DSGD DISCUSSION PAPER NO. 14

STRATEGIC ANALYSIS AND KNOWLEDGE SUPPORT SYSTEMS FOR RURAL DEVELOPMENT STRATEGIES IN SUB-SAHARAN AFRICA

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with Simon Bolwig, Jordan Chamberlin, Liangzhi You,
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ABSTRACT

While greater growth in agriculture and the broader rural sector is crucial for ameliorating Africa's high levels of poverty and malnutrition, developing strategies to achieve these objectives is hindered by a number of factors, including the broad array of interventions needed, the lack of accurate data, and dearth of trained local policy analysts. As such, this paper proposes a Strategic Analysis Knowledge Support System (SAKSS) in which data, tools, and knowledge are compiled, analyzed, and disseminated for the purposes of identifying a set of priority investment and policy options to promote agricultural growth and rural development. These analyses can in turn help inform the broader process of designing, implementing, and monitoring and evaluating a country's rural development strategy. In order to be an influential and sustainable part of this process and become a genuine "knowledge system," SAKSS will need to be established with an awareness of each country's development priorities and unique political, social, and economic context. By institutionalizing SAKSS through a network structure that includes government ministries, research institutions, universities, regional organizations, non-governmental organizations, and donors, SAKSS can become not only more relevant and legitimate for its intended end-users but also help strengthen local analytical capacity to inform the policy debate on future development strategies and outcomes.

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1. INTRODUCTION

With approximately 49 percent of its population living below the international poverty line and one-third of its population undernourished, sub-Saharan Africa requires faster and more sustained economic growth. The need is particularly urgent in the rural sector, where approximately 75 percent of Africa's poor live and where livelihoods are dominated by agricultural and rural non-farm activities. Encouragingly, efforts such as the Millennium Development Goals (MDGs) and the New Economic Partnership for African Development's (NEPAD) Comprehensive African Agriculture Development Program (CAADP) have prompted key donors and national policymakers to increase their commitments to Africa's agricultural and rural development. Many of these commitments are being operationalized through national development strategies, often presented in the form of poverty reduction strategy papers (PRSPs) and agricultural investment strategies, which aim to relate planned public investments and other policy reforms to specific development goals.

However, the preparation of such strategies is challenging. Due to the complex nature of the development process, development strategies need to account for multiple goals as well as balance the trade-offs and complementarities between goals. Indeed, many existing strategies only provide recommendations for each separate sub-sector rather than demonstrate how all the components can be integrated into a coherent and

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verifiable strategy. Since development priorities and the approaches for targeting them can change depending on circumstances, designing a development strategy cannot be a one-shot, static exercise but rather a dynamic process in which strategies are updated and improved over time. In Africa, these challenges are exacerbated by the weakness of available data and analytical tools, the dearth of trained policy analysts, and the growing decentralization of investment decisions.

Recognizing these difficulties as well as the dire need to attack hunger and poverty, we propose in this paper a strategic analysis and knowledge support system (SAKSS). Specifically, SAKSS has been conceived as a system in which data, tools, and knowledge, at the micro, meso, and macro levels, are compiled, analyzed, and disseminated to inform the design, implementation, and monitoring and evaluation of rural development strategies.[1] At the moment, SAKSS remains focused on the role of agriculture for rural development and economic growth. As a result, many of the analyses within SAKSS identify investments that lead to greater agricultural productivity and commercialization, and in turn reduce poverty and malnutrition. Because of the inherently spatial characteristics of agriculture and rural economies, a distinguishing feature of SAKSS is its emphasis on spatially relevant information. This not only facilitates location-specific analyses but also provides a powerful basis for linking with other aspects of rural development, including health, education, the environment, and safety net programs.

Significantly, SAKSS is not an effort to revive the top-down development planning approaches that have prevailed in the past. Rather, SAKSS intends to foster an appropriate balance between credible research based on rigorous methodologies and stakeholder involvement that ensures the research is relevant to local needs. In other words, while the SAKSS analytical framework contains a number of fundamental components, it is flexible enough to adjust to different country contexts as well as

[1] SAKSS was initially conceived under the financial support of the U.S. based Initiative to End Hunger in Africa (IEHA) to aid in the planning, and monitoring and evaluation of smallholder-led agricultural growth strategies (see Johnson et al. 2003).

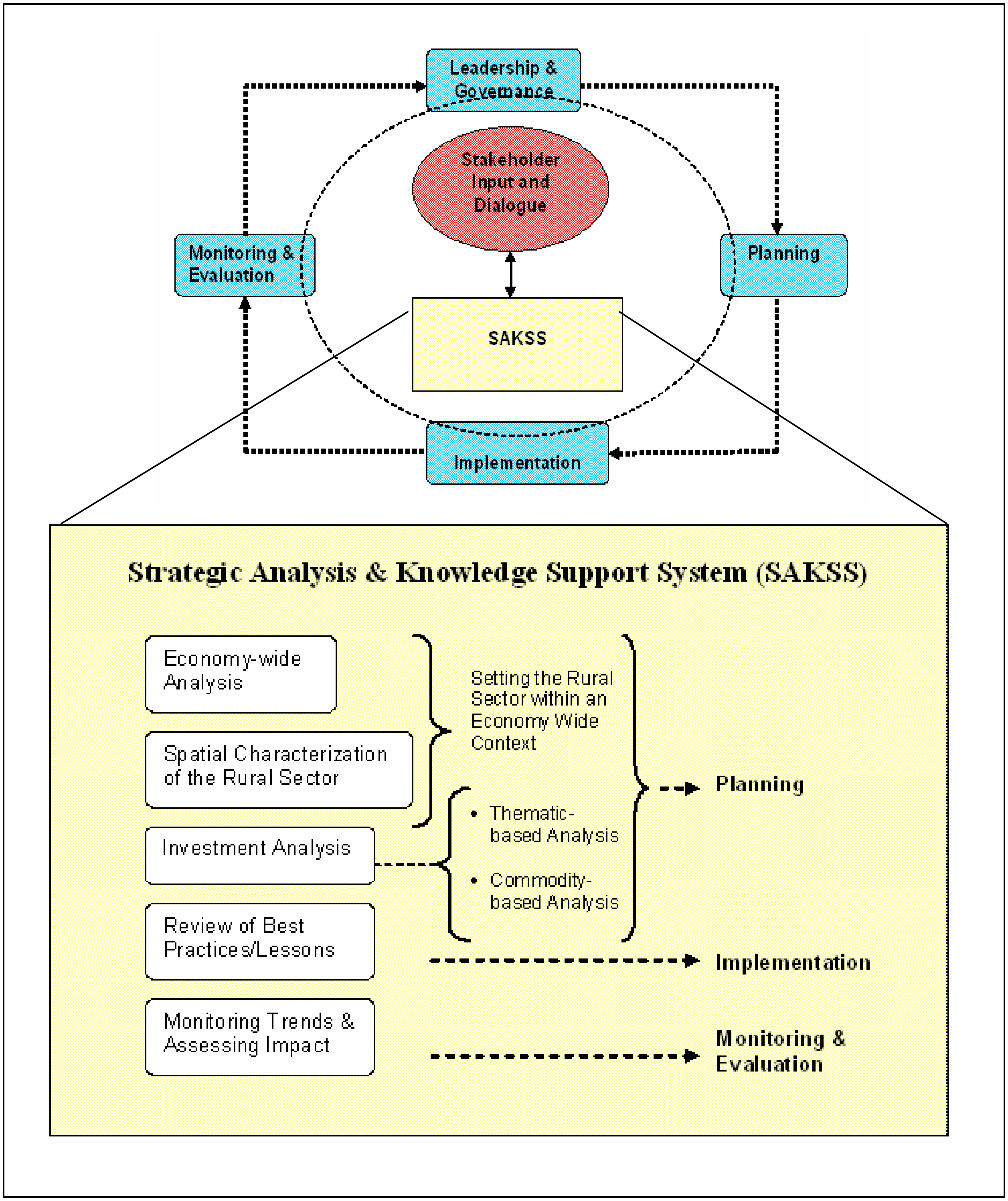
different levels of analysis, including the household, community, regional, and national levels. It is also dynamic enough to integrate, on a continuous and timely basis, information that is relevant for planning, filling in certain knowledge gaps, and for engaging in monitoring and evaluation (M&E) to assess progress against planned goals.

As seen in **Figure 1**, SAKSS is envisioned to represent only part of a country's broader development strategy making process. In order to be an influential and sustainable part of the process and become a genuine "knowledge system," there needs to be an awareness of a country's development priorities and the broader policymaking context. By institutionalizing SAKSS through a network structure that includes government ministries, research institutions, universities, regional organizations, non-governmental organizations, and donors, SAKSS can become not only more relevant and legitimate for its intended end-users but also help build local analytical capacity to achieve a long-term impact.

Thus, the SAKSS proposed here intends to: a) strengthen capacity for planning and agricultural policy analysis; b) improve the data and knowledge base available for applied policy analysis; c) address specific knowledge gaps related to the implementation of rural development strategies; d) promote the use of integrative analytical frameworks for cross-sectoral planning; e) generate momentum within the broader research community regarding appropriate rural development strategies; f) enhance communication between researchers, policymakers, and donors; and g) improve coordination among all donors concerned with rural development.

Creating such a system is more viable today than in the past for two main reasons. First, dramatic advances in information sciences, computer technology, geographic information systems, and modeling techniques have created powerful new possibilities for providing better and timely information to decision makers at all levels. Secondly, while SAKSS is unique in many respects, it can benefit from the lessons learned from similar efforts to establish information and knowledge systems in the past.

Figure 1. **Building a Strategic Analysis and Knowledge Base to Inform the Design and Implementation of Rural Development Strategies**



In order to explore in more depth the various components of SAKSS, we first introduce an illustrative analytical framework that is designed to inform both the planning and implementation of rural strategies. This discussion integrates evidence of how elements of the framework were applied in Uganda. We then discuss other efforts to promote knowledge-based decision-making in order to draw lessons on how the analytical framework can be made operational as a knowledge system that ensures credibility, relevance and ownership among its intended end-users. The final section offers a summary conclusion.

2. A STRATEGIC ANALYTICAL FRAMEWORK

The framework presented here aims to illustrate how analyses can be made more strategic. In particular, at all levels of analysis, the higher level goals of the development strategy should be kept in mind in order to answer key questions related to the planning, monitoring and evaluation of investments and policy reforms. In addition, the analysis should be placed within the context of a participatory process that involves interacting iteratively with key stakeholders at different levels and stages. This process includes, for example, exploring issues that are directly relevant to local needs, validating data and methodological assumptions, and communicating results.

Given that the development context, including the existing stock of data, analytical capacity, knowledge base, and institutional settings for planning and implementing rural development, vary widely across countries, the framework must always remain flexible and dynamic to adapt to these local circumstances.[2] This is why, by and large, the system should be regarded as part of a much larger political process of defining needs and strategies to implement development as depicted in **Figure 1**. It does not provide definitive solutions but offers credible options to weigh against many other alternatives.

Set within a broad analytical framework, the ultimate objective of the analysis would be to clearly identify a set of targeted investment options (and thus development alternatives). For example, the SAKSS analytical framework complements the FAO's Twin Track approach for informing country level food security strategies (see **Box 1**). The Twin Track approach provides a conceptual and policy framework that highlights where particular interventions should occur to increase "rural development and productivity enhancement" as well as provide "direct and immediate access to food."

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[2] A broader framework of analysis proposed by the World Bank, the Poverty and Social Impact Assessment (PSIA) Guide for Practitioners, is especially suited for considering national poverty reduction strategies. The current scope of the illustrated analytical framework is primarily focused at the country level. However, there is certainly a useful justification for also setting up a regional framework to inform cross-country public sector initiatives that are designed to spur regional growth through greater exchange in technology and information and regional market integration. But this is beyond the scope of this paper.

BOX 1. CONCEPTUALIZING THE LINKS BETWEEN POVERTY AND FOOD INSECURITY

Encouraged by recent international commitments to reduce hunger and poverty, the Food and Agricultural Organization (FAO) devised a framework for addressing the multi-faceted nature of food insecurity. Termed the *twin track approach*, the framework recognizes that poverty and hunger reduction requires both increasing agricultural and rural productivity to stimulate wider economic growth as well as directly targeting the hungry to improve their productivity and overall welfare.

As seen below, strategies for addressing the two tracks can be examined across four main dimensions. The first, *availability*, relates to the existence of adequate quantities of food of appropriate quality. *Access* refers to whether an individual can obtain sufficient quantities of nutritious food given her entitlement bundle, which in turn is determined by the social, legal, economic, and political circumstances prevailing within her community. Ensuring that food is nutritious and safe is a matter of *utilization* and requires attention to non-food inputs, such as clean water and sanitation. Finally, achieving *stability* entails that individuals and households always have access to adequate food, regardless of the season or shocks such as economic crises, natural disasters, and HIV/AIDS.

FAO's Twin Track Approach and the Dimensions of Food Security

Twin Track Approach	Availability	Access	Stability	Utilization
Rural Development and Productivity Enhancement	• Improving productivity and production capacity, especially of small-scale farmers • Investing in rural markets and infrastructure • Enhancing urban food supplies • Improving the functioning of input and output markets	• Promoting income earning opportunities • Enhancing access to assets • Facilitating the creation of rural non-farm enterprises • Improving the functioning of rural financial systems and labor markets	• Improving transition and sequencing of emergency rehabilitation-development efforts • Facilitating diversification • Reducing production variability (irrigation, water harvesting, pest control, etc.) • Monitoring production and consumption shortfalls • Improving access to credit and saving services	• Food handling and storage infrastructure • Food safety regulation and institutions • Safe drinking water and sanitation
Direct and Immediate Access to Food	• Food aid • Market information • Transport and communication	• School meals • Food for work programs • Cash transfers • Community and extended family structures	• Emergency food relief • Safety nets	• Nutrition intervention and education programs

Source: FAO 2003. "Strengthening Coherence in FAO's Initiatives to Fight Hunger," Rome, Italy. http://www.fao.org/docrep/meeting/007/J0710e.htm

The framework's flexibility enables it to be applied not only to different countries but also to different levels of analysis, including at the individual, household, community, regional, and national levels. Moreover, the twin track approach encompasses the entire rural space rather than just the farming sector. As a result, the role of the non-farm sector and links with the urban sector can also be explored (Stamoulis and Zezza 2003).

(FAO, 2003). The SAKSS analytical framework is especially useful for identifying the intervention options in the rural development and productivity enhancement track, with an emphasis on smallholder agriculture.

Smallholder agriculture is a major source of growth and rural development in most African countries and is especially important among the poorest of the poor. It employs over 90 percent of the population, either directly or indirectly through trading and small enterprises, and provides strong linkages with the rest of the economy that can potentially lead to strong multiplier effects on overall growth. This occurs because smallholders are more likely to spend a larger proportion of any extra income on locally produced goods and services, thus supporting growth in non-farm sectors as well (e.g. Delgado et al. 1998; Haggblade and Hazell, 1989).

