THE STRUCTURE, CONDUCT, AND PERFORMANCE OF AGRICULTURAL MARKET INFORMATION SYSTEMS IN SUB-SAHARAN AFRICA

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ABSTRACT

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This dissertation addresses three sets of questions: (1) what evidence is there that supports the premises that second-generation agricultural Market Information System (MIS) models are likely to meet user needs and become financially sustainable relative to first-generation models? (2) How have different MIS models tried to address the generic design issues of any MIS and what are the relative advantages of different models of MIS in addressing those challenges? (3) What factors affect the reception of improved agricultural market information among smallholder farmers in Mozambique; and how does reception of improved agricultural market information affect their marketing behavior?

The key findings are that: (1) there is great heterogeneity among MIS in terms of their structure and conduct design issues. (2) Whether or not an MIS is government-based explains very little in terms of its performance. What matters is the: (a) mandate, (b) financial and managerial autonomy, (c) information and communication technology (ICT) used in transmission and diffusion, (d) funding strategy, (e) quality control methods, and (f) feedback methods of the MIS. (3) All MIS types still heavily depend on donor funding for sustainability. (4) Private MIS do not engage in policy analysis compared to government supported MIS, but could provide data to units that do. (6) There is a rapidly evolving market environment in terms of (a) market actors, and (b) ICT

availability and usage. (5) It is difficult to analyze the key design issues of MIS independent of overall environment in which they operate.

From the econometric analysis of a two-year panel household data set for four provinces in Mozambique, the study finds that the generic factors that influence the reception of improved agricultural market information include involvement in growing of marketable staples, access to alternative information and communication technologies, and access to markets and extension services. The specific factors include: growing maize, large and small groundnuts; owning a radio; presence of a cell phone network in the village; proximity to a road with public transport; membership to farmer association; access to extension services; level of education; the agro ecological zone of households; and distance to village administrative post. Holding other factors constant, reception of market information increases farmers' probability of market participation by 34 percent.

The average price difference per kilogram of maize sold between households with and without information (also referred to as an information premium or information rent) is 12%. This premium translates into an average income gain of 0.34 meticais per kilogram of maize sold, or an income gain of $3.13 (about 1% of average gross and net total household income in 2005 meticais) for an average household that sells about 214 kilograms of maize in the main growing season per year. The average marginal population gain in income by an estimated a quarter million households that received information and sold maize is estimated to be $766,748 in the main marketing season per year. These gains are 6 times more than the operational costs in MIS of $130,000 in 2002. The cost-benefit analysis shows that less-commercialized farmers are less likely to afford the use of information from MIS than are more-commercialized farmers.

DEDICATION

To Juliet, Lydia, Jesse, Jenell, and Lyndsey

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1. INTRODUCTION

1.1 Introduction

The importance and use of improved agricultural market information in developing economies increases with the transformation of agriculture from diversified-subsistence to more specialized-commercial production. As farmers move away from subsistence agriculture to commercial agriculture, they interact more with traders and other actors in input and output markets, and information becomes the lubricant that facilitates such exchanges.

In high-income countries, the spread of the internet has transformed the way some goods and services (e.g., information, new knowledge, and software) are produced. There is increasing peer production and sharing of information by individuals, for example through Wikipedia, and the development and use of open-source software. The increase in the use of the internet has enabled the social production of some goods and services that were previously produced through the market using capital-based firms (Benkler, 2008). In low-income and middle-income countries, however, the peer-production and sharing of information and new knowledge is still limited within smaller social networks due to the limited or costly use of some Information and Communication Technologies (ICT), especially the internet and cell phones, implying the need for formal information production systems to provide information to poor households.

Increased commercialization; the evolution of market structure (e.g., the increase in the number of commodity buyers and sellers); the changes in vertical coordination arrangements from state-organized cooperatives and marketing boards to spot markets, private trade, and group marketing (Rashid, et al., 2008); the changes in pricing methods (e.g., use of open auctions in commodity exchanges); the spread of ICT such as cell phones, internet, and private FM radios; and enabling government policies (e.g., privatization and liberalization) increase stakeholders' demand for market information on one side, and broaden peoples' choices of sources of information on the other side, including market information systems (MIS). As a result of the above factors, several types of market information systems have emerged, with some substituting, competing or complementing each others' roles.

1.2 Problem Statement and Research Objectives

Historically, many agricultural Market Information Systems have faced two main problems: (1) they often failed to meet the informational needs of the stakeholders, and (2) they frequently were not financially sustainable once donor support was withdrawn (Aldridge, 1999, Holtzman, et al., 1993, Shepherd, 1997). In their initial stages in early 1990s, MIS were often not designed to involve the users in the design and to understand the information needs of different users; instead, they were usually designed to collect mostly price information on a wide range of commodities, often without much attention to quality differences, making the information collected of limited value. In addition, they covered vast geographic areas; had poor data collection, transmission and dissemination methods; and were not well managed (Holtzman, et al., 1993). Other MIS faced problems of duplication of activities and political interference in some cases (Shepherd, 1997). Indeed, lack of financial sustainability can also be viewed as failing to meet the needs of the users such as donors, governments, private companies, and researchers who could potentially pay for the information products —i.e., some users such as donors and governments do not pay for MIS products because they do not meet their needs and expectations.

The emergence of many MIS models has created debate among stakeholders such as governments, donors, charity organizations, and researchers in terms of what MIS are, who their stakeholders are, what activities they conduct, and the kind of information they produce. There is also debate about who should provide the different information products to users: should it be the state-, private-, farmer organization-, or trader and NGO-based MIS? There is debate about who should provide the purchasing power to convert the information needs of poor stakeholders such as smallholder farmers and small-scale traders into effective demand for information, e.g., by paying for the information directly, or indirectly through state and donor budgets.

For example, currently, there is a premise that the increase in cell phone and internet use may help MIS to become financially sustainable, especially due to more private-sector involvement in their provision and financing. These arguments may not take sufficient account of other factors such as the environment in which the MIS operate (e.g., supportive government policies, macro- and social- economic indicators, market structure, coordination arrangements, pricing methods, agro-climatic conditions, effective demand among users, seasonality of crop production, and security) that could also be preconditions to the financial sustainability of MIS. Moreover, it has been historically argued that low effective demand and supply of some types of market information is partly due to market failures caused by "public good" characteristics of information demand and supply such as nonappropriability and non-rivalry and other characteristics such as indivisibility, quality uncertainty, and perishability. These characteristics of information have meant that the private sector is likely to under-invest in the provision of certain types of information—thus the need for some public financing to complement the investment in MIS activities through the private sector, the public sector, farmer organizations, or through trader and NGO-based MIS.

Presently, there is limited detailed and systematic analysis of the strengths, weaknesses, and complementarities of public-, private-, farmer organization-, and trader and NGO-based MIS models in Sub-Saharan Africa (SSA) in terms of supplying agricultural market information. To guide future investments in provision of improved agricultural market information that meet stakeholder needs, such analysis is needed. Researchers have not developed a systematic framework to guide the analysis and design of alternative MIS models, with the exception of the one developed by Aldridge (1992), which analyzes the alternative institutional arrangements for the production of market information products in state-based MIS using the transactions cost framework (Aldridge, 1992). With this background, this dissertation addresses the following key questions.

1. What evidence is there that supports the premises that the new MIS models, which are mostly based in non-government organizations and mostly rely on cell phones and the internet to collect and diffuse information, are likely to meet user needs and become financially sustainable in comparison to the first-generation MIS models that are typically housed in state departments or state-supported?
2. How have different MIS models tried to address the generic design issues of any MIS and what are the relative advantages of different models of MIS in addressing those issues?

3. What factors affect the reception of improved agricultural market information among smallholder farmers in the context of Mozambique; and how does reception of improved agricultural market information affect their marketing behavior?

The specific hypotheses related to objective 3 in this dissertation are stated in chapter 4 after the appropriate conceptual materials are presented in chapter 2 and 3 that help frame the hypotheses. Answering these questions requires developing a typology of the structural, conduct, and performance issues of different MIS models, and then conducting a comparative analysis of the models. Building on Aldridge's framework and on guidelines developed by researchers at Michigan State University over the past 20 years (Dembélé, et al., 2000, Weber, 2005), this study uses concepts from industrial organization and information theory to develop an analytical framework to guide the answering of the key research questions above.

The rest of this chapter is organized as follows. Section 1.3 defines an MIS and improved agricultural market information, divides MIS into different categories, and gives examples for each category. Section 1.4 presents the conceptual framework and theoretical tools. Section 1.5 presents the analytical framework based on the Structure, Conduct, and Performance paradigm. Section 1.6 discusses the sources of data. Section 1.7 describes the contributions of the dissertation, and section 1.8 outlines the structure of the remaining parts of the dissertation.

