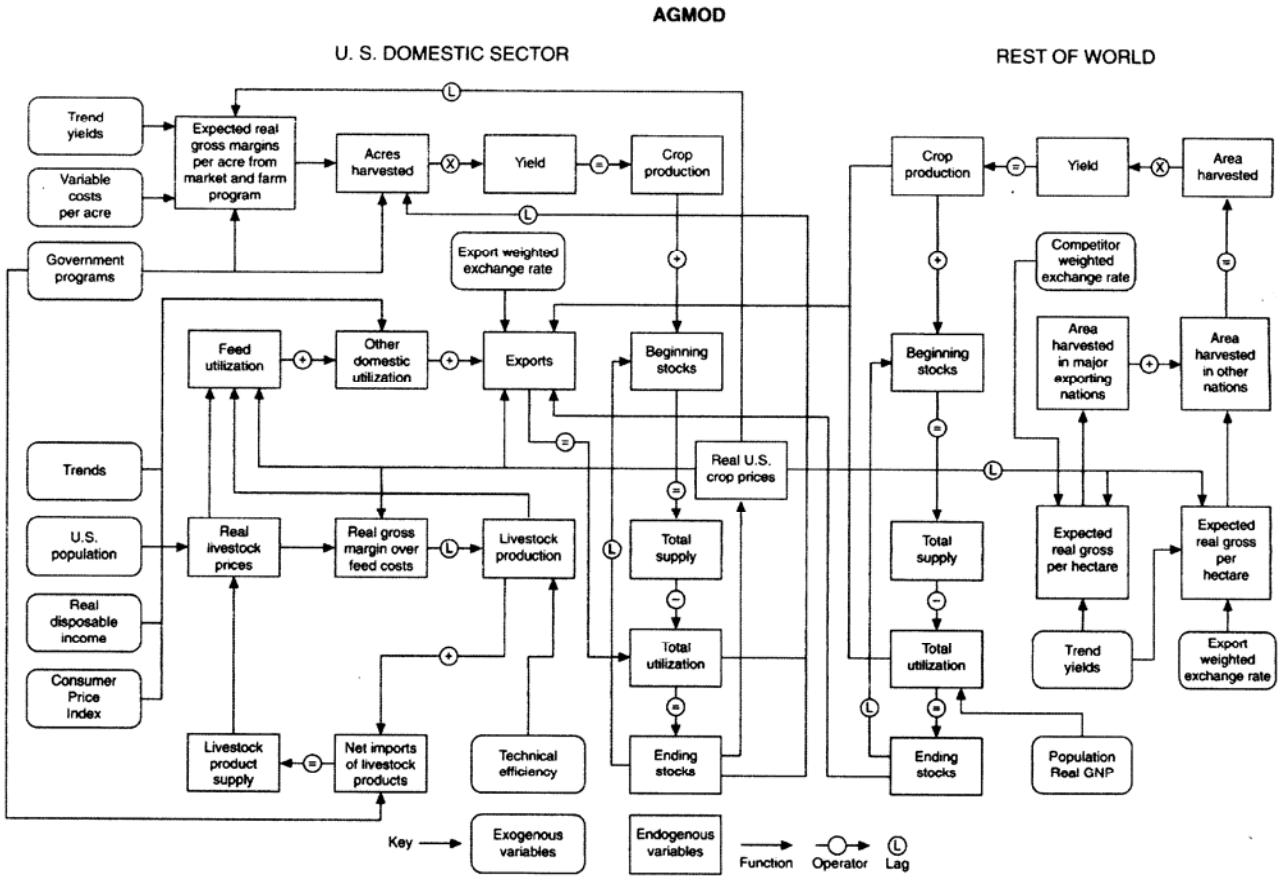
The analytical tool for this report is an econometric model of U.S. agriculture called AGMOD (Ferris 2005). AGMOD focuses on the major crop and livestock enterprises in U.S. agriculture with sectors on coarse grain, wheat, and oilseeds in the rest of the world. The model is mostly recursive in structure with 952 endogenous variables and 129 exogenous variables. Crude oil prices, consumer incomes, gross domestic products, population, interest rates, and exchange rates are exogenous in the model. The regression equations are based on annual data for periods as far back as the 1960s. The model is designed to generate annual projections for a 10-year period. In Figure 17 is a schematic of the model. While the schematic indicates that the consumer price index is exogenous, AGMOD does generate consumer price indexes on food.[19]

A feature of the model is that crop acreages are driven by real gross margins over variable costs per acre. As such, the gross margins include not only returns from market sales but also returns from direct government payments. Price expectations for participants in the farm program relate to prices in the past crop year or the known loan rate which ever is higher. Yield expectations are based on trends. In a sense, this formulation attempts to simulate how farmers would formulate profit expectations. While the past year prices enter such expectations, the supply equations are established using geometric distributed lags, which account for prices received back beyond the previous year. Similarly, returns from livestock enterprises are measured by gross margins per unit of output over feed costs.

Because the four coarse grains of corn, sorghum, barley, and oats are close competitors, this analysis deals mostly with the coarse grain combination. In the U.S., corn represents about 85% of coarse grain production. Outside the U.S., corn production has recently been about 60% of total coarse grain output. Because the U.S. has been and is quite prominent in the world grain and oilseed sectors, the Gulf and Midwest market prices for grain and the oilseeds are the focus of this analysis. These markets are closely correlated to the prices received by U.S. farmers.

[19] The information used in this paper was almost exclusively from the U.S. Department of Agriculture. Data collected by the National Agricultural Statistics Service and the Agricultural Marketing Service, analyzed and organized into historic data bases by the Economic Research Service (ERS) were invaluable for this presentation. For international commodity statistics, the *Production, Supply and Distribution Online* of the Foreign Agricultural Service was an excellent source. ERS's *International Macroeconomic Data Set* not only provided historical information for the world but also provided projections used in this study.

Figure 17. Schematic Diagram of AGMOD



As an example of how forecasts of the U.S. farm price of corn are generated in AGMOD, the process is as follows. A weighted average of the real gross margins per acre on corn, soybeans, and wheat determines the total harvested acreage of these three crops plus other coarse grains. Relationships between the gross margins on the major crops establish the allocation of their acreages. On corn, multiplying trend yields by acres provides the production forecast, which in turn, establishes the production for the other coarse grains.

Utilization of coarse grains for feed is a function of normal feeding rates for each of the major classes of livestock plus an index of livestock prices, the farm price of corn, the price of soybean meal and a variable that encompasses the influence of other feeds. This latter variable captures the growing influence on the utilization of coarse grains in livestock rations from the rapid expansion of the availability of distillers' dried grain from dry mill ethanol plants.

Exports of coarse grain are related to the production and stocks abroad and indexes of real trade-weighted dollar exchange rates for the export markets of the selected crops. Similar to the process for generating forecasts of acreages, yields and production in the U.S., for foreign nations, one equation establishes the acreage for a collection of the major crops based on a weighted average of expected returns per hectare; a second allocates acreages to the separate crops based on the relative expected returns for each crop.

Because variable production costs have not been readily available for the model's foreign regions, the expected returns variable is real gross returns per hectare. U.S. prices are used in the calculation. For example, the computation of the real expected returns per hectare for coarse grain in the major grain exporting nations is trend yield times the real U.S. prices of corn lagged one year times the index of real trade-weighted dollar exchange rates for U.S. competitors for corn times 39.368 (the conversion of $/bushel to $/metric ton).

With trend yields, production is forecast. Production is then added for the regions to derive a total for the foreign nations. The regions and commodities are as follows:

Major grain exporting nations of Argentina, Australia and Canada
  Coarse grain
  Wheat
Brazil and Argentina
  Soybeans
European Union (15)
  Coarse grain
  Wheat
  Oilseeds
Rest of the World
  Coarse grain
  Wheat
  Oilseeds

Except for the utilization of corn for ethanol in the U.S., the other food and industrial uses (high fructose corn syrup, glucose and dextrose, starch, beverage and manufacturing, and cereals) are projected in line with past trends. Incorporating ethanol into AGMOD will be explained in a subsequent section.

A very useful tabulation generated routinely by major models of U.S. agriculture is called a "balance sheet," which is nothing more than adding up the items in supply, subtracting the items in demand, with the net of ending stocks. The balance sheet provides the means to calculate the ratio of ending stocks to total utilization, a key independent variable in forecasting prices.

On the farm price of corn in AGMOD, the regression equation was based on annual data from the 1976 crop year through 2007. This equation incorporated the independent variables of: (1) the ratio of ending stocks of coarse grain in the U.S. to annual utilization, (2) the government non-recourse loan rate which has helped to put a floor either under the market or under the returns per bushel to the participating farmers, and (3) the ratio of ending stocks to annual utilization in the rest of the world. Corn prices have been negatively related to the stock-use ratios and positive to the loan rates. The "adjusted R-squared" on this equation was .88, which means that about 88% of the annual variation in corn prices is associated with the independent variables. Most significant was the U.S. stock-use ratio. However, the foreign stock-use ratio was not statistically significant.

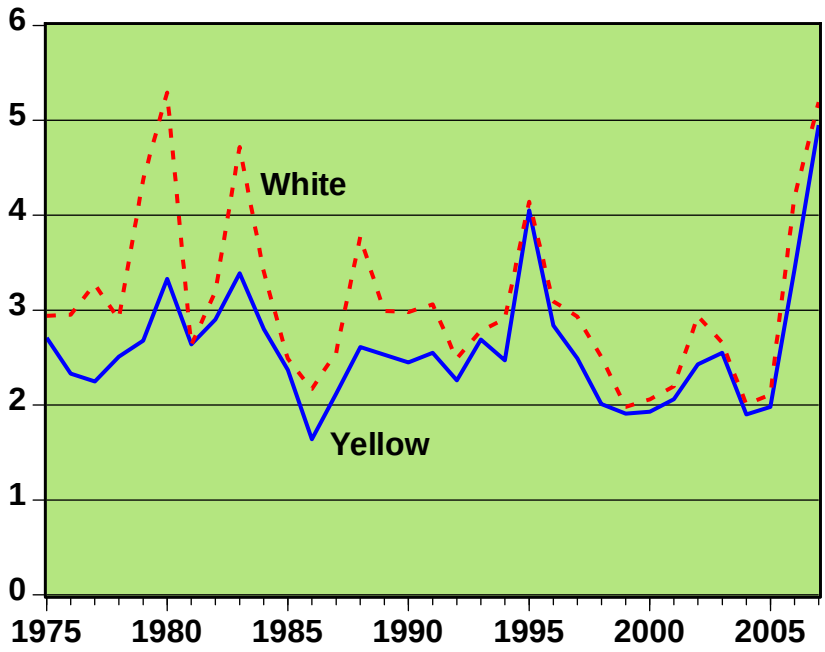
Because corn used for ethanol production has expanded rapidly in recent years, ethanol prices have become an additional factor in the corn market. To introduce the ethanol impact into the model, the corn price equation includes a "breakeven" price for corn in ethanol production. This price is weighted by the relative importance of ethanol utilization compared to corn production.

To derive prices on corn at the U.S. Gulf, the price of No. 2 Yellow Corn for the crop years of 1976 to 2007 were regressed on the price received by U.S. farmers. An instrument to handle autocorrelation was added to the equation, which explained about 98% of the variation in the Gulf market price. Another classification of particular interest to developing nations is white corn, which they strongly prefer over yellow corn for consumption as food. The database from the United States Department of Agriculture's (USDA) Agricultural Marketing Service does not have available quotes at the Gulf, but an historical series is included in a website of the USDA's Economic Research Service for Kansas City, MO. Because prices on No.2 Yellow Corn are also tabulated at Kansas City, a comparison was tracked and is shown in Figure 18.

Prices on white corn have been closely correlated with yellow corn, particularly since 1993. Note how much higher white corn prices were during periods of shortfalls in coarse grain supplies in the 1970s and early 1980s. This reflects the inelasticity in demand for corn-for-food versus corn-for-feed.

Because prices on white corn were more in line in the period from 1993 to 2007 than before, that period was the base for comparison. In this period, the price of white corn averaged 27 cents above yellow corn at Kansas City. That difference increased slightly over time, a trend introduced into an equation in which the price of white corn at the Gulf was assumed to be equal to the price of yellow corn there plus the price difference between white and yellow corn at Kansas City.

Figure 18. Market Prices on No. 2 Yellow and White Corn at Kansas City, MO ($/Bu)



7.1. Projections to 2014

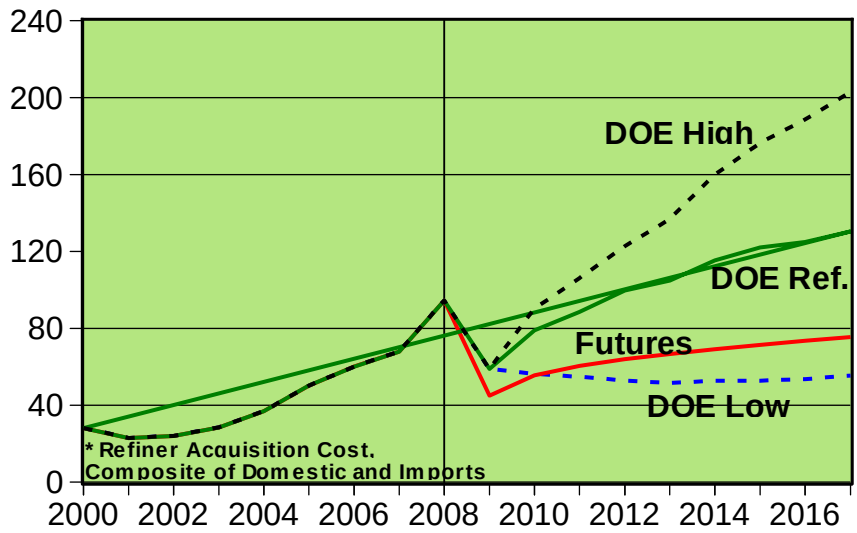
7.1.1. Assumptions and Macroeconomic Projections

Projections of population, U.S. real disposable income, foreign real gross domestic products, and real trade weighted exchange rates were obtained from the USDA's "International Macroeconomic Data Set," (USDA Economic Research Service 2009). General inflation is measured by the Implicit Price Deflator (IPD) for Personal Consumption Expenditures of the U.S. Department of Commerce and the Consumer Price Index (CPI) of the Bureau of Labor Statistics of the U.S. Department of Labor.

Considering the abnormal uncertainties relative to future energy prices, compounded by the global recession, which began in 2008, both a "baseline" scenario and three alternative scenarios are presented in an effort to embrace a wide range in possible crude oil prices. Crude oil prices in the projections are for the "composite refiner acquisition cost" as measured by the U.S. Department of Energy (DOE). In the baseline, these crude oil prices were derived from the futures quotes on the New York Mercantile Exchange on February 27, 2009. The alternative scenarios were based on the DOE's "Low, Reference, and High" projections of crude oil prices as indicated in Figure 19 (U.S. Department of Energy, Energy Information Administration March 2009).

The essence of the 2008 farm bill labeled *Food, Conservation, and Energy Act of 2008* is a continuation of the 2002 farm legislation with the addition of a new provision called the *Average Crop Revenue Election (ACRE)* program. ACRE addresses the weakness of past programs, which have provided price but not revenue support. An examination of the feature indicates that it will not affect agricultural projections in a major way.

Figure 19. Annual Average Crude Oil Prices, 2000 to 2008 and Projected to 2017 by Futures and the DOE ($/Barrel) *



Source: U.S. Department of Energy, Energy Information Administration March 2009.

The projections for the macroeconomic variables are presented in Table 15. The explanation of the data sources and origin of the projections is largely covered in the footnotes. The population in the Former Soviet Union (FSU) nations is expected to remain stable while the U.S. population grows at a rated of about 0.85% per year compared to 1.71% per year in foreign nations outside of the FSU. The real per capita disposable income in the U.S., after dipping in 2009, is slated to increase slowly over the remainder of the 2009 to 2014 period averaging 1.14% per year. The nations of the FSU are more isolated from the global financial crisis and are expected to achieve a 4.33% increase annually in real gross domestic product per year. Other foreign nations are expected to see an interruption in the long-term increase in per capita incomes, resuming growth in 2010, and averaging about 1.85% per year for the 2009 to 2014 period.

Inflation rates remained relatively low in 2009 and below the rates of the previous five years; this is predicted to continue through 2014. For the CPI on energy, after about a 25% decline in 2009, the inflation rate is expected to move up to a 3 to 4% rate by the end of the period. Food price inflation, at 5.5% in 2008, is expected to drop to about 1.0% in 2009 and increase at about a 2.0% afterward. Core inflation, which is all items except food and energy, is slated to increase about 1.7% in the 2009 to 2014 period. Of course, these projections are based on a rather nominal increase in crude oil prices in the baseline scenario.

Interest rates are employed in AGMOD to calculate production costs on corn and to forecast farmland prices. Declines to levels below 5% are indicated in Table 15 for 2009 and 2010 with increases to over 7% by 2014. Indexes of real trade-weighted dollar exchange rates related to U.S. markets on corn and soybeans, as shown in Table 15, are expected to remain close to the level of 2008, increasing over time for wheat.

Table 15. Macroeconomic Variables for the Baseline (Futures) Scenario, 2005 to 2008 and Projected to 2014[1]

Item	Unit	Year[1] 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Population											
United States	Mil.	296	299	302	305	308	310	313	316	318	321
Former Soviet Union	"	279	278	278	278	278	278	278	278	278	278
Rest of the World	"	5877	5951	6025	6101	6176	6251	6327	6403	6479	6555
Real disposable income per capita in the U.S. [2]	2000 $	27403	28098	28614	28704	27900	28238	28900	29481	30079	30692
Real gross domestic product per capita											
Former Soviet Union	2005 $	1757	1882	2018	2105	2185	2275	2376	2485	2600	2715
Rest of the World	"	4205	4324	4348	4418	4418	4485	4585	4698	4815	4931
Inflation											
Implicit Price Deflator [3]	2000=1.000	1.116	1.147	1.177	1.215	1.218	1.244	1.273	1.301	1.321	1.345
Consumer Price Index [4]											
All Items	1982-84=1.000	1.953	2.016	2.073	2.153	2.156	2.209	2.268	2.323	2.364	2.412
Food	"	1.907	1.952	2.029	2.141	2.163	2.209	2.262	2.309	2.345	2.386
Energy	"	1.771	1.969	2.077	2.367	1.790	1.772	1.904	1.995	2.067	2.134
Except Food, Energy	"	2.009	2.059	2.107	2.156	2.196	2.258	2.309	2.363	2.401	2.448
Crude oil [5]	$/Barrel	50	60	68	94	45	56	61	64	67	69
Interest rates on farm real estate loans [6]	Percent	5.91	6.72	6.50	5.57	4.93	4.69	6.51	7.11	7.25	7.48
Indexes of real trade-weighted $ exchange rates, markets											
Corn	2005=1.000	1.024	1.021	0.955	0.979	0.973	0.974	0.972	0.978	0.985	0.991
Soybeans	"	1.004	0.976	0.905	0.963	0.965	0.974	0.972	0.977	0.985	0.991
Wheat	"	0.998	0.970	0.898	0.900	0.905	1.008	1.004	1.008	1.015	1.021

[1]Data and projections for population, real gross domestic product per capita and dollar exchange rates were based on ERS, USDA's "International Macroeconomic Data Set." [2]Data is from the BEA of the U.S. Department of Commerce and projections from USDA's Baseline, 2009.
[3]Deflator for personal consumption expenditures from the BEA of the U.S. Department of Commerce and projected by AGMOD.
[4]Data from the BLS of the U.S. Department of Labor projected by AGMOD except for energy prices.
[5]Refiner acquisition cost, composite of domestic and import sources as tabulated by the EIA of the U.S. Department of Energy and projected by futures.
[6]Data from the *Agricultural Newsletter* of the Federal Reserve Bank of Chicago with projections derived from the USDA's 2009 Baseline.

7.1.2. Biofuels

The lower bounds for the production of ethanol (from corn starch) and biodiesel are the Renewable Fuels Standard (RFS) (mandates) under the *Energy Independence and Security Act of 2007* (EISA). The specifics are somewhat complex, but in essence, the total RFS increases from 9 billion gallons in 2008 to 36 billion gallons in 2022. Of this, Conventional Biofuels refers to ethanol derived from cornstarch, which increases from 9 billion gallons in 2008 to 15 billion gallons in 2012 and remains at that level. Presumed is that corn ethanol will fill that RFS, although the classification of Biomass-Based Diesel is also eligible. The ACT sets the RFS for this biodiesel classification at 0.5 billion gallon for 2009, increasing to a minimum of 1.0 billion gallons by 2012 and beyond. Biomass-Based Diesel is also eligible under the classification of Undifferentiated Advanced Biofuels to bring the total for biodiesel potential to 4.5 billion gallons by 2017 and 6.0 billion gallons by 2022.