To assess the key policy and investment options needed to yield *rapid and sustained* increases in productivity and commercialization of smallholder agriculture, a logical and sequential framework of analysis is required (see **Figure 1**). The analysis would need to begin with:

1. Setting the context of planning a rural development strategy within the broader economy wide goals of achieving growth and poverty reduction;
2. Characterizing the magnitude of the problem facing rural areas (such as those areas requiring immediate access to food) and exploring spatially explicit 'development domains';
3. Assessing key investment and policy reform options, both those specific within a spatial domain and those more broadly relevant across domains, in terms of their contributions to income growth, poverty reduction and environmental sustainability.

Once choices have been identified and verified through locally defined decision-making processes and stakeholder dialogue, further analysis would be needed, to include:

1. Reviewing best practices and lessons learned for designing and implementing the chosen set of investments and/or policy reforms

2. Developing a monitoring and evaluation system in order to assess whether the chosen investments are on track to achieving target outcomes, e.g. income growth, poverty reduction, and reduced malnutrition.

Engaging in the analysis in the sequential manner described above involves drawing on a suite of existing and appropriate data, tools, and knowledge. For example: using economy-wide models to explore the long term consequences for growth, poverty and hunger; compiling key data (and preferably spatially referenced) at the micro, meso and macro levels; analyzing key data to inform priorities for investment decisions to achieve growth and poverty reduction goals; and finally, building on this information and set of analytical tools to develop a monitoring and evaluation system to assess performance against planned goals. Compiling knowledge on best practices for designing and implementing certain type of interventions will also be key, as well as, defining further actionable research to fill knowledge gaps identified during the analysis and in consultation with stakeholders. How all these come together as a dynamic process will be discussed in more detail in the last section.

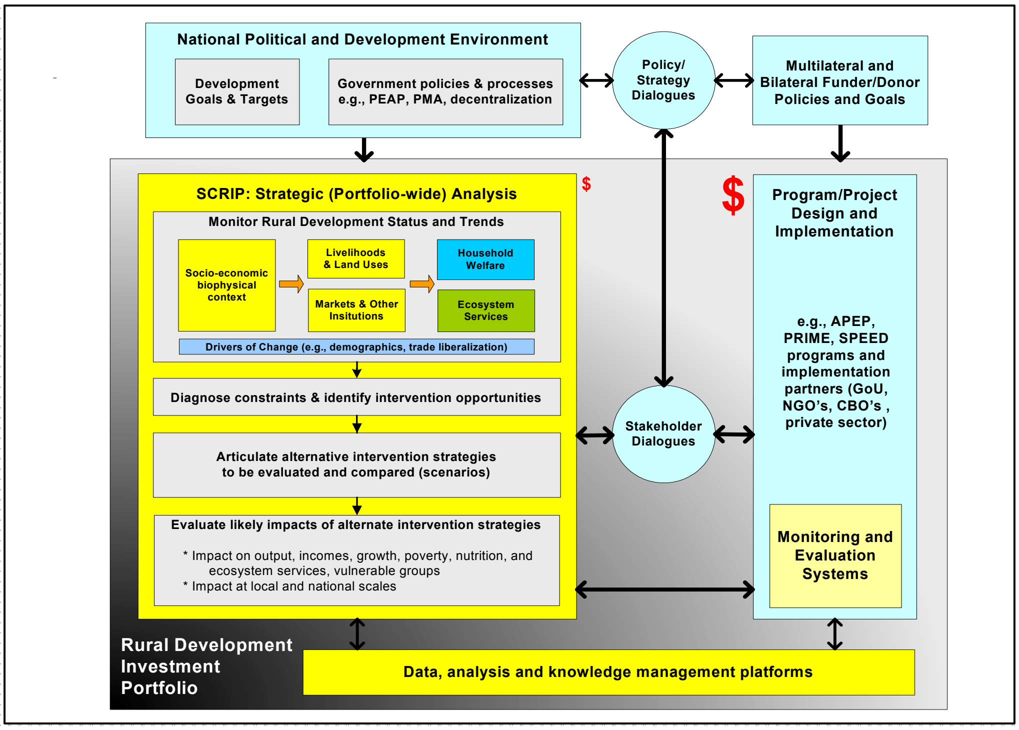
Below, we first focus on presenting an illustrative analytical framework that draws extensively from examples of ongoing efforts in Uganda. **Box 2** elaborates on how the analytical framework is being adapted to the particular rural development needs and priorities in Uganda.

2.1. Rural Development in the Broader Economy-Wide Context

From a strategic perspective, it is useful to first conduct a scenario analysis at the economy-wide level to understand more broadly the rural development and policy alternatives facing a particular country. Policies at the macro level, such as trade and market liberalization, can have a profound impact on the rural economy and can determine whether growth is pro-poor (Dorward et al. 2003). At the same time, policies that directly affect rural areas can have an impact on the overall economy and in turn have feedback effects on the rural sector. By examining many of these policy options

BOX 2. AN ANALYTICAL PLATFORM FOR IDENTIFYING INVESTMENT OPPORTUNITIES FOR SMALLHOLDER-FOCUSED AGRICULTURAL GROWTH IN UGANDA (*SOURCE*: SIMON BOLWIG)

The Figure below illustrates a strategic analytical platform that is being applied in Uganda to inform for both government and donor partners in the design and implementation of the Plan for the Modernisation of Agriculture (PMA), a multi-sectoral, smallholder-based, and market-focused agricultural development strategy. The platform aims to provide key evidence of potential returns among many investment alternatives to serve as useful input into the broader stakeholder and policy dialogue on selecting agricultural-based and environmentally-sustainable rural development priorities. The platform involves various interactions and consultations with stakeholders at each stage of analysis and in disseminating results. Data and information sources are derived from extensive national household surveys, other survey data collected by researchers, official government documents, peer-reviewed and gray literature, and expert consultations. Acknowledging the fundamental relevance of location from an agricultural and environmental perspective, the platform has been designed to be spatially explicit, relying extensively on spatial information organized in a geographical information system (GIS).



Framework of the strategic analytical platform in Uganda and stakeholder linkages

The strategic platform of analysis for Uganda has involved: 1) the establishment of *baselines* regarding the current structure and performance of agriculture-based production, markets and trade, as well as related indicators of human well being and natural resource conditions; 2) an assessment of the *growth potential* for specific commodities and markets, with particular emphasis on those commodities and markets that might offer the greatest opportunities (direct or indirect) for smallholder participation; 3) an evaluation of the likely *attractiveness* of high-potential commodity/market opportunities in terms of (a) their potential economic payoff to smallholders and consumers, and (b) other potential environmental, social and regional equity impacts; 4) an evaluation of the likely *feasibility* of enhancing smallholder responses to each of the promising commodity/market opportunities, based on a review of institutional, human capacity, technical, policy and other constraints; 5) the articulation of *development scenarios* built around a portfolio of commodity/market opportunities, as well as investments in complementary (sub-)sectors, that provide pathways from the baseline situation through to a target planning horizon – 2015 in this case; 6) an evaluation of the likely *macroeconomic effectiveness* of each scenario in terms of its potential to generate overall economic growth; 7) Identification of *'best bet' investment scenarios* for improved smallholder-focused agricultural enterprises identifying, as far as possible, specific areas of investment.

within the context of the broader economy, key relationships and welfare implications can be assessed in ways that lessen any potential adverse impacts on the poor.

The potential role of agriculture and the rural economy can then be explored with respect to how it contributes to economy-wide growth and national development priorities (e.g. the MDGs). Within this normative mode of analysis, questions regarding the long-term distributional consequences of alternative investment and policy reforms for meeting these targets can also be explored. Specific to rural sector strategies, both macro-economic reform and sector-wide investment options can also be examined more closely, especially with regard to how they affect the incentives for rural agricultural production and commercialization.

The economy-wide perspective permits higher-level strategic questions to be posed for shaping the rural development strategy within the context of overall national development goals, and ultimately therefore, provides the greatest strategic leverage to priority setting (Byerlee, 2000). Relevant questions may include: what agricultural growth rates would be needed to meet the MDGs? Is agriculture the only way to reduce poverty? What other sector investments would be needed? If agriculture grows at a rapid pace, are there sufficient markets (national, regional or international) to absorb the rapid growth in supply? How sensitive would agricultural incomes be to international price instability? What are some key sector-wide and sub-sector policy reforms and investments that have the potential to influence smallholder production and income growth at the national level? Are there opportunities for regional linkages that would generate spill-ins or spillovers in the areas of trade and technology (which is particularly important for small countries)? Answers to these questions can also add valuable information to national debates concerning broader national development strategies such as the PRSP process.

Economy-wide models like the Computable General Equilibrium (CGE) model are well suited for answering many of these questions. They have the advantage of capturing both direct and indirect effects of policy changes on poverty and income distribution given a country's overall economic structure. The effects are channeled through changes in employment, wages and relative prices while considering forward and backward linkages in the economy. Where data is limited and a CGE is not available, a multi-market model may be more suitable. Although less sophisticated and partial by treating only the agricultural sector in more detail, the model has the advantage of incorporating useful market and trade linkages across various commodities and locations by combining a system of demand and supply equations that allow for interactions across commodities. A non-agricultural sector can also be modeled to capture potential agricultural linkages with this sector.

Recent examples of the results derived from utilizing both CGE and multi-market models are illustrated in **Tables 1&2**.[3] With regard to assessing the growth required to meet the MDGs, only Ghana seems closest to meeting this goal at current growth rates. Zambia, on the other hand, can hardly expect to do so, at least not until 2045 (Diao 2003; Thurlow, 2004). In fact, Zambia would have to grow at about eight percent per year in per capita GDP if the MDGs are to be met. Almost all the case studies emphasize how infrastructure improvement and market development will have to accompany investments in agriculture if the sector is going to play any significant role in reducing poverty.

Preliminary findings from these studies show that to realize agricultural growth, it is essential that there is sufficient demand to absorb the increase in supply, whether in domestic or international markets. This issue is examined directly for food staples, livestock products, and traditional and non-traditional exports, all of which are grown on smallholder farms in one combination or another. In comparing across the countries, both Ghana and Zambia seem more likely to face a collapse in domestic food prices due to limited domestic demand. Although Ethiopia faces a similar outcome, domestic demand is almost always constrained by high transportation and transaction costs (Diao et al 2004).

[3] Besides IFPRI's own standard CGE model and the multi-market model, other economy wide models have also been applied to the developing country context. These models range in sophistication, from single macroeconomic models to a set of integrated suite of models designed to link the various development dimensions of economic growth, environmental sustainability, and macro-economic policy reforms. Well known ones include the 123PRS model and the T21 model of the Millennium Institute.

Table 1. Assessing the Potential to Meet the MDGs Using Economy-wide Models

	Ethiopia	Zambia	Ghana	Kenya
Current Levels				
GDP per capita (1995 constant US$)	127	405	436	325
Poverty rate (%, national standard)	42	58	40	58
Prevalence of under 5 malnourished children (%)	47	28	25	22
Simulations to 2015				
1. With business as usual				
GDP per capita growth rate (%)	1.1	1.8	2.0	0.5
Poverty rate (%, national standard)	42	52	30	55
Prevalence of under five malnourished children (%)	45	n.a.	17	n.a.
2. Growth required to meet MDGs				
GDP per capita growth rate (%)	4.1	8.4	3.2	3.9
Agricultural GDP growth rate (%)	4.1	7.9	3.3	3.3
Poverty rate (%, national standard)	22	29	<20	29
Prevalence of under 5 malnourished children (%)	24	n.a.	13	n.a.

Source: Simulation results compiled from individual work by Xinshen Diao, James Thurlow and Peter Wobst in the Development Strategy and Governance Division, IFPRI, 2004.

Table 2. Size of Agricultural Sub-sectors

	Ethiopia	Zambia	Ghana	Kenya
		(%)		
Share of agriculture in GDP	**52**	**25**	**36**	**29**
Share in total agriculture				
Staple crops[a]	**49**	**56**	**54**	**38**
Livestock and fishing	**29**	**n.a.**	**18**	**27**
Nontraditional exports	**14**	**30**	**17**	**21**
Traditional exports	**7**	**10**	**11**	**12**

Source: Simulation results compiled from individual work by Xinshen Diao, James Thurlow and Peter Wobst in the Development Strategy and Governance Division, IFPRI, 2004.

[a] *For Zambia this includes both crops and livestock.*

Outcomes from the simulations further suggest that demand limitations on cereals, for example, could be avoided if there is simultaneous growth in the livestock sector, which would help absorb the growth in cereals production faster than the demand for human consumption. The same is also true if cereals can be easily exported to regional markets among neighboring countries.

These various exploratory scenarios help emphasize the importance of reducing demand constraints and market risk, while suggesting possible policy intervention areas in more general terms, such as, enhancing the links between livestock and cereals, and promoting greater intra-regional trade through the removal of cross-border trade restrictions and improved transportation networks.[4] Even within a single country, integrating markets between food grain surplus and deficit areas through improvements in infrastructure and removal of any policy barriers could also have similar effects. Under these conditions, growth in food staples and livestock would have a far wider impact on poverty reduction. In contrast, although non-traditional exports have a real potential to experience rapid growth due to unlimited demand, they are less likely to have a broad enough impact on poverty reduction due to their small value share relative to total agricultural production (Diao et al. 2003).

However, the economy-wide models are not as useful for identifying specific investment options at a more disaggregate level, especially considering the diverse natural resource and climatic environment, as well as physical remoteness, within which agriculture operates. In the next two sections, we describe some illustrative criteria for disaggregating the analysis further, beginning with a spatial characterization of the problems and opportunities facing the rural sector, followed by a delineation of these into so called ‘development domains’. Whenever possible, examples are drawn from the Uganda case study.