1.3 Market Information Systems and Improved Agricultural Market Information

In this study, a Market Information System (MIS) is considered to be an organization or a group of organizations that: (1) collects and transmits data to a processing center, (2) processes and analyses the data to transform it into market information, and (3) disseminates market information products to different stakeholders via one or more dissemination channels for private and/or public decision making. Market information includes: (1) market news (e.g., information on prices, quantities, market conditions, regulations, and business contacts for both factor inputs and outputs), (2) market analytical reports (e.g., reports that analyze factors that cause changes in market conditions and their effects on stakeholders, including policy analysis), and (3) business reports (e.g., providing information that can help stakeholders identify reliable trade partners, including their creditworthiness).

Not all MIS produce all these products. The MIS may also gather and transmit complementary information produced by others, such as weather forecasts. The MIS may be based in the public-sector, private-sector, a farmer organization, a trader organization, or an NGO. The information is generated from processes that take place before, during, or after the exchange of rights over agricultural commodities and services between two or more parties in the different levels of the food system.

The activities of the MIS can also be viewed as the different production stages of market information, which consist of identification of the information needs of users, data collection, data analysis, policy or business analysis, dissemination, and coordination among system components (Aldridge, 1992). Although Aldridge does not mention business analysis, it could be a part of a more agribusiness-focused MIS. Thus, at each stage, for each type of information, the MIS faces the "make or buy" decision of whether to produce the information itself or get it from someone else. The "produce the information itself" can include the type of "social production" of information using wiki approaches where users can contribute information through internet and cell phone updates. The “get it from someone else” can include information obtained at a cost or for free from other sources. .The different production stages of information system can be in different organizations for each type of information; thus there is a need to examine how they are coordinated to produce information that meets user needs. Also, the question of which information the MIS produces itself and which it redistributes from others becomes a key strategic issue for the organization.

Data and Improved Agricultural Market Information

In the context of an MIS, data refers to the unprocessed figures that are collected from market transactions (e.g., retail or wholesale prices of commodities) or from events that can affect market transactions (e.g., complementary information on production techniques, weather, the policy setting). They might be numeric (e.g., today’s wholesale price of a kilogram of maize is $.50 cents in market A and $.80 cents in Market B) or non-numeric (e.g., the bridge connecting village A and town B has collapsed due to heavy rain, or the government has banned the export of maize this month). Data is transformed into *improved agricultural market information* when it is processed, analyzed, interpreted, and disseminated to users for making production, marketing, consumption, and policy decisions.

Processing involves capturing the numeric data and/or non-numeric data (e.g., market commentary) reported by enumerators from questionnaires or forms into an organized format such as a price database or a simple Word document. Analysis involves tabulating, graphing, and computing estimates desired by different users for making different private and public decisions. Examples of estimates include descriptive statistics such as means, medians, and modes. Other types of analysis include computing ranges, ratios (especially in food security and early warning analysis), percentage changes, and time series graphs. Interpretation involves explaining the analyzed information in relation to the decisions public and private users need to make. The interpreted information becomes *improved agricultural market information* when disseminated using one or more dissemination channels to users for making private and public decisions. From here onwards in this dissertation, market information, or information refers to improved agricultural market information.

MIS Stakeholders

MIS stakeholders include MIS personnel who provide the information on the supply side, and information users on the demand side. Information users are defined by their need to use the information generated by the MIS in decision-making. They include farmers, farmer organization officials, traders, local and central government policy analysts and policy makers, researchers, users in education institutions, extension officials, private companies, donors, and consumers who directly or indirectly express needs or effective demand for MIS information products.

The above definition of market information systems is much broader, in a sense that it includes data and information collected from all market coordination arrangements such as spot markets and contract transactions, than that used by the FAO, which defines a market information service as "*A service, usually operated by the public sector, which involves the collection on a regular basis of information on prices and, in some cases, quantities of widely traded agricultural products from rural assembly markets, wholesale and retail markets, as appropriate, and dissemination of this information on a timely and regular basis through various media to farmers, traders, government officials,* *policymakers and others, including consumer*" (Shepherd, 1997, Shepherd and Schalke, 1995).

The FAO definition of MIS was written before the cell phone revolution, which has led to the increase in cell phone-based MIS that are usually operated in the private sector like Esoko-Ghana and from farmer-based organizations like the ZNFU 4455 SMS MIS. The categories and some examples of what are considered in this study as MIS include:

- **Public MIS:** These include MIS housed in government or state departments, ministries or autonomous bodies. Examples include the Agricultural Market Information Center in Zambia and the Agricultural Market Information System (SIMA[1]) in Mozambique. In this dissertation, MIS initiatives under autonomous public-private partnerships, such as the MIS section under the Ethiopia Commodity Exchange are also grouped in public MIS. Other examples of public MIS include the Fruit and Vegetable Market News and the National Agricultural Statistics Service in the USA.
- **Farmer organized-based MIS:** These include MIS under farmer organizations such as the Malian Observatoire du Marché Agricole (OMA), which is housed in a farmer organization (l'Assemblée Permanent des Chambres d'Agriculture du Mali) but with strong government support, and the Zambia National Farmers' Union (ZNFU 4455) SMS[2] MIS.

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[1] The Portuguese names of the SIMA and SIMAP are respectively Sistema de Informação de Mercados Agrícolas De Moçambique (SIMA) and Sistema Provincial de Informacao Sobre Mercados Agro-Pecuario (SIMAP) de Nampula.

[2] Short Message Service

- **Private MIS:** These consist of two groups:
    - Private MIS that provide information, but are not involved in trade of agricultural commodities. Examples include the Reuter's Project Market Light in India and Esoko in Ghana.
    - Private MIS attached to emerging commodity exchanges such as the KACE (Kenya Agricultural Commodity Exchange) Market and Information Linkage System located in a private-sector based commodity exchange.
- **Trader and NGO-based MIS**: This category consists of MIS based in trader organizations or associations such as the Regional Agricultural Trade Intelligence Network (RATIN), which is housed in a trader organization (Eastern Africa Grain Council (EAGC)); and the Rice Observatory (OdR), which is like a consortium of the rice value chain actors in Madagascar.

Organizations that amalgamate market news from secondary or administrative sources alone, e.g., Fewsnet and INFOCOM and INFOSHARE under the United Nations Conference on Trade and Development, are not considered in this document as an MIS. Nonetheless, some of the MIS described above also distribute complementary information (e.g., weather forecasts and foreign exchange rates) produced by others along with the information they compile themselves. Also, not all improved market information comes through MIS. For example, improved cell-phone access can improve actor's access to market information without a formal MIS—a point that is discussed in section 4.5.2.

1.4 Conceptual Framework and Theoretical Tools

The MIS enter formal and informal contracts with different stakeholders in a broad sense, to provide information. MIS activities are viewed as production stages of information that under different situations has "public good" characteristics of nonappropriability (high exclusion cost) and non-rivalry and other characteristics such as indivisibility, quality uncertainty, and perishability, as defined below in section 2.2. Several factors then interact to affect the way the MIS meets the needs and demand of the various stakeholders. Moreover, some stakeholders have conflicting interests and incentives that are not aligned with having the MIS meet user needs and to be sustainable. Thus, concepts from welfare economics; information theory; industrial organization such as Structure, Conduct and Performance (SCP), sub-sector analysis; institutional economics; and organization theory are used to analyze how the increase in modern ICT (especially the cell phones and the internet); the market structure, coordination arrangements, pricing methods; and government policies have allowed MIS to overcome some of the characteristics of information such as indivisibility, nonappropriability, non-rivalry, quality uncertainty, and perishability that have limited private provision of such information at socially desirable levels. These concepts are also used to analyze the different options of providing and funding of MIS activities, the different ways of coordinating the MIS production stages and how to align incentives of MIS workers to induce them provide information that meets user needs. Also, themes from the literature on Information and Communication Technologies for Development (ICT4D) are used to examine the role of ICT in the conduct design issues and performance of MIS.

1.5 Analytical Framework: Structure, Conduct, and Performance of MIS

This section presents the analytical framework used in the analysis in this dissertation based on Structure Conduct and Performance (SCP) paradigm. Table 1 outlines the environment in which the MIS operate, their distinguishing structure and conduct design issues, and their performance issues. These features can vary from country to country; a detailed analysis and examples of the environment in which the MIS operate are given in chapter 2 and that of the structure and conduct design issues are given in chapter 3.

1.5.1 The Environment in which the MIS Operates

The environment in which MIS operates includes: (1) government policies, (2) some key macro-economic indicators and social-economic characteristics (e.g., inflation levels, interest rates, GDP from agriculture, employment, transport and feeder roads, market infrastructure, storage and credit facilities, literacy and education levels, and user voice); (3) the market structure, vertical coordination arrangements, and price discovery methods in the market; (4) agro-climatic conditions, pests and diseases; (5) the level of ICT usage in a country; (6) the geographical setting; (7) cultural factors; (8) lack of effective demand for improved information by some users; (9) seasonality of crop production; and (10) the level of security in a country. A detailed analysis of the environment in which the MIS operates is discussed in section 2.3.