The RFSs can be filled by imports as well as from domestic production. In addition, RFSs are prescribed for Advanced Biofuel except Cellulosic Biofuel and Cellulosic Biofuel, the latter increasing from 0.1 billion gallons in 2010 to 5.5 billion by 2017 and 16.0 by 2022. Presumed is that EISA and other federal and state legislation will remain intact through 2014. This includes the blenders' tax credits for ethanol and biodiesel and the $.54 per gallon tariff on ethanol imports. Anticipated is that a tariff will be imposed by the European Union on biodiesel imports from the U.S. except for Cellulosic Biofuel. The assumption is that waivers to the RFSs will not be issued and that prices on ethanol and biodiesel will be maintained at a level high enough to generate sufficient profits to meet the mandates as indicated in Table 16.

As shown in Table 16, the projected corn grain based ethanol production, estimated at 9.2 billion gallons in 2008, will increase to 14.4 billion gallons by 2014 in line with the RFS. Additional ethanol derived from other feedstock and imports are not analyzed in the paper. The Environmental Protection Agency (EPA) permits blends up to 10% ethanol to be used in all gasoline engines. Additional utilization is permitted in flex-fuel vehicles designed for 85% ethanol blends, but the number of such vehicles is somewhat limited. By 2012 or 2013, estimates are that the availability of ethanol will reach the 10% blend wall. Presumed is that the EPA will have raised the allowable blend to about 15%, removing a possible restriction on the demand for ethanol.

Biodiesel production, at an estimated 0.7 billion gallons in 2008, is projected to 1.8 billion gallons in 2014, exceeding the energy bill mandates. This is based on existing capacity of about 2.6 billion gallons and the needed profits to meet the mandate to produce at least 1.0 billion. Net exports of biodiesel, registering 54% of the domestic biodiesel production in 2008, will likely be reduced by the anticipated tariff for exports to the European Union.

As for the rest of the world, the projections for biofuels in Table 16 are highly empirical, based on trends beginning around the year 2000. The projections for ethanol are only for production from corn, plus some wheat, which will be about half of the total – the remainder mostly from sugar cane in Brazil.

Table 16. Variables Related to Biofuels for the Baseline (Futures) Scenario, 2005 to 2008 and Projected to 2014

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ethanol											
Production											
United States											
Mandate for Corn Starch	Mil. Gal.	NA	4000	4700	9000	10500	12000	12600	13200	13800	14400
Production	"	3904	4884	6500	9224	10500	12000	12600	13200	13800	14400
Foreign (from corn, wheat)	"	2257	3201	3300	4443	4491	5018	5563	6125	6704	7301
Prices, U.S.											
Wholesale gasoline [1]	$/Gal.	1.67	1.97	2.18	2.60	1.20	1.51	1.66	1.77	1.86	1.93
Ethanol [2]	"	1.80	2.58	2.24	2.47	1.84	1.89	1.89	1.96	2.01	2.06
Ethanol, energy based [3]	"	1.42	1.62	1.77	2.05	1.04	1.24	1.34	1.41	1.46	1.51
Corn prices, calendar year	$/Bu.	1.96	2.28	3.39	4.79	3.88	3.76	3.54	3.37	3.36	3.42
Profits [4]											
Ethanol	$/Gal.	0.36	1.05	0.40	0.13	-0.03	0.03	0.03	0.12	0.17	0.17
Ethanol, energy based	"	-0.02	0.10	-0.07	-0.29	-0.83	-0.62	-0.52	-0.43	-0.38	-0.38
By-products											
Production											
Corn gluten feed and meal	1000 MT	11327	11049	11350	11738	12832	13048	13145	13227	13302	13363
Distillers' dried grain	"	10002	14430	21226	25161	29095	31047	32455	33859	35260	36658
Prices											
Corn gluten feed [5]	$/Ton"	56	71	119	99	92	89	85	84	84	87
Corn gluten meal [5]	"	269	336	512	413	360	363	361	356	356	363
Distillers' dried grain [6]	"	86	110	152	114	107	104	101	99	99	102
Biodiesel											
Production											
United States											
Mandate	Mil. Gal.	NA	NA	NA	NA	500	650	800	1000	1000	1000
Production	"	91	250	496	685	900	1200	1500	1600	1700	1800
Foreign	"	2873	3562	3707	4020	4578	4985	5392	5799	6206	6613
Prices, U.S.											
Wholesale diesel [7]	$/Gal.	1.74	2.01	2.20	3.00	1.41	1.74	1.90	2.02	2.10	2.19
Biodiesel [8]	"	2.79	2.85	3.21	4.45	2.94	3.14	3.29	3.39	3.47	3.55
Biodiesel, energy based [9]	"	2.60	2.85	3.03	3.76	2.24	2.54	2.69	2.79	2.87	2.95
Feedstock prices, calendar year											
Soybean oil [10]	Cents/Lb.	23.8	24.2	35.4	49.8	33.4	36.7	38.8	39.5	39.3	39.6
White grease [11]	"	15.8	23.7	36.5	23.0	24.9	25.6	25.6	25.4	25.6	26.2
Profits [4]											
Soybean oil	$/Gal.	0.42	0.40	-0.05	-0.04	0.00	0.04	-0.01	0.02	0.10	0.14
Soybean oil, energy based	$/Gal.	0.12	0.29	-0.40	-0.79	-0.70	-0.56	-0.61	-0.58	-0.50	-0.46
White grease	$/Gal.	0.92	0.32	-0.41	1.92	0.09	0.34	0.43	0.53	0.57	0.59

[1] All gasoline, refiner prices for resale (DOE) [2] F.O.B., Omaha, NE

[3] Assumes that ethanol is priced at its energy value relative to gasoline plus the blenders' tax credit. This would be two-thirds of the retail gasoline prices plus 45 cents translated back to the wholesale level.

[4] Costs include feedstock, direct processing, depreciation, and a nominal returnon investment for a new 50 million gallon ethanol or a 10 million gallon biodiesel plant.

[5] Illinois points (ERS, USDA) [6] Lawrenceburg, IN (ERS, USDA) [7] No. 2 refiner prices for resale (DOE).

[8] Upper Midwest (Jacobsen Publishing Company).

[9] Assumes that biodiesel is priced at its energy value relative to petroleum diesel plus the blenders' tax credit. This would be 92 percent of the retal diesel prices plus $1.00 translated back to the wholesale level.

[10] Crude, Decatur, IL. [11]

7.1.3. Maize and other Coarse Grains

The balance sheets for the U.S. and the rest of the world on coarse grains for 2005 to 2008 crop years and projected to 2014 are presented in Table 17. Harvested corn acreage is projected to increase from about 79 million in 2008 to 84 million in 2014 with production reaching about 14 billion bushels. Adding sorghum, oats and barley, total coarse grain output would be about 367 million metric tons (MT) by 2014. The leveling off of the utilization of coarse grain for livestock feed reflects the substitution of distillers' dried grain (DDG) in livestock rations. By 2014, corn processed into ethanol could represent as much as 36% of production, nearly reaching the amounts fed to livestock. Exports of coarse grain are projected to increase rather slowly, picking up toward the end of the period.

Ending stocks should remain at amounts which might be termed *barely adequate*. While about in line with the past 20 years (16% of total utilization), carryovers abroad will be well below the past 20 years. Stock levels and ethanol prices should support corn prices above those prevalent prior to 2007, averaging between $3.30 and $3.80 per bushel. With general inflation, particularly with energy prices, variable costs will average about $260 per acre, about $80 above the previous decade. Even so, gross margins over variable costs per acre will hold at an elevated level in both nominal and real terms.

Area in coarse grain is also slated to expand in the rest of the world from about 275 million hectares in 2008 to 287 million in 2014, a 5% increase. With increased yields, production could reach 831 million MT, more than a 7% increase. A 15% increase in the utilization of coarse grain for feed will be partly offset by a reduction in the utilization for food. Utilization of coarse grains for ethanol production is assumed to nearly double by 2014 but will represent only about half of U.S. output. Ending stocks would edge lower in terms of percent of utilization and remain well below the average of the past 20 years.

Table 17. Coarse Grain in the U.S. and Rest of the World, 2005 to 2008 and Projections to 2014

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
United States											
Corn											
Harvested acreage	Mil. Acres	75.1	70.6	86.5	78.6	79.6	81.6	82.9	83.0	83.3	83.7
Yield	Bu./Acre	148	149	151	154	155	157	159	161	164	166
Production	Mil. Bu.	11114	10531	13038	12101	12321	12817	13199	13397	13632	13889
Coarse grain											
Production	Mil. MT	299	280	350	326	330	345	354	358	362	367
Utilization											
Feed	"	163	148	158	144	141	139	142	143	143	144
Ethanol	"	41	54	76	91	106	112	117	122	126	131
Other domestic	"	41	41	40	40	38	38	38	38	38	38
Exports	"	60	58	70	48	53	49	50	52	59	67
Total	"	305	301	352	303	337	338	347	354	367	379
Ending stocks	"	55	36	45	50	45	54	64	70	69	60
Corn											
Farm price	$/Bu.	2.00	3.04	4.20	3.90	3.81	3.60	3.38	3.34	3.39	3.52
Loan rate	"	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
Target price	"	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
Variable costs	$/Acre	186	206	230	301	245	239	247	259	273	288
Gross margin[1]	$/Acre	164	272	428	324	375	356	321	311	313	327
Rest of World											
Hectares	Mil.	267	272	277	273	279	283	285	285	286	287
Production	Mil. MT	679	708	729	774	754	778	793	805	818	831
Utilization											
Feed	Mil. MT	472	487	496	502	509	521	535	549	563	578
Food	"	274	286	289	300	257	260	263	266	269	272
Ethanol	"	28	36	37	47	47	51	56	60	65	70
Total	"	746	772	785	803	813	823	844	859	873	895
Ending stocks	"	110	102	112	129	121	122	119	114	115	116
Corn Prices and Determining Factors											
Corn prices at the Gulf											
No. 2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.29	4.08	3.86	3.85	3.93	4.11
No. 2 White[2]	"	2.82	4.70	5.77	4.80	4.64	4.43	4.22	4.22	4.31	4.50
Ending stocks as a % of utilization											
U.S.	%	18	12	13	16	13	16	18	20	19	16
Rest of world	%	15	13	14	16	15	15	14	13	13	13
Ethanol price[3]	$/Gal.	1.80	2.58	2.24	2.47	1.84	1.89	1.89	1.96	2.01	2.06

[1] Over variable costs [2] Derived from prices at Kansas City, MO [3] F.O.B. Omaha, NE.

In the bottom section of Table 17 are posted the two corn markets at the U.S. Gulf along with the variables which directly relate to the determination of the prices – ending stock in the U.S. and the rest of the world (as a percent of utilization) and ethanol prices. Of course, ending stocks are the result of many other determining factors. For 2009 to 2014, the price of No. 2 Yellow Corn is projected to average about 50 cents per bushel over the U.S. average farm price and No. 2 White Corn is projected to average about 35 cents over the price of No. 2 yellow at the Gulf.

7.1.4. Soybeans and Soybean Products

The soybean complex in the U.S. and oilseeds in the rest of the world are so important for analyzing coarse grains because: (1) not only are the consumers turning more to vegetable oils in their diets in the developed world but also in the developing nations as well; (2) of the rapidly expanding use of vegetable oils for biodiesel production; and (3) oilseeds are competition for areas in the U.S. and rest of the world for coarse grains. In addition, the by-products of oilseed crushing are high protein feeds that are both complements and substitutes for energy feeds such as corn in livestock rations.

In Table 18, the major variables for the soybean oil complex are projected to 2014. In the competition for land, soybeans and corn both expand by about the same number of acres. With increasing yields, production increases to about 3.6 billion bushels, an expansion of over 20% between 2008 and 2014. Carryover drops from relatively high levels in 2005 and 2006 to 7 to 9% of the forecast period, about the same as in the previous 20 years.

U.S. farm prices are expected to range in the low $9 to $10 level with stocks around 5 to 7% of utilization. Growth in demand for soybean oil as both a food and for biodiesel production will still leave room for exports to supply a rapidly expanding demand in the rest of the world

Table 18. Soybeans and Products, 2005 to 2008 and Projections to 2014

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Soybeans											
Harvested acreage	Mil. A.	71.3	74.6	64.1	74.6	74.3	75.0	76.4	78.6	80.0	80.8
Yield	Bu/Acre	43.0	42.9	41.7	39.6	42.8	43.2	43.6	44.0	44.4	44.8
Production	Mil. Bu.	3063	3197	2677	2959	3181	3242	3332	3460	3553	3619
Crush	"	1739	1808	1801	1650	1899	2052	2131	2181	2224	2258
Exports	"	940	1116	1161	1150	1066	1108	1056	1070	1145	1193
Ending stocks	"	449	574	205	210	268	192	179	231	257	267
as a % of Use	%	16	19	7	7	9	6	5	7	7	7
Farm price	$/Bu.	5.66	6.43	10.10	9.20	9.00	9.20	9.20	9.04	9.05	9.16
Variable costs	$/Acre	90	97	106	130	120	124	129	135	142	149
Gross margin[1]	$/Acre	165	191	327	246	279	287	285	276	273	275
Soybean oil											
Production	Mil. Lbs.	20387	20489	20568	18810	21623	23397	24327	24923	25452	25865
Utilization											
Biodiesel	"	1555	2762	2981	3200	4861	6157	6805	7237	7669	7994
Other	"	16404	15813	15346	14700	14913	15028	15063	15186	15243	15292
Imports	"	35	37	65	50	50	50	50	50	50	50
Exports	"	1153	1877	2908	1500	2000	2012	2287	2378	2480	2522
Price, Decatur, IL[2]	Cents/Lb.	23.4	31.0	52.0	32.5	36.1	38.5	39.6	39.3	39.5	40.0
Soybean meal											
Production	Mil. Tons	41	43	42	39	42	45	47	48	49	50
Feed utilization	"	33	34	33	31	32	32	32	33	34	34
Exports	"	8	9	9	8	10	14	15	15	16	15
Price, Decatur, IL[3]	$/Ton	174	205	336	280	280	279	273	266	266	271

[1] Gross margins over variable costs [2] Crude, degummed [3] 48 percent protein [4] Corn Belt states.

for the same purposes. Prices on soybean oil, at over 50 cents per pound, hurt the U.S. biodiesel industry in 2007. Into the forecast period, prices are expected to moderate to the mid 30 cent levels before rising to about 40 cents by 2014.

For most years in the past, soybeans were crushed more for their meal as livestock supplemental feeds and less for oil. This has changed somewhat, but in any case soybean meal remains as an important part of the soybean complex. Just as DDG competes with feeding coarse grain, it also competes with high protein feeds such as soybean meal. With expanding supplies of both soybean meal and DDG, exports of both basically protein feeds will continue to expand. The availability of these protein feeds will tend to keep prices on soybean meal in check over the 2009 to 2014 period.

7.1.5. Wheat

Wheat is much less competitive for acreages with corn in the Midwest than is soybeans. In fact, very little wheat is grown in the central Corn Belt such as in Iowa. However, acreage does shift among these crops based on gross margins over variable costs. As indicated in Table 6, wheat acreage is expected to drop in 2009 but return to the 55 million acre level for the remainder of the projection period.

Wheat used as feed tends to be a balancing mechanism with coarse grains both in the U.S. and in the rest of the world as observed by the sharp changes from year to year. For the U.S., total wheat utilization for domestic use and export is projected to increase about 15% between 2008 and 2014 leaving ending stocks ranging between 20 and 23% of utilization. This compares with 26% for the previous 20 years, so the ratio is a bit on the low side. For the rest of the world, the ending stock to utilization ratio at 17 to 21% compares with 27% for the previous 20 years. In conclusion, world carryovers of wheat are expected to be near "pipeline" amounts – levels needed to assure adequate supplies based on variability of annual production.

As with corn and soybeans, prices and gross margins are expected to drop from the elevated levels of 2007 and 2008 but hold above the previous period. As with corn, the market prices on No. 2 Hard Red Winter wheat (ordinary protein) and No. 2 Soft Red Winter wheat at Gulf ports in Louisiana, as shown in Table 18, are highly correlated with farm prices. The hard wheats are for bread, and the soft wheats are for pastry foods (Table 19).

7.1.6. Fertilizer Prices and Variable Costs Per Acre

Besides prices on fuels as indicated in Table 16, farmers also face volatility in prices and costs on fertilizer. This is illustrated in Figure 20 on the principal forms – anhydrous ammonia, super-phosphate (44-46 %), and potassium chloride (60 %) (USDA, ERS *U.S. Fertilizer Use and Price* 2009).

Table 19. Wheat in the U.S. and Rest of the World, 2005 to 2008 and Projections to 2014

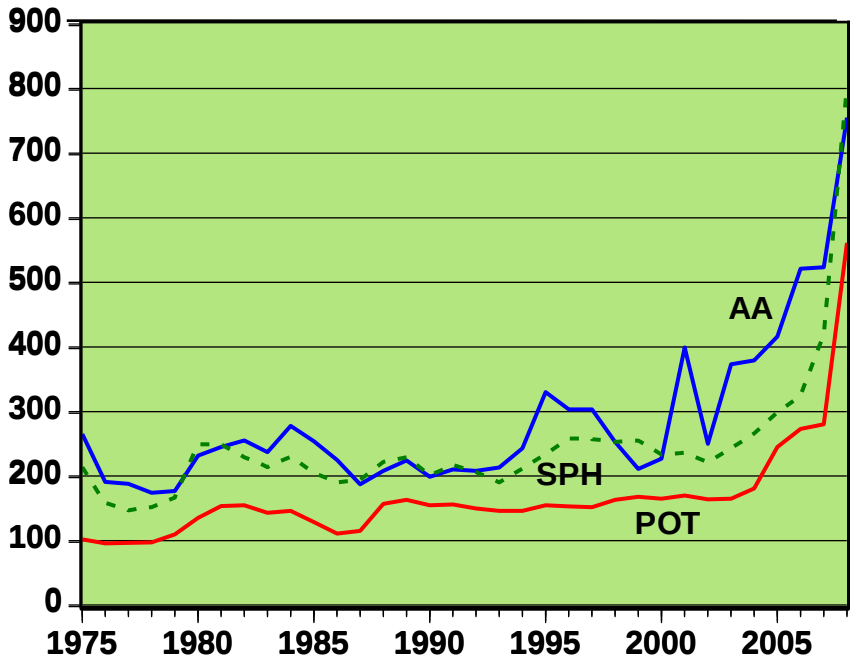
Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
United States											
Harvested acreage	Mil. Acres	50.1	46.8	51.0	55.7	52.5	55.9	55.7	55.5	55.0	54.8
Yield	Bu./Acre	42	39	40	45	43	43	44	44	44	44
Production	Mil. Bu.	2105	1808	2051	2500	2252	2415	2426	2434	2428	2438
Utilization											
Food	"	915	938	947	950	968	976	984	992	1000	1008
Feed, residual	"	160	117	15	230	215	265	235	234	238	235
Exports	"	1003	908	1264	1000	1178	1193	1205	1208	1232	1242
Total	"	2155	2049	2378	2216	2442	2514	2504	2514	2550	2565
Ending stocks	"	571	456	306	655	555	547	559	569	537	500
as a % of use	%	26	22	13	30	23	22	22	23	21	20
Farm price	$/Bu.	3.42	4.26	6.48	6.70	5.19	5.39	5.11	4.90	5.00	5.15
Variable costs	$/Acre	79	85	93	121	93	88	89	91	93	95
Gross margin[1]	"	79	95	182	195	148	163	151	141	146	151
Market prices, Gulf											
Hard Red Winter	$/MT	168	204	340	274	252	262	248	236	242	250
Soft Red Winter	"	138	171	310	210	230	239	226	215	220	228
Rest of World											
Hectares	Mil.	198	193	197	194	204	202	203	204	203	203
Production	Mil. MT	564	547	555	615	594	596	606	613	617	623
Utilization											
Food	Mil. MT	486	483	496	501	508	514	520	527	533	539
Feed	"	107	103	94	117	118	117	119	123	128	132
Total	"	593	586	590	618	625	631	639	645	653	658
Ending stocks	"	132	115	111	132	130	126	123	121	117	114
as a % of use	%	22	20	19	21	21	20	19	19	18	17

[1] Over variable costs.