[4] A recent study that uses a gravity model also highlights poor infrastructure and mismanaged economic policies as key factors constraining the expansion of intra-African trade (see Longo and Sekkat, 2004)

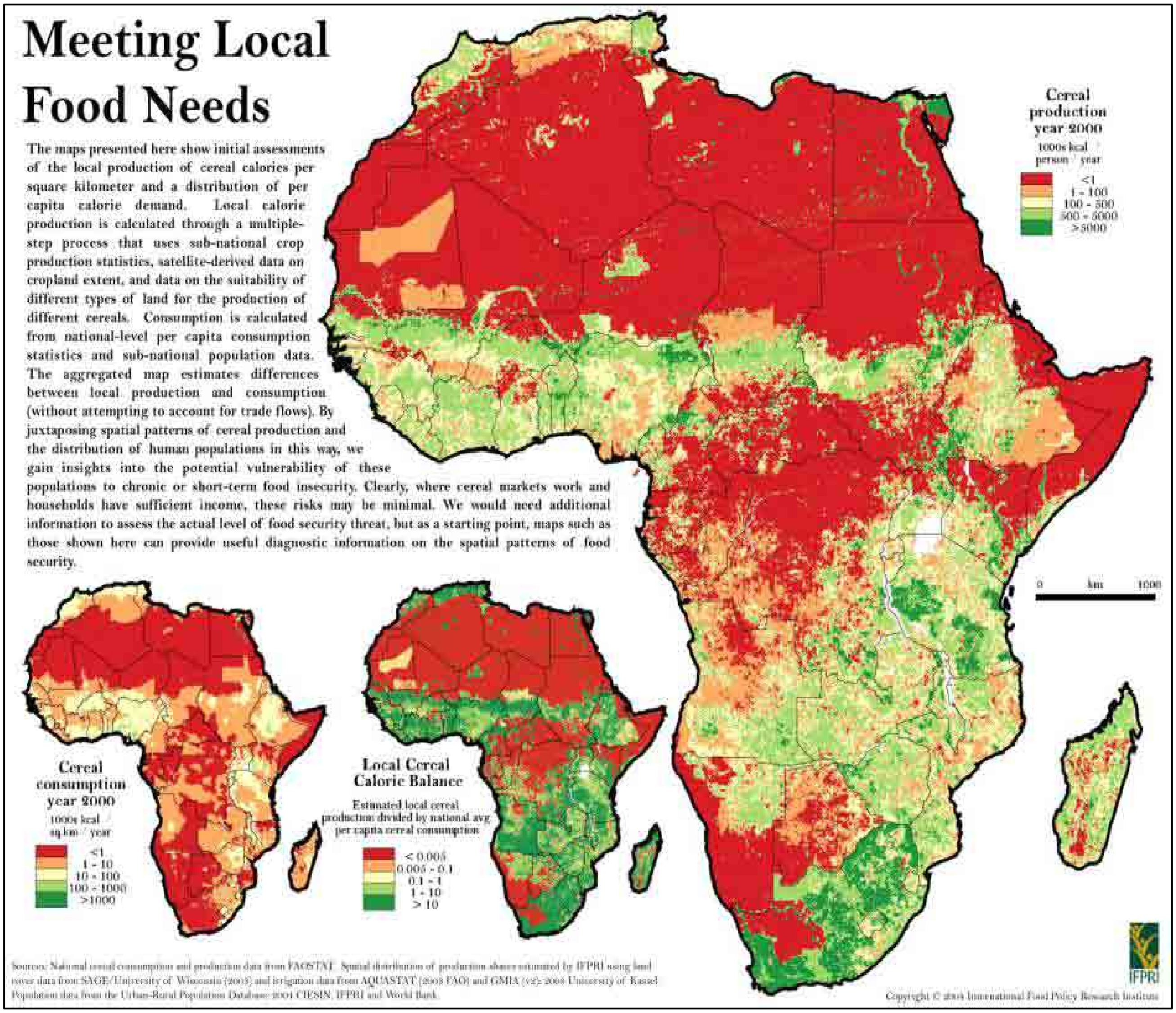
2.2. Spatial Characterization of the Rural Sector

Characterizing the Problem

An essential component of any rural development strategy is a broad statement of a vision, one that describes long run strategic policy goals. Goals are usually a statement describing a desirable end for overcoming existing conditions limiting rural livelihood options, improved economic welfare, improved food security and nutrition, and the overall health of the rural economy. In order to articulate the magnitude of the problem, justify the goals of the rural development strategy, and determine the required responses, an important first step is to quantify the extent and distribution of poverty and malnutrition across geographic areas and population groups (Babu and Per Pinstrup, 1994). For example, the response will be quite different for more remote and food insecure areas versus areas in close proximity to large market centers. **Figure 2** illustrates just how the distribution of cereals production and consumption in Africa can vary widely by location, even within a country. The map provides a useful example of the diagnostic tools available for determining the spatial patterns of potential vulnerability to food insecurity.

The monitoring of food insecurity trends is already an important activity of groups like the Food Insecurity and Vulnerability Indicators Monitoring System (FIVIMS) of FAO. Even though such systems are primarily designed to help inform impending food shortages at the national and local levels, they are also relevant for assessing longer-term development alternatives by identifying the degree to which certain areas and population groups face higher risks of food insecurity and malnutrition, and the coping mechanisms they use to adapt to these risks (FAO, 2003). Poverty mapping exercises are also useful for similar reasons, identifying where the poor are as a first step for targeting poverty reduction programs. The spatial characterization of food insecurity and poverty helps stress the need to plan and monitor rural strategies within a spatial dimension in order to better target priority investments according to differences in comparative advantage and market opportunities, and thus rural livelihoods, across different regions of the country.

Figure 2. Production and Consumption of Cereals



Source: Prepared by IFPRI for the 2020 Vision Conference on Assuring Food and Nutrition Security in Africa - Kampala, Uganda, 1-3 April 2004)

Exploring Spatially Explicit 'Development Domains'

One way to spatially disaggregate the range of rural livelihood options is to define 'development domains' that represent a unique combination of those key factors, such as land use, farming practices and income sources, that influence the type of options available at the community level. In Uganda, for instance, Pender et al. (1999) define ‘development domains’ on the basis of population density, access to markets and agro-climatic conditions. This is due to a strong association between these three factors and the basic types of livelihood strategies pursued by most communities, including: expanded cereal crop production, intensive livestock/dairy production, agro-processing, and non-agricultural based rural enterprises (see **Box 3**).

Under different local circumstances, other factors, such as socio economic conditions, resource endowments, and vulnerability to production shocks, will also have important implications for characterizing available livelihood options. In some instances, focusing more attention on commercialization issues may be more critical, requiring domain specifications that are distinguished by existing regional and global end-markets for exports and domestic markets, such as large urban centers, for food staples. By adding aspects of market accessibility to the analysis, commodity-specific domains can be mapped out that characterize how end markets are linked to certain attributes along a supply chain. **Box 4** illustrates how this is being done for Uganda.

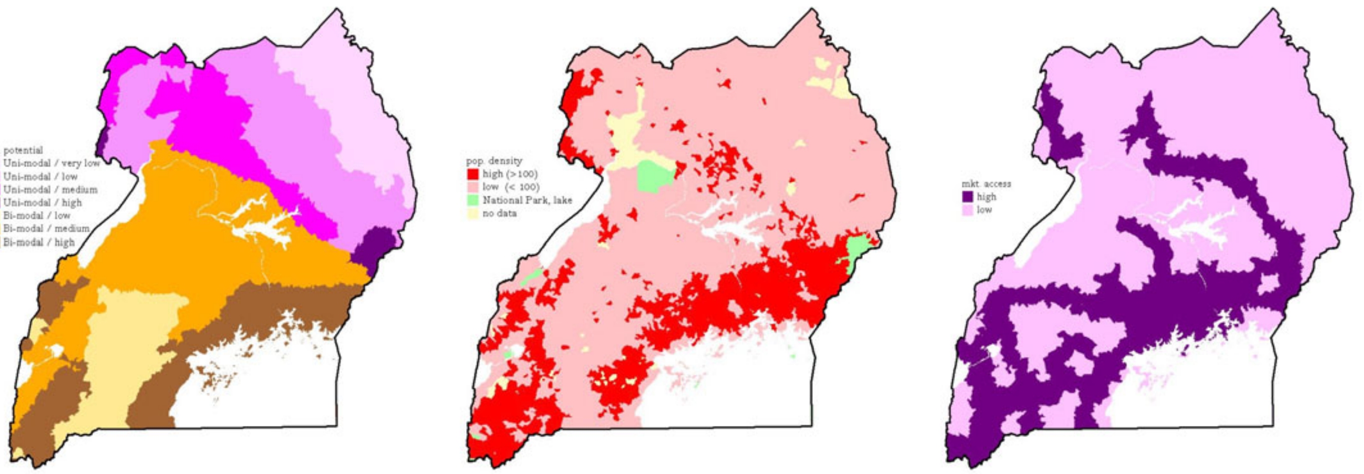
Ultimately, data limitations will most likely define the type and degree of disaggregation possible. A difficulty inherent in disaggregating socio-economic data by domain is the fact that much of the data is not geo-referenced but is summarized at the district or provincial level. In reviewing some of these types of problems, Wood and Chamberlain offer possible solutions that involve combining satellite image data with mathematical techniques like maximum entropy. However, from a purely practical perspective, it is important to consider whether conducting the analysis at this higher resolution will provide information that is more valuable than would be produced at a more aggregate level. For example, it may be preferable to analyze sector-wide or thematic issues (e.g. physical infrastructure and policy environment) at the economy-wide level if the costs of doing so are exorbitantly high at the domain level.

Because the ‘development domain’ characterization can ultimately shape the type of policy intervention and public investment alternatives available to policy makers, consultations with key stakeholders is required to not only validate the domains to local

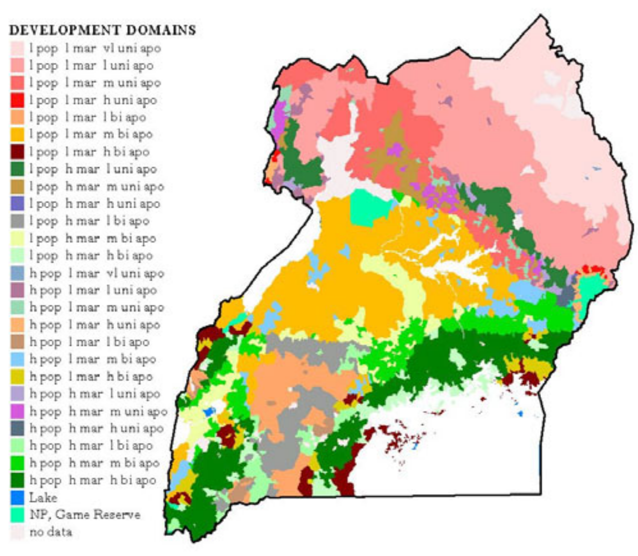
BOX 3. DEVELOPMENT DOMAIN CHARACTERIZATION (SOURCE: SUMMARY BY JORDAN CHAMBERLIN)

Development domains for Uganda have been identified according to the three characteristics defined by Pender *et al*.: agricultural potential, market access, and population density. *Agricultural potential* refers to those factors that circumscribe the absolute potential of a given location to produce agricultural commodities. Components of agricultural potential include climatological as well as biophysical factors, and are recognized as being subject to both natural and human-induced changes over time.

Understanding an area's *access to markets* is necessary to appreciate how a location's absolute agricultural potential translates into a comparative advantage for different productive activities. As with agricultural potential, this is a complex factor, definable in a variety of ways. Since the ratio of land to labor is believed to have significant consequences for land management and other production technology strategies, *population density* is a useful organizing frame for examining actual and potential management decisions.



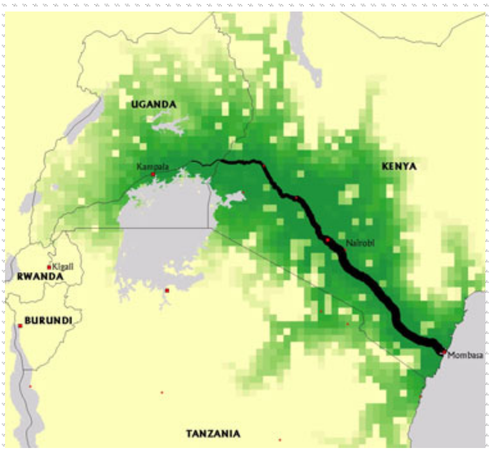
Combining these three factors together into development domains can capture much of the information necessary to provide an overview of the conditions guiding rural livelihood options in different places at the community level. The development domains shown below for Uganda are defined on the basis of high and low population density and market access across seven zones of different agricultural potential.



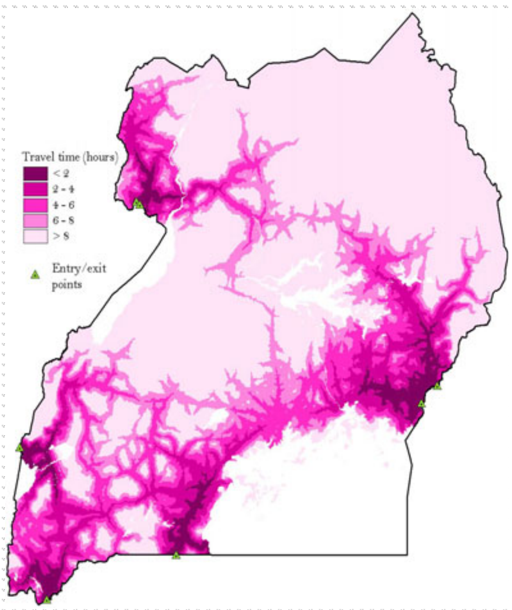
BOX 4. MARKET ACCESSIBILITY (SOURCE: ANALYSIS AND SUMMARY BY JORDAN CHAMBERLIN)

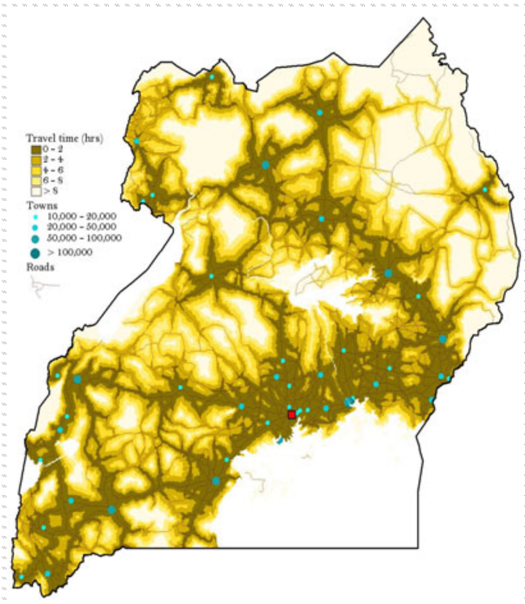
Market accessibility is a key concept in the analysis of actual and potential development patterns and is strongly linked with the kinds of livelihood strategies that people are able to pursue in different places. Mapping the areas of high versus low access in a country can be a very powerful characterization of heterogeneous development options, and is often incorporated into the definition of recommended domains for different policies. Such characterizations are often measured in terms of physical access to targets that are proxies for market opportunities (e.g., estimated travel time to towns of more than 100,000 persons) and are designed to be relevant to generalized agricultural inputs and outputs.

However, there are several ways in which we might take a more nuanced view toward access to markets, which have implications for how we choose to represent them both conceptually, and in space – i.e., in cartographic models that enable quantitative analysis.



In Uganda, for example, we can distinguish between local markets where low-value food crops are bought and sold; regional markets where low as well as higher valued commodities, including perishables, are sold; regional exports of non-perishable food crops via the border with Rwanda and DRC; access to the Kigali-Kampala-Nairobi-Mombasa rail corridor, for non-perishable exports; and "international fresh markets" for horticulture via the airport at Entebbe. As we think of the different commodities, qualities or levels of added value that are required by these markets, we can recognize that cartographic representations of physical access must be begin with "spatializing" the relevant marketing chains, i.e., mapping access to the sequential nodes of the entire production and marketing process. The result is a more complex, but more directed, set of indicators for policy analysis.





Incorporating the temporal dynamics of accessibility is another challenge. These dynamics may be regular (e.g., seasonality) or probabilistic (e.g., different degrees of stability associated with different markets). Finally, the baseline conditions under which we may trace physical access to a set of markets can be expected to change over time, which has implications for long-term policies and strategy development. For example, changes in urbanization, infrastructure development (and decay), regional trade reforms, etc. will translate into changing geographical patterns of physical accessibility to markets.

realities, but to also consider other information not available through data alone. Moreover, doing so ensures that any further analysis performed by domain will have local relevance and legitimacy among government decision makers and the broader development community (e.g. practitioners, NGOs, researchers, private sector, and donors).