Table 1: The Environment, Structure, Conduct, and Performance Design Issues of Any MIS

<table>
<tr><td colspan="3">The Environment in which the MIS operates: (1) Government policies, (2) key macro-economic indicators and social-economic characteristics (e.g., inflation levels, interest rates, GDP from agriculture, employment, transport and feeder roads, market infrastructure, storage and credit facilities, literacy and education levels, and user voice); (3) market structure, vertical coordination, and price discovery methods; (4) agro-climatic conditions, pests, and diseases; (5) the level of ICT usage in a country, (6) geographical setting; (7) cultural factors; (8) lack of effective demand for improved information by some users; (9) seasonality of crop production; and (10) security.</td></tr>
<tr><th>Structural design issues</th><th>Conduct (behavior) design issues</th><th>Performance (outcomes)</th></tr>
<tr>
<td>1. MIS's perceived mandate (Aims, objectives, and clientele)
• Policy formulation and monitoring
• Food security planning and monitoring
• Attainment of efficient markets
• Attainment of "fairer[1]" agricultural markets
• Clientele (e.g., farmers, traders, consumers, government, donors)
2. Institutional home, organization, and coordination
• Public-, private-, farmer organization, or trader and NGO-based MIS
• Provides complementary services that generate or increase value of information
• Geographic coverage and range of commodities
• Assuring coordination among stages
o Integration of MIS Activities
o Centralized or decentralized MIS activities
o Specialization in MIS Products
• Design of incentives for MIS staff
• Profit orientation of the MIS
3. Nature of commodities covered (e.g., staple, cash, or perishable commodities)</td>
<td>1. Information provided
• Market news
• Market analysis
• Business reports
2. ICT used in transmission and diffusion
• Traditional ICT (e.g., radio, television, and fax)
• Modern ICT (e.g., email, internet, SMS)
3. Funding strategies
4. Data collection methods used
• Structured questionnaire and enumerators
• Wiki approach (users SMS or update web)
5. Quality control methods used
6. Feedback mechanism used</td>
<td>1. Reliability
2. Credibility
3. Accessibility to different clientele
4. Timeliness
5. Sustainability of MIS
• Financial support
• User support
• Cost minimization
Some Impact Indicators
1. Production, marketing, and consumption behavior
2. Revenues (income) obtained
3. Reduction in transaction costs
4. Welfare changes among actors
5. Integration of markets
6. Policy decisions and outcomes</td>
</tr>
</table>

1. "Fairer" relates to the political judgment about the distributional outcomes of a policy or intervention. The outcomes may be income, prices or quantity obtained, or participation in a program and may lead some sections of the population to be worse-off while others are made better-off, depending on the weights used in computing what is "fair".

1.5.2 Structural Design Issues

In SCP analysis, structure refers to the relatively stable features that influence the rivalry among the buyers and sellers operating in a market (Caves, 1992). Some examples of the elements of structure include the number of buyers and sellers in the market, barriers to entry and exit, and the vertical coordination mechanisms. This concept is modified to be applicable to an information sub-sector. The key structural design issues include: (1) MIS's perceived mandate (aims, objectives, and clientele served), (2) institutional home and related organizational and coordination features, and (3) the nature of the commodities covered by the MIS (e.g., staple, cash, or perishable commodities). It is noted that in typical SCP, structure relates to the features in the market or industry in which firms operate. This means that some of the elements included in the environment in section 1.5.1 fall under structure when SCP is used to analyze firms in the market or industry. In this dissertation, structure relates to the stable features or characteristics of the MIS themselves and not the features in the market in which the MIS operates. These structural features are affected by the environmental features identified in section 1.5.1 that influence the key MIS structural design issues, and consequently performance of the MIS. The rational is that the MIS structure is an adaptation to the environment in which it operates. A detailed discussion and synthesis of these structural design issues from MIS experiences around the world is given in section 3.5.2.

1.5.3 Conduct Design Issues

In the SCP analysis, conduct refers to the patterns of behavior that market participants adopt to affect or adjust to the markets in which they sell or buy goods and services (Caves, 1992). Examples of conduct include price-setting behavior and buying and selling practices. In the context of an MIS, the key conduct design issues are: (1) the information products provided and frequency at which they are provided, (2) the ICT used in transmission and diffusion, (3) funding strategies, (4) the data collection methods, (5) quality control methods used, and (6) the feedback mechanism used by the MIS.

Some of the conduct and structural design issues have no clear boundaries. For example, the level of ICT in the country may be an environmental or structural issue, but its use is a conduct feature. Likewise, the boundary between conduct and performance features discussed below is not always clear. For example, the funding strategies of an MIS are a conduct feature, but its sustainability, which largely depends on the funding strategies, is considered as a performance feature. A detailed discussion of these features with empirical examples is given in section 3.7.

1.5.4 MIS Performance Features

Performance refers to the extent to which markets result in outcomes that are deemed good or preferred by society (Caves, 1992). Examples of performance include price levels and price stability in the short and long term, profit levels, costs, efficiency, and quantities and quality of goods sold or provided. The performance features of the MIS relate to the extent to which the MIS provides information that meets different user needs—i.e., how the MIS ensures that it produces useful products. Performance dimensions include reliability (including accuracy), credibility, accessibility (including digestibility), timeliness, and sustainability of the MIS. Aldridge (1992) defines the first four as follows:

1. Reliability refers to data quality and accuracy, measured by the amount of errors in the data as well as their overall utility or relevance to the uses for which the data are intended.
2. Credibility refers to the unbiased objectivity of the statistical or analytical products as perceived by users of the information. Credibility depends on the skills of the MIS employees who collect and analyze the information; and the presence of structures that protect the MIS from pressures to compromise the objectivity of the data (e.g., pressures from political leaders or businesses to report favorable or unfavorable information depending on the problems they intend to solve).
3. Accessibility refers to equal access for all targeted users. This includes the capacity of users to digest the information provided, which may require use of simple and understandable techniques including user education (e.g., on how to interpret forecasts). Accessibility requires identifying appropriate ICT that can be used for direct and indirect reception of information so as to assure its static and dynamic benefits to stakeholders.
4. Timeliness refers to the continuous and consistent diffusion of information. Timeliness also refers to delivering the information when the stakeholders need it for making critical production, marketing, consumption, and policy decisions. The use of ICT and automation may increase timeliness.

The sustainability of the MIS refers to: (a) the ways it generates funding internally (e.g., through user fees); (b) the way it mobilizes support from users, especially farmers, traders and policy makers, to voice their support for the service so as to compel governments through political pressure to provide information through tax revenues; and

(c) cost control—i.e., running the organization so as to minimize the costs of information collection and diffusion. Such efficiency reduces the amount of funding needed for the organization and also likely increases the willingness of users or the state and external agencies to provide the funding. Also, the MIS may gain political support from smallholder farmers and NGOs working in rural areas that may compel external donors to financially support the MIS.

Some of these performance features cannot be measured or defined in absolute terms. They can only be defined relative to the needs and decisions made by a particular user, implying that different users have their own evaluations of the performance characteristics. In Zambia, for example, in a case study carried out by the author, some government policy analysts found the timeliness and quality of price data from AMIC to be good for early warning analysis, while the traders felt that the information was not timely and accurate to be used for trading decisions. The traders, however, found the information bulletin useful in gauging government "thinking" —i.e., what the government was planning to do in the food sector (e.g., planning to import food, ban food exports, or distribute fertilizer).

Table 1 also shows some of the impact indicators that result from a well-functioning MIS, together with several other factors in the environment. They include production, marketing, and consumption decisions of users; revenues (income) obtained; reduction in transaction costs; welfare changes among actors; integration of markets; and policy decisions made by government and their outcomes.

1.5.5 Weakness of the SCP Framework

The main weaknesses of the SCP framework as applied to MIS are:

(1) The performance features: (a) cannot be measured or defined in absolute terms, and (b) depend on the needs of different users. It is therefore difficult to statistically test hypothesis on MIS performance without their absolute measurements, nor with survey data on the perceptions of MIS users on MIS performance indicators. One way of measuring these performance measures is to conduct a survey among different MIS stakeholders and ask them to rank the performance measures of the MIS.

(2) It has limited capacity to develop testable hypothesis, partly due to (a) small sample sizes – i.e., few MIS; and (b) several unique SCP design issues within and between MIS. These two observations mean that it is difficult to obtain statistical values (observations) for most variables across all MIS that are sufficient for the application of traditional statistical methods such as computing means and standard deviations with sufficient degrees of freedom to enable the computation of hypotheses test statistics.