Contributing to the rise in fertilizer prices were the expanded acreages of major crops in the U.S., higher commodity prices and the expectation for much higher farm profits. Between 2006 and 2008, acreages of major grain and oilseed crops in the U.S. increased by about 10%. In the spring of 2008, expected gross margins over variable costs for the collection of coarse grain, wheat, and soybeans, as measured by AGMOD, were more than double two years earlier. The rising prices in recent years can be traced to energy related inputs in the manufacture and transportation of fertilizer. About 74% of the total energy used to manufacture fertilizers comes from natural gas (Twaddle 1982). Natural gas is the main input to produce ammonia, which in turn is the major input in the manufacture of all nitrogen fertilizers. Higher crude oil and electricity prices also impact production costs for phosphate and potash fertilizers. In addition, the spike in fertilizer prices in 2008 “reflects low inventories and the inability of the U.S. fertilizer industry to quickly adjust to surging demand or sharp declines in international supply” (Huang 2009). The U.S. has increasingly become dependent on imports of nitrogen and potash to meet domestic demand.

With the decline in energy prices, particularly natural gas, and with lower commodity prices, fertilizer prices are expected to average much lower than in 2008 with nitrogen prices holding above levels prior to 2006 (Table 20). Fertilizer prices are in terms of the nutrients rather than in short tons (2000 pounds) for the major carriers as shown in Figure 20.

Figure 20. U.S. Farm Prices on Anhydrous Ammonia (AA), Super-Phosphate (SPH) and Potassium Chloride (POT) in $/Ton



Source: USDA ERS 2009.

7.2. Alternative Scenarios for Selected Price Variables to 2014

In recent years, the most glaring errors in macroeconomic forecasts, both short and long run, have been projections on energy prices centered on crude oil prices. For that reason, as mentioned earlier in this paper, alternative crude oil prices to the Baseline (Futures) were introduced into AGMOD as pictured in Figure 18. The High and the Reference projections by the Energy Information Administration of the U.S. Department of Energy were substantially above the Baseline.

In initial runs of AGMOD with the higher crude oil prices, profits from biofuel operations would trigger expansions in biofuel production beyond the levels assumed in the Baseline analysis. Two adjustments were made. Under the DOE Reference and High alternative, ethanol production in 1999 to 2014 was assumed to increase 8-9% over the Baseline and biodiesel was assumed to increase 50 to 55%. Secondly, the price margins for ethanol and biodiesel over the *energy based* prices were reduced and the blenders' tax credit was eliminated by the end of the forecast period in the High alternative. For these reasons, the impact of these higher scenarios on corn and other prices is somewhat muted.

To provide a perspective on the effects of the alternative crude oil prices relative to the Baseline, key variables were selected which would affect the outlook for food prices in the five African nations. The comparisons can be viewed in Tables 23 and 24. With prices on #2 white corn as a relevant classification for the developing nations, the projected prices in 2014

range from $4.34 per bushel in the DOE Low scenario to $5.68 in the DOE High scenario, compared to $4.50 in the Baseline.

Similarly, prices on #2 Hard Red Winter wheat in 2014 ranged between $235 per short ton in the DOE Low scenario to $340 in the DOE High scenario, compared to $250 in the Baseline. On soybean oil, the range was from 38 to 49 cents per pound with 40 cents in the Baseline.

The impact of crude oil prices on wholesale gasoline and diesel prices along with natural gas is delineated in Table 22. By 2014, the wholesale gasoline price will range from $1.46 to $3.28 per gallon depending on crude oil prices, with the Baseline at $1.93. Similarly, the prices on wholesale diesel would be expected to range between $1.68 and $5.00 per gallon with the Baseline at $2.19. The wide range on prices of natural gas, from $5.84 per 1000 cubic feet in the DOE Low scenario to $13.80 in the High, reflects the major risks to be encountered in the petroleum and biofuels markets. For the Baseline, the $7.05 would represent a rather conservative projection, near the levels of 2005 to 2007.

The range in fertilizer prices in 2014 reflects both the projections on production costs, triggered by natural gas prices but also the level of farm prices and returns on crops. As stated earlier, the outlook for the U.S. grain and oilseed market is a global outlook. As crude oil prices are the great imponderable, the use of scenarios helps to capture the impact of the ever-changing supply, demand and the efforts of government policies to achieve reasonable stability.

Table 20. U.S. Fertilizer Prices and Variable Costs of Production for Corn, Soybeans and Wheat

[1]

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Fertilizer prices in terms of nutrients											
Nitrogen	$/pound	0.25	0.32	0.32	0.48	0.32	0.29	0.30	0.31	0.32	0.33
Phosphate	"	0.33	0.36	0.46	0.55	0.50	0.31	0.28	0.29	0.30	0.31
Potash	"	0.20	0.23	0.23	0.28	0.26	0.17	0.15	0.14	0.14	0.14
Variable costs per acre											
Corn											
Seed	$/Acre	40	44	49	62	67	74	82	91	101	113
Fertilizer, lime	"	69	80	94	140	95	77	75	76	78	80
Chemicals	"	23	24	25	26	27	27	27	27	27	27
Fuel, lube, electricity	"	27	29	31	43	26	31	33	35	36	38
Other	"	27	30	31	29	30	30	30	30	30	30
Total	"	186	206	230	301	245	239	247	259	273	288
Soybeans											
Seed	$/Acre	33	34	38	49	52	56	61	65	71	76
Fertilizer, lime	"	10	11	14	24	21	17	15	14	14	13
Chemicals	"	14	14	15	16	16	17	17	17	17	18
Fuel, lube, electricity	"	14	16	17	20	10	13	14	16	17	18
Other	"	20	22	22	20	21	22	22	23	23	24
Total	"	90	97	106	130	120	124	129	135	142	149
Wheat											
Seed	$/Acre	8	8	10	12	13	11	11	11	10	11
Fertilizer, lime	"	26	28	33	51	33	28	27	28	29	30
Chemicals	"	9	9	9	10	9	10	10	10	10	11
Fuel, lube, electricity	"	16	18	19	27	15	17	18	18	19	19
Other	"	20	21	22	22	22	23	23	24	24	25
Total	"	79	85	93	121	93	88	89	91	93	95

[1]

Source: USDA, ERS 2009.

Table 21. Key U.S. Crop Price Variables in Four Scenarios for World Food Security Based on Alternative Crude Oil Prices, 2009 to 2014

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Baseline (Futures)											
Crude oil prices	$/Barrel	50	60	68	94	45	56	61	64	67	69
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.29	4.08	3.86	3.85	3.93	4.11
#2 White	"	2.82	4.70	5.77	4.80	4.64	4.43	4.22	4.22	4.31	4.50
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	252	262	248	236	242	250
#2 Soft Red Winter	"	138	171	310	210	230	239	226	215	220	228
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	36.1	38.5	39.6	39.3	39.5	40.0
DOE Low											
Crude oil prices	$/Barrel	50	60	68	94	59	56	55	53	52	53
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.09	3.86	3.75	3.77	3.96
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.44	4.22	4.12	4.14	4.34
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	268	246	232	230	235
#2 Soft Red Winter	"	138	171	310	210	233	245	224	212	209	214
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	35.5	37.3	38.6	37.9	37.7	38.1
DOE Reference											
Crude oil prices	$/Barrel	50	60	68	94	59	79	89	100	105	115
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.18	4.24	4.41	4.23	4.71
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.54	4.61	4.79	4.62	5.11
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	274	266	276	285	276
#2 Soft Red Winter	"	138	171	310	210	233	250	242	252	260	251
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	38.3	42.5	42.4	43.9	44.5	43.7
DOE High											
Crude oil prices	$/Barrel	50	60	68	94	59	90	106	123	137	160
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.53	4.15	4.26	4.77	5.26
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.89	4.53	4.65	5.17	5.68
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	282	289	264	293	340
#2 Soft Red Winter	"	138	171	310	210	233	257	263	241	267	310
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	37.3	43.2	42.1	44.5	44.2	48.8

Ferris, J. 2009.

Table 22. Key U.S. Crop Price Variables in Four Scenarios for World Food Security Based on Alternative Crude Oil Prices, 2009 TO 2014

Item	Unit	Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Baseline (Futures)											
Crude oil prices	$/Barrel	50	60	68	94	45	56	61	64	67	69
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.29	4.08	3.86	3.85	3.93	4.11
#2 White	"	2.82	4.70	5.77	4.80	4.64	4.43	4.22	4.22	4.31	4.50
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	252	262	248	236	242	250
#2 Soft Red Winter	"	138	171	310	210	230	239	226	215	220	228
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	36.1	38.5	39.6	39.3	39.5	40.0
DOE Low											
Crude oil prices	$/Barrel	50	60	68	94	59	56	55	53	52	53
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.09	3.86	3.75	3.77	3.96
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.44	4.22	4.12	4.14	4.34
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	268	246	232	230	235
#2 Soft Red Winter	"	138	171	310	210	233	245	224	212	209	214
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	35.5	37.3	38.6	37.9	37.7	38.1
DOE Reference											
Crude oil prices	$/Barrel	50	60	68	94	59	79	89	100	105	115
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.18	4.24	4.41	4.23	4.71
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.54	4.61	4.79	4.62	5.11
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	274	266	276	285	276
#2 Soft Red Winter	"	138	171	310	210	233	250	242	252	260	251
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	38.3	42.5	42.4	43.9	44.5	43.7
DOE High											
Crude oil prices	$/Barrel	50	60	68	94	59	90	106	123	137	160
Corn, Gulf											
#2 Yellow	$/Bu.	2.69	3.94	5.53	4.38	4.37	4.53	4.15	4.26	4.77	5.26
#2 White	"	2.82	4.70	5.77	4.80	4.72	4.89	4.53	4.65	5.17	5.68
Wheat, Gulf											
#2 Hard Red Winter	$/MT	168	204	340	274	256	282	289	264	293	340
#2 Soft Red Winter	"	138	171	310	210	233	257	263	241	267	310
Soybean oil, Decatur, IL	Cents/Lb.	23.4	31.0	52.0	32.5	37.3	43.2	42.1	44.5	44.2	48.8

Ferris, J. 2009.

8. EXPERIENCES WITH SPECIFIC INTERVENTIONS AND PROGRAMS TO DEFEND OUTPUT PRICE INCENTIVES IN THE FACE OF SUPPLY EXPANSION

This section examines the literature on specific marketing interventions and approaches to encourage the sustained adoption of productivity-enhancing green revolution inputs by small farmers. Three are potential types of such policy responses. The first type – (i) piloting and facilitating the adoption of market-based risk management instruments – is consistent with creating space for private markets and transitioning to a market-based system, while retaining an important public goods provisioning role for governments. The second two—(ii) variable tariffs and (iii) strategic reserves are more interventionist policies that would need to be applied with great care and be accompanied by specific safeguards to ensure 'arms length' rule-based management.

8.1. Market-Based Risk Management Instruments[20]

A market-based risk management instrument is any freely exchanged financial contract that allows parties on one or both sides of the exchange to reduce their risk exposure and/or to alleviate its consequences. A simple example is a loan obtained through a bank that can be used to smooth variable income flows and allow consumption to remain relatively stable over time. A more complex example is a weather derivative that can be bought for a fee and pays off when an objectively measured rainfall index falls outside a specified normal range. Some of the major instruments are now discussed in more detail.

8.1.1. Credit Markets

Credit markets allow borrowing to maintain consumption levels in the face of negative income shocks. This is an *ex-post* coping mechanism because it does not reduce risks *per se* but helps individuals or firms to cope with the consequences of negative shocks after they have occurred. Access to credit markets can also reduce or delay distress sales of assets that are often detrimental to long-run productivity and growth (Rozensweig and Wolpin 1993; Morduch 1995; Townsend 1995).

More broadly, marketing systems' ability to mop up surplus production and stabilize output prices depends on crucially on trader finance. Wholesale traders are the main source of finance for assemblers (smaller traders) that buy directly from farmers. Thus, assemblers' ability to go deep into rural areas to pull out surpluses quickly depends on a wholesaling system that has the incentives to pass along credit to agent assemblers and the ability to re-distribute those surpluses through long-distance trade and storage. As mentioned earlier, such a coordinated is unlikely to develop in a policy environment that is unpredictable with regard to export bans, import tariff rates, the volume and location of marketing board operations and prices, prices at which stocks are released onto markets, etc.

All food sector participants should benefit from reliable access to credit at reasonable terms. Many of the more sophisticated risk management instruments discussed below rely on credit markets to be able to function effectively. For example, it is unlikely that individuals or firms will be able to purchase insurance or trade futures contracts without good access to credit at reasonable interest rates. Credit markets therefore provide the foundation for a market-based

[20] Much of this section draws from Byerlee, Jayne, and Myers (2006).

approach to risk management. Without available and effective credit markets it is difficult to see how more sophisticated instruments are going to be successful in managing food sector risks, except perhaps for the largest firms and public agencies that can access international credit markets. Policy approaches to facilitating development of rural credit markets are discussed in detail in World Bank (2005) and are not addressed further here.

8.1.2. Warehouse Receipt Systems

Warehouse receipt systems offer another alternative for facilitating private storage, as well as helping farmers and traders get better access to formal credit markets and improving the efficiency of the food marketing system in general (Lacroix and Varangis 1996; Coulter and Onumah 2002; Coulter 2005). A warehouse receipt system allows participants to deposit a stated amount of a specified quality of a commodity into a warehouse, where it can be pooled with other grain of similar quality. A receipt is issued to the owner as evidence of location and ownership. The receipt then becomes a negotiable instrument that can be sold or used as collateral for a loan, backed by the claim to the commodity held in the warehouse.

Warehouse receipts facilitate risk management in three main ways. First, they give participants better access to formal credit markets by providing reliable, verifiable collateral for loans. This could allow consumption smoothing in times of stress, as well as provide investment funds and reduce distress sales of assets. Second, the system provides farmers with the flexibility to market their crop at different times of the year rather than strictly at harvest when prices are usually the lowest. This allows risk management via diversification of sales across time and, when widely adopted, can contribute to a reduction in seasonal price variability (Lai, Myers, and Hanson 2003). Third, a well structured and reliable warehouse receipts system acts like a clearinghouse that enforces ownership claims and can be an impartial third party that guarantees performance on contracts.

Warehouse receipts are already widely used in grain marketing systems around the world to provide secure collateral for credit and as an instrument for delivering traded commodities. To be successful, these systems must: (i) have an effective system of grades and standards in place; (ii) have sufficient trust, integrity, and quality control that there is essentially no default risk in using them; and (iii) have regulatory procedures and oversight to ensure the integrity of the system. South Africa has developed a substantial warehousing industry for agriculture but such services are in very short supply in other southern African countries. The only systems in this region outside of South Africa are the grain warehouse receipt system in Zambia (see Box 1), a system for coffee in Tanzania, and few localized pilot schemes for grain in Uganda and Kenya.

If models like those in Zambia can grow and be replicated elsewhere, this could add significantly to private storage capacity of smallholder farmers and improve the efficiency, transparency, and competitiveness of grain marketing systems. Public food agencies and food relief agencies may also participate in and use the systems. Nevertheless, warehouse receipt systems, and other means of improving private storage capacity and access to credit, should be viewed as long-run investments in institutional capacity building and are unlikely to provide immediate relief for problems caused by short-run price instability and food insecurity. Furthermore, there are several preconditions that need to be satisfied before warehouse receipt systems can be successful. There needs to be an effective system of grades and standards, there must be compelling reasons for a range of different stakeholders to participate, and above all, there must be a regulatory system of high integrity that is trusted by all participants. Government has an important role to play in ensuring the integrity of the system.

Box 1. The Zambian Warehouse Receipts Program

The Zambian program was launched in 2000 and is regulated by the Zambian Agricultural Commodities Agency Ltd., a non-governmental stakeholder owned body, and to date involves four certified warehouse operators and four banks. In 2004/05, farmers deposited 65,500 tons of maize, most of which were collaterally financed. In 2005/06, over 70,000 tons were deposited. However, so far in 2006, only 20,000 tons have been deposited. Recent evaluations indicate that the system has not achieved the required volumes to make it financially sustainable. This is due to: (a) the inability to pass the required changes in the Agricultural Credit Act; (b) heavy government intervention in the maize market, which has reduced the supply of commercially traded grain that could be deposited in licensed warehouses (the public Food Reserve Agency has chosen to store its grain in unregistered storage sites); and (c) policy uncertainty in the market, which makes some market actors utilize other time-tested and low-risk forms of trading. Because of specific trade and marketing policies adopted by the Government in 2006, seasonal price patterns have been unusual in the 2006/07 marketing season, causing disillusionment by some traders and large farmers in the wisdom of storing grain using registered silos more than a month or two.

Sources: Coulter (2005); Coulter (2006, personal communication); field visits by authors to Zambia in November 2006.

8.1.3. Commodity Exchanges, Futures and Options Contracts

Some of the key challenges facing agricultural markets in Africa are those related to imperfect information, lack of assurance on quality grades and standards that create problems of adverse selection and moral hazard. This follows from lack of proper grading procedures and incentives to adhere to them. These problems create asymmetric information, mistrust between market actors, and higher transaction costs of trade, which in turn gives rise to reliance on personal relationships and networks to reduce the risks transaction costs. In cases where such market relations and trust is weak, search methods depend on personal visits by the trader or her agent, and quality control requires the presence of the trader or an authorized agent at the time of purchase. The added transaction costs - including transport, search time, and supervision to ensure compliance with agreed commitments - increase marketing costs and reduce the overall efficiency of the market.

One way to deal with such problems in the trading system is to establish more transparent and rule-based commodity exchanges. If properly designed and implemented at low cost, commodity exchanges can help bringing integrity, security, and efficiency to the market. Commodity exchanges can provide real time market information, institutionalize a system of grades and standards, reduce search costs and link buyers and sellers through auction-based physical trading floors, encourage investments in warehousing facilities, and link the grain marketing systems with transport and logistics, banking and financial services.

Following structural adjustment and market reform programs, some countries in Sub-Saharan Africa have initiated commodity exchanges that provide different functions. Examples are private owned Kenya Agricultural Commodity Exchange (KACE) whose role is primarily providing market information, and the Ethiopia Commodity Exchange (ECX) promoted by the Ethiopian government. ECX was established on the premise to institutionalize a transparent, clearly defined, and rule-based trading system that brings integrity into markets and offers reliable and impartial market information to market actors. ECX has started

operations with traditional commercial crops (e.g. coffee, sesame, and beans) and major staple grains, which have significant traded volumes (wheat, maize, and teff). It has established its own defined commodity grading and certification systems, warehousing facilities, and operates an auction-based physical trading floor in Addis Ababa that connects sellers and buyers. It has launched warehouse receipt systems that aim to ensure reliable storage and handling, timely financial transactions and low-risk grain delivery. Whether ECX can be a successful example for Africa that would bring rule-based trading systems to tackle the chronic challenges of asymmetric information and high risks inherent in grain market transactions at low and competitive costs is yet to be seen. The challenge would be to reduce costs and maintain the competitiveness of these structured trading systems under situations where market institutions (e.g. financial systems and judiciary) are weak and gain the confidence of the private sector actors under the environment of discretionary actions and in some cases substantial interference by governments.

Commodity futures contracts are commitments to make or take delivery of a specific amount of a specified quality of a commodity at a particular location and time in the future. However, most well functioning futures markets have only a small percentage of contracts that are satisfied by actual product deliveries. Instead, traders offset their commitment by taking out an opposite position in the same contract (i.e. buying contracts previously sold and selling contracts previously bought). As prices fluctuate between the time the initial position is taken out and the time it is closed out, holders of the contracts make profits or losses. By taking out futures positions whose returns are negatively correlated with profits from production, trading, or processing operations, the cash position becomes hedged and overall portfolio risk is reduced. Box 2 provides a simple example.

Options are different in that they give the option buyer the right, but not the obligation, to buy (a call option) or sell (a put option) the underlying asset (usually a futures contract in the case of commodity options) at a strike price specified in the option contract. The option can be exercised at a specified maturity date (and sometimes before, at the discretion of the buyer). Trade in options can be used to put a floor under losses but still allow individuals and firms to participate in gains when prices move in their favor. In this way, options operate a lot like price insurance because a premium (the price of the option) is paid up front in order to reduce risk by guaranteeing a minimum return.