Geographic Information Systems (GIS) and Remote Sensing

Useful tools in the spatial analysis of development domains are the Geographic Information Systems (GIS) and remote sensing. This typically involves overlaying several spatial maps that examine environment and land use systems in order to highlight any correlations that may exist between them and across space (Dalal-Clayton and Bass, 2002). Although quite effective at influencing policies, the tools can be easily misleading if they are not integrated with other more sophisticated behavioral or normative models. This is because simple correlations do not go far enough to address socio-economic interrelationships that are so often relevant for policy making. When combined with socio-economic data and analysis, GIS can actually provide a powerful way to communicate the results of more complex interrelationships (Yeh, 1999).

2.3. Investment Analysis

Here we present a set of criteria for investment analysis, focusing on the smallholder sector and set within a spatially explicit context. It is certainly not meant to be the only logical criteria for analysis. For example, in Uganda, the unique issues and concerns facing government and donor partners helped shape the set of criteria adopted (**Box 2**). What is more important is that the criteria are logically sequenced and integrated to narrow the set of investment options.

Assuming there is sufficient data, the analysis involves first identifying key options for investment in terms of their contributions to income growth, poverty reduction and environmental sustainability, and secondly, identifying specific bottlenecks that need to be overcome if the potential is to be exploited. Such an approach can be distinguished between 1) *sub-sector or* commodity*-oriented investment options* that are designed to exploit market opportunities, and 2) *sector-wide or thematic lines of investment options* (e.g. infrastructure, broad policies, education) designed to create an enabling environment that facilitates broader patterns of growth and poverty reduction. These two types of investments are mutually reinforcing and expected to address the opportunities and constraints typically faced by rural households, both for smallholder agriculture and non-farm activities. Investments are defined broadly here to include those in institutional and policy reforms as well as in capital formation. The feasibility for conducting more disaggregated and spatially explicit analysis (e.g. at the development domain level) will naturally depend on the degree to which key spatially referenced socio-economic information at the *micro* (household), *meso* (e.g. district) and *macro* (national) levels is readily available.

Prioritizing Sub-sector and Commodity-Oriented Investment Options

A sub-sector or commodity-specific approach to selecting investments makes sense for many trade and market oriented interventions as well as for many investments in technology development and dissemination. For technology related investments, most public interventions are location specific because of the diverse physical, socio-economic, and agro-climatic environments within which agriculture operates (Byerlee, 2002; Wood and Pardey 1997). While for trade and market investments, many valued-added products in agro-industry can be traced back to a single primary commodity, whose production is location-specific. Finally, a commodity approach can be especially beneficial for targeting particular groups, such as the smallholder sub-sector. Even when thematic lines of investment are to be considered separately, however, it is still useful to anticipate the potential value that such investments will have on other commodities.

To help narrow down to a limited set of priority commodities (or value-added products), a set of fundamental criteria can be used (also see **Figure 3**). The first identifies commodities that provide the highest potential returns, based on future market and technology opportunities. The criteria examines both demand and supply aspects relevant at the national and development domain level by answering the following questions:

- Which commodities (or value added products) have the most promising demand opportunities?
- What is the comparative advantage in producing these promising commodities? Is there significant potential to raise productivity of these commodities? What are the likely economic returns to different investment options?
- Would increased production and commercialization of selected commodities have adverse effects on the environment?
- Could the production and commercialization of selected commodities benefit the poor and malnourished, women farmers, HIV/AIDS afflicted communities and reduce conflict?

Once a narrower set of commodities (or sub-sectors) have been identified as having the greatest potential for rapid and sustainable growth in rural areas, a second set of criteria is needed to focus more attention on gaining a better understanding of the specific constraints facing a particular stage analysis. The purpose is to assess in more detail the type of investment programs needed to improve the productivity and/or commercialization of that product. Such detailed sub-sector analyses would generally seek to answer questions like:

- What is currently constraining production and commercialization?
- What investment or policy options are available to overcome these constraints?

Identifying Key Priority Commodities

Beginning with the first set of criteria, and more broadly on the demand side, examining which commodities (or value added products) have the most promising future market opportunities is an essential first step to ensure that any rapid supply response from public investments can be absorbed by sufficient demand in domestic, regional or

Figure 3. An Illustrative Analytical Framework Set within a Smallholder Context for Identifying Key Commodity Investments by Development Domain

Criteria for identifying priority 'commodities' and 'development domains'

- Which commodities *(these could be value added goods among crops, livestock, and fisheries, including traditional and non-traditional)* have the most promising demand opportunities?
- Does the country have, or could have, a comparative advantage in producing these promising commodities and in what development domains?
- Is there significant agronomic potential to increase production of these commodities and in what development domains?
- Would increased production (and commercialization) of these commodities have adverse environmental effects and in what development domains?
- Could the production (and commercialization) of these commodities benefit the poor and malnourished and in what development domains?

↓

Assessing Potential Investment Entry Points

↓

Determining investment priorities and options for commodities and development domains

- What is currently constraining increased production of these commodities
- What is constraining increased commercialization of these commodities?
- What are the likely economic returns and reductions in hunger and poverty resulting from specific investments to overcome production and commercialization constraints?

↓

Assessing Implementation Options

↓

Selecting best practice approaches for implementing chosen investments

- What are the best ways to design and implement the chosen investments?

international markets. To project the potential growth of existing markets, various tools can be used to simulate national, regional and global demand growth for different commodity groups. For example, population growth projections offer a useful proxy for demand growth projections of food staples. Assessing demand growth for traditional and non-traditional exports will need more careful analysis, such as the recent work at IFPRI that used a combination of a global CGE model, partial equilibrium model, and trends analysis to determine the future market opportunities for African agriculture (Diao et al. 2003). Some of this would have already been evident from the economy wide simulations. Sub-sector analyses that assess end markets, such as urban consumers and the domestic agro-industry, can also help provide insights into the growth patterns of these markets.

On the supply side, for those commodities where demand is not constraining, the next question to ask is whether the commodity actually has a comparative advantage, i.e. whether it is economically profitable after accounting for any existing market distortions. The domestic resource cost (DRC) ratio is a commonly used measure of comparative advantage, given sufficient data on yields and costs of production, processing, bulking, delivery, and so forth. Although calculations are usually done under existing technology conditions and market transactions costs, they can also be assessed in the light of the feasible changes being considered in these conditioning factors (World Bank, 2004).

Where data on costs is not available, an alternative approach is to perform a 'revealed comparative advantage' (RCA) analysis that examines trends in commodity trade patterns and market shares. RCA measurements are calculated as the ratio of a commodity's share of total exports to the same commodity's share of total imports (Diao et al. 2003). A positive and large ratio would imply a strong comparative advantage. In the Uganda example, this and other additional criteria were used for identifying the growth potential of export commodities (see **Box 5**). Using measurements of revealed comparative advantage, barriers to market entry, demand projections and projected trends in unit value, results clearly show that few commodities enjoy both a high export base (in terms of scale) and a high value added return. Low value bulk commodities like coffee

BOX 5. THE GROWTH POTENTIAL OF UGANDA'S INTERNATIONAL EXPORT COMMODITIES (*SOURCE*: SUMMARY BY SIMON BOLWIG)

The growth potential of Uganda's international export commodities can be approximated by using the following criteria: high growth in market demand; large market size; favorable world price trends; large Uganda export base; strong comparative advantage for producing the commodity; and low barriers to market entry, particularly regarding quality and SPS standards. The table below shows the performance of Uganda's 12 largest international exports according to these criteria. This information is complemented with in-depth, industry assessments of the specific characteristics of the markets and their accessibility for Ugandan producers.

Commodity	Uganda export base	RCA Index	Projected world price trend	Barriers to market entry[3]
	Million $		*% p.a.*	
Coffee	117.8	255	5.4	Low
Finfish	74.4	142	0.6	High
Tobacco	34.7	36	-0.1	na
Black Tea	32.8	86	0.1	Low
Flowers	16.9	na	na	High
Cotton lint	15	13	2.1	Low
Hides & skins	12.5	10 / 142	na	Low
Vanilla	6	118	Negative	Low
Fruits & vegetables	3.6	51	-0.42	High
Cocoa	3.3	7	-1.8	Low
Sesame	0.8	na	na	Low
Sustainable coffee[4]	0.7	na	na	High

Source: Compiled by authors. Notes: na = not available. 1. Vegetables only. 2. Vegetables only. Value for fruits is -0.6. 3. Authors' best judgment based on literature review. 4. Organic and fair trade. 5. Revealed Comparative Advantage (Diao 2003).

As seen in the matrix below, the commodities can then be arranged according to market demand growth, Uganda's export base, and unit value. Highlighted commodities face higher market entry barriers. It is clear that no commodities enjoy both high demand and high base, reflecting the dominance of low value, bulk export commodities (coffee, cotton, tobacco, and tea) that have experienced variable prices over the last decade. It underscores the need for stronger diversification of the export base into commodities with faster growing markets.

Flowers, vanilla, fruits and vegetables, *sustainable coffee and other organics* are all high value commodities with medium to high demand growth. Due to their small export base, however, there is a greater risk of over supply. Moreover, many fruits and vegetables, along with flowers, suffer increasingly high barriers to market entry and smallholder participation is currently absent or very limited. The high value commodities that enjoy smallholder participation include fish, tobacco, cocoa, vanilla, sustainable coffee, and some spices and fruits and vegetables (birds eye chili, papain, passion fruit, dried fruits, ginger). This is due either to low barriers to market entry (e.g. vanilla, cocoa) or to recent improvements in supply chains that have enabled market entry despite high barriers (e.g. fish, sustainable coffee).

Export Base	**Projected Demand Growth**	**Low / Very Low**		**Medium / High**	
	Unit Value	**Low**	**High**	**Low**	**High**
Small / V. Small		Sesame	Cocoa	Papain	Vanilla, Specialty coffee, Fruits & vegetables
Medium		Cotton, Hides & Skins			Flowers
Large / V. Large		Coffee, Tea	Tobacco, Fish		

Notes: Low value export crops are defined as receiving an export price (Uganda fob) of less than $1.5/kg in 2002/03, which is the minimum cost of air freight from Entebbe to Europe, except for sustainable coffees that is grouped as high value to distinguish it from mainstream Robusta. Projected demand growth refers to annual growth rates, where: < 1 = Very Low; 1 – 2.9 = Low; 3 – 5.9 = Medium; 6 and above = High. Uganda's export base refers to the value of exports (average 2000 – 02), where: < $1 million = Very Small; $1 – 9.9 million = Small; $10 – 24.9 million = Medium; $25 – 49.9 million = Large; > $50 million = Very Large.

continue to experience variable (and sometimes declining) world prices. Alternatively, among the high value but low export base commodities, demand growth is quite rapid and promising, but tends to also face higher barriers to entry. Moreover, their shares remain small relative to the total value of agricultural exports, and thus they are less likely to have a broad-based impact on poverty reduction.

Assessing agronomic potential can help identify where opportunities exist for raising productivity. For primary crop commodities, a yield gap analysis is helpful for assessing such potential. This includes potential yield gains under improved conditions (e.g., adoption of improved varieties, natural resource management, improved quality, integrated pest management, etc.). Gains from improved practices and technologies can be assessed in terms of their effects on reducing production costs (as in the case of Uganda, see **Box 6**). For value -added products, assessments will also need to be broadened to analyze the potential gains from post-harvest improvements (e.g., adoption of improved processing technologies, better quality and timing relative to market opportunities) and the potential for more diverse utilization options (e.g., varieties with more vitamins, starch, protein, longer shelf life or other traits valued by processors, retailers or consumers).

To ensure sustainability in agricultural growth, it is also critical to consider any adverse environmental effects of increased production and commercialization on the key commodities being analyzed. An analysis of the carrying capacity of the agricultural resource base might be required – based on factors such as agro-climatic variability, prevailing farming systems, population density, rate of deforestation, soil degradation and fertility, etc. Because the environmental consequences tend to be location specific, spatial analytical tools can be integrated to map out potential tradeoffs between environmental and increased commodity production goals. The Uganda case study provides an excellent example for assessing agricultural and environmental 'hot spots' (see **Box 7)**. Identification of such 'hot spots' can help policy makers design special policies and interventions that balance both environmental and rural development goals.

BOX 6. POTENTIAL ECONOMIC BENEFITS OF INCREASED AGRICULTURAL PRODUCTIVITY IN UGANDA, SOME PRELIMINARY RESULTS (*SOURCE*: ANALYSIS AND SUMMARY BY LIANG YOU)

Studies in Uganda demonstrate that crop profitability often depends on input technologies. These technologies can be characterized as subsistence, low input, and high input with best practice. Through technological interventions, such as those that emerge from investments in research and development (R&D), producers who use low inputs can move up to using high inputs and therefore enhance crop profitability. By using both IFPRI's DREAM model as well as sub-national production and market information for 13 major crops and 45 districts in Uganda, preliminary baseline assessments can be made of the economic gains from enhancing the productivity of crop production in different locations.

Current estimations indicate that 80% of Uganda's producers use low inputs while 20% use best practices. Based on this information, You et al. use DREAM to simulate for each development domain a scenario that allows for expanded use of best practices, changing the current ratio of 80:20 (low input v. best practice) to 20:80 by 2015, while assuming no technological spillover across domains. Results indicate that, for Uganda as a whole, plantain ranks highest in terms of the potential revenue from improved best practices (Fig 6.1), followed by cassava, millet, sweet potato, maize, and Robusta coffee (Fig 6.2). The development domain with high agricultural potential, high market access, and high population density (bhhh*) gains the highest benefits for all the crops except cassava. The total benefits for this domain for the 13 crops are over $231 million (with plantain accounting for about two thirds of that).