1.6 Sources of Data

The analysis in this dissertation is drawn from triangulated information obtained using three methods: (1) A global literature review of MIS in USA, Asia, and Africa; (2) Case studies of MIS stakeholders in Mozambique, Ethiopia, and Zambia; and (3) from an email survey (E-survey) of MIS practitioners in African countries carried out in collaboration with the Agricultural Research for Developing Countries (CIRAD), and the National Institute for Agricultural Research (INRA) in France. This information is triangulated with data from other secondary sources such as the World Bank's World Development Indicators. Information was also obtained from discussions with MIS practitioners such as researchers, providers, users, and funders during meetings and a workshop on market information system in Sub-Saharan Africa conducted by CIRAD/INRA and MSU in France in March 2010; and from past experience of the author working on MIS in the East African Region. The analysis to address objective 3 is done using statistical and econometric methods on randomly collected household data of the Mozambique National Household Survey (*Trabalho de Inquerito Agricola* (TIA)). The detailed methods used in the study are included in section 3.5 and in 0.

1.7 Contributions of the Dissertation

This study makes the following analytic and policy contributions to MIS literature:

- Broadening and updating the definition of an MIS to take account of the changes that have occurred in the past 10 years such as the cell phone revolution and liberalization and privatization by governments, which have led to the emergence of many cell phone-based MIS operated in the private sector, farmer organizations, trader organizations, and NGOs.
- Development of a comprehensive framework built on information theory and accounting for the environment in which the MIS operate, to conduct a cross-country synthesis of how different MIS models have tried to address the structural and conduct MIS design issues; and the implications for MIS design and performance in Sub-Saharan Africa.

- In some ways, the dissertation is exploratory, identifying hypotheses that could be examined empirically if one did a broader study. It is also useful in raising questions about some a-priori assumptions about the importance of different forms of MIS.
- The study also uses econometric models to understand factors that affect reception of improved agricultural market information, and its effects on the marketing behavior of smallholder farmers in Mozambique. Such analyses have not been carried out in Mozambique in the past.
- The study also contributes to literature on the costs and benefits of using radio, cell phones, and meetings as methods of search among users in Mozambique.
- The policy contributions of this study are a list of suggestions and guidelines for coordination and funding of public-, private-, farmer organization-, and trader and NGO-based MIS activities in a way likely to improve on their capacity to collect, analyze, and diffuse information that meets the needs of diverse users, subject to the limited human, time and financial resources at their disposal. These results are useful for informing policy makers, donors, and MIS practitioners on how to invest in MIS in a way that increases the benefit to users.

1.8 Structure of the Dissertation

The rest of the dissertation is in five chapters and an appendix, organized as follows: Chapter 2 covers concepts on the economics of information and their implications for MIS design and impact. Chapter 3 presents a cross-country synthesis that examines the premises that gave rise to the second-generation MIS models and how they deal with the generic design issues of any MIS relative to the first-generation MIS models. Chapter 4 analyzes the impact of MIS on marketing behavior of smallholder farmers in

Mozambique. Chapter 5 presents the summary, conclusions, and areas of further research. Appendix A covers a global review of MIS in Africa, Asia and USA and case studies of MIS in Mozambique, Ethiopia, and Zambia that form the basis of the synthesis presented in chapter 3. Two very different styles of analysis are used in the dissertation. Chapter 3 uses a qualitative (descriptive, case-study, and exploratory) approach of analysis, while chapter 4 uses a deductive, quantitative (statistical and econometric) approach of analysis.

2 ECONOMICS OF INFORMATION: IMPLICATIONS FOR MIS DESIGN AND IMPACT

This chapter presents the key conceptual issues related to the provision of market information and their implications for the design of MIS and their impact. These include the role of MIS in agricultural marketing; the characteristics of information such as indivisibility, nonappropriability, non-rivalry, quality uncertainty, perishability; and the environment in which an MIS operates that affects the demand and supply of market information. The main analytical question addressed in this chapter is: given some of the characteristics of information and the environment in which the MIS operates, what are some of the ways of funding MIS activities?

2.1 The Role of Market Information Systems in Agricultural Marketing

In the early 1990s in sub-Saharan Africa (SSA), MIS were designed to improve market efficiency (more competitive markets) and help attain “fairer” markets (Dembélé and Staatz, 2000, Holtzman, et al., 1993, Keita, 2006, Shepherd, 1997, Tollens, 1994, Tollens, 2006). This section presents a summary of some of the ways in which MIS lead to efficient and fairer markets. In this study, the benefits of the MIS are analyzed in the context of the decisions and actions made by private and public users.

2.1.1 Market Efficiency through Reduction of Information Asymmetries

MIS help to attain efficient or competitive markets through reduction of information asymmetries among food system participants, which leads to reduction in transaction costs (i.e., reducing costs of negotiating, signing, and enforcement of contracts), and integration of markets through spatial and temporal arbitrage. Reducing information asymmetries is equivalent to increasing market transparency, but it is important to note that MIS may reduce information asymmetries without solving the problem of imperfect or incomplete information; trading partners can have symmetric but imperfect or incomplete information. The role of MIS in improving market efficiency is also presented in terms of helping to establish the law of one price, where there is reduction in price dispersion.

2.1.2 "Leveling the Playing Field" and Income Redistribution

Market information helps to "level the playing field" by increasing the bargaining power of market players who cannot afford to collect information on their own, resulting in "fairer" markets and income redistribution among actors. "Fairer" relates to the political judgment about the distributional outcomes of a policy or intervention. The outcomes may be income, prices or quantity obtained, or participation in a program and may lead some sections of the population to be worse-off while others are made better-off, depending on the weights used in computing what is "fair". "Leveling the playing field" will also normally have an efficiency impact through reducing the dead-weight loss associated with a less-than-competitive pricing structure, although the scale of the income redistribution typically exceeds the pure efficiency gain (Azzam and Schroeter, 1995).

2.1.3 Reduction in Risk and Efficient Allocation of Productive Resources

Improved market information helps in the reduction and managing price risks (e.g., stability of marketing margins) and allows market actors to make better production, marketing, and consumption decisions that result in efficient allocation of productive resources. For example, market information helps smallholder farmers and traders to identify new market opportunities (in space, time, and scope) and reliable trade partners, thereby improving spatial and temporal arbitrage and possibly capturing of economies of scale due to reduction in transaction costs. In developed countries, MIS products are commonly used in insurance contracts (e.g., yield, price, and revenue insurance) and in derivative contracts (e.g., forward, options, and future contracts) to manage production and marketing risks.

2.1.4 Design of Better Policy and Monitoring by Governments and Donors

MIS provide information used by governments, donors, food assistance agencies, and researchers for (1) better policy formulation, (2) monitoring and evaluation of development projects and programs on technology transfer, (3) food security and early warning analysis, and (4) monetization of agricultural crops and products, including food aid. Some of the decisions made by governments include deciding when and how to distribute food assistance in a way that does not distort markets. Information from MIS is also used to analyze and guide local food purchases and to promote market participation among smallholder farmers by food assistance organizations such as the Purchase for Progress (P4P) program under the World Food Program (WFP).

Improved agricultural market information can increase or decrease the welfare and risks for different market actors under different scenarios. For example, when some farmers improve their bargaining power and obtain higher prices as a result of access to better information, some traders pay higher farmgate prices or assembly market prices for agricultural produce. When traders cannot transmit the higher prices to consumers, their profits reduce. Thus, under different scenarios, the welfare of some market-actors increases or decreases when information asymmetry among market actors reduces.

Also, it is not necessary for all market participants to have complete and symmetric information in order to attain efficient market outcomes. In some situations, it is sufficient to have complete and symmetric information among a few market players in strategic levels of the value chains in order to attain efficient market outcomes. For instance, it is not necessary to have all volumes traded between sellers and buyers to be "informed". What is important is to have higher percentages of "informed" volume traded and the "uninformed" volume traded (market transactions) will be forced by market competition to move toward the informed competitive equilibrium. For example, more efficient market outcomes may be achieved when information is provided to a few more-commercialized famers (with a higher percentage of volumes traded) than to many less-commercialized ones (with a lower percentage of volumes traded.)

2.2 Characteristics of Information That Affect Its Demand and Supply

What are the characteristics of information that affect the demand and supply of improved agricultural market information? This section presents the characteristics of information that are likely to limit its provision by the private sector at socially desirable levels.