One of the major difficulties in using futures and options to manage food system risks in low-income countries is the limited availability of relevant markets. Almost all of the high volume markets are located in developed countries and have contract specifications that were designed specifically to meet the needs of developed country producers, traders, and processors. A major exception is SAFEX in South Africa, which provides regional southern African futures markets for wheat, white maize, and yellow maize. SAFEX contracts have been growing steadily in liquidity since the market's was established in 1995.

One solution to the problem of missing local futures and options exchanges is to establish local markets. Some developing countries are moving in this direction (e.g. India and China). However, there are severe obstacles to developing futures exchanges in low-income countries, such as weak marketing infrastructure and lack of liquidity. Therefore, investing in the development of local exchanges should, be viewed at best as a very long-run response to the problems of food price instability.

Box 2. Example of Futures Hedging

Suppose a trader buys 100 tons of white maize at 500 Rand/ton with the intention of holding it, transporting it, and finally re-selling it to an urban-based processor. The trader does not yet have a sell price and is exposed, therefore, to the risk of price declines. The trader sells one futures contract (equivalent to 100 tons) for September delivery at a price of 618 Rand/ton. A month later, the trader has the maize transported and ready to sell but the prices have fallen and the price received from the processor is only 480 Rand/ton. The trader has lost 20x100=2000 Rand on the physical trade.

But futures prices have also fallen and so the futures price for September delivery a month later is now 600 Rand/ton. The trader buys the futures contract back at this price and makes 18x100=1800 Rand on his futures trade (minus brokerage commissions). Hence, losses on the physical trade were offset by gains on the futures trade and overall portfolio risk is reduced.

If the prices had risen over the month instead of fallen, then extra profits on the physical trade would have been offset by losses on the futures trade and, again, overall portfolio risk is reduced.

In the short run, existing global markets may be useful for managing food price risks, depending on basis risk—the extent to which local grain prices are correlated with futures prices quoted on global futures exchanges. If these prices move together closely then the potential for managing price risks will be high, but if they are only loosely correlated then basis risk will be high and futures and options hedging will not be effective at reducing price risks.

The degree of basis risk is an empirical question that will differ by commodity and location and needs to be evaluated on a case-by-case basis. However, unlike coffee, cocoa, and to some extent sugar, where markets are globally integrated (i.e., low basis risk), food grain markets tend to be more localized and insulated from one another due to transport costs, quality differences, and trade restrictions (see Section 3).

Some case studies have examined basis risk and hedging potential for particular food crops in particular countries. Faruqee, Coleman, and Scott (1997) evaluated wheat imports in Pakistan and found good hedging potential using U.S. wheat and futures and options contracts. This has been supported by an analysis of hedging aggregate wheat and maize imports in several developing countries using Chicago Board of Trade wheat and maize futures and options (Sarris, Conforti, and Prakash 2005). Dana, Gilbert, and Shim (2005) evaluate the potential for Malawi and Zambia to hedge maize imports using SAFEX in South Africa, concluding that hedging could be an effective risk management strategy. These studies suggest that basis risk is low enough that existing global futures and options markets may provide effective hedging potential for food imports into low-income countries, at least in some important cases.

Where hedging potential exists, a key question is who would do it? Potential users are listed in Table 15 but small-scale farmers and traders would generally find the costs of individual participation prohibitive. Trading on global futures and options markets requires a considerable amount of resources, including access to credit, use of foreign exchange, good market intelligence, reliable and speedy communications, and the analytical capacity to

construct risk-minimizing portfolios. Furthermore, the volume specifications on most global futures and options contracts are too high to be of use to small-scale operations. Even in developed countries where the exchanges are located, farmers make little direct use of futures and options markets.

Larger-scale traders and processors (and even large-scale farmers) have a higher potential for using futures and options because they have better access to the required resources and their scale of operations can accommodate the quantity specifications on the contracts. However, a fairly large and sophisticated operation is required to trade directly in these markets.

The most commonly suggested strategy for low-income countries to use global food futures and options markets is for a public agency that controls or regulates imports to do the hedging (as in Faruqee, Coleman, and Scott 1997; Dana, Gilbert, and Shim 2005; and Sarris, Conforti, and Prakash 2005). In this case, countries are essentially hedging their export revenues or import bills, presumably to enhance macroeconomic stability and fiscal outlays. However, with a public agency doing the hedging it is not always clear how the benefits of hedging will be passed back to the producers, traders, processors, and consumers that make up the food system. If the public agency is directly involved in procurement (i.e. buys and imports or exports the grain itself) then the gains or losses from hedging can be passed back along the supply chain by altering domestic prices bid or offered by the agency.

Intermediation can also occur without direct government involvement. This could occur through large traders, processing firms, supermarket chains, cooperatives, or farmer organizations offering fixed or floor price contracts to smaller producers, traders, and processors. Then the intermediaries could pool the risks and hedge them using global futures and options markets. This is exactly what happens in many developed countries. In the U.S., for example, individual farmers (particularly smaller ones) make very little direct use of futures and options markets, but grain elevators (i.e., traders) offer cash contracts to the farmers that have forward fixed or floor prices embodied in them. For example, the elevator offers farmers a forward contract that prices the grain at planting but does not require delivery until harvest. Or the elevator offers a contract at planting that requires the farmer to deliver at harvest and guarantees a minimum price, but allows the farmer to receive a higher price if prices move up over the growing season. The elevator is able to offer these contracts because it pools the resulting risks across a large number of farmers and then hedges the aggregate risk on futures and/or options markets. This allows elevators to be competitive and attract business, while both farmers (indirectly) and elevators (directly) are able to manage their price risk through futures and options trading.

The choice between direct government procurement and hedging versus a decentralized approach where trade is undertaken by the private sector and hedging is encouraged via intermediation, either by firms, strong farmer organizations, and/or by public agencies, is an important one. If procurement and hedging is being undertaken directly by a government agency, then incentives for private individuals and firms to participate will be significantly reduced. Furthermore, this approach will really only work in countries that are consistent importers (exporters), and if import (export) requirements are known well in advance. For example, if a country that expected to import maize actually produces enough maize to export, then hedging the expected import requirement before the harvest is known could lead to unexpected and possibly large losses. Of course, uncertainty about the right quantity to hedge is a problem that will also plague individual farmers and firms. However, individuals

and firms probably have better knowledge of their production situation, and can respond more quickly to changes in that situation, than a centralized government agency hedging aggregate imports or exports.

Because public and private sector use of futures and options markets are unlikely to coexist very easily, governments are going to have to make a choice between centralized control of procurement and hedging activities and a decentralized approach that encourages more private sector participation. The latter approach has significant advantages and is more consistent with the long-run emergence and development of market-based institutions. However, extensive decentralized use of futures and options contracts is not going to emerge rapidly or spontaneously. Growth will require public investments in education and capacity building, as well as institutional innovations that facilitate indirect use of these instruments by smaller scale farmers and traders.

One final point about futures and options hedging is that even when relevant markets are available, they only allow risk reduction over the short run and are generally not useful for hedging annual income fluctuations over long time periods (Gardner 1989; Lence and Hayenga 2001). This is a limitation in terms of the degree of risk reduction that is possible but has the benefit of forcing market participants to continue to be responsive to longer-run changes in prices, which is desirable from an economic efficiency perspective.

8.1.4. Index-based Weather Insurance

Index-based weather insurance is a class of financial derivatives written against deviations from a threshold rainfall or temperature indices constructed from objective weather records measured at secure weather station locations throughout a country. For example, a farmer may pay a premium for an insurance contract that pays $25 for every 1 mm that the observed rainfall index falls below its critical level of 500 mm per year, up to a maximum of $5,000, (i.e. there are no extra payments if rainfall drops below 300 mm per year). Then if observed rainfall is below the threshold level, leading to low yields, the farmer receives a payment that can compensate, at least partially, for the lowered crop production.

Index-based weather derivatives are quite common in developed countries where contracts are primarily focused on heating-degree and/or cooling-degree-days in major cities, and are used by firms whose returns depend heavily on the weather (e.g. electricity generation). They are less common in developing countries but there is an emerging private market for rainfall insurance in India, and several other schemes have been piloted or investigated (see Box 3).

It should be clear that weather insurance is not focused directly on managing price risks, at least for the micro-level product for farmers. In fact, when producers are receiving payouts on their rainfall insurance then yields should be low and prices generally higher (but with incomes low due to reduced yields). In this way, the insurance acts more like an income safety net for producers rather than price insurance. However, in principle there is no reason to restrict rainfall insurance to producers. Consuming households might also benefit from purchasing rainfall insurance if it provides income when local food prices are high (due to low rainfall and low local yields). This payout can then be used to buy additional food at the higher prices. The only real requirements for this to be feasible is a premium that is attractive to consuming households given the risks they face, and ability to pay the up-front premium. Weather insurance could also be used to manage the food aid requirements of donor agencies, as is being proposed in Ethiopia (Morris 2005).

Box 3. Proposal for Weather Insurance in Malawi

A proposal for weather insurance in Malawi has two components (see Ibarra *et al*. 2005)—a micro-level insurance product that could be sold to individual farmers, and a macro-level product that the government could use to obtain emergency funds to meet food security commitments in times of drought.

The micro micro-level product would:

- Focus on the important maize-producing region surrounding Lilongwe.
- Construct a rainfall index that is highly correlated with maize yield outcomes in the region, based on rainfall data collected from the Lilongwe airport.
- Estimate the extent of financial loss per unit area that is associated with changes in the index (e.g. a 1 mm reduction in the rainfall index below a *normal* trigger level causes, on average, a 10 kg/ha yield reduction that is valued at 15 Malawi Kwacha (MKW) per kg, with an overall payout of 150 MKW per mm of the index per ha).
- Set the trigger level to determine the deductible on the insurance (the amount of risk the farmer has to bear before the insurance payouts begin to kick in).
- Require that farmers have access to credit so they can afford the premium, and insurers willing to offer the product at premium levels that remain attractive to farmer participation.

The macro-level product would:

- Focus on countrywide maize production.
- Construct a rainfall index that is correlated with average Malawi maize yield, based on rainfall data collected at weather stations throughout the country.
- Estimate the extent of financial burden facing the government food reserve agency in times of yield stress (e.g. to finance food imports or costly social safety net policies).
- Structure an insurance product that pays out according to the agency's need for funds as the countrywide rainfall index declines.
- Require specification of the exact nature of the agency's financial burden, and an insurer willing to willing to offer the product at premium levels that remain attractive to agency participation.

Source: Ibarra et al. (2005).

Governments and government agencies could also use index-based weather derivatives to insure their liabilities in times of climatic crisis (see Box 2), but this strategy would be subject to severe rent-seeking problems without a credible commitment to use the insurance payouts for their intended purpose (Myers 1992; Innes 2003).

The advantage of index-based weather insurance is that it is based on objective measures of readily observable events, which cannot be influenced by human behavior. Such schemes therefore avoid the moral hazard and adverse selection problems that plague traditional agricultural insurance schemes based on individual farm yields. They also have low transaction costs and can be scaled down to payout levels that might be of interest to relatively poor individual households.

The weakness of the index-based weather insurance approach is that individual farmer or trader returns (or the food prices paid by individual consumers) may not be strongly correlated with the weather index and hence the insurance payout. For example, if a farmer fails to receive a payout when yields are low, then the insurance will not provide effective

risk management. This is similar to the issue of basis risk for futures and options trading, and can destroy the incentive to insure. Furthermore, if there is a lot of demand for these index-based insurance products the insurer is exposed to catastrophic risk (i.e., if the insured event occurs widely then many payouts will have to be made at the same time). This can increase the price of insurance because insurers will require a risk premium to compensate them for taking on this catastrophic risk, and if this premium is high enough it can destroy the incentives for insurers to participate (Duncan and Myers 2000). The risk premium may be kept lower by reinsuring part of the risk on global insurance markets, if opportunities to do so are available.

While index-based weather insurance may not be attractive to all food sector participants in all situations, these contracts do have considerable potential in managing risks and providing a safety net in times of climatic stress. Farmers, both small-scale and large-scale, are the obvious potential users but others, including traders and even consuming households may potentially benefit from buying such insurance. Public agencies may also have potential demand for these insurance products but this would require on objective measure of the agency's liability under unfavorable weather outcomes. Furthermore, there is a danger that rent-seeking will eat into the insurance payouts when they occur if the agency is not credibly committed to use the funds for their intended purpose.

Similar to the case of futures and options, growth and development of index-based weather insurance will require public investment in developing both insurance products and the institutions to support viable insurance markets. This is another example of long-term institution and capacity building that is consistent with long-run market development.

8.1.5. Commodity-linked Finance

A problem with most existing rural credit products is that there may be little connection between the income flows of borrowers and the service flow requirements of the debt. In other words, farmers may be required to make large loan repayments at precisely the time that current incomes are low. One potential means of overcoming this problem is with commodity-linked finance. While there are many different types of commodity-linked finance, commodity-linked bonds are a prominent example (Priovolos and Duncan 1991). These are bonds that have principal, and possibly interest payments, linked to future realizations of a specified set of commodity prices. Hence, when commodity prices are high, debt service obligations are also high but the bond issuer has the income to service the debt (and vice versa). In this way, commodity-linked finance can help hedge price risk and smooth consumption streams.

While an interesting idea in principle, commodity-linked bonds (and other forms of commodity-linked finance) have several limitations for managing food price risks in low-income countries. In many cases, the necessary institutions and market infrastructure to support these kinds of financial products are not available. Even in developed countries, commodity-linked finance is only used by large firms that can accommodate the high transaction costs associated with these products. One major problem is that while there may be strong incentives to issue the bonds there are often no strong incentives for someone to buy them, other than for speculative purposes. Hence, the interest rates on these bonds can be quite high because buyers require a significant risk premium before they are willing to hold them. For the same reason, these bonds tend to be very illiquid. It seems the only viable way in which commodity-linked finance may offer real risk management alternatives for

individual farmers and households is through some kind of public or private intermediary that issues the bonds on a larger-scale and then packages the resulting financial instruments into products that might be accessible and of use to individual farmers and households. Commodity-linked finance would appear to hold more promise for managing the macroeconomic risks associated with import/export fluctuations and the external debt positions of governments rather than the individual risk portfolios of small-scale producers and households (O'Hara 1984; Myers and Thompson 1989).

8.1.6. Village Cereal Banks[21]

One of the main objectives of cereal banks has been to avoid putting farmers in the position of 'over-selling' grain at low prices and then buying back at high prices, to avoid exploitation by middlemen, and to help surplus-producing farmers to find a better market for their grain. The money saved from not having to buy back grain at higher prices later in the season could be spent on improved inputs and therefore contribute to agricultural intensification.

Thousands of cereal banks have been created since the 1970s in West Africa. These cereal banks were usually established with the assistance of a sponsoring agency (typically an NGO) which would supply materials (cement, timbers, nails etc.) and skilled labour for erecting a building for storing bags of grain. The villagers themselves normally provided the unskilled labour. The sponsoring agency would also provide a stock of grain, as a donation or loan at below market rates. The Cereal banks' operations consisted of buying, storing, and selling the grains. Although some cereal banks sold grain on a strict cash basis, others would sell to members on credit, to be repaid in kind or with cash, and with interest. Most cereal banks employed both sales methods. After receiving their initial capital injection, cereal banks would be required to operate without further financial support, though the sponsoring organization usually provided oversight and technical support for several years (Berg and Kent 1991).

There have been several evaluations of cereal banks in West Africa, including those by FAO (Gergely, Guillermain, and De Lardemelle 1990.), Development Alternatives Inc. (Berg and Kent 1991) and GTZ (Günther and Mück 1995). Most evaluations have concluded that cereal banks have mainly failed to sustain themselves in the long term. Catholic Relief Services (CRS 1998) found that of 1,500 Cereal banks created in Burkina Faso before 1991, at least 80% were bankrupt by 1997. FONADES, a pioneer NGO in the field of cereal banks, had set up 27 Cereal banks, each with a fund of 30 tons of cereals. However by the end of the first year of operations, the average fund had declined to an average of 23 tons, by the end of the second year 12 tons, by the end of the fourth year 4 tons, and by the end of the sixth year 1 ton. The CRS report also found that of 88 cereal banks tracked, only 41 were considered potentially sustainable, but this could not be ascertained for sure until these 41 cereal banks stopped receiving assistance from the support NGO that had formed them.

Coulter (2006) identifies four main sources of poor performance among cereal banks:

- Promoters of the cereal banks had failed to understand the highly competitive nature of private trade, and that net margins were thin.[22] In this environment, cereal banks

[21] This discussion draws heavily from Coulter (2006).
[22] Günther and Mück (1995) observe that "the supply of cereals from relatively distant markets requires high performing logistics of a kind most Cereal banks are incapable of providing".

had found it difficult to compete with private traders and for the most part had lost money. However, some NGOs had mitigated the problem by subsidizing transport.
- Most cereal banks were unable to engage successfully in temporal arbitrage. Generally speaking, promoters had over-estimated the gains to be made through speculative storage of grain, and some years such activities resulted in losses.
- Lending of grain to local people in the lean season. In this case the result was generally "disastrous", and members who borrowed frequently felt little obligation to repay.
- Dependence on outside monitoring and support by sponsoring organizations. While the support continues, cereal banks experience problems but generally continue to operate. When the support ends, they generally de-capitalize and cease operations.

Apart from these factors, losses often arose from cereal banks buying at above market rates and selling at below market rates. The social function of the CB drove its leaders to provide advantageous prices to local people, but this tended to compromise long-term financial viability. Of equal or greater significance, cereal banks often made management errors due to a mixture of inexperience, slow collective decision-making and social pressures, and/or suffered from corruption or other abuses of the cash box, such as insider loans. On some occasions the staff of sponsoring organizations themselves became corrupt and used their position to steal from the cereal banks. However, there have been cases of sustainable cereal banks, and the most successful examples have tended to be in areas which are neither structurally surplus or deficit (Günther and Mück 1995).

8.1.7. Market Information Systems

In many African countries, national food production estimates are considered unreliable and public agencies and private traders often over- or under-estimate import needs. For example, Zambia's estimates of maize production from the large-scale sector are problematic due to very low farmer response rates to its annual production questionnaire. Likewise, food balance sheets and import requirements are often determined without reference to informal cross-border trade or local "food security crops" such as cassava, resulting in overshooting official import requirements and exacerbating food price uncertainty and volatility (Tschirley et al. 2006).

A major priority in many countries is *improved crop forecasting and supply estimates* to help private and public marketing actors make better-informed decisions and avoid the potential to exacerbate market instability through poorly informed trade and stock release decisions. Food supply estimates must be developed within the context of overall *food balance sheets*. Here a priority is the inclusion of substitute 'food security' crops (such as cassava in southern Africa). During the onset of a crisis, timely price information is needed to assess the degree to which supplies in more accessible areas are reaching more remote areas through markets. During the crisis response, these data are needed also to determine whether food aid is reaching intended beneficiaries and not depressing markets. Finally, these systems need to track price trends for food staples and the assets, especially livestock, which tend to be liquidated during crises. Plummeting livestock-to-staple price ratios are a classic indicator of mounting vulnerability as increasing numbers of households sell livestock to purchase staple foods. Early warning systems in drought prone areas have been developed in most African countries in recent years to guide emergency responses, and some such as the systems in Mali and Ethiopia, seem to be working reasonably well.

The other major priority is *market information systems* that are commercially oriented but at least partially publicly financed. Most existing public systems do little more than collect market prices and report them, too often late and inconsistently.[23] In some cases (e.g. in Kenya and, very recently, Malawi), there has been a tendency to bypass public systems in favor of private systems which are seen as potentially more client-oriented and sustainable. Yet the public good nature of basic market information means that fully private systems will not be profitable for the foreseeable future and will be sustained primarily with donor support. Donor support for public sector market information systems may produce the most sustainable option in the long run. Mali's public grain market information system is now fully paid and managed with public resources, and Mozambique's is making progress toward this goal. At the same time, these information services should have the financial and managerial autonomy to generate revenue, seek additional outside funding, and manage these funds. The objective is to reduce the asymmetry of price information between farmers and traders, to improve market efficiency by reducing the costs of obtaining market information for traders to discover opportunities for spatial arbitrage, and to reduce potential barriers to entry for new traders.