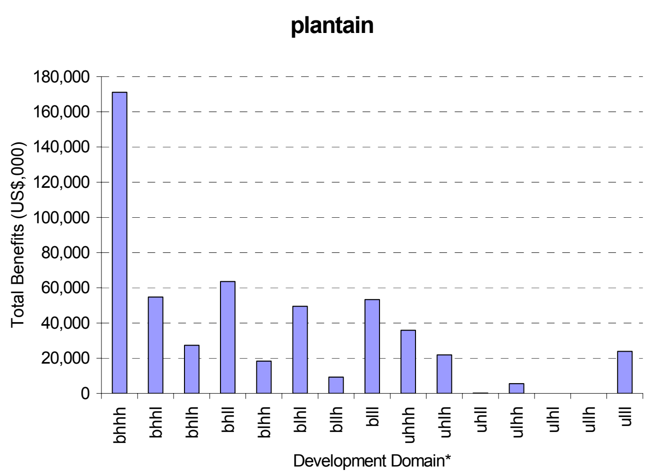
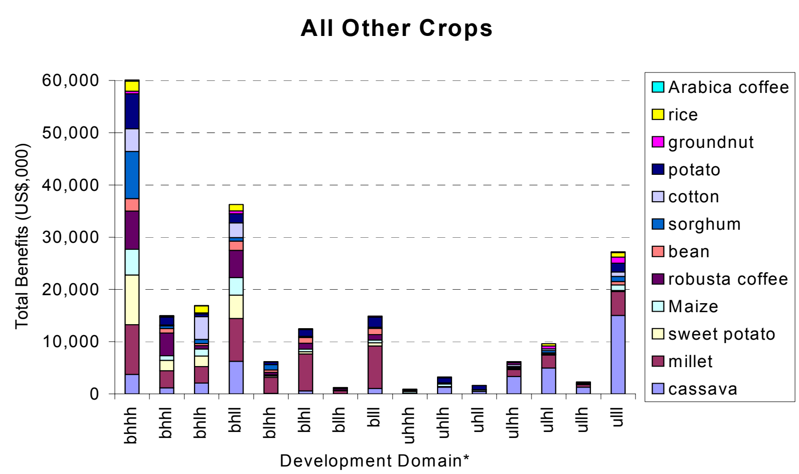


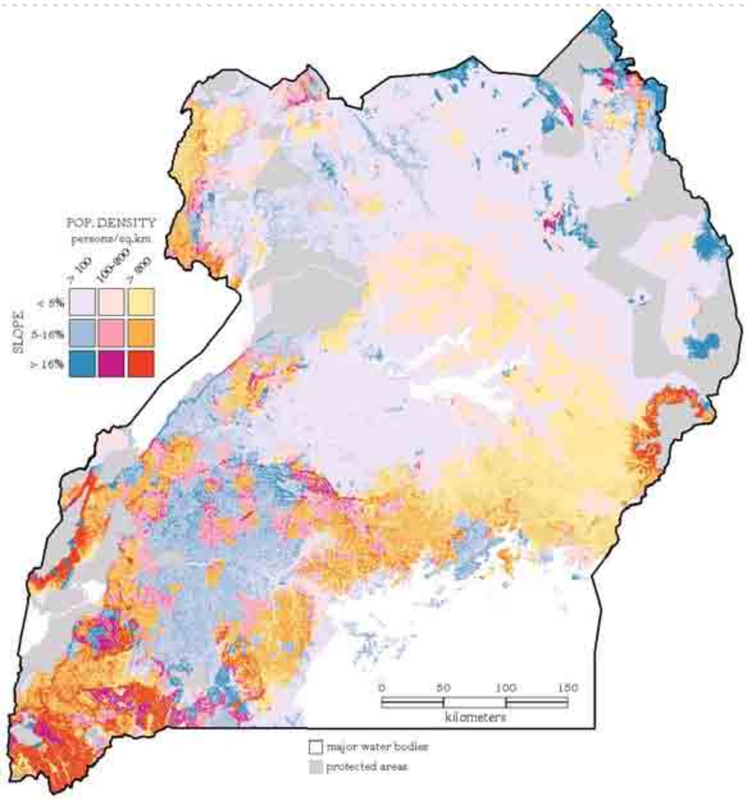
Figure 6.1

* *Development domain key*: b = bimodal; u = uni-modal; h = high; l = low. For development domains, the first letter represents climatic features, i.e. bimodal (b) or unimodel (u); the second represents agricultural potential (high or low); the third is market access (high or low); the fourth is population density (high or low).

Figure 6.2



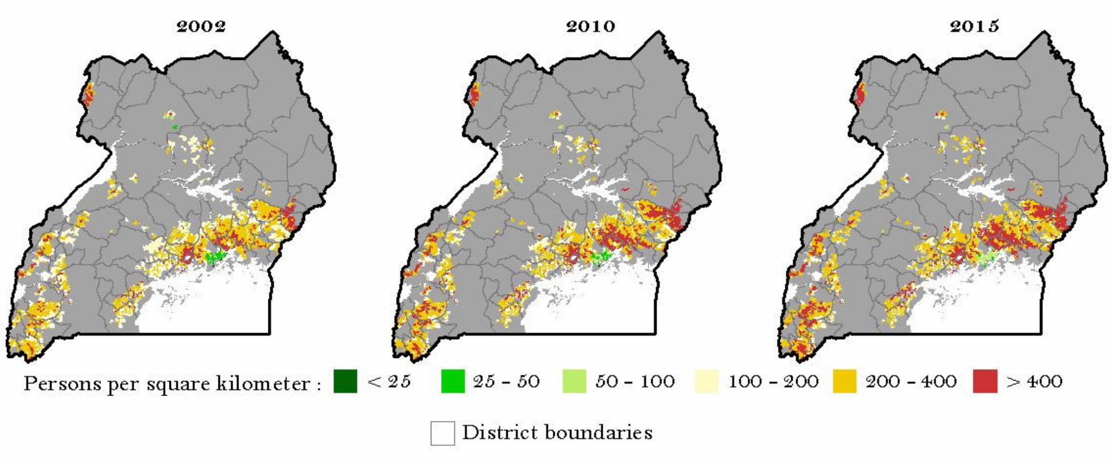
BOX 7. ENVIRONMENTAL AND SOCIAL WELL-BEING HOTSPOTS (SOURCE: SUMMARY BY JORDAN CHAMBERLIN)



"Hotspots" are useful for identifying where development investments may have unintended consequences. For example, these may be areas of potential conflict between policy goals of enhanced agricultural productivity, on the one hand, and environmental conservation goals, on the other. While the relationships between economic, environmental, social and institutional patterns of rural development are often difficult to adequately assess, policy makers require a framework that begins making these linkages and determines where interventions may produce negative externalities. Hotspot mapping can help articulate these issues in a geographically explicit way.

Hotspots for rural development may be defined in terms of environmental or social wellbeing. On the environmental side, the focus is the negative consequences of development pathways on ecosystem goods and services, such as: soil fertility, hydrological functioning, and the diversity of biological resources at the landscapes, species and genetic levels. Humans derive benefits from well-functioning resources directly, e.g., through agricultural productivity, as well as indirectly, such as through the buffering effects healthy systems provide for climatic and other shocks. Spatial frameworks for identifying hotspots are also a step towards more accurate efforts to "scale up" the cumulative effects of different policies for more informed cost-benefit accounting. Hotspots may also be defined in terms of more direct impacts on human wellbeing, such as poverty and health outcomes associated with different investment scenarios. By examining the geographical distribution of such potential hotspots, decentralized decision-making and locally relevant policies are enabled.

The map above shows estimated population densities at the parish level in Uganda in 2015. Steeply sloped areas falling within high-density parishes are highlighted as possible hotspots for soil erosion and impaired hydrological services. One policy recommendation deriving from this may be to target agroforestry extension toward such hotspots. Similarly, the maps below show predicted increases in population density within the traditional zones of intensive agriculture in Uganda: parishes with high population densities and good access to markets. Such estimates may help to gauge the level of risk associated with rapid intensification and to direct efforts to promote the adoption of inputs and more sustainable land management regimes.



Identifying Investment and Policy Reform Options for each Priority Commodity

Once a set of key commodities (or products) have been identified with respect to their potential for affecting smallholder incomes, either by development domain or more broadly, the next stage of analysis is to conduct more in depth analysis on the constraints to production and commercialization that are specific to these commodities. This is important because as markets are increasingly liberalized, the ability of smallholder farmers to compete effectively in the market place depends on many factors that define the structure of the sub-sector within which the commodity belongs, its profitability relative to other commodities, etc.

On the production side, assessing the constraints to productivity growth is a prerequisite to identifying the type of interventions necessary to raise productivity of the key commodity sub-sectors identified in the initial analysis and along a vertically coordinated supply chain. To do so will require a review and analysis of the key factors constraining productivity and performance of the value chain: production, processing, packaging, wholesale and retailing. The analysis would need to be done within the food, export, livestock and aquaculture sub-sectors for instance. Naturally, the overriding set of constraints will differ by location (or development domain) as characterized by agro-ecology, farming system, access to improved technologies (e.g. post harvest technologies and potentially biotechnology), and access to inputs (e.g. fertilizer, seeds, livestock vaccines, credit, etc.).

To help identify specific constraints to productivity growth, various analyses can be conducted. One approach is to use regression analysis to examine some of the key factors affecting the supply response of select commodities. Another is to examine, through brief key informant surveys, some of the critical bottlenecks affecting productivity such as access to input supply services, soil degradation, etc. For example, for a landlocked country like Uganda, the cost of importing critical inputs like fertilizer over land can prove quite high. While it takes an average of 30 days to reach the Mombassa port from overseas ports, it will take about the same time to reach the

Ugandan border from the port of Mombassa, and another 10 days to reach the buyer (Economic Commission for Africa, 2003)

To assess the commercialization potential, and thus competitiveness, of any of the select commodities, an assessment of the overall performance of the commodity (or value added product) is also critical. Performance here refers to the efficient coordination between the various stages of production, processing, and marketing along a vertically coordinated supply chain, which ultimately affects how well a product can compete. To determine whether there are any significant bottlenecks affecting performance, an analysis of the structure and conduct of the various stages along the entire value chain is needed. Typical bottlenecks may include: market information systems; policies (market and institutional); transportation costs and roads; access to finance and credit; quality issues (grades and standards, food safety; transaction costs; post-harvest technologies (processing, storage, bulking), etc. An in depth sub-sector analysis of this type can be conducted using, for example, the structure-conduct-performance (S-C-P) model (see Holtzman, 2002). The model helps to highlight any dominant constraints along a complex supply chain, from production to consumption. This is especially relevant under liberalization as governments increasingly seek to promote greater private sector participation in the provision of inputs (seed, fertilizer and credit), research and extension, and maintenance of product quality.

The experience of the smallholder cotton sector, a highly commercialized activity, is a particularly useful example on which to draw. In reviewing the experience across six countries, Poulton et al (2004) conclude that the challenges for improving the performance of this sector have centered more around how to enable greater levels of competition while also ensuring better coordination between buyers and sellers with regard to the provision of inputs, output delivery, contract negotiations, uniformity in product quality, and so forth. They find that countries with fewer concentrated buyers in the ginning sector tend to outperform those with many. The improved performance comes at a cost of reduced competition, and thus potentially lower returns to smallholder producers. In Zambia, public sector involvement has helped to strike a balance by providing incentives for both buyers and sellers to coordinate more effectively through existing out-grower schemes established by a few companies in the ginning sector (Tschirley, Zulu and Shaffer, 2004). **Box 8** also provides an illustration for the maize sector in Uganda.

Based on sub-sector analyses like these, key policy recommendations can be devised. For instance, policies could be designed to empower smallholder producers to cooperate through producer organizations in order to improve their bargaining power when negotiating contracts with a few buyers. Innovative institutional arrangements may also be needed to establish 'rules of the game' for market coordination, as well as a system for improving quality control through grades and standards.

Prioritizing Thematic Lines of Investment Options

The product or sub-sector oriented approach outlined above is likely to highlight some common thematic constraints faced by a majority of investment options. For example, lack of roads and weak marketing institutions can constrain the commercialization and growth potential of many types of potential marketable products in the region. Investments that remove these constraints can therefore have a broader impact beyond the number of priority products considered, to include opportunities in the non-farm economic sector. Examples of such rural sector-wide thematic investments include investments in roads, education, health and rural finance. Econometric analysis of community and household survey data is a useful way of evaluating the potential impact on productivity and poverty of such thematic investments at regionally disaggregated levels. This approach draws upon cross-sectional variation between communities and between households to measure differences in community and household income and poverty attributable to the accumulated stock of past investments in infrastructure, human capital and other thematic areas. Where time series data are also available for the same communities or households (as in rural household surveys), then more detailed work can be done on the dynamics and lagged effects of many longer-term investments. When combined with independent estimates of the unit costs of different types of investment, the approach provides immediate measures of cost/benefit ratios and the unit costs of raising poor people out of poverty for each investment, which is extremely useful information for setting investment priorities.

BOX 8. SUB-SECTOR ANALYSIS OF THE PERFORMANCE AND STRUCTURE OF THE MAIZE MARKET IN UGANDA (*SOURCE*: BY THE INDEPENDENT CONSULTING GROUP FOR PRIVATE SECTOR FOUNDATION (PSF) OF UGANDA, 2004)

A recent study conducted by the Independent Consulting Group in Uganda assesses constraints and prospects for Uganda's maize supply chains. The analysis was conducted to assess the potential for increasing the competitiveness of the maize sector to increase exports and raise rural incomes. Some of the key findings include:

- The supply chain begins at the smallholder farm level, producing up to 800,000 mt of maize grain. Few use any modern inputs nor have post harvest equipment. The marketing chain involves several participants involving rural and urban traders, millers, large-scale traders and exporters.
- At the production level, the need to increase efficiency, reduce post harvest losses, improve quality, and improve linkages with the private sector were identified as key areas needing attention
- Participants in the marketing chain have no formal linkages and are therefore not integrated well as in export industries like tobacco and sugar cane. Transactions are mostly done through spot markets with much speculation.
- Because of the bimodal nature of rainfall patterns in Uganda, the country has a comparative advantage to potentially supply maize to Southern African countries during their May to September dry season. Even the Kenyan markets tend to be undersupplied from Uganda, with room to expand exports to Kenya by another 400,000 - 700,000 mt.
- There is a need to pre-process maize destined for exports, allowing stocks to be accumulated over time through better storage, cleaning and re-drying. Sorting will also help improve the quality and consistency of the grain.
- Current packaging of maize meal is not suitable for exports markets. Unfortunately the quality of packaging is dependent on costly imports of packaging materials.
- The greatest threats to the supply chain involve the high production costs, transaction and transportation costs, poor quality and enforcement of grades and standards, and generally a lack of strategic investments to improve the competitiveness of the sector in regional markets.

In the example of Uganda, the recent findings by Fan et al (2004) show clearly that the returns to government investments are particularly high for agricultural research and development (R&D), rural feeder roads, and education (See **Table 3**). At the national level, per million shilling invested in R&D, approximately 81 are lifted out of poverty. Not surprisingly, across the various regions in Uganda, the poorer, isolated and politically insecure North shows the highest gains from public investments.

Table 3. Returns to Government Investment in Rural Uganda (also see Box 11)

Investment	Central	East	North	West	Uganda
Benefit–cost ratio					
Agricultural R&D	12.49	10.77	11.77	14.74	12.38
Education	2.05	3.51	2.10	3.80	2.72
Feeder Roads	6.03	8.74	4.88	9.19	7.16
Murram Roads	n.s.	n.s.	n.s.	n.s.	n.s.
Tarmac Roads	n.s.	n.s.	n.s.	n.s.	n.s.
Health	1.37	0.92	0.37	0.96	0.90
Number of poor people reduced per million shilling					
Agricultural R&D	30.23	92.15	243.92	67.97	81.14
Education	3.57	21.60	31.38	12.62	12.81
Feeder Roads	10.51	53.85	72.82	30.49	33.77
Murram Roads	4.08	11.88	14.80	9.77	9.70
Tarmac Roads	2.59	13.12	62.92	9.39	9.73
Health	2.60	6.15	5.95	3.46	4.60

Source: Fan et al. 2004
Notes: n.s. indicates that the respective coefficients were not statistically significant.