2.2.1 Indivisibility

Indivisibility means that the cost of collecting and diffusing information in an area is the same regardless of the number of users. The argument has been that indivisibility can lead to economies of scale in information collection and dissemination of certain types of information, and can consequently affect supply for information because one firm can become a monopoly in information collection (Stigler, 1961). With an information monopolist, the advantage can be that when the low-cost information collector is efficient, information users may pay lower prices. The disadvantage is that when the monopolist uses market power, information users may pay higher prices, and poor farmers may not afford it. The fear of an information monopolist applying market power is one of the reasons advanced in favor of public investment in MIS. The information monopolist could be a private firm or public sector department or unit, depending on who controls or owns the information generated from the market transactions and the coordination mechanisms used in the market. For example, implicitly, the Ethiopian Coffee Exchange (ECX) controls all the coffee trading on the commodity exchange from which information is the byproduct; thus it approximates a monopolistic supplier of information in the coffee sector in Ethiopia. In the case of ECX, however, some types of information generated (e.g., prices, grades and standards) are disseminated for free to some users, such as traders and farmers, through radio, websites, and electronic billboards.

2.2.2 Nonappropriability (High Exclusion Costs)

Nonappropriability means that when information is disseminated through some channels, such as radio, broadcast TV, or loaded on the internet without a password, then excluding non-paying users is impossible, and the information provider cannot recover production costs. Market information becomes a High Exclusion Cost (HEC) good. Nonappropriability of information may also be viewed as lack of enforcement of property rights over information once it is disseminated or sold to the first user. Because of the high exclusion cost, suppliers of the information cannot, through sale of the information, recover the full costs of producing it, thereby reducing the private-sector incentives to produce it; thus the need for the public sector to finance provision of some types of information, especially those needed by the poor users, if the marginal social benefits exceed opportunity cost of collecting the information. It is noted that the argument is for some public financing of market information provision, which is not necessarily the same thing as the state directly providing the information. The state could subsidize its production by the private sector or civil society, for example.

The increase in availability of cell phones and the internet allows some types of information to be sold to subscribing users, for example through e-mail, SMS, or a webpage with a password, thus making information a Low Exclusion Cost (LEC) good. In terms of performance, this reduces the free-ridership problem, and increases cost recovery by the information provider for some types of information by MIS. It is still possible, however, for one user to buy the information and share it with others (spillover effects). Another problem with making information a low exclusion cost good is that poor farmers, who cannot afford to subscribe to information, are excluded from direct access (although they may benefit indirectly from a more competitive market resulting from their neighbors or traders being better informed). This exclusion may conflict with the objectives of the some MIS, especially when government, using tax payers' money, is one of the investors.

2.2.3 Non-rivalry (Marginal Cost of Another User/Use = Zero)

When some types of market information are disseminated using some channels (e.g., through broadcast radio and television, the internet without passwords, or billboards), they can be viewed as non-rival goods because they can be listened to or viewed by many information users at no extra cost. Goods and services that have zero marginal cost (MC=0) characteristics can be provided depending on the structure (institutional arrangement) of deciding the rules of how to cost-share (i.e., who pays the fixed vs. variable costs), and who chooses the quality (Schmid, 2004). This then affects the distribution of benefits between users (e.g., who gets the information first, and who gets it last, and in which formats and channels is the information provided to different users).

This concept may be used to determine who (which users) cover fixed vs. variable (marginal) costs, as well as the relative share of each type of cost in the total cost. For example, one party, e.g., the government, or donors can pay the fixed costs of installing the bill boards and other users (e.g., poor farmers) pay the variable costs (e.g., of traveling to the billboards to watch information). This compares to price discrimination or preferential pricing where different types of people pay different rates for the same good. In terms of quantity and quality, the users who pay the least may be given the least quantity and/or quality while those who pay more are given the higher quantity and/or quality. For example, the MIS may disseminate only market news to poor farmers who pay little or nothing at off-peak times, or for very short periods of time; and disseminate both market news and analytical market reports to paying customers such as traders using their preferred channels in a timelier manner. This concept may also be applied by MIS to negotiate for air time with radios and TVs where the MIS, because of limited funds, may seek to be allocated dissemination time in the off-peak hours at no or lower costs, with richer private firms advertising in peak hours at a higher cost. This concept may also be used to determine: (1) which crops the MIS focuses on (e.g., disseminating market analysis on the main traded crop only and market news on other crops); (2) whether the MIS only operates over a few months during the peak marketing season or throughout the year; and (3) which geographical area the MIS concentrates in to diffuse market information (e.g., main production vs. consumption areas).

2.2.4 Quality Uncertainty

Quality uncertainty means that market information users may not be able to judge the usefulness and quality of the information provided by the MIS before they use it, leading to adverse selection and moral hazard. When quality of a good cannot be easily established or verified by users, such a good is called a High Information Cost (HIC) good. In general, when buyers are uncertain about the quality of the commodity being sold, they offer an average price, which further leads to quality deterioration, and reduction in the size of the market (Akerlof, 1970). Other examples of how asymmetric information affects market outcomes is in credit markets where lenders can fail to distinguish between low and high risk borrowers, leading to credit rationing (Stiglitz and Weiss, 1981); and when insurance companies fail to distinguish between high and low risk customers leading to no, or “strange” competitive equilibriums (Rothschild, 1974).

Quality uncertainty makes risk-averse users under-invest in information acquisition. For private-sector providers, incentives to produce information are reduced, as potential clients will want to see the information before deciding whether to pay for it. But once the information is revealed, the private client has an incentive to say that the information is not useful to her, thereby avoiding the need to pay for it.

2.2.5 Perishability

Perishability means that some types of information lose value more rapidly than others. For example, in fruit and vegetable markets, prices can change several times during the day. In addition, the degree of perishability for the same information depends on the client. For vegetable farmers and traders, for example, timely price information may be much more crucial and perishable than for policy analysts, who might only need average historical (times series data) at less frequent intervals. Thus, perishability raises the question of which clients' needs receive priority in the activities and investments of the MIS.

2.3 Environment in which the MIS Operates

This section explains the environmental features identified in section 1.5.1 that influence the key design issues, and consequently performance of the MIS directly or by affecting the demand and supply of information in a country. The environmental features include: (1) government policies; (2) some key macro-economic indicators and social-economic characteristics; (3) the market structure, vertical coordination arrangements, and price discovery methods used in the market; (4) agro-climatic conditions, pests and diseases; (5) the level of ICT usage in a country; (6) the geographical setting; (7) cultural factors; (8) lack of effective demand for improved information by some users; (9) seasonality of crop production; and (10) the level of security in a country.

2.3.1 Government Policies

Government policies include how the state promotes the role of the private sector relative to the state in the marketing of food (e.g., crop and input subsidies to producers, food subsidies to consumers, and import and export restrictions). Government policies influence many MIS design issues such as the mandate of the MIS and the institutional features within the MIS such as its institutional home, whether it provides complementary services, whether it is centralized or not, its level of autonomy, its geographic coverage, and range of commodities covered.

For example, when the state offers crop and input subsidies to farmers, or food subsidies to consumers, the MIS mandate is likely to focus on collecting information for monitoring how markets are functioning on behalf of government. Governments need to detect and avoid urban consumer unrest (e.g., food riots in Mozambique in 2010 and the walk-to-work protests in Uganda in 2011) when food prices significantly increase, or to avoid rural area unrest when producer prices decline considerably by coming up with timely interventions using information signals gathered by the MIS. Also, when governments allow national and regional agricultural commodity trade by the private sector as opposed to state marketing boards, the mix of information needed by the public and private sector actors changes as their roles in the marketing system vary. Private users such as traders and farmers may need both national and regional market information compared to when trade is restricted, which influences the geographical coverage and range of commodities covered by an MIS. This implies that the MIS need to evolve as markets evolve, and provide more regional information as a result of government policies. Moreover, the flexibility or ability of the MIS evolve as markets evolve becomes a key design feature of the MIS; historically, one of the arguments for private-sector provision of services (in general—e.g., some types of extension services—not necessarily information) is that private firms may be more agile in responding to change than public structures.

2.3.2 Key Macro-Economic Indicators and Social-Economic Characteristics

Some of the key macro-economic and social indicators that affect the structure, conduct, and performance of an MIS include: inflation levels, the importance of agriculture in the country in terms of contribution to GDP, employment and proportion of consumer expenditures going to basic food staples, physical market infrastructure, availability of storage and credit facilities, the level of transportation and conditions of feeder roads, and availability of sufficient electricity. Others include household income levels, literacy and education levels, and the thinness of markets.

For example, employment and proportion of consumer expenditures going to basic food staples are key factors in driving the political-economy of food price regulation. Food price regulation needs market information to be well implemented, which can compel governments, donors, and food assistance agencies to monitor food market prices. This affects the MIS mandate in terms of its objectives (e.g., monitoring food prices for food security monitoring and policy formulation) and in terms of its targeted clienteles (e.g., government and food assistance agencies).

The need and demand for information is higher among users in countries where there is future price uncertainty and where prices change rapidly due to variance in inflation over time. In terms of conduct, price uncertainty and inflation imply that the MIS need to provide more frequent information compared to those where the price levels are relatively predictable and constant.