8.2. Assessing the Potential of Market-Based Risk Management Instruments

8.2.1. The Advantages of a Market-Based Approach

Relying on a market-based approach to managing food system risks has a number of distinct advantages (Anderson 2001; Larson, Anderson, and Varangis 2004). Participation is generally voluntary so people will only participate at a level that is right for them in their particular situation. This is in contrast to traditional price stabilization schemes in which participation is compulsory (everybody is subject to the stabilized prices). Furthermore, the welfare gains to individuals and firms using market-based risk management strategies have been shown to be substantial in some cases, particularly when risks and the degree of risk aversion are high (Anderson 2001).

From a policy perspective, a market-based approach to risk management should not require large persistent budgetary outlays as has occurred historically with price stabilization schemes. Even if public agencies are trading futures and options the trading profits and losses should approximately cancel each other in the long-run if the futures and options markets are operating efficiently. It is important to note, however, that there could be large trading losses in the short run (which would presumably be offset by gains in physical trading operations, or be passed back to others if the agency is operating as an intermediary).

Perhaps the most important advantage of using market-based risk management instruments is that in general they facilitate and enhance the role of the private sector in the food system rather than displace it. The use of market-based risk management can improve price discovery, enhance market efficiency, and improve price transparency and information dissemination throughout the marketing channel. These secondary benefits occur most commonly with organized commodity exchanges. For futures and options to work effectively, there must be an open, highly transparent system of exchange that facilitates information dissemination. These markets also generate incentives to collect market intelligence and information (because futures and options exchanges provide a forum for making trading profits based on superior information) and, in so doing, help to disseminate

[23] A notable exception is in Mali, where price information following the 2004/05 drought has been used extensively to guide government and private sector cereal import decisions (Staatz 2005).

this information to other market participants through the price system. Finally, an important social benefit of such markets is that they facilitate collection of time series data on market prices that can be used for evaluating market performance over time.

8.2.2. Challenges to Implementing a Market-Based Approach

Despite the apparent potential for using market-based instruments to manage food sector risks, there has been little use to date of these instruments in low-income countries for a number of reasons. Contract enforcement may be difficult for food staples in times of local shortage. The small size of farms and traders serving the traditional food sector in these countries, and poorly developed financial markets, also limit the liquidity required for successful trading. Few of these countries have the market intelligence systems, grades and standards systems, communication systems, storage and marketing infrastructure, and experience and education to use these markets effectively. Basis risk is another major impediment to both futures and options trading and index-based weather insurance.

Somewhat ironically, one of the most serious impediments to innovation and development of risk management markets for food sectors in many countries may be continuing government interventions in food markets. These policies reduce or destroy the incentive to participate in market-based risk management mechanisms because there is no incentive to manage risk when prices are being effectively stabilized via policy, and because such policies tend to disconnect local prices from world prices, which reduces the hedging potential of the global markets. Furthermore, if government interventions are discretionary and difficult to predict then they can add another layer of risk that individuals and firms may find difficult to hedge using available market-based risk management instruments.

In a liberalized market environment, however, governments can play an important role in facilitating and expanding the use of market-based risk management instruments. This role includes investing in:

- basic market infrastructure such as transport, communication, grades and standards, and market information systems (see section 3). Without these basic investments more sophisticated risk management instruments are unlikely to succeed;
- institutions that support the development of rural finance markets, expand the availability of credit, and encourage and facilitate private grain storage;
- analytical capacity, technical support, and education to facilitate use of global futures and options markets by large-scale domestic producers, traders, and processors;
- the development and support of intermediary institutions that can pool and repackage the risks facing small-scale producers, traders, and processors and then hedge the pooled risks using global futures, options and insurance markets; and
- the development of objectively measured weather indices that can provide a foundation for index-based weather insurance.

8.2.3. Main Messages on Market-Based Approaches

Market-based risk management instruments have some clear advantages for managing food price risks in low-income countries in efficient ways that allow voluntary participation. Furthermore, existing evidence suggests that hedging potential is considerable in some cases, even when restricted to using existing global futures and options markets. However, effective

development and use of such markets is clearly not going to occur without active public policy support. There are many barriers to participation, especially for small-scale producers, traders, and processors, and the public sector can play an important role in reducing these barriers and facilitating use.

Direct trading of market-based risk management instruments by public food marketing agencies to hedge government liabilities is an option that could be adopted very quickly. However, this is a risky venture for the public sector. Not only does such trading require considerable information and analytical capacity but is subject to the same problems of inefficiency and rent seeking that have plagued direct public intervention in food markets in the past, especially when there is no credible commitment regarding how the gains will be spent (and the losses financed). A preferred strategy is to encourage private sector use of these markets by making long-run investments in the standard public goods relating to the enabling environment for finance and risk markets, including grades and standards, credit market development, communication systems, market intelligence systems, regulations, and support for locally or regionally-based commodity exchanges and insurance products. There may also be a role for policy support of market intermediaries that provide access to risk management markets for small-scale operations, particularly in the early stages of developing these markets. Perhaps most important, governments can provide a predictable policy environment that does not destroy the incentives for private individuals and firms to trade market-based risk management instruments.

8.3. Variable Tariffs to Manage World Price Shocks

Variable tariffs can be used as a short-run policy in food importing countries to insulate domestic food markets from large world price shocks. The challenge with such policies is to manage the tariff level in a way that allows domestic prices to track world prices in the long run, and that maintains the private sector's incentive to participate in international trade. The historical tendency to manage variable tariffs in a very discretionary way makes private sector planning difficult and opens the programs to capture by vested interests. If variable tariffs are used, therefore, rates should be set according to well-specified rules rather than discretion.

Variable tariffs work best for imposing a floor price in food importing countries because the tariff can be raised in the event of an extreme drop in world prices. Foster and Valdes (2005) suggest that the floor price be set based on the cost of production in the most efficient exporting country in order to minimize risks of encouraging inefficient domestic production. Other countries have used a fixed departure from a moving average border price as the trigger (e.g., Chile). Unless the tariff is already high, variable tariffs do not address effects of price spikes on consumers, and since high tariffs on food grains are sources of both inefficiency and higher inequality (the poor are penalized), this is not usually a desirable option. Nor are variable tariffs appropriate for price extremes generated by domestic shocks in countries that operate in wide bands between import and export parity. Furthermore, under current World Trade Organization (WTO) rules the scope for variable tariffs is limited to the bound tariff (the tariff level declared to the WTO), although proposals are being discussed to allow variable tariffs as a safeguard to food importing developing countries.[24] Finally, if countries are to liberalize and encourage regional trade, variable tariffs have to be agreed at the regional level as implemented in the Andean zone.

[24] For a full discussion of variable levies and tariffs within WTO rules, see Foster and Valdes (2005).

In sum, variable tariffs have some scope to protect producers from extremely low prices in food importing countries but require very open and transparent rules that would preferably be monitored by the WTO to prevent abuse and political patronage (Foster and Valdes 2005). They should only be used for very small number of 'strategic commodities' that have well-defined international reference prices. Finally, it is clear that variable tariffs are of limited value for protecting against price spikes, which is often the main concern of food importing countries.

8.4. Food Reserves and Price Bands to Absorb Domestic Production Expansion

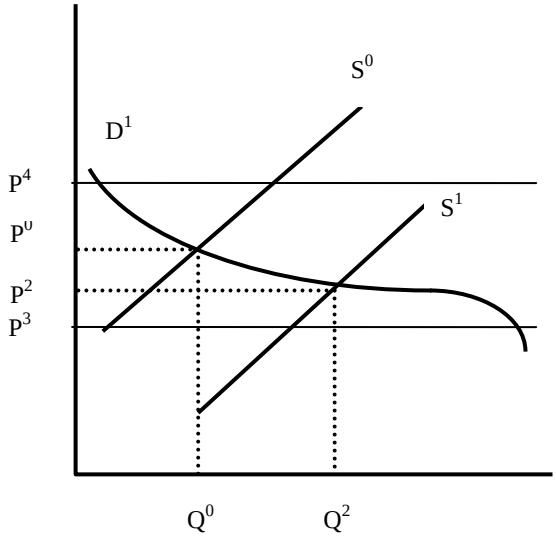
The last and most difficult step for countries undergoing market liberalization and privatization is how to deal with public grain reserves. Countries maintain such reserves for three major reasons (NEPAD 2004).

1. *Emergency reserves* for a major natural crisis, such as a severe drought, especially in eastern and southern Africa, usually linked to food aid donations.
2. *Food security reserves* for servicing both emergency relief and a public distribution system (mainly in Asia) for the chronically poor, again often supported in part through food aid donations.
3. *Buffer stocks*, now often known as *strategic reserves*, aimed at smoothing prices for producers, but also serving as emergency relief and supporting public distribution systems, if they exist.

Clearly, the first two objectives, which operate largely on the consumer side of the market, are not focused on stabilizing prices *per se*, although they do target food security for vulnerable consumers. However, buffer stocks can be part of a strategy to absorb surpluses off the market in order to protect farmers against downside price risk.

Figure 21 illustrates the concept. Transparent and non-discretionary trigger prices are announced according to a pre-determined decision rule (e.g., upcoming prices linked by some formula to a world market reference price). If market prices go as low as P3, the marketing board or other entity would open its doors to accept grain delivered to it by farmers or traders at price P3. If prices rose to P4, the marketing board or other entity would release commodity onto the market to prevent prices from exceeding P4. This is the true definition of a "residual buyer and seller". Between prices P3 and P4, prices would fluctuate freely according to supply and demand conditions and there would be no direct government participation in the market. Both P3 and P4 could be adjusted according to location and over time to account for seasonal costs of storage.

Figure 21. Price Band Policy with Buffer Stock



The ability of this price band with buffer stock policy to defend against downward price risk and promote small farmer incentives to sustainably use improved crop technologies would depend on many factors, including:

(1) how high is P3 to be set? If it is set too low, prices could fall to levels that discourage technology adoption. If it is set too high, the state could find itself accumulating massive stocks without being able to dispose of it profitably at P4. Prices would also need to be considered in relation to input costs, and export and import parity prices;
(2) stockholding costs in relation to import costs and export prices. Studies by Buccola and Sukume (1988), Pinckney and Valdes (1988), Pinckney (1993) indicate that, in general, price bands P4-P3 should be set fairly widely apart, both to minimize the state's potential for financial losses and to allow scope for commercial trading activity within the price band;
(3) the proportion of rural households that are buyers vs. sellers of grain. To the extent that most rural (and almost all urban) households are grain buyers, a price band policy that raises mean price levels would make most of the population worse off. This would most likely have regressive income distributional effects; because the largest farms that tend to sell the most grain would benefit the most, while the poor, who are mostly buyers of grain, would become worse off. However, these results are based on a static analysis. Dynamic effects over time may be different, but there is little information available to assess dynamic effects; and
(4) alternative uses of the commodity. As mentioned earlier, past efforts in Africa to defend marketing board producer prices could rarely be sustained for long because support prices led to a supply response, creating huge and costly stock accumulations that African governments could not afford, leading to subsequent abandonment of the support prices, price plunges, which then led to lower fertilizer use and a reversion to former low yield levels.

While there is a demonstrable potential for major supply response, the level at which prices are set largely determines whether states will be able to defend prices from going below some minimum level to make the technology widely and sustainably adopted. However, the advent of a biofuels industry in some African countries could potentially help to stabilize downside

price risk by diverting surplus production into biofuels, acting as a residual demand source when prices get low enough to substitute competitively for imported petrol. Efforts to intensify small farm productivity growth might be more sustainable with a "floor price" to help defend against downside price risk, which could in turn promote input adoption and grain productivity growth by African smallholders. There are many questions and risks of course, such as: (a) what is the minimum price at which biofuels production could be competitive with imported petrol for specific crops (sugars, grains); (b) what are the technology options that could be feasible in Africa; (c) are there scale-economies in production and distribution, and how would this affect the desired number of production facilities in the region; and (d) could such a system really be operated in a transparent and non-discretionary way, or would the temptation be to great to utilize the board for non-market purposes that ultimately depress the development of the market (and small farmer production incentives.

In practice, 'social objectives' could be combined with this procurement, such as requiring that tenders be supplied from remoter poorer regions with a grain surplus but with thin markets. Efficiently run public procurement could provide needed competition and demand stimulus in such markets. However, in practice, there are tradeoffs between efficiency and social objectives that have to be recognized.

On a larger scale, many countries in Africa, in the wake of closure of public food marketing agencies, still attempt to operate a buffer stock to support prices in good harvest years and dampen price rises in poor harvest years, or even to ride out extreme prices in world markets. Of course, these same reserves also serve emergency crises and public food distribution systems. Despite their appeal, the record of such operations is not encouraging (Box 4). Indeed consumers often face *greater* instability in prices and availability due to the operation of such strategic reserves as seen in Malawi (see Section 5).[25]

Box 4. New Partnership for African Development's (NEPAD) Sobering Findings on Strategic Reserves

A comprehensive review by NEPAD (2004) captures the record of food reserve agencies as follows:

"In Southern Africa, continued attempts to use strategic grain reserves to help stabilize cereal prices for both producers and consumers have undermined market incentives for private traders to perform normal arbitrage functions that could otherwise have satisfied governments' food security objectives in most years. Consequently, small farmers have often been penalized for producing a surplus crop by falling prices and lack of markets. This has led them to reduce plantings with subsequent adverse impact on the overall production and grain availability situation in following years. At the same time, consumers have also faced greater instability in grain markets, with respect to both physical quantities available and price. In most cases, therefore, experience with strategic grain reserves in this part of Africa up to now has been less than satisfactory."

Source: NEPAD (2004), p. 34.

[25] Even seasonal price movements may be exacerbated by operation of such reserves. Mozambique, with no food reserve and no restrictions on maize trade, shows a typical seasonal price rise for maize at retail of about 50% in its deficit southern region (see Box 4). Malawi on the other hand, which frequently holds a large reserve and intervenes in other ways in the market, shows the *highest* seasonal price movement, averaging 90% over the past decade (Tschirley et al. 2006).

The case for these reserves is strongest in landlocked countries that are close to self-sufficiency in a major staple, and where reliance on trade to equalize supply and demand can potentially lead to large price swings (from export to import parity). But even here, timely access to financial resources is critical to effective operation of such a reserve, and any grain reserve needs to be combined with a financial reserve (usually in foreign currency). In coastal countries, the financial reserve should be all that is needed (Poulton et al. 2005). For example, Senegal depends solely on a dedicated financial reserve for drought emergencies (NEPAD 2004). A professionally managed reserve could also take out insurance or hedge to reduce financial exposure.

Conceivably, some of the past problems with these reserves could be surmounted by setting up an arm's length professionally managed reserve along the following lines:

- Central-bank type autonomy, with complete independence from political processes, and with clear and well-defined objectives;
- Highly professional management with a good information system and analytical capacity;
- Flexibility to hold the combination of grain and financial reserves that minimizes costs within acceptable levels of risks;
- Clear and open rules for market intervention and transparency in its interventions; and
- Access to a fund or financial markets, to provide flexibility to respond in an emergency.

These are fairly strict requirements that have proven very difficult to implement. Whether this could be achieved in practice is unclear and would vary by country and region. Such a reserve is also costly and these resources have significant opportunity costs.

8.5. Summary of Risk Management Options

This section has examined the literature on specific marketing interventions and approaches to encourage the sustained adoption of productivity-enhancing green revolution inputs by small farmers. Three potential types of such policy responses. The first type – (i) piloting and facilitating the adoption of market-based risk management instruments – is consistent with creating space for private markets and transitioning to a market-based system, while retaining an important public goods provisioning role for governments. The second two – (ii) variable tariffs and (iii) strategic reserves are more interventionist policies that would need to be applied with great care and be accompanied by specific safeguards to ensure 'arms length' rule-based management. Focusing on market-based risk management instruments might best be viewed as long-run investments that require the sustained development of marketing institutions, and which can eventually be fully consistent with long-run market development. Variable tariffs and strategic reserves might best be viewed as short-run measures designed to achieve specific short-run food security objectives that, depending on how they are implemented, may be in conflict with the transition to a market-based system.

There are many different types of market-based instruments that are either being used or potentially could be used to manage food system risks in developing countries. Similarly, there are many different participants in the food system that could potentially benefit from using these instruments, ranging from individuals, households, and firms engaged in producing, storing, processing, and trading food commodities to public marketing agencies participating in and regulating food markets.

Table 23. Market-Based Risk Management Instruments and Their Potential Users

Potential User	Potential for Risk Management Instrument				
	Credit Markets	Warehouse Receipts	Futures and Options	Weather Index Insurance	Commodity-Linked Finance
Small-Scale Farmer	High	High	Low	Moderate	Low
Small-Scale Trader or Processor	High	High	Low	Low	Low
Larger-Scale Farmer	High	High	Moderate	High	Low
Larger-Scale Trader or Processor	High	High	High	Low	Moderate
Consuming Households	High	Low	Low	Low	Low
Public Food/Strategic Reserve Agency	High	Moderate	Moderate	Moderate	Moderate

Table 23 summarizes the major types of market-based risk management instruments and suggests the degree to which different potential users might find the instruments useful.

Because public and private sector use of futures and options markets are unlikely to coexist very easily, governments are going to have to make a choice between centralized control of procurement and hedging activities and a decentralized approach that encourages more private sector participation. The latter approach has significant advantages and is more consistent with the long-run emergence and development of market-based institutions. However, extensive decentralized use of futures and options contracts is not going to emerge rapidly or spontaneously. Growth will require public investments in education and capacity building, as well as institutional innovations that facilitate indirect use of these instruments by smaller scale farmers and traders.

One final point about futures and options hedging is that even when relevant markets are available, they only allow risk reduction over the short run and are generally not useful for hedging annual income fluctuations over long time periods (Gardner 1989; Lence and Hayenga 2001). This is a limitation in terms of the degree of risk reduction that is possible but has the benefit of forcing market participants to continue to be responsive to longer-run changes in prices, which is desirable from an economic efficiency perspective.

Index-based weather insurance is a class of financial derivatives written against deviations from a threshold rainfall or temperature indices constructed from objective weather records measured at secure weather station locations throughout a country. Index-based weather derivatives are quite common in developed countries where contracts are primarily focused on heating-degree and/or cooling-degree-days in major cities, and are used by firms whose returns depend heavily on the weather (e.g. electricity generation). They are less common in developing countries. Weather insurance is not focused directly on managing price risks, at least for the micro-level product for farmers. In fact, when producers are receiving payouts on their rainfall insurance then yields should be low and prices generally higher (but with incomes low due to reduced yields). In this way, the insurance acts more like an income safety net for producers rather than price insurance. The weakness of the index-based weather insurance approach is that individual farmer or trader returns (or the food prices paid by individual consumers) may not be strongly correlated with the weather index and hence the

insurance payout. While index-based weather insurance may not be attractive to all food sector participants in all situations, these contracts do have considerable potential in managing risks and providing a safety net in times of climatic stress.

Similar to the case of futures, options and warehouse receipt systems, the growth and development of index-based weather insurance will require public investment in developing both insurance products and the institutions to support viable insurance markets. This is another example of long-term institution and capacity building that is consistent with long-run market development.

In our assessment, commodity-linked finance and village cereal banks are relatively far down on the list of institutional innovations options with the potential to cost-effectively address the problems of food price instability and market development.

Relying on a market-based approach to managing food system risks has a number of distinct advantages. From a policy perspective, a market-based approach to risk management should not require large persistent budgetary outlays as has occurred historically with price stabilization schemes. Perhaps the most important advantage of using market-based risk management instruments is that in general they facilitate and enhance the role of the private sector in the food system rather than displace it. The use of market-based risk management can improve price discovery, enhance market efficiency, and improve price transparency and information dissemination throughout the marketing channel.

Despite the apparent potential for using market-based instruments to manage food sector risks, there has been little use to date of these instruments in low-income countries for a number of reasons. Contract enforcement may be difficult for food staples in times of local shortage. The small size of farms and traders serving the traditional food sector in these countries, and poorly developed financial markets, also limit the liquidity required for successful trading. Few of these countries have the market intelligence systems, grades and standards systems, communication systems, storage and marketing infrastructure, and experience and education to use these markets effectively. Basis risk is another major impediment to both futures and options trading and index-based weather insurance.

One of the most serious impediments to innovation and development of risk management markets for food sectors in many countries is continuing discretionary state interventions in food markets. The discretionary nature of policy interventions reduce or destroy the incentive to participate in market-based risk management mechanisms because there is no incentive to manage risk when prices are being effectively stabilized via policy, and because such policies tend to disconnect local prices from world prices which reduces the hedging potential of the global markets. Furthermore, if government interventions are discretionary and difficult to predict then they can add another layer of risk that individuals and firms may find difficult to hedge using available market-based risk management instruments.