Other Considerations

Although broad-based agricultural growth centered on small farms can have long run and permanent effects on reducing poverty and hunger in Africa, there will always be a continuing need for targeted assistance for many of the chronically poor and for safety net programs to protect the vulnerable against shocks (e.g. due to weather, market and health risks). As highlighted in the FAO's Twin Track approach, many communities may still lack the ability to take advantage of the opportunities created by rural development (**Box 1**). For example, the prevalence of high undernourishment, HIV/AIDS and malaria, and illiteracy, can prevent many households and communities from taking advantage of policy incentives and public investments designed to stimulate growth and development. Therefore, by raising the well-being and asset base of rural households, they become empowered and gain a greater capacity to deal with future shocks (Hazell and Haddad, 2001).

A key advantage of adopting a spatially oriented analytical framework is that it can help to map out evidence of any varied pattern in livelihood options across communities. By overlaying poverty maps with maps that describe local conditions and well-being, development options that have a good chance of helping the poor and food insecure can be further explored. A more detailed analysis of household level characteristics and constraints would also be required to help target specific policy interventions and safety net programs aimed at ensuring stable and adequate access to food among households and communities. Options for intervention would include, for example, enhancing access to productive assets and income transfers, promoting the emergence of non-farm enterprises, improving access to rural credit, targeting direct-feeding or food-for-work programs during periods of poor harvest, and creating safety nets and emergency food relief programs in areas prone to famines or facing a high prevalence of HIV/AIDS.

Re-assessing the Sufficiency of the Choice and Level of Investments

Once a potential set of investments have been identified, the question arises as to whether they would be sufficient in terms of their coverage and scale to achieve agreed agricultural development strategy goals, e.g. halving poverty and hunger by 2015. The same analytical tools used at the goal level provide a useful framework for such evaluations. For example, for Uganda, a CGE model was used to assess the likely implications of investment and policy reform options on overall economic growth (see **Box 9**). The simulations were conducted around a portfolio of potentially feasible policy interventions and commodity-based investments. The results show larger growth effects of an export-oriented strategy focused on improvements in total factor productivity (TFP) of export crops (coffee, maize, horticulture, and other crops). In contrast, a similar shock in non-tradable staple commodities (plantain, cassava, sweet potato, millet and sorghum), results in depressed producer prices (declining by 8 percent). When TFP improvements are introduced for all agricultural tradable and non-tradable commodities, and combined with a proportional decrease in marketing margins, the impact on poverty reduction is far larger, about twice that expected from improvements in tradable commodities alone. This final result is particularly important in emphasizing the combined income effects of falling food prices and increased returns from export crops on overall consumption, investments and economic growth.

A multi-regional, single commodity partial equilibrium model can also be used to analyze the impact of supply and demand changes of a single commodity on both producer and consumer welfare and within each development domain. In this way, different investments by commodity and domain can be compared and contrasted in terms of net benefit streams over time (say to 2015), and allowing decision makers a narrower set of priority commodities and products from which to choose. Using information on the cost reducing effects of improved practices, the Uganda study assesses the potential economic gains from adopting such practices for each commodity and development domain included in the study (see **Box 6)**. Not surprisingly, results show that plantain would gain the most given its scale of production as a major staple. This assumes demand will continue to grow at close to current population growth rates. Other staples like cassava and millet rank right behind it. The bimodal 'high agricultural potential, high market access, and high population density' development domain gains the highest returns for all crops except cassava. Because the costs for research and extension were unknown, these returns are currently presented as gross benefits. Ideally and wherever possible, some indicative investment costs must be used to calculate a more appropriate economic rate return or cost-benefit ratio.

Even if a final set of investment priorities have been decided on by key stakeholders based on the analysis and policy dialogue, the question of how to go about implementing the recommended policy reforms and investments, including the appropriate sequencing and timing, targeting, and level of effort, that is considerate of local circumstances (political, institutional, social, etc.) is indeed a challenge. Moreover, the establishment of a monitoring and evaluation system to track progress, performance and assess impact over time is also critical to ensure accountability and to assess progress against planned goals.

BOX 9. ECONOMY WIDE IMPACTS OF INCREASED AGRICULTURAL PRODUCTIVITY, SOME PRELIMINARY RESULTS (SOURCE: SUMMARY BY SIMON BOLWIG)

Using a Computable General Equilibrium (CGE) model of the Ugandan economy (Dorosh et al. 2002), which accounts for spatial variations in agricultural production and household incomes, various simulations were conducted to quantify some of the important linkages between agriculture and other sectors, as well as the implications of various external shocks and investment scenarios. The Uganda CGE model was chosen for this analysis in order to assess more broadly the macro-economic effectiveness of alternative development scenarios in terms of their potential to generate overall income growth. These scenarios are built around a portfolio of high-potential and feasible commodity/market opportunities and investments in complementary sub-sectors, which were identified through previous analytical steps (illustrated in earlier boxes of the Uganda case study). Presented here are some selected results of the simulations. Results are reported as the percent change from the base year (1999) that results from a 'one-shot' productivity increase (the results are only preliminary).

The first example compares a *Staples* scenario with a *Coffee & other* scenario. The *Staples* scenario simulates the combined effect of increasing TFP by 10% for staples (sorghum/millet, cassava, sweet potatoes, and matooke), 2.5% for milling, and 1% for manufacturing. Staples, which account for about 15% of total value added in the Ugandan economy, are non-traded goods, and the productivity assumptions would mean an increase in the value added for staples by about 4%. Total household consumption would increase by 1.6%. As a result of increased supply, the prices of staples would fall by around 8%. This particularly benefits the urban population who experience higher income growth than farmers in most regions and who increase their consumption by 1.7 %. The *Coffee & other* scenario simulates the combined effect of increased TFP by 10% for coffee & other (coffee, maize, horticulture, and other crops), 2.5% for milling, and 10% for coffee processing. Milling, manufacturing, and coffee processing account for very marginal shares of value added in the Ugandan economy and are included only to illustrate that a portfolio of agriculture sector investments also would include related non-farm activities, particularly agro-processing and marketing. On the other hand, the coffee & other sub-sector accounts for about 20% of total value added and consists of internationally traded goods. The growth effects of productivity changes are generally larger than for staples, but it is not possible to determine whether this is due mainly to its higher share in total value added or to the differing macro-economic dynamics of traded and non-traded goods. The assumed productivity gains for 'coffee and other' would imply an increase in total value added by 1.8%, whereas total household consumption would increase by 2.3%. The prices of the sub-sector would decrease by 0.6 – 8.9%. Farmers would increase their household consumption by 1.7 – 2.1 percent, depending on agroclimatic zone, and the urban poor would increase their consumption by 2.5%.

The second example compares a relatively 'narrow' rural investment scenario with a 'broad' scenario. In the 'narrow' scenario, a 10% increase in TFP for all agricultural sectors is combined with a 10% reduction in the agricultural domestic and export marketing margins. The 'narrow' scenario leads to an increase in total household consumption by 4.5%, and in total value added by 3.4%. Total value added increases by 6.4% for agriculture alone, and the percent increases in value added for each sub-sector runs from 0 for manufacturing to 10.5% for coffee and coffee products. This is significantly higher than for the *Staples* and the *Coffee & other* scenarios. The 'broad' scenario includes all of the above simulations as well as a 10% TFP increase in milling, coffee processing, meat and dairy, a 2.5% TFP increase for textiles and leather, and 1% TFP increase for manufacturing. The results show a 4.6% increase in total household (real) consumption, a 3.5% increase in total value added, and a 6.5% increase in agricultural value added. Total growth rates for each of these variables range from 0.10 to 0.17 %, which is only marginally higher than in the 'narrow' scenario. The 25 sectors of the Ugandan economy will experience growth rates in value added from 0 for trade to 10.1% for coffee and coffee products.

2.4. Review of Best Practices and Lesson Learned

To help guide the process of designing investment and policy intervention programs, a review of best practice approaches and lessons learned can be particularly useful. This would include drawing heavily on a country's own experiences, buttressed by a thorough review of lessons learnt elsewhere. For example, on the sequencing of public investments, a review of lessons from India suggests that large rural infrastructure investments (roads, irrigation, and agricultural research and extension) are fundamental prerequisites (Johnson, Hazell and Gulati). The challenge is ensuring that the scale of infrastructure investment is targeted to those areas where there are positive economic returns from investment. For example, as pointed out earlier, Fan et al. 2004 show positive returns across much of Uganda for rural feeder roads and agricultural research (see **Table 3**). Without basic road infrastructure to link farmers to markets, most African farmers will continue to depend on low input technologies. According to Dorward et al. (2003), most African countries remain at the early stages of rural agricultural transformation. At this early stage, they argue, investments in basic infrastructure and institutional arrangements are needed to provide incentives for farmers and entrepreneurs to engage in commerce.

The role of the public sector is particularly critical during this early period, as evidenced in Asia's successful transformation. Unfortunately, the abrupt withdrawal of public sector involvement in the provision of inputs like fertilizer and seeds, and the procurement of smallholder output, simply forced a majority of smallholder producers to return to subsistence farming. Meanwhile, governments throughout Africa neglected to establish well functioning market institutions and a regulatory environment to encourage the private sector to enter in its place (Kherallah et al. 2002). As a result, high costs and difficulties in distributing improved technologies due to poor infrastructure and market development have kept out the private sector from assuming this role. As long as delivery costs remain exorbitantly high due to poor infrastructure and production uncertainties, there may well be justification for an initial fertilizer subsidy, at least until such constraints have been removed (Johnson, Hazell and Gulati).

Even if we know more generally the appropriate sequencing of investments, how to go about designing programs and targeted interventions will require a review of best practices adapted from within or from outside a country's own experience. A recent review of successes in Africa provides a rich source of experiences on what type of interventions have worked and been successful over the years (see Gabre-Madhin and Haggblade, 2003 and Haggblade et al. 2004). Among the case studies reviewed, the most successful interventions were found to be those related to: soil and water conservation, replication of proven commodity-specific breeding and processing successes (e.g. cassava), marketing and information systems, vertical supply chains to improve efficiency, and improving regional cooperation in trade and agricultural technology. Overall, the evidence from the successes reviewed suggested two fundamental prerequisites for sustained agricultural growth in Africa: good governance and sustained funding for agricultural research and extension.

Another difficult question that follows is how to design successful programs and policies to implement the recommended sequence of investments. Omamo (2003) suggests that this has been one of the weakest links in placing research and analysis on the policy agenda, especially by failing to analyze the operational feasibility of implementing alternative policy options.

2.5. Monitoring and Evaluation

A critical part of any rural development strategy is the establishment of a monitoring and evaluation system to track progress, performance and assess impact over time. Not only does this help justify resource investments and ensure accountability, it also helps inform what has (or has not) been working. As a result, strategies can either be adjusted or maintained depending on the progress towards achieving development targets. This only emphasizes the role of monitoring and evaluation as an integral part of the strategy development process, which if it is to be successful, has to be amenable to adjustments as lessons are learned during implementation.

Typically, an M&E system of a development strategy is intended to ask questions such as: Are investments on track to meet the MDGs of halving hunger and poverty by 2015? If not, what needs to be altered? How can the impact of these investments be traced to improvements in the diversity, productivity and long-term viability of production systems, food processors, agro-industries, markets and trade? How have these improvements affected incomes and the poverty status of rural and urban households? What was the distribution of these intermediate impacts, e.g. on smallholders, on equity, on gender?

According to Dalal-Clayton and Bass (2002), for an M&E system to be effective, it will need to be established under a systematic framework, one that combines various aspects such as: i) the state of affairs in the socio-economic and natural resource environment; ii) performance monitoring of strategy implementation; iii) evaluating results and assessing impact; and (iv) reporting and disseminating the M&E analysis. From an analytical perspective, the framework will need to incorporate both internal and external types of M&E. Internal M&E is useful for management purposes while the external one is geared towards ex-post impact assessment. Moreover, the analysis will also need to be driven by the strategic objective rather than data availability alone, emphasizing the importance of strategically selecting development targets.

The selection of appropriate indicators for M&E systems is critical. Indicators must be SMART: specific, measurable, accessible, relevant and time-based (Baker et al, 2001). To maintain credibility, an M&E system will also need to utilize sound baseline data and analysis in order to measure any counterfactual with respect to the 'before and after' and 'with and without' impact from investment. Therefore, developing a sufficiently robust M&E system that links strategy implementation with outcomes is an especially challenging task, as the example for Uganda illustrates in **Box 10**. Specifically, it is difficult to track information on intermediate outputs, e.g. productivity, wages, transaction costs, etc., that ultimately affect outcome goals like income. A real analytical challenge is to measure and explain the causality and attribution between inputs (expenditures) to output and outcomes, given many other potential confounding factors.

We discuss ways in which some of this could be accomplished, focusing the attention on possible analytical approaches

BOX 10. THE NEED FOR DEVELOPING AN M&E SYSTEM: THE EXPERIENCE OF UGANDA (*SOURCE*: HAUGE, 2003)

According to a recent report commissioned by the World Bank to review Uganda's capacity for M&E, the report concludes that despite the availability a large body of information derived from existing M&E systems in Uganda, "there are growing indications of poor effectiveness and value-for-money for a better understanding of development effectiveness—what works, what does not, in which contexts, and why." (pvi, Hague, 2003).

The challenge is adding the various parallel M&E efforts managed by different government units into a cohesive whole to avoid duplicating data collection efforts and reduce the overall M&E workload. The good news is that Uganda is seriously trying to find way to establish a systems approach to M&E – especially as civil society increasingly demands for better government accountability and donor support is increasingly channeled through budgetary support mechanisms. According the report, four actions were recommended for improving M&E systems in Uganda:

1) Even though there are sufficient accurate measures of input data (expenditures) and outcomes (poverty), information on intervening output indicators is needed (i.e. often referred to as the missing middle).
2) The system needs to consider issues of causality and attribution between the stages of development change.
3) Incentives need to be better tied to the underlying performance revealed by M&E, rather than on the simple compliance with reporting requirements
4) The multiple M&E arrangements currently in place between national and donor programs result in complex and burdensome guidelines for data collection and reporting.

In reviewing the general lessons with existing M&E systems, the report summarizes some of the aspects of those systems that have worked best:

1) Those that have been designed for and by national decision makers have worked best, citing the example of Uganda's Poverty Eradication Program (PEAP).
2) Systems with a small amount of relevant and reliable data
3) Those that have effectively integrated the evaluation aspect as part of the monitoring exercise.
4) And, those that have involved civil society to assess end-user's perceptions of public services
5) Clear stated goals and objectives help strengthen a results orientation in planning and management.

2.5.1. Descriptive and Spatial Analysis

Although many types of investments may be tracked using a variety of tools, attributing impact to specific investments may not always be possible. Therefore, in many cases, tracking changes in major outcome indicators may be sufficient (including proxy variables where appropriate). Descriptive analysis can provide a powerful means for narrating a compelling story at all levels of analysis: community, sub-national or domain level, national, regional and sub-continent wide (see for example Resnick, 2004). The statistics can help to quantify changes in the extent and distribution of poverty and malnutrition across geographic areas and population groups, even influencing a response in adapting to changing conditions in one region or more.