The literacy levels in some countries in sub-Saharan Africa are still low. According to the World Bank's World Development Indicators, the literacy rate among adults aged 15 years and above was 36 percent in Ethiopia in 2004, 66 percent in Ghana in 2008, 87 percent in Kenya in 2008, 26 percent in Mali in 2006, 54 percent in Mozambique in 2008, and 71 percent in Zambia in 2008; compared to 63 percent in India and Indonesia in 2006, and 94 percent in Philippines in 2008. The education and literacy levels of the population greatly affect how the MIS collects information and how it diffuses information. For example, illiterate users cannot participate in data collection methods that involve writing. In terms of diffusion, illiterate users, who are mostly located in rural areas, may fail to digest information received through billboards, newspapers, email and even SMS that require reading.

In terms of MIS performance, low-income levels imply that some households may not afford to buy ICT such as radios and cell phones that enable them to receive information, thus affecting accessibility of information. The presence of thin markets characterized with low volume of marketable surplus can lead to the MIS providing prices that are unrepresentative of overall supply-demand conditions, which affects the reliability and credibility of the information from the MIS. Also, the extent to which farmers and users can voice their interests individually or through their leaders in support of MIS activities can affect sustainability of the MIS.

2.3.3 Market Structure, Vertical Coordination, and Price Discovery Methods Used

Market structure: The sources and need for market information is higher when the agricultural commodity market structure consists of many buyers and sellers compared to when it is concentrated. For example, when farmers sell their commodities to a few cooperatives and state-sponsored marketing boards, farmers' sources and need for market information is limited compared to when they sell to many traders in the absence state-sponsored marketing boards and cooperatives. However, it can be argued that when there are so many buyers and sellers that the market is perfectly competitive, then the market becomes the MIS. There will be no need for an independent MIS for farmers and consumers, as competition will ensure that farmers get a price that represents the marginal willingness of the consumers to pay for the product, less marketing costs. The presence of few buyers and sellers of agricultural inputs and outputs may indirectly affect the mandate of the MIS, such as considering farmers and government as its main clienteles. Indeed, the main reason why many African governments invested in the provision of MIS was to attain “fairer” markets among market participants after liberalization (Tollens, 2006).

Market coordination: Market coordination arrangements influence the demand of information by some stakeholders and consequently the conduct of a responsive MIS. For example, when farmers sell in the spot or assembly market, they need market information on prices and quantities traded in nearby markets. However, when they sign a long-term contract in which price and quantity is specified for that period of time, the intensity of their information needs changes. For example, trading partners in tighter vertical coordination methods may need information on traceability, quality, post-harvest handling, commissions, and contract terms offered to other farmers. Some of this information might be provided by farmers’ and traders’ trading partners rather than a separate MIS because in tighter coordination such as in marketing contracts, some information becomes private. This also implies that the MIS need to evolve as markets evolve and provide information products and frequencies dictated by changes in market coordination arrangements.

Price discovery methods: The supply of information varies with the price discovery methods used in markets. For example, open auctions, where there are many buyers and sellers, generate open information as a byproduct, increasing the reliability of the data and accessibility to the data. Obtaining information as a byproduct (e.g., on a commodity exchange) also reduces data collection costs such as allowances for data collectors, vehicles, and fuel for data collection, which contributes to sustainability of the MIS. In contrast, private treaties, which involve direct negotiations between buyers and sellers, and which remain the most prevalent means of price discovery for staple foods in Sub-Saharan Africa, do not generate open information as a byproduct, implying that such information is not easily accessible unless there is a structure in place to collect it.

2.3.4 Agro-Climatic Conditions in a Country

Agro-climatic conditions such as rainfall, temperature, and soil types; and pathological conditions such as pests and diseases may affect agricultural production and consequently the demand for information, or may alter the information needs of users from market news to agronomic information. For example, when there is crop failure, there is less demand by farmers for information on marketing opportunities since farmers have little output to sell. The demand for information for making consumption decisions may increase, however, since many households (including farmers who are now net buyers of food) may resort to the market as the source of food. Traders may also need increased information at this time on alternative sources of supply.

2.3.5 Level of usage of ICT in a country

Most information is transmitted through some form of ICT such as radio, cell phones, newspapers, email or websites. The level of ICT usage in a country, such as the proportion of the population with cell phone subscriptions, access to the internet, and investment in private FM radios, affects some structural, conduct, and performance design issues of the MIS. For example, in terms of structure, ICT availability and usage in a country influences the geographic coverage of the MIS in terms of data collection and dissemination. An MIS cannot use SMS or telephone interviews to collect data where there are no telephone services. Also, the decision for an MIS to become a profit-making enterprise by charging user fees depend on the availability and usage of ICT such as emails and cell phones among users.

In terms of conduct, ICT availability influences: (1) the types of information an MIS can provide, such as market news through text messages or historical information through email; (2) the dissemination channels such as the use of radio or cell phones; (3) the funding strategies such as charging user fees through password protected websites, emails and SMS; (4) the data collection methods such as use of telephone interviews or wiki approaches where users can contribute information through internet and cell phone updates; and (5) feedback methods such as the use of internet based customer satisfaction surveys.

The structural and conduct features affected by ICT usage in the country in turn affect performance in terms of: (1) reliability of information depending on the ICT used to transmit it; (2) accessibility of information depending on the ICT used to diffuse it; (3) timeliness of the information depending on the ICT used to transmit and diffuse it; and (4) sustainability of the MIS due to economies of scale gained in collection and diffusion of information and the cost-recovery by the MIS during diffusion. The details of the effects of ICT as a conduct feature in MIS performance are given in section 3.7.2 below.

2.3.6 Geographic Setting

Another factor in the environment in which the MIS operates includes the geographical setting of the countries. For example, land-locked countries have a greater range of prices between import- and export-parity prices, so farmers and consumers typically face greater price variation than in coastal countries (in the absence of trade restrictions), thereby increasing demand for market information ceteris paribus. This may influence the mandate of the MIS in terms of objectives of the MIS and the clientele it serves.

Also, countries that have greater rainfall variability, ceteris paribus, are likely to have more volatile markets, and hence more demand for market information. In West Africa, this effect is compounded by the landlocked effect, which leads to a larger range between import- and export-parity prices in the landlocked countries. These Sahelian countries historically invested earlier in MIS than did coastal West African states, which had more stable food markets. Countries such as Niger and Mali invested in MIS in the 1980s, much earlier than several other non-Sahelian countries such as Uganda, Mozambique, and Zambia that invested in MIS activities in the 1990s as part of the liberalization and privatization process. The geographical setting may need the MIS to collect information at several levels of the marketing chains, ending up with a wider range of information collected (e.g., FOB-, CIF-, farmgate-, retail-, and wholesale prices, and marketing costs).

2.3.7 Cultural Factors in a Country

Examples of cultural factors include the level of trust among stakeholders such as between farmers, traders, government and the MIS, and between funders and MIS implementers that can influence (1) the credibility of the data, and (2) the sustainability of the MIS. Other examples include the number of languages used in the country in relation to the literacy levels. In a few countries such as Kenya and Tanzania, there is one national language (*Swahili*), which is understood by almost the whole population. In several other countries such as Ethiopia, Mali, Uganda, Mozambique, and Zambia, information has to be disseminated in several local languages. This affects the performance of the MIS by increasing the diffusion budgets and time for contracting and monitoring radio and newspaper diffusion.

2.3.8 Lack of Effective Demand for Improved Information by Some Users

Some information users have no effective demand for information because they have (1) low incomes, or (2) a small level of market involvement. Many smallholder farmers and traders in Sub-Saharan Africa are poor and lack resources to access some sources of market information such as cell phones, the internet, radios, newspapers, and TV. This limits their capacity to effectively demand for information. For example, in Mozambique and Ethiopia, where the researcher conducted field visits, farmers complain about the costs of buying batteries for their radios, and traders complain about the high cost of cell phone air time. These two examples illustrate the impact of how changing technologies (e.g., greater availability of crank radios, which lowers the cost of purchasing them and consequently that of accessing the information) or policies (e.g., allowing greater competition in the wireless telephone business, which lowers the cost of airtime for voice and SMS) could change the quantity of market information demanded due to lower search costs. Also, some smallholder farmers have limited or no marketable surplus, implying that they have a small level of market involvement, at least as sellers, which may limit demand for market information. However, even farmers who sell very little may want market information as consumers, as they are frequently net buyers of staples.

2.3.9 Seasonality of Crop Production

Demand for some types of information is seasonal. For example, in Zambia, there is higher demand for maize price information using SMS requests from the ZNFU 4455

SMS MIS during the peak marketing periods in the months of June to August, compared to other months of the year (see section A.5.1 on the ZNFU 4455 SMS MIS).

2.3.10 Security in a Country

The level of security in the country affects the geographical coverage and range of commodities covered by the MIS. For example, trade, and consequently market information activities, were missing or did not operate efficiently in Northern Uganda during the 1990s and early 2000 due to political instability caused by the Lord's Resistance Army (LRA) war.