9. SUMMARY, POLICY OPTIONS, AND PRIORITY INVESTMENTS

Making markets work for smallholder farmers and consumers will require actions from many different kinds of actors, both in the private and public sectors as well as from international financial and donor organizations. Our premise, however, is that the public sector role is decisive. If public sector policy choices do not reduce the currently high levels of risk and uncertainty in African food markets, and if governments use their scarce resources in ways that do not provide greater investment incentives for the private sector, then there will be very limited scope for the development of a market-oriented system to provide smallholder farmers with the access to markets that they need. A highly uncertain policy environment will also continue to scare off bank financing for needed investment in the sector. This path will lead to frustration over the private sector's apparent unwillingness to invest in support of smallholder agriculture. On the other hand, if African governments define their roles clearly, implement these roles transparently and consistently, and use their scarce resources to invest in public goods that provide new profitable opportunities for private sector investment, then this approach is likely to fuel private sector investment in support of smallholder agriculture. Private capital tends to seek out profitable opportunities with tolerable exposure to risk. If the conditions are created for profitable and stable private investment, the private sector has in other parts of the world grown and responded, and there is little reason to believe Africa is different. Hence, private sector investment patterns and the supply of bank financing for private investment, are largely *outcomes* of public sector behavior – its policy choices, integrity of its institutions, and the ways it spends its funds through the treasury. For these reasons, the focus of this report is mainly on what the public sector can do in the first place to generate the incentives for system-wide private investment in staple food markets. We also address the role of African governments in addressing situations of market failure, i.e., where the returns to investment are high from a social welfare standpoint but not from the standpoint of a private firm.[26]

9.1. Summary of Main Findings

1. One of the fundamental concerns about the performance of markets in Africa concerns' smallholders' "access to markets". In the fieldwork carried out thus far on the maize value chain (Kenya, Malawi, Zambia in progress), we are finding that even in the most inaccessible areas, smallholders cite numerous traders visiting their villages during the 4-5 months after harvest to buy surplus grain. When pushed to estimate a number, smallholders in most areas talk about 30-40 different traders visiting their village each year to buy maize. According to farmers interviewed in numerous focus group discussions, most traders go right into villages to buy. This observation is supported by available Kenya survey data indicating that the median distance from the farm to point of maize sale is typically zero, and the mean distance has declined over the past decade. This points to evidence of steady investment in grain assembly and transport over the 20 years since private grain trade was legalized. These observations, if they continue to hold through the remaining fieldwork, call for a re-

[26] Examples of market failure include public goods and externalities. A public good such as a new road may have extremely high returns to communities enjoying greater access to markets as a result of the investment, but in most cases, private firms would not invest in roads unless they could recover the costs of the investment by, e.g., setting up a toll tax on users. Another example of market failure is the productive potential of certain open pollinating seed varieties (OPVs), which could greatly benefit farmers in many areas. However, private investment in OPVs is limited by their inability to recover costs after the first season. Unlike hybrids, which require farmers to buy seed regularly, OPVs can be recycled by farmers. OPVs are an example of an investment for which the returns cannot be fully captured by the firm, leading to external benefits to farmers.

examination of the meaning of *access to markets*, *isolated area*, and similar phrases. Access to markets at a remunerative price is more likely to be the main issue.

2. While proximity to demand centers and access to markets are important determinants of smallholder farmers' ability to participate in food markets, survey data reveal that limited land and capital are perhaps the primary constraint preventing the majority smallholder farmers to enter into commercialized staple food production. Even with major improvements in the performance of food markets, a large percentage of smallholders will continue to be unable to produce a surplus that would enable them to link to markets. An important conclusion appears to be, therefore, that "access to markets" may not be the primary constraint for the bottom 50% of smallholders with inadequate land or productive assets to produce a staple food surplus in the first place. For this bottom 50% of the rural farm population, there is a double burden of providing the means to put improved farm technology in their hands that is appropriate for their conditions, and then provide a market for the output that protects against severe downward price risk. This boils down to simultaneous improvements in farm technology (including for semi-arid conditions in which a large fraction of the smallholder populations in the region reside), access to credit, improved rural road infrastructure, and hospitable conditions for private investment in rural input retailing and crop assembly. For the top 50% of smallholders ranked by land and productive potential, the main challenges are reducing the transaction costs of marketing output and protection against downside price risk.

3. As rural populations continue to grow (albeit at a slower rate than in earlier decades), access to land is going to increasingly be a problem and preclude many rural households from participating as sellers in grain markets, unless there is tremendous growth in food crop yields.

4. The marketed grain surplus in most countries is highly concentrated among a small group of relatively capitalized smallholder farms, reflecting the disparities found within the smallholder sector in access to land and other productive resources.

5. The rise of cassava in the some areas of eastern and southern Africa (largely a breeding technology success story) will increasingly help to stabilize maize market prices and supplies (Collinson 1984; Nielson 2009; Dorosh, Dradri, and Haggblade 2009).

6. Rapid investment in medium- and small-scale staple food processing and retailing are largely responsible for the reductions in marketing margins and retail food prices that have been documented in much of the region. However, the small- and medium-scale processing sector tends to be frozen out of the grain marketing system when formal importation is necessary, which greatly changes the structure of the milling and retailing market, making these stages more vulnerable to non-competitive behavior. Formal maize imports, e.g., from South Africa or international markets, tend to be channeled to the large millers only, effectively sidelining the small and medium-scale processing sector that low-income consumers prefer. Strategies to ensure the circulation of grain in informal markets will engage the small-scale milling and retailing stages of the food system, which will exert competitive pressure on the large-scale processing sector to keep their margins down.

7. Traders frequently indicate constraints on availability of quality storage facilities. There are five main causes of storage capacity shortages:

i) Threat of grain confiscation. As shown by recent events in Malawi, Ethiopia, and Kenya), there is some risk that stored commodities will be confiscated or destroyed.

ii) In areas with staggered harvest seasons, such as Kenya, Uganda, and northern Tanzania, there is relatively small intra-seasonal price rises. Maize production is hitting the market at various times throughout the year. This induces fast turn-around trade, shifting grain from places where the harvest is hitting the market to areas experiencing demand at that time.

iii) Unpredictable government operations in grain markets inject a great deal of additional risk into grain storage. Growing concerns over manipulation of national crop production estimates and food balance sheets also further erodes confidence in publicly provided information that plays an important role in encouraging storage activity in other parts of the world.

iv) Local banks tend to prefer investing their capital in safe high-return government treasury bills. Most governments in the region are running deficits, which they finance by offering high-interest bills and bonds. Local banks naturally are content to earn a safe return rather than make loans to highly risky investments in grain arbitrage. Most of the silo capacity in countries such as Kenya, Malawi, and Zambia remains in public sector hands. The potential for selling parastatal storage facilities at concessionary prices as part of some future privatization plan acts as a deterrent to new commercial investment in storage. This pattern of bank investment also shifts major investible liquidity in a country into government operations and programs rather than private sector investment.

v) The fifth major factor depressing grain storage is the lack of quality standards with respect to moisture content. Assembly traders and wholesalers make little effort to discourage the buying of wet maize or to separate it from higher quality dry maize. If anything, the tendency is to combine wet and dry maize in order to mask the ability to detect wet maize by the next buyer. The storage of high-moisture content maize results in rotting and high storage losses.

8. Constraints on rural storage also exacerbate the flow of grain out of informal markets and contribute to a circuitous flow of grain from surplus-producing farmers in grain deficit areas to urban areas, only to be milled by large-scale processors and then re-distributed back to the grain-deficit rural areas in the form of expensive commercially milled meal. Because of the inadequate storage in many areas, grain surpluses tend to be sold and quickly distributed to urban areas for milling by large-scale firms instead of stored for later sale locally. This reflects a variety of disincentives to investment in grain storage, which are explored later. However, the main point made here is that the lack of storage accentuates the outflow of grain from deficit rural areas and subsequent backflow, which leads to redundant transport costs and higher food costs for consumers.

9. The viability of certain marketing investments (e.g., storage facilities near urban centers) and marketing institutions (e.g., warehouse receipt systems, commodity exchanges), and the effectiveness of programs to nurture their development, will depend importantly on government food marketing and trade policies. The corollary is that certain types of state behavior in grain markets will preclude the development of warehouse receipt systems, commodity exchanges, and other types of market institutions.

10. Wheat and cassava appear to have made major inroads into urban and rural staple food consumption patterns, while maize has declined somewhat, leading to a more diversified pattern of staple food consumption in the region. Maize is still the main staple among the urban poor.

11. In the absence of trade barriers, the evidence shows that maize markets in the region are reasonably efficient in moving grain from surplus to deficit areas. In the cases where local prices exceed import parity prices, this is almost always associated with policy barriers that prevent private traders from moving grain across borders.

9.2. First-Order Policy Actions to Promote the Development of Markets

A complicating factor in supporting the development of food marketing systems to promote small farmer productivity growth is that food markets are politically sensitive. Elections can be won or lost through policy tools to reward some farmers with higher prices and reward others with lower prices; however, this is hardly unique to developing countries (Bates 1981; Bates and Krueger 1993; Bratton and Mattes 2003; Sahley et al. 2005). The issue of how to stabilize food markets is transcended by issues of governance. The transition to multi-party electoral processes over the past decade may have intensified the politicized nature of food prices in some cases as political parties compete to show how they will deliver benefits to the public in times of need (Toye 1992; Sahley et al. 2005). This kind of environment, in which political struggles are played out in food marketing and trade policies, create major challenges for developing a market environment that provides adequate scope and incentive for private trade. A comprehensive framework for addressing the challenge of making markets work better for smallholder farmers requires a political economy approach. A political economy approach is required to move beyond analysis that attributes failure to implement reforms and encourage market-based risk transfer mechanisms to insufficient political will. Likewise, a political economy approach is required to convincingly demonstrate how past failures of state intervention in markets can be overcome so as to address small farmers' real needs for sustainably using improved seed and fertilizer.

A major challenge is how to move away from a situation where leaders feel they have to respond to food price instability by taking populist stances that may entrench dependence on food or fertilizer handouts, but which do little to alleviate poverty or hunger in the longer run. A related challenge is how to create constituencies for policies that are believed to promote market stability and small farm incentives to sustainably use improved seed and inputs, but which may not necessarily provide short-term patronage benefits. Given that governments are likely to continue intervening in food markets, there are several guidelines that might be followed to improve overall market performance:

9.2.1. Follow Clearly-Defined and Transparent Rules for Triggering Government Intervention.

In countries where government involvement in food markets is seen as part of a transitional phase towards full market reform, predictable and transparent rules governing state involvement in the markets would reduce market risks and enable greater coordination between private and public decisions in the market. The phenomenon of subsidized government intervention in the market, or the threat of it, leading to private sector inaction, is one of the greatest problems plaguing the food marketing systems in the region. Governments

and private trading firms strategically interact in staple food markets – they respond to each other's actions and anticipated actions. Effective coordination between the private and public sector will require greater consultation and transparency between the private and public marketing agents (Brunetti, Kisunko, and Weder 1997), especially with regard to changes in parastatal purchase and sale prices, import and export decisions, and stock release triggers. As stated by Øygard et al. (2003), "unless some very predictable and credible management rules can be established for the [strategic grain] reserve, private agents will be reluctant to hold stocks, out of a fear that the reserve will be sold out at unpredictable times at subsidized prices, undercutting the value of their stored commodity."

This approach does not imply that government need be impassive. The big problem is to avoid swamping the whole system with government stock releases or relief aid that is uncoordinated with what the private sector is doing.

9.2.2. Institute Regular Periodic Government-Private Sector Consultations to Coordinate Decision Making.

This will help to nurture trust and cooperation and avoid surprises.

9.2.3. Eliminate Export Bans and Import Tariffs on Trade among COMESA and SADC Member States.

This will accelerate the development of both regional and domestic marketing systems and promote access to markets for smallholder farmers, both on the selling and buying side.

9.2.4. Streamline Border and Custom Clearing Processes and Removing Controls on the Issuing of Import and Export Permits.

This would promote the interests of both producers and consumers over the long run.

9.2.5. Adopt a Policy to Support the Breaking of Bulk Imports for Release on Local Grain Markets to Facilitate Access for Small- and Medium-Scale Millers and Other Market Participants.

The existing system of channeling all formal imports to large millers starves informal markets, makes the structure of the milling and retailing stages of the system less competitive, and imposes major costs on urban consumers and grain-deficit smallholder farmers.

9.2.6. Take Steps to Actively Nurture and Encourage Informal Regional Trade.

Informal traders can play a valuable role in buying grain in surplus areas and making it available in deficit regions as there are supplies across the border to allow informal cross-border trade (e.g., between Mozambique and Malawi; Zambia and DRC; Zambia to Zimbabwe; Uganda to Kenya, etc.). However, when the region itself runs into a tight market situation, as in 2008/09, imports from South Africa or the international market are now

required to keep price levels within tolerable levels. In this situation, the market structure changes completely. Informal traders generally lack the expertise, the access to finance, or the license to contract with commercial trading firms in South Africa or the international market, so they are effectively sidelined from participating in the market. There are only a few registered trading companies in each country who are able to contract with international trading firms (with exception of Kenya). However, these firms strongly prefer to line up large buyers (generally millers) to whom to contract with for the imported maize, i.e., *back to back* transactions. They line up the buyer for immediate resale in the process of arranging to import. The problem with this approach is that the local public markets still remain starved for grain – these channels simply dry up, making all urban consumers dependent on the large millers for maize meal. Trading margins tend to go up during these periods because the large millers now are under little or no competition from the informal marketing system including small-scale millers.

9.2.7. Promote Supply Chain Development for a Wider Set of Crops

Governments may promote more stable farm revenue and consumption patterns through supporting private systems of input delivery, finance, and commodity marketing for a range of crops that offer higher returns to farming in the changing environment of Africa's rural areas. Such investments would represent a shift from the strategy of price stabilization and price support for a dominant staple grain to a portfolio approach that puts greater emphasis on a range of higher-valued commodities. This approach would shift the emphasis from direct approaches to stabilize and/or support the price for a dominant staple grain to one of minimizing the impact of food price instability by making the socio-political economy less vulnerable to the effects of food price instability.

9.2.8. Performance Contracts with International Seed Companies to work with national and regional agricultural organizations to develop improved maize seed technology relevant for the semi-arid areas that characterize much of eastern and southern Africa (Lipton 2005; Bhagwati 2005). Strategies attempting to link African farmers to markets must take account of how low crop productivity and inequality in productive assets constrain most smallholders' ability to participate in markets. Performance contracts with international seed companies would mobilize the needed expertise to expand the potential for surplus production in semi-area areas and stimulate investment in assembly markets to improve smallholder farmers' access to markets.

9.3. Priority Investment Options

Based on the findings on smallholder and urban consumer behavior in Sections 5 and 6 as well as initial findings from the maize value chain studies, this section identifies a small number of priority investments that would appear to have major potential to improve the functioning of food markets in the region.

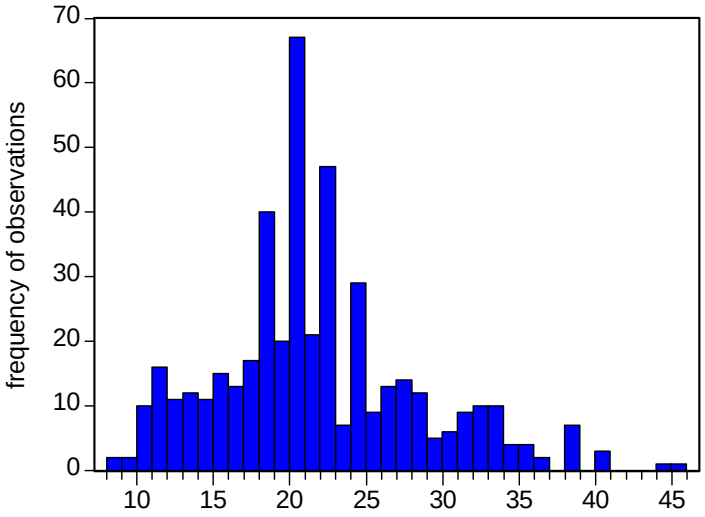
9.3.1. Training Programs for Farmers to Provide Them with Knowledge and Strategies for Marketing Their Crops

While new technologies, crop diversification, and cooperative marketing arrangements may provide farmers with the tools to move from being price-takers to price-seekers, few of these options are successfully exploited by farmers. For example, while the majority of farmers now own or have access to a mobile phone, few feel that owning a mobile phone helps them to find a better price for their maize. Instead, the majority of farmers use their phones to notify a buyer that they have maize to sell, not to negotiate a price, or to search for price differences between buyers. This passive approach to marketing is the result of a common belief among farmers that private buyers collude to set prices and price negotiation is futile. This belief, however, is not supported by empirical data. According to individual price data collected during focus group discussions in Kenya and Malawi in 2009, farmers in the same locations obtained widely varying prices for their maize in the same month (Figure 22).

Market training and education does have noticeable effects. Discussions with farmers in Kenya who have received marketing training from the Kenya Market Development Programme (KMDP) display a markedly different understanding of the challenges they face than discussion with farmers who have not received training. Rather than claim that the primary marketing problem they face is the unscrupulous behavior of private traders, which is a common refrain heard both in discussions with the Ministry of Agriculture and among farmer groups with no market training, farmers who have received KMDP training often talk about ways of increasing their gross margins, using certain strategies to explore higher prices, and even by-passing middlemen. This represents a dramatic shift from a sense of helplessness to one of entrepreneurship.

The effects of marketing training can also be measured in terms of farm gate prices. Table 24 presents the prices received by farmers in May and June 2009 for KMDP training recipients vs. non-recipients. KMDP recipients received 10% higher prices on average (22 shillings vs. 20 shillings per kg). To examine the training effect more precisely, we regressed these prices on a training dummy variable, distance of the household to the nearest market town and a village dummy to capture spatial price differences. OLS results indicate that the KMDP recipients received, on average, 1.8 shillings per kg more than non-recipients (a 9% price difference), significant at the 5% level.

Figure 22. Frequency of Maize Prices Received by Farmers in Trans Nzoia District in May 2009 (Horizontal Axis=Maize Price Received in Shillings Per Kg; Vertical Axis=Frequency of Observations)



Source: 2009 MSU/Tegemeo Maize Value Chain Study, Kenya.

Table 24. Mean Maize Selling Price for Farmers Receiving Vs. not Receiving Marketing Training, Kenya, May/June 2009

Average price per kg received by farmers exposed to market training versus those who have not received training			
Received training (n=279)	22 Ksh per kg	Standard Deviation	7.26
Have not received training (n=171)	20 Ksh per kg	Standard Deviation	6
Average price per kg (n=450)	21.5 Ksh per kg	Standard Deviation	7

For a farmer selling five bags of maize, the difference of 2 Ksh per kg is equivalent to almost 900 Ksh of additional profit, or roughly the price of a half-year of public schooling for one child. Although market training has not yet transformed farmer's groups into effective cooperative marketing enterprises, it has had a measurable effect on farmer's understanding of the maize market and their ability to profitably and confidently participate in it. Developing greater understanding and comfort within these dynamic and intimidating markets is critical both for smallholder welfare and for the future development of the region's maize market.

9.3.2. Programs to Encourage the Adoption of Weights and Measures

The maize value chain studies in Malawi and Kenya indicate a widespread use of improper weights for paying farmers. This is farmers' Number 1 complaint about private traders. Based on our measurements of *gorogoro* in Salgaa, Nakuru District, and Kapkwen, Bomet District in Kenya, three different sizes of *gorogoro* were identified, with sizes changing as maize moves up and down the value chain. The tins used to buy maize from farmers held 3 kg of

maize, the tins used by wholesalers to sell maize to retailers held 2.25 kg, and the tins used by retailers to sell to consumers held 2 kg. Obviously these weights will change based on the moisture content of maize, but the relative difference will hold constant. The consequence of this variegated form of measurement is that, for example, if a farmer claims to have sold three 90kg bags of maize, but the assembler measured 40 *gorogoro* per bag, in all likelihood the farmer sold four 90kg bags of maize, while only being compensated for three. This is a significant loss of profit. We found similar problems in Malawi. Identifying effective ways of ensuring the use of accurate weights in farmer-assembler grain trade could have very high payoffs.