Mapping the spatial distribution of key variables and/or M&E indicators can also offer a powerful means for monitoring progress. In addition to the traditional mapping of outcome variables like poverty, mapping out the wide range of targeted investment inputs among donors and government agencies can improve the transparency of development activities, allowing for better coordination and dialogue in planning, as well as offering another monitoring tool for the efficient allocation of resources. A few countries are beginning to do this. For example, in Ghana, the Center for Remote Sensing and Geographic Information Systems (CERSGIS) is currently conducting such an exercise.

2.5.2. Economic Models and Approaches

Although a descriptive analysis of trends in key outcome variables can be useful for assessing broad progress, more in-depth analyses are often needed to disentangle the direct effects of investments from other confounding factors.

Since a lot of information on rural investments is collected at the project level, an ideal approach to assessing direct impact on outcome variables would be to collect information on randomly selected members of target and non-target populations (as a control group) located in relatively homogenous environments in order to assess the "with" and "without" investment scenarios, as well as the "before" and "after" investment scenarios. Accounting for both types of analyses that includes a control group isolates any confounding factors and the probability that the outcome was simply due to chance since both groups would have been randomly picked from the same population (Johnson et al, 2003).

In most cases, however, information on target beneficiaries may not always be straightforward (such as for thematic type investments like infrastructure), nor do policy makers often want to deliberately exclude anyone for the sake of a scientific experiment. Therefore, it may not always be possible to undertake such a micro-level analysis of impact. Rather, analytical models can be used to simulate changes under more aggregate 'with and without' or 'before and after' scenarios. Assuming model specifications and baseline parameters are indeed correct, *ex ante* models like CGE and the multi-market model that are often utilized for priority setting can also be applied here. If sufficient time series data exists with regard to the key input and outcome variables, econometric methods can be used to assess impact *ex post*. If neither approach is feasible, short cut approaches can be devised by taking advantage of what we already know about the marginal impact of investments on outcome variables, either from relevant country case studies or from other countries that share similar characteristics. We review now some of these approaches in more detail below.

2.5.2.a. *Partial and General Equilibrium Models*

Ex ante simulation models such as the CGE and multi market models can be used to provide a means to track pathways by which project investments impact on final goals, potentially explaining the causality and chain of events throughout a project's life (e.g. investment → productivity → enhanced profitability and consumption → poverty reduction). Such information is extremely valuable for explaining why changes in certain outcome variables may not be occuring at the desired rate. Moreover, by evaluating impact *ex ante*, the models can not only help assess whether investments are on track for achieving overall program goals, they can also help highlight whether current investment portfolios and levels of effort are appropriate.

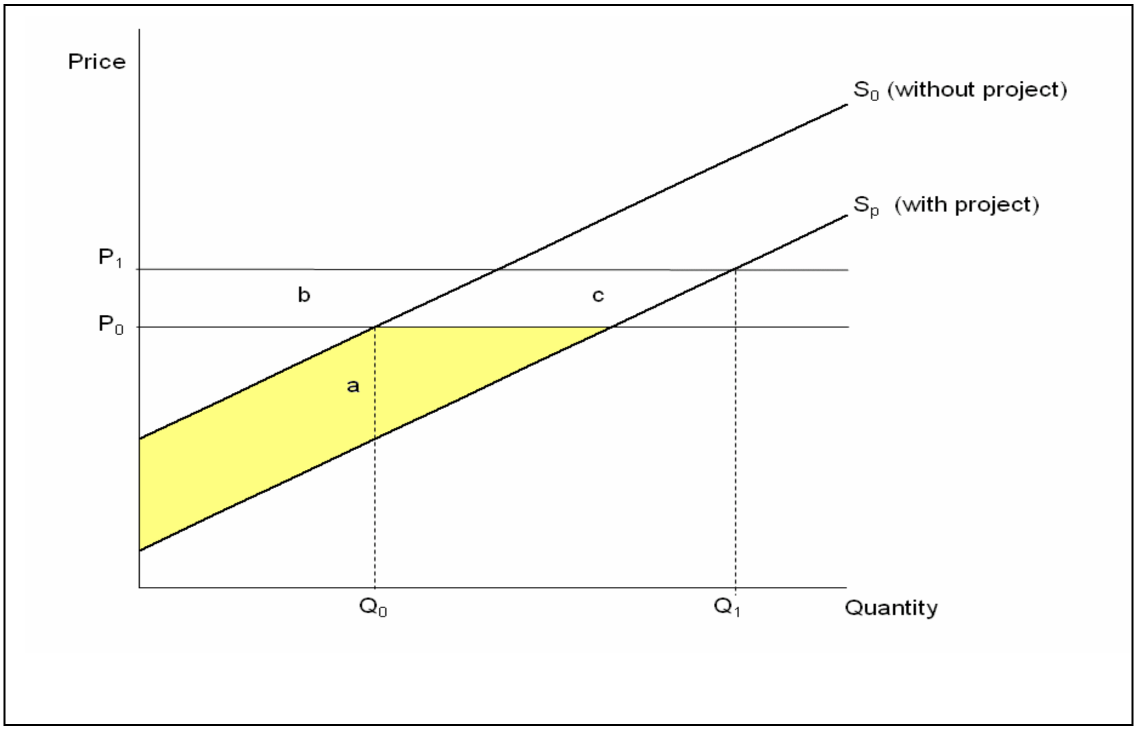
Economic simulation models may also be used to evaluate *ex post* impact. This can be accomplished by quantifying projected outcomes both 'before' and 'after' program investments and 'with' and 'without' changes in confounding factors over the life of the project investment (e.g. exogenous changes in prices or weather events). This provides a basis to isolate project impacts when all confounding factors are held constant, and to measure windfall gains or losses attributable to confounding factors.

Consider a project investment that leads to an increase in the productivity of a tradable commodity facing a perfectly elastic demand. In Figure 4, the project shifts the initial supply function from S_0 to S_p, with the rightward rotation reflecting reductions in the unit cost of production. However, suppose that while the project is being implemented, the price of the commodity also increases from Po to P_1 for reasons that have nothing to do with the project. This represents a typical confounding factor in impact analysis.

In order to distinguish between the impact of a project from exogenous price changes requires model simulations of "with" and "without" project scenarios that hold the price unchanged, and "with" and "without" price change scenarios assuming that the project was not undertaken. As the result of such simulations, area **a** in Figure 4 represents the income gain attributable to the project alone while area **b** indicates the income gain due solely to the price change. Area **c** is the interaction term that emerges from the joint happening of the project and price change while **b+c** represents the windfall gains due to the exogenous price increase. Thus, lessons about the effectiveness of the project should be based on area **a** rather than the total gains represented by **a+b+c.**

The degree of sophistication and coverage of simulation models will vary according to the level of analysis needed, whether economy wide, sub-sector or commodity focused, and the type of interventions, whether technology-based, market or trade policy oriented, or institutional in nature. For example, the CGE or multi-market models are particularly useful at analyzing policy issues related to trade and macroeconomic reforms, including reforms or institutional changes that directly affect marketing and trade transaction costs. Key information that can serve as model inputs include quantitative representation of policy shifts, changes in factor productivity, marketing margins or transportation costs, and income transfers. By incorporating all the sectors of the economy, interaction effects across sectors, and the extent to which sector-specific investments can impact on economic growth and poverty, the models are particularly suited for assessing overall progress towards achieving future targets, such as halving poverty by 2015.

Figure 4: Measuring Project Impact *Ex-Post*



Single commodity economic surplus models, on the other hand, are more suitable for commodity specific analysis, such as analyzing the direct and spillover impact of productivity enhancing technology dissemination activities (see Alston et al. 1995). For monitoring and impact assessment purposes, key variables to shock in the model would include a known (or projected) adoption rate, the cost-reducing effect of a new technology, and any spillover effects to non-targeted regions. Ideally, these are variables that could be collected periodically.

Since the model parameters and underlying data structure are benchmarked to a particular base period with sufficient data, the models will need to be revised and calibrated as new data becomes available. By validating to the new underlying data, the models will remain reasonably adapted to reality by capturing any changing conditions in the overall economic structure and environment.

2.5.2.b. *Econometric Approach*

Given sufficient historical data, the marginal impact of investments can be estimated directly using the econometric approach. This principally benefits monitoring and evaluation by helping to provide estimates on the actual marginal impact of a dollar invested on important outcome variables like poverty. Furthermore, it provides a means for measuring the efficiency of investments, such that the current portfolio of investments can also be reviewed and challenged.

The econometric approach uses multivariate regression techniques to isolate important relationships among many variables, and for impact assessment, help explain any causality that may exist between inputs (independent) variables and outcome (dependent) variables. For example, if there is sufficient household level information on the beneficiaries of the program, econometric approaches will also be helpful with untangling the effects of the various investments on overall welfare measures such as poverty. Subsequently, the models can also be used to delineate and validate the different channels by which investments translate into impact by imposing a hypothetical relationship or model structure *a priori*. For example, Fan, Hazell, and Thorat (2000) and Fan, Zhang, and Zhang (2002) constructed an econometric model to estimate the effects of government spending on poverty reduction through various channels. Similar to the logical framework presented in the previous section, causal linkages are represented by a system of equations that can be further used to derive empirical measures of the marginal impact of various investments through different channels. This time however, the system of equations is estimated directly, in effect estimating elasticities that are relevant to the data itself. Because this type of analysis requires long, time-series data which most African countries lack, certain adjustments may have to be made to adapt to the African context (see example for Uganda in **Box 11**).

BOX 11. ASSESSING THE IMPACT OF PUBLIC INVESTMENTS ON POVERTY IN UGANDA (SOURCE: FAN ET AL. 2004)

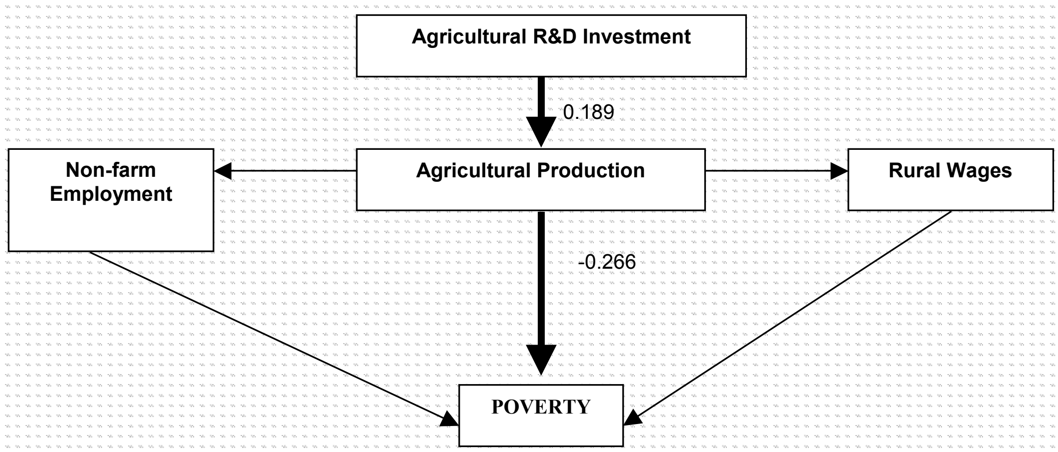
Using a simultaneous equations model, Fan et al. 2004 estimate the effects of government expenditure on rural poverty through various channels. Limited to data availability, the formal structure of the system involved four equations:

P = f (AOUTPC, RWAGES, NFE)
AOUTPC = f (LANDP, FERTP, AGEXT, RLITER, DROADS, PSICK)
RWAGES = f (AOUTPC, RLITER, DROADS, PSICK)
NFE = f (AOUTPC, RLITER, DROADS, PSICK)

Where the major determinants of poverty are hypothesized to include: Agricultural production (AgPROD); rural wages (RWAGES); and NFE = non-farm employment (NFE). Each of these are in turn determined by other factors: land inputs (LANDP), fertilizer per unit of labor, (FERTP), agricultural R&D and extension (AGEXT), rural literacy rate (RLITER), different types of roads (DROADS), and the share of people who have been sick within the past 30 days (PSICK). Once the system had been estimated, the marginal impact and elasticities for different public expenditures was derived by totally differentiating the four equations. Taking the derivative of the equation with respect to agricultural R&D (AGEXT), the resulting relationship shows how agricultural R&D affects poverty through its impact on agricultural productivity.

$$
\begin{aligned}
dP/dAGEXT = & (\partial P/\partial AOUTPC)(\partial AOUTPC/\partial AGEXT) \\
& + (\partial P/\partial RWAGES)(\partial RWAGES/\partial AOUTPC)(\partial AOUTPC/\partial AGEXT) \\
& + (\partial P/\partial NFE)(\partial NFE/\partial AOUTPC)(\partial AOUTPC/\partial AGEXT)
\end{aligned}
$$

The marginal impact of AGEXT on P is then calculated by using the coefficients derived from the system of equations estimation (calculated as –0.05). The resulting relationship can also be represented graphically as:



Multiplying the poverty elasticity with respect to agricultural R&D investments by the total number of poor people in Uganda, and then dividing by the total cost of R&D investments (in millions of Ugandan shillings), provides an estimate of the number of people that would be lifted out of poverty by each one million shillings spent. The results are presented in **Table 3** (outside this box) and estimate this number to be about 81. Such information can also be useful for M&E. For instance, if we know the government spent about one hundred million shilling on agricultural R&D investments, we would expect approximately 810 people to escape poverty, *ceteris paribus*. This approximation can eventually be verified and adjusted with actual poverty trends once new surveys are available (usually once every 3-5 years).

Note: Also see **Table 3**

Based on available data covering three years (1992, 1996 and 1999), the model specification assumes that agricultural labor productivity, rural wages, and the share of non-agricultural employment are major determinants of rural poverty. In the system of equations, agricultural labor productivity was assumed to contribute directly to poverty reduction through increased income. Both rural wages and the share of non-agricultural labor were assumed to be reasonable proxies for non-farm income. Meanwhile, agricultural productivity was defined as a function of production inputs (land and fertilizer) and public investment outcomes (an agricultural research and extension stock variable, education status as measured by the rural literacy rate, and the average distance of households to different types of roads). Their estimation results revealed that government spending on agricultural research and extension, rural roads, and education had the largest marginal impact on poverty reduction. Investments in roads and education had the largest poverty reduction effects in the poor, Northern region while the impact on agricultural productivity was most pronounced in the relatively better endowed Western region.

2.5.2.c. *Short Cut Approach*

Where an appropriate econometric model has not already been estimated, it may be possible to use available empirical estimates on the behavioral relationship among key variables, such as estimates of the marginal impact of certain investments on poverty (in terms of elasticities). **Box 12** provides a simple but hypothetical illustration of the approach. An advantage of using this so-called 'short cut' approach is that rather than building costly and data demanding models for impact assessment, the approach takes advantage of what we already know about some of the important causal linkages between certain input and outcome variables.

While the approach is pragmatic and simple, there are limitations for its use. First, there are only a limited number of elasticity estimates relating investments to outcomes, both in terms of the investment type and its application in the African context. Even if elasticity estimates are derived from African case studies, they are still likely to vary across countries and over time. Secondly, the channels by which certain public investments, such as strengthening institutional capacity, will impact on poverty is not straightforward, at least without any additional, and potentially costly, empirical work.