2.4 Implications for Information Funding and Impact of MIS

Given some of the characteristics of information and the environment in which the MIS operates, what are some of the ways of funding MIS activities? Table 2 gives four alternatives for the funding MIS activities. In the first column of Table 2, baseline conditions refer to the inherent characteristic of some information products among users. For example, price information broadcast on radio and TV is a High Exclusion Costs Good (HEC) among users. In the second column, structure refers to the "institutional alternatives that people can choose to order the interdependencies created by the situation of various technologies"(Schmid, 2004). Structures may be administrative such as hierarchies or public structures; bargaining such as markets or private firms; or customary. The alternative institutional structures of funding market information in a HEC situation include: (1) Administrative funding where taxpayers' money is used to fund the provision of information. In low-income countries, funds from government budgets can also be from donor funds. (2) A combination of administrative and private effective demand of information by users such as when users invite MIS to bid to supply market information (see example in Box 1 below). (3) Use of tie-in sales of market information with other low-exclusion-cost goods and services. (4) Letting private effective demand alone to fund the provision of information. The last column shows the performance under each of the alternative structure and is discussed in the next subsections.

Table 2: Alternative Ways of Funding Market Information Systems

Baseline conditions	**Structure**	**Performance**
Good = Information broadcast on radio and TV, and published on internet without password. High Exclusion Cost (HEC) good among users.	1. Administrative funding: Free dissemination on government (taxpayers' money) or donor budget such as in OMA[1], SIMA[2], AMIC[3].	• No free riders, but some unwilling riders. • All users with radio, TV or internet receive information at a small search cost. • The tax burden falls on consumers and producers of taxed commodities (depending on the elasticity of demand and supply), assets, and income. • Weak link between MIS performance and revenue.
	2. Combination of administrative and private effective demand: Using government or donor funds, farmers through their leaders call for bids from MIS providers to provide market information such as in NAADS[4] in Uganda (explained in 2.4.2 below).	• No free riders within group or county, but some unwilling riders. • All users with radio, TV or internet receive at a small search cost. • The tax burden falls on consumers and producers of taxed commodities (depending on the elasticity of demand and supply), assets, and income.
	3. Tie-in sale of information with other services such a fee for selling a commodity on the ECX[5].	• No free-riders, but some unwilling riders.
2. Good= Information through email, SMS, or password protected webpage. Low exclusion cost among users.	1. Private effective demand through user fees and subscriptions, or subsidies to information users such MIS that use SMS to diffuse information (KACE[6], Esoko -Ghana).	• Users pay for information if they can afford. • Poor users fail to pay for information and do not benefit directly.

1. OMA= Observatoire du Marché Agricole (Mali); 2. SIMA= Agricultural Market Information System (Mozambique); 3. AMIC= Agricultural Market Information Center (Zambia); 4. NAADS =National Agricultural Advisory Services (Uganda); 5. ECX= Ethiopia Commodity Exchange MIS section; 6. KACE= Kenya Agricultural Commodity Exchange Market and Information Linkage System.

2.4.1 Administrative: Government Funding Using Tax Money

The advantage of an administrative structure, where taxpayers' money or donor money is used to fund MIS activities and information is broadcast on radio and TV or published on internet without password, is that there are no free-riders. All users with radio, TV or internet can obtain information at a small search cost (e.g., of buying radios, batteries and their opportunity cost of listening time). The provider can be a public-, private-, farmer organization-, trader organization-, or and NGO-based MIS. The disadvantages are that there are some unwilling riders who are forced to contribute funds to public information provision when they do not want it. Assuming that the taxes used to finance the MIS are imposed on goods and services rather than assets or incomes, the tax burden (incidence of the taxation) falls on consumers and producers of taxed commodities or services depending on the elasticity of demand and supply. For example, the tax incidence will largely fall on consumers with inelastic demand for the taxed commodities or suppliers facing elastic demand for the taxed commodities (e.g., in the case of a marketing assessment of goods whose prices are covered by the MIS broadcasts). Also, lack of sustainability emerges when governments or donors withdraw funding. Another disadvantage is that users who are unable to pay taxes (e.g., poor users) may face punishments of failure to pay their taxes when they exist. Another performance aspect of funding MIS using tax money is that the direct link between how well the MIS does its job and its revenue may be weaker than in a user-fee based system, thereby reducing the incentives for good performance. Note that the provider can be a government or non-government MIS.

2.4.2 Combination of Administrative Funding, Donor Funding, and Private Effective Demand

Another institutional structure, when information is a high exclusion cost good, is a combination of administrative funding, donor funding, and relying on private effective demand for funding. In this structure, using government tax funds or donor funds and some matching funds from local governments (also taxes), farmer organizations or local government units (e.g., at county or sub-county level) can be given funds to pay for market information from MIS. The contract of information provision can also be at a national level such as in Mali's OMA. The provider can be a public-, private-, farmer organization-, trader organization-, or and NGO-based MIS. Farmers and traders through their leaders may call for bids from MIS providers to provide market information, e.g., through radio, SMS, or meetings. This funding model is possible when the MIS provides multiple products, some of which can be sold to generate revenue (to cover both variable and some of the fixed costs), and others are provided for free to users. The OMA in Mali follows this model, charging for custom analyses carried out for private businesses or consultants, but providing market reports on the radio for free.

In the National Agricultural Advisory Service (NAADS) programs in Uganda, one of the services farmers could procure was market information. Farmers through their groups identified the advisory services and technologies they needed, which they forwarded to an elected Sub-county Farmer Forum (SFF). The SSF amalgamated all service requirements from eligible farmers groups, ranked, scored and selected the top prioritized services needed by farmer groups. A procurement committee awarded the service contracts. The signing of contracts involved four parties: the sub county chief, the farmer forum chairperson, the service provider and the sub-county NAADS coordinator who acted as a witness. Once contracts had been signed, service contractors provided the services to farmers groups and reported accomplished tasks to the sub-county chief. The tasks of assessing quality and monitoring the service provider's performance was done by the SFF, which reported the performance results to farmers, the sub county chief and district farmer fora (NAADS, 2004). A small percentage of the money came from taxing farmers. This percentage was matched by government and donor money, but with farmers given a chance to voice their needs through their leaders. In more recent years, however, this process has been marred by some problems. After some time, in some districts and sub-counties, farmers complained that the process was hijacked by prominent farmers and politicians, and service delivery was interrupted by government in a bid to control alleged corruption in the procurement process.

The performance under this structure (i.e., a combination of administrative funding, donor funding and private effective demand) is similar to the first one in some aspects. Farmers and traders with radios, TVs or cell phones receive information at a small search cost. The incentive to free-ride emerges when funding is provided at neighboring-small-administrative units that are empowered to choose the services they can procure. The free-rider problem may also be considered as a spillover effects among users. Some administrative units may not like to contribute but will listen to information for free, and service provision may collapse because it is difficult for the information provider to recover production costs. As a result, the market fails to provide the optimal levels of information that society demands. In Mali, contracting for the provision of information is at the national level, but with a mix of funding sources from public and private sector. The contracting the provision of information at the national level overcomes some of the free-rider/ spillover problems between local units of government described above.

Another problem is that prominent farmers and politicians may determine what information is provided instead of ordinary farmers, especially when there are no channels through which farmers express their voices, such as regular meetings and election of farmer leaders.

2.4.3 Tie-in-sale of Market Information and Members Fees

Another administrative option is a tie-in sale of market information with other low-exclusion-cost goods. Examples given by Olson are the lobbying organizations such as the American Farm Bureau that sell insurance at lower costs to farmers only after they pay membership fees. Part of the fees help to provide high-exclusion-cost good of lobbying for legislation that benefits all farmers, some of whom may not be members (Olson, 1965). Tie-in-sales of information can be introduced in commodity subsectors with tighter vertical coordination mechanisms or where trading can be easily regulated at strategic levels in the production stages of the subsector. The performance outcome under a tie-in sale is that there are no free-riders, but some unwilling riders.

2.4.4 Private Effective Demand: Subscriptions Fees and Information Sales

As already noted, the use of email, SMS, or a webpage with a password can turn some types of information into low-exclusion-cost goods. In this approach, MIS disseminate information through excludable channels so as to recover some costs through subscriptions and user fees when individual users request for information. Also, the provider can be a public-, private-, farmer organization-, trader organization-, or and NGO-based MIS. The performance outcomes under a private effective demand structure are that (1) users pay for information if they can afford and get it, and (2) poor users fail to pay for information and do not benefit directly. Poor users, however, can benefit indirectly when for example a few traders obtain information and indulge in spatial and temporal arbitrage that results in more competitive markets.