9.3.3. Programs to Encourage the Use of Adequate Maize Grading

Buying of wet maize by assemblers raises storage losses in the system. It also partially segments the maize market, because large commercial millers prohibit moisture content >13%, which forces assemblers/wholesalers to channel wet maize to other types of informal buyers, or take steps to mix wet maize with drier maize. In fact, however, some wholesalers are able to bribe their way past grain inspectors of large milling companies. The mill management are aware of these problems and aim to put pressure on inspectors but in one case said, “There is not much we can do about it.” Identifying strategies for encouraging a wider use of maize grading would reduce storage losses and probably encourage incentive for seasonal storage.

9.3.4. Invest in Rural Feeder Roads to Reduce Marketing Costs

Abundant evidence indicates that the highest per kilometer costs are incurred between the farm gate and the nearest motorable road. The marketing costs associated with moving grain or fertilizer 25 km on a dirt path by bicycle trader is about the same as that charged to move the same product 500 km along a tarmac road. While traders appear in most cases to be moving to the farm gate to buy product, they charge farmers for this service, which is a function of the costs associated with transporting grain from the farm to the place where a large truck is able to bulk up supplies. Efforts to improve road networks linking district towns to farming villages could be a cost-effective way of improving smallholders’ competitive position vis a vis traders and would reduce costs for all manner of commerce, not simply grain trading.

9.3.5. More Generally, Find Strategies for Encouraging Governments to Re-Allocate Their Own Resources to Prioritize Investment in Agriculture-Supportive Public Goods

Donor resources generally are dwarfed by the size African governments’ own budgets. Identifying strategies to leverage donor funds so as to positive influence the allocation of government resources may have high payoffs. Governments could make a major contribution to the welfare of their rural and urban populations by prioritizing investments in crop science, effective extension programs, irrigation, and physical infrastructure. Many agricultural market failure problems in Africa reflect an under-provision of public goods investments to drive down the costs of marketing and contracting. Ameliorating market failure is likely to require increased commitment to investing in public goods (e.g., road, rail and port infrastructure, R&D, agricultural extension systems, market information systems) and

institutional change to promote the functioning of market-oriented trading systems.[27] Unfortunately, the large share of government expenditures devoted to food and input marketing operations represents a high opportunity cost in terms of foregone public goods investments to promote the functioning of viable food markets.

9.3.6. Coming to Grips with the Likelihood That a Large Fraction of the Smallholder Population Will Not be Surplus Food Producers until Land and Resource Constraints Are Addressed

Given the existing distribution of landholdings within the small farm sectors of eastern and southern Africa, strategies to improve rural households' access to land may need to be on the agenda. Farmer organization can help to some extent to overcome dis-economies of scale associated with small farmers' attempts to acquire inputs and marketing output. However, the evidence suggests that as the land frontier closes in many parts of the region, mean smallholder farm size continues to gradually decline even with very low rural population growth. The bottom 25% of rural agricultural households is virtually landless, having access to 0.50 hectares per capita or less in each country examined. Even farmers in the second land quartile have less than 1.2 hectares. Without major productivity growth or shifts to higher-return activities, at least 50% of the smallholder households in the region are unlikely to produce any significant food surplus or escape from poverty directly through agriculture. In this context, the main issue is not how to ensure that smallholders can participate in evolving modern supply chains. The more fundamental questions involve how to enable smallholder farmers to gain access to productive resources and how to improve the productivity of their scarce resources so that they are capable of producing a meaningful farm surplus in the first place.

In many parts of the region, governments may be able to promote equitable access to land through a coordinated strategy of public goods and services investments to raise the economic value of customary land that is currently remote and unutilized. This would involve investments in infrastructure and service provision designed to link currently isolated areas with existing road and rail infrastructure and through allied investment in schools, health care facilities, electrification and water supply, and other public goods required to induce migration, settlement, and investment in these currently under-utilized areas. Such investments would also help to reduce population pressures in areas of relatively good access and soils, many of which are being degraded due to declining fallows associated with population pressure. The approach of raising the economic value of land through public investments in physical and marketing infrastructure and service provision was successfully pursued by southern Rhodesia and Zimbabwe starting in the 1960s with its "growth point" strategy in the Gokwe area, once cleared of tse tse flies. Key public investments in this once desolate but agro-ecologically productive area induced rapid migration into Gokwe from heavily populated rural areas, leading to the "white gold rush" of smallholder cotton production in the 1970s and 1980s (Govereh 1999). A second and complementary approach would be to institute more transparent and orderly procedures for the allocation of state and customary land (Munshifwa 2002; Stambuli 2002). Such an approach would be of limited feasibility in countries such as Rwanda, but could have much potential in parts of Zambia, Mozambique, and even Malawi.

[27] For evidence of the payoffs to these public goods investments and their contribution to agricultural market performance, see Johnston and Kilby 1975; Mellor 1976; Binswanger, Khandkur, and Rozenzweig 1993; and Evenson and Huffman 1993).

9.3.7. Market Risk Shifting Mechanisms

Market risk-shifting tools (such as warehouse receipt systems, commodity exchanges offering spot, forward, and option contracts where possible) are an important part of the tool kit to help stabilize food markets in the region. However, self-sustaining market-oriented risk transfer mechanisms are unlikely to develop in an environment where one actor (e.g., the government) has the power and proclivity to influence price levels in a discretionary way, as this would mean that certain actors would have an information advantage that they could benefit from at the expense of other traders. The development of modern risk management tools cannot thrive under a clearly unlevel playing field.

9.3.8. Provide Policy Incentives for Small- and Medium-Scale Milling Sector to Store Grain in Rural and Peri-Urban Areas

Promoting business models for the small- and medium-scale milling firms to buy grain, store it, and mill it on a regular basis will lower the unit cost of fixed investments in equipment and labor, provide consumers with alternative sources of maize during the lean season, reduce the incidence of redundant transport, and provide farmers with local alternatives for marketing their maize. This is particularly important in peri-urban areas, where farmers and urban consumers are in close proximity.

9.3.9. An Important Component of an Agricultural Markets Programs Should Be On-The-Ground Monitoring of Program/Policy Implementation and Impact.

Close monitoring in the field would provide the potential for quick feedback to policy makers regarding on-the-ground implementation of reform policies and allow for mid-course corrections if activities are not conforming to expectations. It would also enable researchers to measure more accurately the impacts of particular marketing policy strategies (as actually implemented instead of basing their impact assessments on stated policy documents). This will reduce the tendency to misidentify policy effects and thereby provide a more accurate empirical foundation for future discussions of food marketing and trade policy options.

REFERENCES

Abdulai, A., C. Barrett, and J. Hoddinott. 2005. Does Food Aid *Really* Have Disincentive Effects? New Evidence from Sub-Saharan Africa. *World Development* 33.10: 1689-1704.

Agricultural Market Information Centre and Central Statistical Office, Republic of Zambia. Unpublished Data Files. Lusaka, Zambia: AMIC.

Amani, H.K.R. and W. Maro. 1992. Policy to Promote an Effective Private Trading System in Farm Products and Farm Inputs in Tanzania, In *Food Security Research in Southern Africa: Policy Implications*, ed. J. Wyckoff and M. Rukuni. Harare: University of Zimbabwe.

Anderson, J.R. 2001. *Risk Management in Rural Development: A Review*. Rural Development Strategy Background Paper No. 7. Washington, D.C.: The World Bank.

Antle, J.M. 1983. Infrastructure and Aggregate Agricultural Productivity: International Evidence. *Economic Development and Cultural Change* 31.2: 609-20.

Argwings-Kodhek, G., T. Jayne, G. Nyambane, T. Awuor, and T. Yamano. 1998. *How Can Micro-level Household Survey Data Make a Difference for Agricultural Policy Making?* Nairobi: Egerton University/Tegemeo Institute of Agricultural Policy and Development. http://www.tegemeo.org/viewdocument.asp?ID=28

Avalos-Sartorious, B. 2006. What Can We Learn from Past Price Stabilization Policies and Market Reform in Mexico? *Food Policy* 31.4: 313-27.

Awudu, A. 2007. Spatial and Vertical Price Transmission in Food Staples Market Chains in Eastern and Southern Africa: What Is the Evidence? Paper presented at the FAO Trade and Markets Division Workshop on Staple Food Trade and Market Policy Options for Promoting Development in Eastern and Southern Africa, 1-2 March. Rome.

Ayieko, M., D. Tschirley, M. Mathenge. 2005. *Fresh Fruit and Vegetable Consumption Patterns and Supply Chain Systems in Urban Kenya: Implications for Policy and Investment Priorities*. Tegemeo Working Paper No. 19. Nairobi: Tegemeo Institute of Agricultural Policy and Development.

Barrett, C. 2008. Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa. *Food Policy* 33.4: 299-317.

Barslund, M. 2007. *Regional Differences in Food Consumption in Urban Mozambique: A Censored Demand System Approach.* University of Copenhagen Discussion Papers Nos. 07-15. Copenhagen: University of Copenhagen.

Bates, R. 1981. Markets and States in Tropical Africa: The Political Basis of Agricultural Policies. Berkeley: University of California Press.

Bates, R. 1989. *Beyond the Miracle of the Market: The Political Economy of Agrarian Development in Kenya.* Cambridge: Cambridge University Press.

Bates, R. and A. Krueger (eds.). 1993. *Political and Economic Interactions in Economic Policy Reform: Evidence from Eight Countries.* Oxford: Basil Blackwell.

Berg, E. and B. Kent. 1991. *Cereal Banks in the Sahel.* Consultancy Report by Development Alternatives Inc. Washington D.C.: DAI.

Bhagwati, J. 2005. Development Aid: Getting It Right. *OECD Observer* 249, May.

Binswanger, H., S. Khandker, and M. Rozenzweig. 1993. How Agriculture and Financial Institutions Affect Agricultural Output and Investment in India. *Journal of Development Economics* 41.3: 337-66.

Bratton, M. and R. Mattes. 2003. Support for Economic Reform? Popular Attitudes in Southern Africa. *World Development* 31.2: 303-23.

Brunetti, A., G. Kisunko, and B. Weder. 1997. *Institutional Obstacles to Doing Business: Region-by-Region Results from a Worldwide Survey of the Private Sector*. Policy Research Working Paper No. 1759. Washington, D.C.: The World Bank.

Bryceson, D.F. 1993. Urban Bias Revisited: Staple Food Pricing in Tanzania. In *Real Markets: Social and Political Issues of Food Policy Reform,* ed. C. Hewitt de Alcantara. London: Frank Cass.

Buccola, S. and C. Sukume. 1988. Optimal Grain Pricing and Storage Policy in Controlled Agricultural Economies: Application to Zimbabwe. *World Development* 16.3: 361-71.

Burke, W. and T.S. Jayne. 2008. *Spatial Disadvantages or Spatial Poverty Traps: Household Evidence from Rural Kenya*. International Development Working Paper No. 93. East Lansing: Michigan State University.

Byerlee, D. and C.K. Eicher (eds). 1997. *The Emerging Maize-based Revolution in Africa: The Role of Technologies, Institutions and Policies.* Boulder, CO: Lynne Rienner Publishers.

Byerlee, D. and P.W. Heisey. 1997. Evolution of the African Maize Economy. In *Africa's Emerging Maize Revolution,* ed. D. Byerlee and C. K. Eicher. Boulder, CO: Lynne Rienner Publishers.

Byerlee, D., T.S. Jayne, and R. Myers. 2006. Managing Food Price Risks and Instability in a Liberalizing Market Environment. *Food Policy,* special issue 31.4.

Chimedza, Ruvimbo. 1994. Rural Financial Markets. In *Zimbabwe's Agricultural Revolution,* ed. M. Rukuni and C. Eicher. Harare: University of Zimbabwe Press.

Chirwa, E.W. 2000. *Food Marketing Reforms and Integration of Maize and Rice Markets in Malawi.* School of Economics Working Paper. Norwich, England: University of East Anglia.

Chapoto, A. and T.S. Jayne. 2009. *The Impacts of Trade Barriers and Market Interventions on Maize Price Predictability: Evidence from Eastern and Southern Africa*. MSU International Development Working Paper No. 102. East Lansing: Michigan State University.

Collinson, Michael. 1984. *Farm Management in Peasant Agriculture.* Westview Press.

Coulter, J. 2005. Making the Transition to a Market-Based Grain Marketing System. Paper presented to the Workshop, Managing Food Price Instability in Low-Income Countries, 28 February to 1 March 2005. Washington, D.C.

Coulter, J. 2006. *Review of Cereal Banks in Western Kenya*, draft final report. Consultancy Report for The Rockefeller Foundation. Nairobi, Kenya: The Rockefeller Foundation.

Coulter, J. and G. Onumah. 2002. The Role of Warehouse Receipt Systems in Enhanced Commodity Marketing and Rural Livelihoods in Africa. *Food Policy* 27.2002: 319-37.

Coulter, J. and A. Shepherd. 1995. *Inventory Credit: An Approach to Developing Agricultural Markets*. FAO Agricultural Services Bulletin No. 120. Rome: Food and Agriculture Organization of the United Nations.

CRS. 1988. Notes from the Workshop on Community-Level Grain Storage Projects (Cereal Banks): Why Do they Rarely Work and What are the Alternatives? Dakar, Senegal.

CSO. 1991. 1990/91 Post Harvest Survey. Lusaka, Zambia: Republic of Zambia Central Statistical Office.

CSO. 2009. Central Statistical Office Retail Food Price Database. Lusaka: Central Statistical Office.

CSO/MACO/FSRP (Central Statistical Office, Ministry of Agriculture and Cooperatives/Food Security Research Project). 2008. Urban Consumer Survey, Lusaka, Kitwe, Kasama, Kabwe. Lusaka: Food Security Research Project.

Dana, J., C.L. Gilbert, and E. Shim. 2005. Hedging Grain Price Risk in the SADC: Case Studies of Malawi and Zambia. Paper presented at the workshop Managing Food Price Instability in Low-Income Countries, 28 February – 1 March. Washington, D.C.

Delgado, C. and N. Minot. 2000. *Agriculture in Tanzania Since 1986: Follower or Leader of Growth*. World Bank Country Study. Washington, D.C.: The World Bank.

Dorosh, P., S. Dradri, and S. Haggblade. 2009. Regional Trade, Government Policy, and Food Security: Recent Evidence from Zambia. *Food Policy* 34.4: 350-66.

Dorward, A., J. Kydd, J. Morrisson, and I. Urey. 2004. A Policy Agenda for Pro-Poor Agricultural Growth. *World Development* 32.1: 73-89.

Drucker, P. 1958. Marketing and Economic Development. *Journal of Marketing* 22.3: 252-59.

Duncan, J. and R. J. Myers. 2000. Crop Insurance under Catastrophic Risk. *American Journal of Agricultural Economics* 82.4: 842–55.

Economist Intelligence Unit. 2008. *Lifting African and Asian Farmers out of Poverty: Assessing the Investment Needs*. Research report for the Bill and Melinda Gates Foundation. New York: The Economist Intelligence Unit.

Eicher, C.K. 1995. Zimbabwe's Maize-Based Green Revolution: Preconditions for Replication. *World Development* 23.5: 805-18.

Evenson, R. and W. Huffman. 1993. *Science for Agriculture.* Ames, IA: Iowa State University Press.

Fafchamps, M. 1992. Cash Crop Production, Food Price Volatility, and Rural Market Integration in the Third World. *American Journal of Agricultural Economics* 74.1: 90-99.

Fan, S., A. Gulati, and S. Thorat. 2007. *Investment, Subsidies, and Pro-Poor Growth in Rural India.* IFPRI Discussion Paper No. 716. Washington, D.C.: International Food Policy Research Institute.

FAO Stat Database. http://www.faostat.fao.org/

Faruqee, R., J.R. Coleman, and T. Scott. 1997. Managing Price Risk in the Pakistan Wheat Market. *The World Bank Economic Review* 11.2: 263–92.

Federal Reserve Bank of Chicago. 2009. *The Agricultural Letter*. Number 1943, February. http://www.chicagofed.org/digital_assets/publications/agletter/2005_2009/february_2009.pdf

Ferris, J. 2005. *Agricultural Prices and Commodity Market Analysis*, 2nd ed. East Lansing: Michigan State University Press.

Ferris, J. 2009. AGMOD Simulation Results. East Lansing: Michigan State University.

Foster, W. and A. Valdes. 2005. The Merits of a Special Safeguard, Price Floor Mechanism under Doha for Developing Countries. Paper presented at the workshop Managing Food Price Instability in Low-Income Countries, 18 February - 1 March. Washington, D.C.

Gabre-Madhin, E., C. Barrett, and P. Dorosh. 2003. *Technological Change and Price Effects in Agriculture.* IFPRI Markets and Trade Division Discussion Paper No. 62. Washington, D.C.: International Food Policy Research Institute.

Gardner, B. 1989. Rollover Hedging and Missing Long-Term Futures Markets. *American Journal of Agricultural Economics* 71.3: 311–18.

Gebremeskel, D., T. Jayne, and J. Shaffer. 1998. *Structure, Conduct, and Performance of Grain Markets in Ethiopia: Implications for Grain Market and Food Security Policies.* Working Paper No. 8. Addis Ababa: Grain Market Research Project, Ministry of Economic Development and Planning.

Gergely, N., B. Guillermain, and L. De Lardemelle. 1990. *Evaluaton de Banques de Céréales au Sahel. FAO Rapport de Synthèse.* Rome: FAO.

GMB. 1991. Response from the Management of the Grain Marketing Board to the Structural Adjustment Programme. Harare: Planning Unit, Grain Marketing Board.

Goletti, F. and S. Babu. 1994. Market Liberalization and Integration of Maize Markets in Malawi. *Agricultural Economics* 11.3: 311-24.

Govereh, J. 1999. Impacts of Tsetse Control on Immigration and Household Accumulation of Capital: Zambezi Valley, Zimbabwe. Ph.D. dissertation, Michigan State University.

Grilliches, V. 1957. Hybrid Corn: An Exploration in the Economics of Technological Change. *Econometrica* 25.4: 501-22.

Gulati A. and T. Narayanan. 2003. *The Subsidy Syndrome in Indian Agriculture*. New Delhi: Vedams Books. http://www.vedamsbooks.com/no30366.htm

Günther, D. and O. Mück. 1995. *Les Banques de Céréales ont-elles fait banqueroute?* (Are the Cereal Banks Bankrupt?) Eschborn: *Gesselschaft für Technische Zusammenarbeit* (GTZ).

Haggblade, S. and P. Hazell. 1988. *Prospects for Equitable Growth in Rural Sub-Saharan Africa*. AGRAP Economic Discussion Paper No 3. Washington D.C.: The World Bank.

Hichaambwa, M., M. Beaver, A. Chapoto, and M. Weber. 2009. *Patterns of Urban Food Consumption and Expenditure in Zambia: An Overview Report Based on the CSO/MACO/FSRP Food Consumption Survey in Urban Areas of Lusaka, Kitwe, Mansa, and Kasama, 2007-2008*. FSRP Working Paper No. 43. Lusaka, Zambia: Food Security Research Project.

Howard, J. 1994. The Economic Impact of Improved Maize Varieties in Zambia. Ph.D. dissertation, Michigan State University.

Howard, J., V. Kelly, J. Stepanek, E. Crawford, M. Demeke, and M. Maredia. 1999. *Green Revolution Technology Takes Root in Africa: The Promise and Challenge of the Ministry of Agriculture/SG2000 Experiment with Improved Cereals Technology in Ethiopia*. MSU International Development Working Paper No. 76. East Lansing: Michigan State University.

Howard, J. and C. Mungoma. 1997. Zambia's Stop-and-Go Maize Revolution. In *Africa's Emerging Maize Revolution,* ed. D. Byerlee and C. Eicher. Boulder, CO: Lynn Rienner Publishers.

Huang, W. 2009. *Factors Contributing to the Recent Increase in U.S. Fertilizer Prices, 2002-08.* Economic Research Service, U.S. Department of Agriculture, AR-33. Washington, D.C.: USDA. http://www.ers.usda.gov/Publications/AR33/

Humphrey, J. 2007. The Supermarket Revolution in Developing Countries: Tidal Wave or Tough Competitive Struggle? *Journal of Economic Geography* 7.4: 433-50.