BOX 12: AN ILLUSTRATIVE SHORTCUT APPROACH FOR ASSESSING IMPACT AND ATTRIBUTION (*SOURCE*: PETER HAZELL)

Impact can also be assessed using available empirical estimates on the behavioral relationship among key variables. For illustrative purposes only, suppose there are known estimates of the marginal impact of certain investments on poverty (in terms of elasticities), and we also know the following causal relationships among them:

$$\dot{POV} = 0.8\,\dot{ROADS} - 1.1\,\dot{RDE} - 1.5\,\dot{MKT}$$

Where:

RDE	investments in R&D and extension (science and technology)
ROADS	investments in rural roads (infrastructure)
MKT	investments in market institutions / policy reforms (markets)
POV	number of rural people earning less than $1/day (or rural population falling below

and the dot above each variable refers to a percent change (e.g. $\dot{POV} = \dfrac{dPOV}{POV}$**)**

Further, suppose we observe the following changes in the key variables between two periods:

$$\dot{POV} = -5.2\%, \dot{ROADS} = 1\%, \dot{RDE} = 1\%, \dot{MKT} = 2\%.$$

Then the predicted change in poverty is **-4.9%**. Since the actual change in poverty is **–5.2%**, then the difference of **0.3%** is attributable to a residual variable. The reduction in poverty can now be attributed to its various sources. For example, the share due to change in ROADS is calculated as **(-0.8)(1.0)/ (5.2)** × **100% = 15.4%**. That is, of the observed **5.2%** reduction in poverty, **15.4%** can be attributed to increased roads. If the share of the increase in roads due to investments is known (say **0.3**), then multiplying **15.4%** by this share will give the percentage decline in poverty due to investments in roads (in this case **15.4** × **0.3 = 4.6%**).

Similar calculations show that changes in RDE account for **21.2%** of the reduction in poverty, changes in MKT account for **57.7%**, and the residual accounts for **5.7%**. Again, if the shares of the changes in RDE and MKT due to investments are known, more detailed attributions of the change. Then the predicted change in poverty is **-4.9%**. Since the actual change in poverty is **–5.2%**, then the difference of **0.3%** is attributable to a residual variable.

2.5.2.d. Limitations of Models for M&E

An important limitation with many monitoring and evaluation models (or impact assessment models) is that they tend to impose deterministic and smooth relationships between inputs, outputs and outcomes, which are not always completely realistic. Often, there are thresholds and scale economies beyond which investments have any real direct impact, such as when a weak institutional and infrastructure environment prevents the benefits of policy interventions and public investments from being distributed widely. Additionally, investments or policy interventions do not always have a direct impact on outcomes. Instead, they often have indirect impacts, affected by various other socio-economic variables from the micro (project) level to the macro (national) level. Unpredictable exogenous shocks such as climate and natural disasters, market and trade conditions, political instability, etc. can greatly affect development outcomes. Moreover, linking important output indicators to outcomes or impact is not an easy task either, which raises the difficult task of attribution.

As with any model, the simplified assumptions of the underlying theory on which the model structure is built upon can influence the results significantly. Moreover, the challenge of distinguishing between a simple correlation and a true causal relationship is always present and again, subject to the underlying theory imposed on the system. These limitations show why more emphasis should be placed on the observed interrelationships and direction of change from the analysis, rather than the estimated magnitude of impact.

In addition to the theoretical limitations of the models, the application of many of these types of models in the developing country context adds further obstacles. According to Sagasti (1990), these obstacles include: 1) a lack of reliable data and statistical information; 2) a lack of experience in building policy oriented models (rather than complex research-oriented models); 3) a lack of experience and unwillingness of policy makers to work with mathematical models; 4) a scarcity of financial, physical and human resources, especially to support model building activities and analytical capacity; and 5) weak institutional incentives to retain capacity and continuity in modeling and analysis over time. Moreover, the problems of rural poverty and food insecurity are inherently complex and multi-dimensional and add to the general skepticisms of relying too much on analytical tools alone.

2.5.3. Impact Assessment Case Studies

Periodically, more in-depth impact assessment case studies may be warranted to examine more closely whether certain investments are attributable to observed outcomes (either in terms of the level or distribution of impact). Such studies help to generate additional knowledge on important lessons learnt, especially in revealing conditions under which successes occurred. The recent review of successes in Africa agriculture is an excellent example (Haggblade et al. 2004). So are the many studies that have assessed the impact of agricultural research and development in Africa (e.g. Evenson and Gollin, 2002; Maredia et al. 2000; Masters et al. 1998). Because program impact assessments require additional data and analytical tools, randomly selecting a benchmark or sentinel site to monitor more closely over time can be quite advantageous for two reasons. First, if the sentinel sites include a control site, counterfactuals and attribution can be assessed more accurately. Secondly, monitoring smaller representative sites would be far less costly and more manageable. Even if the assessment is to be done *ex-post*, the choice of projects and program areas to be studied should also involve random sampling.

3. ORGANIZING ANALYSIS AND INFORMATION AS A KNOWLEDGE SYSTEM

The analytical framework described above incorporates a vast array of credible data, knowledge, and analysis to answer important questions related to agricultural and rural development. Yet, the effectiveness and relevance of the analytical framework embedded in SAKSS will ultimately depend on how well it is integrated into the process of strategy development and implementation. In other words, the framework's utility largely depends on how it is organized into a broader knowledge system and becomes institutionalized over time within the country.

In the context of SAKSS, "knowledge system" is being defined as a network of individuals and organizations that combine research and dialogue to support decision-making activities related to achieving development goals in the rural sector. Defined in this way, SAKSS is a unique initiative in many respects. However, in recent years, there has been a growing realization that the creation and communication of knowledge and information represents an input into the development process as critical as any type of financial or physical resource. This has led in turn to a variety of knowledge and information networks and systems, each with their distinct mandates and organizational structures. For instance, agricultural knowledge and information systems (AKIS) link farmers, researchers, and extensionists in order to generate knowledge that will improve farming techniques and rural livelihoods (Berdegué and Escobar). AKIS varies quite markedly from efforts like the World Bank-initiated Global Development Network (GDN), a non-profit organization that focuses on the creation and dissemination of technical research, particularly in the area of development economics (Stone).

Comprehensive case studies that examine the strengths and weaknesses of knowledge/ information networks and systems are relatively rare. Nevertheless, we review below examples of efforts in the areas of food security information systems and policy networks, supplemented by the growing theoretical literature in this area, in order to distill useful lessons for establishing SAKSS in an effective and sustainable manner.[5]

3.1. Food Security Information Systems

During the mid-1970s, in the midst of recurrent natural disasters within the Sahel, it was believed that the lack of accurate information on these disasters was preventing governments from responding in a timely manner. As a result, international donors began to establish famine early warning systems (EWS), an effort that intensified in the mid-1980s as a result of famine in the Horn of Africa. Described as "systems of data collection to monitor people's access to food in order to provide timely notice when a food crisis threatens," EWS have evolved over the last two decades to become more attuned to changes in technology and to a more sophisticated understanding of the dynamics of food crises (Buchanan-Smith et al).

Nevertheless, case studies in countries such as Sudan, Ethiopia, and Chad have shown EWS has not been uniformly successful in mitigating famines and saving lives (Buchanan-Smith et al). This lack of effectiveness has been attributed to EWS being based on the idea that information is a neutral "silver bullet" that can solve all problems regardless of political, economic, and social context as well as to the lack of attention regarding how EWS could be properly integrated into a country's institutions (de Kadt). Other related problems include ignorance of indigenous knowledge of famine survival techniques, the lack of regionally disaggregated data in EWS, and the highly centralized administration of EWS, which limits access to its information. In addition, tensions between international donors and national governments over who funds, and consequently "owns" the EWS, have had an impact on how or whether information from the EWS is used (Buchanan-Smith et al).

Instead of an EWS, IFPRI helped implement in Malawi during the 1990s a system for monitoring food and nutrition security. Through conducting five rounds of data

[5] A more comprehensive review of the literature on knowledge networks is outside the scope of this paper. However, for a good overview of this topic, please see Creech and Ramji as well as Creech and Willard.

collection among about 2600 rural smallholders, IFPRI generated a database on food security and nutrition that it institutionalized in the Ministry of Agriculture and Livestock Development. The database is considered one of the best in Africa and helped the Government of Malawi to respond quickly during the 1991-1992 famine. IFPRI supplemented this work by designing and implementing a curriculum for agricultural policy analysis at Bunda College while also teaching and supervising students. Through building analytical capacity, Malawians perform a majority of the teaching in this area and graduates of the program can be found in the public as well as the private sectors (Garrett).

Yet, IFPRI's involvement has not been an unambiguous success. Since implementing the system, neither child malnutrition nor the level of food insecurity in Malawi has improved significantly. Moreover, the relocation of IFPRI staff from Malawi to Washington, DC stymied IFPRI's opportunity for a long-term impact on the country's agricultural and nutrition policy-making. In fact, IFPRI was not involved in the Government's attempt to create a five-year policy plan in this area. According to one individual involved in the project, this exclusion reflects that "IFPRI may have concentrated too much on data collection and too little on building solid linkages with the national policy environment in Malawi. Links with the donor community are not a substitute for this, as staff turnover and changing priorities are not conducive to sustainability" (Ryan, p.35).

3.2. Policy Networks

Policy networks include all of those individuals and organizations that share a common vision and who seek to influence policy towards achieving that vision. Researchers contribute to these networks by providing existing information, generating new and relevant analyses, and disseminating their knowledge through mechanisms such as websites, workshops, and databases (Stone et al).

In Africa, two notable policy networks include the Trade and Industrial Policy Secretariat (TIPS) and the African Energy Policy Research Network (AFREPREN).

Established in South Africa in 1996, TIPS operates as a clearinghouse for bringing academically credible research in the areas of international trade and microeconomics to the Department of Trade and Industry (DTI). In addition to identifying high quality research output, TIPS also engages in capacity building training for economists and in strengthening the links between the research and policy communities. By incorporating policymakers into the network, TIPS helps ensure that the research provided is relevant to government needs while also being proactive in identifying upcoming policy-relevant issues. Due to the high quality researchers it attracts and its extensive trade database, TIPS has also established a highly credible reputation that in turn creates a demand among policymakers for its research. While the breadth of its influence on government policy is possibly limited by its interaction with one specific department, the specialized focus of TIPS research and the relationship with the DTI helps concentrate its policy impact (Cassim; Court and Young).

The AFREPREN, which includes over 100 researchers and policymakers from predominantly Eastern and Southern African countries, shares many of TIPS' characteristics. The network was founded in 1989 to strengthen the region's energy policy research capacity and help implement sustainable energy policies. The involvement of senior decision-makers in the network not only has provided researchers with insight on salient research themes but also has fostered a high level of trust between the two groups. AFREPREN's capacity building efforts have strengthened this trust, especially since a number of former AFREPREN members are in high positions in their respective countries' energy ministries. In addition, AFREPREN's influence is promoted through its national and regional policy seminars as well as its distribution of its publications to all key stakeholders, including ministers, international and regional policymakers, heads of utilities, NGOs, and universities (Karekezi and Muthui; Court and Young).

3.3. Implications for Establishing SAKSS

A number of key issues emerge from the cases presented above. First, increased data and information does not automatically translate into action by decision-makers.

Indeed, SAKSS will need to be established with an awareness of the local political and institutional context as well as of the prevailing policy processes. This awareness will need to emerge from frequent dialogue with policymakers, through workshops, seminars, dissemination of findings, and even informal communication, which in turn will ensure that the research emerging from the analytical framework is salient and demand-driven. Engaging in this dialogue requires that the key partners involved in SAKSS, including IFPRI, have a long-term commitment to this initiative in order to avoid being de-linked from policy influence, as in Malawi.

Secondly, in order to achieve sustainability, countries ultimately need to have ownership of SAKSS, which supports the objective of institutionalizing SAKSS within local government and research institutions over time. Likewise, the case studies reveal the importance of building local analytical capacity among both policymakers and local researchers. Indeed, both short and long term training courses will be needed to bolster the capacity of local analysts and researchers to conduct the analysis and knowledge that will foster constructive policy debates on future development alternatives (Babu et al. 2004).

Another key lesson that emerges from the policy network case studies is the value of starting with a manageable research focus. As mentioned in the beginning, the SAKSS analytical framework could eventually help identify priority investments in the areas of education, health, safety nets, and more. Yet, initially, SAKSS will remain primarily concerned with those investments that will enable agriculture to contribute to greater rural development. As with TIPS and AFRPREN, this more concentrated focus can also help narrow which government ministries, policymakers, and other stakeholders are essential for purposes of coordination and collaboration.

Issues related to the management of a knowledge system were not addressed in the cases above but require equal attention. Much of the theoretical literature on the management, or "governance," of knowledge systems and networks highlights the need to decide on how project proposals and results will be approved, the roles for special interest committees and advisory groups, clarity on intellectual property rights, and procedures for planning and resource utilization. In order to make some of these decisions, most successful networks have in practice been driven by one or two leading institutions that demonstrate a clear commitment to building strong partnerships and that continuously interact with local stakeholders (Creech and Willard; Brinkerhoff).

4. SUMMARY CONCLUSION

A principal goal of this paper has been to argue for strengthening the analytical foundation and knowledge base for informing the design and monitoring of long-term rural development strategies. Establishing a system that is able to integrate and build upon accurate data and detailed analysis rather than simply relying on ideological considerations or overarching theories could go a long way in helping developing countries achieve their goals of improving food security and reducing poverty. Indeed, as development strategies increasingly include more objectives, data and analysis are important for understanding how improvements in one area of a country's economy will impact those in another. Because frequent shifts in donor priorities, modalities and resources allocation levels can hinder the type of long-term vision necessary for genuine development to occur, the relationship between multiple donors and recipients needs to be revised and made more transparent. More attention should be on the substance of long-term strategies that are shared by African governments, coordinating efforts in those areas where each partner has a comparative advantage (Lele and Jain, 1988).

By conceiving a system in which credible data, tools, and knowledge, at the micro, meso, and macro levels, are compiled, analyzed, and disseminated, as well as a framework that is flexible enough to adjust to different contexts and dynamic enough to integrate, on a continuous and timely basis, stakeholder needs and information relevant for planning, monitoring and evaluation (M&E), development strategies can become far more articulate and effective in the long run. In order to achieve long-term relevance and to increase local analytical capacity, such a system would need to become institutionalized as a network involving appropriate local government agencies and independent local think tanks.

Since the broader process of designing and implementing strategies is inherently political, successful long-term strategies will naturally depend on strong leadership commitment, including sufficient autonomy to guide and sustain national strategies (as illustrated in **Figure 1**). Clearly, a balance needs to be struck between the need for some central autonomy to design and implement development strategies and the need for participatory approaches. Indeed, partnerships between governments, donors, local communities, non-governmental organizations and the private sector are needed and these will only come about through strong African leadership.

As new problems have compounded old problems, implementing long-term development strategies has become far more complex and expensive. Yet, if there is sufficient commitment and political will among Africa's leaders, progress can be achieved. SAKSS system offers the evidence by which stakeholders can debate and engage in dialogue when articulating their aspirations for rural development and overall wellbeing.

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