IAF 1996 and IAF 2002. (*Inquérito às Familias* in 1996 and 2002). http://www.aec.msu.edu/fs2/mozambique/index.htm

Ibarra, H., U. Hess, J. Syroka, and A. Nucifora. 2005. Use of Weather Insurance Markets for Managing Food Supply Risk: Malawi Case Study. Paper presented at the workshop Managing Food Price Instability in Low-Income Countries, 28 February 28-1 March. Washington, D.C.

Innes, R.D. 2003. Crop Insurance in a Political Economy: An Alternative Perspective on Agricultural Policy. *American Journal of Agricultural Economics* 85.2: 318-35.

Jabara, C. 1984. Agricultural Pricing Policy in Kenya. *World Development* 13.5: 611-26.

Jacobsen Publishing Co. *Biodiesel Bulletin. Fats and Oils Bulletin. Grain and Food – The Feed Bulletin.* Various issues and archives. Chicago, IL: Jacobsen Publishing Co.

Jansen, Doris and Kay Muir. 1994. Trade, Exchange Rate Policy, and Agriculture in the 1980s. In *Zimbabwe's Agricultural Revolution*, ed. M. Rukuni and C. Eicher. Harare: University of Zimbabwe Press.

Jayne, T.S. 1994. Do High Food Marketing Costs Constrain Cash Crop Production? *Economic Development and Cultural Change* 42.2: 387-402.

Jayne T.S. and A. Chapoto. 2006. *Emerging Structural Maize Deficits in Eastern and Southern Africa: Implications for National Agricultural Strategies.* FSRP Policy Synthesis No. 16. Lusaka, Zambia: Food Security Research Project.

Jayne, T.S. and M. Chisvo. 1991. Unravelling Zimbabwe's Food Insecurity Paradox. *Food Policy* 16.5: 319-29.

Jayne, T.S., J. Govereh, A. Mwanaumo, J. Nyoro, and A. Chapoto, 2002. False Promise or False Premise: The Experience of Food and Input Market Reform in Eastern and Southern Africa. *World Development* 30.11: 1967-86.

Jayne, T.S. and S. Jones. 1997. Food Marketing and Pricing Policy in Eastern and Southern Africa: A Survey. *World Development* 25.9: 1505-27.

Jayne, T.S., R. Myers, and J. Nyoro. 2008. The Effects of Government Maize Marketing Policies on Maize Prices in Kenya. *Agricultural Economics* 38.3: 313–25.

Jayne, T.S. and Mandivamba Rukuni. 1993. Distributional Effects of Maize Self Sufficiency in Zimbabwe: Implications for Pricing and Trade Policy. *Food Policy* 18.4: 334-41.

Jayne, T.S., T. Yamano, M. Weber, D. Tschirley, R. Benfica, A. Chapoto, and B. Zulu. 2003. Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies. *Food Policy*, Vol. 28(3): 253-275.

Jayne, T.S., B. Zulu, and J.J. Nijhoff. 2006. Stabilizing Food Markets in Eastern and Southern Africa. *Food Policy* 31.4: 328-41.

Johnston, B. F. and P. Kilby. 1975. *Agriculture and Structural Transformation: Economic Strategies in Late Developing Countries*. New York: Oxford University Press.

Jones, S.P. 1994. *Privatization and Policy Reform: Agricultural Marketing in Africa*. Oxford: University of Oxford, Food Studies Group.

Kanyinga, K. 1994. Ethnicity, Patronage, and Class in a Local Arena: "High" and "Low" Politics in Kiambu, Kenya, 1982-92. In *The New Local-Level Politics in East Africa: Studies on Uganda, Tanzania, and Kenya*, ed. P. Gibbon. Uppsala, Sweden: Nordiska Africainstitutet.

Kaplinsky, R. and F.M. Morris. 2001. *A Handbook for Value Chain Research*. Paper for International Development Research Centre (IDRC). Brighthton: Institute of Development Studies (IDS).

Kherallah, M., C. Delgado, E. Gabre-Madhin, N. Minot, and M. Johnson, 2002. *Reforming Agricultural Markets in Africa*. Baltimore: Johns Hopkins University Press.

Koester, U. 1986. *Regional Cooperation to Improve Food Security in Southern and Eastern African Countries*. International Food Policy Research Report No. 53. Washington D.C.: International Food Policy.

Kopicki, R. 2005. National Cereals and Produce Board (NCPB) Financial Situation. Presentation at the Strategic Grains Summit, October 12-13. Nairobi, Kenya.

Lacroix, R. and P. Varangis. 1996. Using Warehouse Receipts in Developing and Transition Economies. *Finance and Development* September: 36-39.

Lai, J-Y, R.J. Myers, and S.D. Hanson. 2003. Optimal On-Farm Grain Storage by Risk-Averse Farmers. *Journal of Agricultural and Resource Economics* 28.3: 558-79.

Larson, D.F., J.R. Anderson, and P. Varangis. 2004. Policies Regarding Risk in Agricultural Markets. Washington DC: World Bank. Mimeo.

Lence, S.H. and M.L. Hayenga. 2001. On the Pitfalls of Multi-Year Rollover Hedges: The Case of Hedge-to-Arrive Contracts. *American Journal of Agricultural Economics* 83.1: 107–19.

Lipton, M. 2005. *Crop Science, Poverty, and the Family Farm in a Globalising World*. 2020 IFPRI Discussion Paper No. 40. Washington, DC: International Food Policy Research Institute.

Loy, J.P. and R. Wichern. 2000. Integration of Zambian Maize Markets. *Quarterly Journal of International Agriculture* 39.2: 173-98.

MACO/ACF/FSRP (Ministry of Agriculture and Cooperatives/Agricultural Consultative Forum/Food Security Research Project). 2002. *Developments in Fertilizer Marketing in Zambia: Commercial Trading, Government Programs, and the Smallholder Farmer*. FSRP Working Paper No. 4. Lusaka, Zambia: Food Security Research Project.

Marion, Bruce W., W.F. Mueller, R.W. Cotterill, F.E. Geithman, and J.R. Schmelzer. 1979. The Food Retailing Industry: Market Structure, Profits, and Prices. New York: Praeger Publishing Company.

Marion, B.W. and NC117 Committee. 1986. *The Organization and Performance of the U.S. Food System*. Lexington, MA: Lexington Books.

Mason, N. and T.S. Jayne. 2009. *Staple Food Consumption Patterns in Urban Zambia: Results from the 2007/2008 Urban Consumption Survey*. FSRP Working Paper No. 42. Lusaka, Zambia: Food Security Research Project.

Mason, N., T.S. Jayne, C. Donovan, and A. Chapoto. 2009. *Are Staple Foods Becoming More Expensive for Urban Consumers in Eastern and Southern Africa? Trends in Food Prices, Marketing Margins, and Wage Rates in Kenya, Malawi, Mozambique, and Zambia.* MSU International Development Working Paper No. 98. East Lansing: Michigan State University.

Masters, William A. 2005. Paying for Prosperity: How and Why to Invest in Agricultural Research and Development in Africa. *Journal of International Affairs* 58.2: 35-64.

Mather, D. and C. Donovan. 2008. *The Impacts of Prime-Age Adult Mortality on Rural Household Income, Assets, and Poverty in Mozambique*. Ministry of Agriculture Directorate of Economics Research Paper No. 65E. Maputo, Mozambique: MINAG.

Mellor, J. 1976. *The New Economics of Growth*. Ithaca, NY: Cornell University Press.

Mittendorf, H. 1989. Improving Agricultural Physical Marketing Infrastructure in Africa Through More Self-Help. *Journal of International Food & Agribusiness Marketing* 1.1: 9-27.

Morduch, J. 1995. Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives* 9.3: 103-14.

Morris, J. 2005. Can Insurance Break Ethiopia's Vicious Cycle of Hunger? *Financial Times* May 10.

Mueller, W.F. 1983. Market Power and Its Control in the Food System. *American Journal of Agricultural Economics* 65.5: 855-63.

Mukumbu, Mulinge. 1992. Effects of Market Liberalization on the Maize Milling Industry in Kenya. In *Maize Supply and Marketing under Liberalization.* Nairobi: Egerton University, Policy Analysis Matrix.

Munshifwa, E. 2002. *Rural Land Management and Productivity in Zambia: The Need for Institutional and Land Reform*. Seminar paper for Oxfam International. www.oxfam.org

Muyanga, M., T.S. Jayne, G. Argwings-Kodhek, and Joshua Ariga. 2005. *Staple Food Consumption Patterns in Urban Kenya: Trends and Policy Implications*. Tegemeo Working Paper No. 19. Nairobi: Egerton University, Tegemeo Institute of Agricultural Policy and Development.

Myers, R.J. 1992. Intervention Bias in Agricultural Policy. *Agricultural Economics* 7.3-4: 209-24.

Myers. R. 2008. *Efficiency of Inter-Regional Trade and Storage in Malawi Maize Markets.* Report prepared for the World Bank. Lilongwe, Malawi: The World Bank.

Myers, R.J. and S.R. Thompson. 1989. Optimal Portfolios of External Debt in Developing Countries: The Potential Role of Commodity-Linked Bonds. *American Journal of Agricultural Economics* 71.2: 517–22.

NEPAD (New Partnership for Africa's Development). 2004. *Study to Explore Further Options for Food-Security Reserve Systems in Africa*. NEPAD draft paper. Pretoria, South Africa: NEPAD.

Nielson, H. 2009. The Role of Cassava in Smallholder Maize Marketing in Zambia and Mozambique. M.Sc. thesis, Michigan State University.

Nijhoff, J.J., D. Tschirley, T. Jayne, G. Tembo, P. Arlindo, B. Mwiinga, J. Shaffer, M. Weber, C. Donovan, and D. Boughton. 2003. *Coordination for Long-Term Food Security by Government, Private Sector and Donors: Issues and Challenges*. MSU Policy Synthesis No. 65. East Lansing: Michigan State University.

Nweke, F., D. Spencer, and J. Lynam. 2002. *The Cassava Transformation.* East Lansing: Michigan State University Press.

Nyameino, D., B. Kagira, and S. Njukia. 2003. *Maize Market Assessment and Baseline Study for Kenya*. Nairobi, Kenya: Regional Agricultural Trade Expansion Support Programme.

Odhiambo, M. and D. Wilcock. 1990. Reform of Maize Marketing in Kenya. In *Food Security Policies in the SADCC Region*, ed. M. Rukuni, G. Mudimu, and T. Jayne. Harare: University of Zimbabwe.

O'Hara, M. 1984. Commodity Bonds and Consumption Risks. *Journal of Finance* 39.3: 193–206.

Øygard, R., R. Garcia, A. Guttormsen, R. Kachule, A. Mwanaumo, I. Mwanawina, E. Sjaastad, and M. Wik. 2003. *The Maze of Maize: Improving Input and Output Market Access for Poor Smallholders in Southern African Region, the Experience of Zambia and Malawi*. Agricultural University of Norway Report No. 26. Ås, Norway: Agricultural University of Norway.

Pinckney, C. 1993. Is Market Liberalization Compatible with Food Security? *Food Policy* 18.4: 325-33.

Pinckney, T.C. and A. Valdes. 1988. Short-Run Supply Management and Food Security: Results from Pakistan and Kenya. *World Development* 16.9: 1025-34.

Poulton, C., J. Kydd, S. Wiggins, and A. Dorward. 2005. State Intervention for Food Price Stabilisation in Africa: Can it Work? Paper presented at the workshop Managing Food Price Instability in Low-Income Countries, 28 February - 1 March. Washington, D.C.

Priovolos, T. and R. Duncan (eds.). 1991. *Commodity Risk Management and Finance.* Oxford: Oxford University Press.

Putterman, L. 1995. Economic Reform and Smallholder Agriculture in Tanzania: A Discussion of Recent Market Liberalization, Road Rehabilitation, and Technology Dissemination Efforts. *World Development* 23.2: 311-26.

Rashid, S. 2004. Spatial Integration of Maize Markets in Post-Liberalized Uganda. *Journal of African Economies* 13.1: 103-33.

Rashid, S., R. Cummings, and A. Gulati. 2005. *Grain Marketing Parastatals in Asia: Why Do They Have to Change Now?* IFPRI Discussion Paper No. 80. Washington, D.C.: International Food Policy Research Institute.

Rashid, S., R. Cummings, and A. Gulati. 2007. Grain Marketing Parastatals in Asia: Results from Six Case Studies. *World Development* 35.11: 1872-88.

Ravallion, M. 1986. Testing Market Integration. *American Journal of Agricultural Economics* 68.1: 102–09.

Ravallion, M. and G. Datt. 2002. Why Has Economic Growth Been More Pro-Poor in Some States of India than Others? *Journal of Development Economics*. 68.2: 381-400.

Reardon, T. and C.P. Timmer. 2006. Transformation of Markets for Agricultural Output in Developing Countries Since 1950: How Has Thinking Changed? In *Handbook of Agricultural Economics*, Volume 3, ed. Robert Evenson and Prabhu Pingali. Amsterdam: Elsevier.

Rohrbach, D.D. 1989. *The Economics of Smallholder Maize Production in Zimbabwe: Implications for Food Security*. MSU International Development Paper No. 11. East Lansing: Michigan State University.

Rubey, L. 1995. Maize Market Reform in Zimbabwe: Linkages between Consumer Preferences, Small Enterprise Development and Alternative Market Channels. Ph.D. dissertation, Michigan State University.

Rubey, L. 2004. *Do No Harm? How Well Intentioned Government Actions Exacerbate Food Insecurity: Two Case Studies from Malawi*. USAID Report. Lilongwe, Malawi: USAID.

Rubey, L. 2005. *Malawi's Food Crisis: Causes and Solutions*. USAID Report. Lilongwe, Malawi: USAID.

Ryan, J. and D. Spencer. 2001. *Future Challenges and Opportunities for Agricultural Land in the Semi-Arid Tropics*. Patancheru: ICRISAT.

Sachs, J. 2005. *The End of Poverty: Economic Possibilities for Our Time.* New York: Penguin Press.

Sahley, C., B. Groelsema, T. Marchione, and D. Nelson. 2005. *The Governance Dimensions of Food Security in Malawi*. Washington, D.C.: USAID Bureau of Democracy, Conflict, and Humanitarian Assistance.

Sarris, A., P. Conforti, and A. Prakash. 2005. The Use of Organized Commodity Markets to Manage Food Import Price Instability and Risk. Paper presented at the workshop Managing Food Price Instability in Low-Income Countries, 28 February 28-1 March. Washington, D.C.

Shaffer, James D. 1980. Food System Organization and Performance: Toward a Conceptual Framework. *American Journal of Agricultural Economics* 62.2: 310-18.

Shaffer, J., M. Weber, H. Riley, and J. Staatz. 1985. Influencing the Design of Marketing Systems to Promote Development in Third World Countries. In *Agricultural Markets in the Semi-Arid Tropics: Proceedings of the International Workshop, October, 1983*. Pantacheru: ICRISAT.

SIMA (Agricultural Market Information of Mozambique). Various Years. Maize Price Files. Maputo: Government of Mozambique.

Smale, M. and T.S. Jayne. 2003. *Maize in Eastern and Southern Africa: Seeds of Success in an Historical Perspective.* IFPRI Discussion Paper No. 97. Washington, D.C.: Environment, Production, and Technology Division, IFPRI Institute.

Staatz, J. 2005. Building Long-Term Food Security while Managing Food Crises: Insights from Mali. Presentation to USAID/Africa Bureau, 28 July. Washington, D.C.: USAID. Online at: http://www.aec.msu.edu/agecon/fs2/mali_fd_strtgy/index.htm.

Stambuli, K. 2002. Elitist Land and Agriculture Policies and the Food Problem in Malawi. *Journal of Malawi Society, Historical & Scientific* 55.2: 45-58.

Taylor, D. 2005. Value Chain Analysis: An Approach to Supply Chain Improvement in Agri-Food Chains. *International Journal of Physical Distribution & Logistics Management* 35.10: 744-61(18).

Tegemeo Institute. 2003. Tegemeo Urban Consumption Survey/2003. Nairobi, Kenya: Tegemeo Institute.

Tostao, E. and B.W. Brorson. 2005. Spatial Price Efficiency in Mozambique's Post-Reform Maize Markets. *Agricultural Economics* 33.2: 205-14.

Townsend, R.M. 1995. Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies. *Journal of Economic Perspectives* 9.3: 83-102.

Toye, J. 1992. Interest Group Politics and the Implementation of Adjustment in Sub-Saharan Africa. *Journal of International Development* 4.2: 183-98.

Traill, B. 2006. The Rapid Rise of Supermarkets? *Development Policy Review* 24.2: 163–74.

Traub, L. 2005. Opportunities to Improve Household Food Security through Promoting Linkages between Formal and Informal Marketing Agents: Experience from Eastern Cape Province, South Africa. Paper presented at conference on Toward Improved Maize Marketing and Trade Policies in Southern Africa, 21-22 June. Centurion, South Africa.

Traub, L. and T.S. Jayne. 2008. The Effects of Price Deregulation on Maize Marketing Margins in South Africa. *Food Policy* 33.3: 224-36.

Tschirley, D. 2007. Supermarkets and Beyond: Literature Review on Farmer to Market Linkages in Sub-Saharan Africa and Asia, report prepared for the AgInfo Project funded by the Bill and Melinda Gates Foundation. Seattle, Washington.

Tschirley, D. and D. Abdula 2007. *Toward Improved Marketing and Trade Policies To Promote Household Food Security in Central and Southern Mozambique*. Working Paper RP62E. Maputo, Mozambique: Ministry of Agriculture.

Tschirley, David, Jan J. Nijhoff, Pedro Arlindo, Billy Mwinga, Michael T. Weber, and T.S. Jayne. 2006. *Anticipating and Responding to Drought Emergencies in Southern Africa: Lessons from the 2002-2003 Experience*. MSU International Development Working Paper No. 89. East Lansing: Michigan State University.

Twaddle, C. Fertilizer and Energy. 1982. In the *Fertilizer Handbook* Chapter 8. Washington, D.C.: The Fertilizer Institute.

U.S. Department of Agriculture, Economic Research Service. Several years. *Fertilizer Use and Price*. http://www.ers.usda.gov/Data/FertilizerUse/

U.S. Department of Agriculture, Economic Research Service. 2008. *International Macroeconomic Data Set.* December. http://www.ers.usda.gov/data/macroeconomics/,

U.S. Department of Agriculture, Economic Research Service. 2009. *Agricultural Outlook: Statistical Indicators*. March. http://www.ers.usda.gov/Publications/Agoutlook/AOTables/

U.S. Department of Agriculture, Foreign Agriculture Service. *Production, Supply and Distribution Online*. http://www.fas.usda.gov/psdonline/psdhome.aspx

U.S. Department of Agriculture, Interagency Agricultural Projection Committee. 2009. *USDA Agricultural Projections to 2018.* February. http://www.ers.usda.gov/Publications/OCE091/OCE091fm.pdf

U.S. Department of Energy, Energy Information Administration. 2009. *Annual Energy Outlook 2009.* Report #DOE/EIA-0383 (2009). March. http://www.eia.doe.gov/oiaf/aeo/index.html?featureclicked=1&

Van Campenhout, B. 2008. Modelling Trends in Food Market Integration: Method and an Application to Tanzanian Maize Markets. *Food Policy* 32: 112-27.

Vitale, J.D. and J.H. Sanders. 2005. New Markets and Technological Change for Traditional Cereals in Semi-Arid Sub-Saharan Africa: The Malian Case. *Agricultural Economics* 32:111-29.

Weatherspoon, D. and T. Reardon. 2003. The Rise of Supermarkets in Africa: Implications for Agrifood Systems and the Rural Poor. *Development Policy Review* 21.3: 333-55.

Westlake, M. 1994. *The Impact of Deficient Commodity Pricing and Payment Systems and Delay in the Payment of Farmers: Lessons from Kenya.* HIID Discussion Paper No. 475. Cambridge: Harvard Institute for International Development.

World Bank. 1981. *Accelerating African Agricultural Development.* Washington, D.C.: The World Bank.

World Bank. 2005. *Agricultural Growth and the Poor: An Agenda for Development.* Directions in Development Report. Washington, D.C.: The World Bank.

Wright, P.D. and W.L. Nieuwoudt. 1993. Price Distortions in the South African Maize Economy: A Comparative Political Analysis. *Agrekon* 32.2: 51-59.

Zulu, B., J.J. Nijhoff, T.S. Jayne, and A. Negassa. 2000. *Is the Glass Half-empty Or Half Full? An Analysis of Agricultural Production Trends in Zambia*. FSRP Working Paper No. 3. Lusaka, Zambia: Food Security Research Project.