2.4.5 Complementarity and Endogeneity of Market Information

The provision and use of improved market information is complementary to other government policies and programs, such as infrastructure development and provision of security that also contribute to increased or decreased welfare among different market actors. Thus, there is endogeneity between provision of improved market information and other government policies that improve market performance. For example, if information from public MIS improves government policies that in turn improve market performance, then some other stakeholders such as farmers and traders may also benefit from the MIS. These complementarities also introduce attribution problems in measuring the impact of MIS. For example, in Mali, some of the benefits from market reforms, which utilized information from the market information system, included integration of markets, stabilization of prices, development of grain markets (entry of new traders, expansion of investments in transport and storage facilities), increase in volumes traded, avoidance of poor policies, and facilitation of regional integration (Dembélé and Staatz., 1999, Diarra, et al., 2004, Keita, 2006). All these benefits are partly attributed to the existence of the MIS. In the subsequent analysis, these challenges of attribution will be discussed.

3 CROSS-COUNTRY SYNTHESIS OF THE GENERIC DESIGN ISSUES OF EMERGING AND TRADITIONAL MIS MODELS

3.1 Characteristics and Premises for the Support of Emerging MIS

This chapter analyses the premises that gave rise to the “emerging” or “new” MIS models and how they deal with the generic design issues of any MIS relative to the “traditional” or “old” MIS models. The “emerging” or “new” MIS models are also referred to as *second-generation* MIS while the “traditional” or “old” MIS models are also referred to as *first-generation* MIS (CIRAD-UMR-MOISA, 2010, J.Rakotoson, et al., 2010). First-generation MIS are mostly housed in government ministries, departments, or semi-autonomous bodies. Their mandate was to help attain efficient and “fairer” markets and to provide information for the design of better policy and monitoring market performance. First-generation MIS mostly started in the 1980s and early 1990s and complemented structural reforms (liberalization and privatization) in many sub-Saharan African countries. Examples (full names of MIS in Table 3 below) of first-generation MIS include OMA in Mali, AMIC in Zambia, SIMA in Mozambique, Siam in Senegal, SIMA and SIML in Niger, and SIPAG in Guinea Conakry. Second-generation MIS have the following characteristics and premises that lead to their creation and support.

1. MIS perceived mandate: Second-generation MIS aimed at helping to attain transparent and efficient markets under the premise that public MIS had not achieved this objective (CIRAD-UMR-MOISA, 2010).
2. Institutional home and organizational innovations: Second-generation MIS are mostly based in the private sector, farmer organizations (with the exception of OMA

in Mali), trader organizations, NGOs, and other professional bodies and were meant to be decentralized. The premise was that locating the MIS in non-government institutions would come with high-powered market incentives that would enable MIS to be responsive to client needs, unlike the first-generation MIS that were located in hierarchical organizations (government departments, ministries and autonomous organizations (with the exception of ECX MIS section in Ethiopia)) with low-powered hierarchical incentive structures.

3. Information provided and frequency of provision: Second-generation MIS were meant to provide more information products beyond mostly prices and quantities traded in markets, and provide information at more frequent intervals. Moreover, some of the second-generation MIS evolved towards exchange models with the characteristics of collecting and disseminating "individualized" information such as offers and bids— such as in KACE (Kundu and Mukhebi, 2010)—or buying prices by traders – such as in Zambia (Mulozi, 2010)—or attributes of commodities that individual sellers wish to sell or that buyers wish to buy (Davies, 2010). This was in contrast with aggregated information, such as average and mode prices and that first-generation MIS provided.
4. Start years: The second-generation MIS started in the late 1990s and 2000s compared to the first-generation MIS that started in the 1980s and early 1990s. This period also coincided with the increase in use of ICT, especially cell phones and to some extent the internet in sub-Saharan Africa.
5. ICT used in transmission and diffusion of market information: Second-generation MIS were meant to have more technological invitations in terms of ICT used in

diffusion and dissemination. The premises were that (1) reliance on the internet and mobile phones for transmission from market collection sites to information processing centers would increase timeliness and reduce errors; and (2) increased dissemination through the internet and to some extent the cell phones would also improve on timeliness and frequency of the information provided to users and recovery of some production costs by enabling exclusion of free riders.

6. Financial sustainability and profit orientation of the MIS: Second-generation MIS were meant to be financially sustainable, mostly through the sale of information.
7. Data collection methods: Second-generation MIS would use wiki approaches of data collection, where multiple users would contribute information, thereby increasing timeliness of the MIS compared to the first-generation MIS that mostly used structured questionnaires with enumerators in the market.
8. Quality control methods: Second-generation MIS were expected to offer superior quality control methods compared to first-generation MIS.
9. Feedback mechanisms: Second-generation MIS were expected to offer superior feedback mechanisms compared to first-generation MIS.
10. Overall results: Expected results were that the second-generation MIS would be (1) timely in providing information for decision making by market actors, (2) accessible to market actors, and (3) sustainable even when there were no external donors.

Examples of second-generation MIS include Esoko in Ghana, KACE Market linkage in Kenya, OdR in Madagascar, ZNFU 4455 SMS MIS in Zambia, INFOTRADE in Uganda, RML in India, RATIN in Kenya, and the ECX MIS section in Ethiopia. In the subsequent analysis, government MIS also mean public MIS or first-generation MIS and non-government MIS refer to second-generation MIS. Non-government are sub-categorized as farmer organization-based MIS, private MIS, and trader or NGO-based MIS.

3.2 Key Research Questions

The key questions addressed in this chapter are:

1. What evidence is there that supports the premises stated above about the second-generation MIS models in comparison to the first-generation MIS models?
2. How have different MIS models tried to address the generic design issues of any MIS and what are the relative advantages of different models of MIS in addressing those issues?
    a. How have the different ways MIS try to address these issues affect their performance; subject to the (i) characteristics of information demand and supply, and (ii) the environment in which MIS operate?
    b. Whom do the different model(s) serve and how well?
    c. In which areas are different MIS models complementary or competitive to each other?
    d. What is the likely evolution of MIS structures over the next 5-10 years?
3. What are the implications for stakeholders in terms of promoting and supporting different types of MIS?

3.3 Organization of the Chapter

Section 3.4 presents a summary of the conceptual, theoretical, and analytical framework used in this chapter. Section 3.5 presents the sources and methods used to collect the information and data and methods of analysis. Section 3.6 describes the different ways

MIS deal with the generic structural design issues, their relative advantages and disadvantages, and discusses questions (a) to (d) listed above under each structural design issue. Section 3.7 examines the different ways MIS deal with the generic conduct design issues, their relative advantages and disadvantages, and discusses questions (a) to (d) listed above under each conduct design issue. Section 3.8 presents the summary of the key observations and conclusions from the synthesis. Section 3.9 addresses question 3 concerning the implications for stakeholders in terms of promoting and supporting different types of MIS.

3.4 Conceptual, Theoretical, and Analytical Framework

Information has characteristics such as nonappropriability, non-rivalry, indivisibility, quality uncertainty, and perishability that have that have limited private provision of such information to less-than socially desirable levels. Each MIS has stakeholders, including workers, some with conflicting interests and incentives that are not aligned with having the MIS serve the needs of other stakeholders efficiently; thus, there is a need to align their incentives, including noneconomic inducements, to achieve MIS "viability" (Williamson, 1981)—i.e., provide information that meets user needs and that are sustainable. Thus, concepts from information theory and organization theory such as high-powered market incentives and low-powered hierarchical incentives (Williamson, 1985), are used to analyze which MIS types are best suited to meet the needs of various stakeholders under different circumstances. A key element of the analytical framework used is borrowed from industrial organization, consisting of the SCP paradigm described in section 1.5 and summarized in Table 1 in chapter 1.

3.5 Methods Used in the Study

3.5.1 Sources of Information and Data

The analysis in this chapter is based on information obtained using several sources (each is described in detail below): (1) A global literature review of MIS in USA, Asia, and Africa; (2) Case studies of MIS stakeholders in Mozambique, Ethiopia, and Zambia; and (3) an email survey (E-survey) of MIS practitioners in African countries carried out in collaboration with the Agricultural Research for Developing Countries (CIRAD), and the National Institute for Agricultural Research (INRA) in France; and (4) and from discussions with MIS practitioners such as researchers, providers, and funders during meetings, and a workshop on market information system in Sub-Saharan Africa conducted by CIRAD/INRA and MSU in France in March 2010. This information is triangulated with data from other secondary sources such as the World Bank's World Development Indicators and from past experience of the author working on MIS in the East African Region. Table 3 gives the names of MIS included in the study, grouped by their categories identified in section 1.3, their acronyms and "generation", country(ies) of operation, and methods used to collect the information from each.

Table 3: Institutional Home, Acronym, Generation , Country, and Method Used to Collect Information for the MIS Study

	Name of MIS	Acronym	Generation	Country	Method
	Farmer organization-Based MIS				
1	Observatoire du Marché Agricole	OMA	1st G	Mali	LR[1]+ES[2]
2	Economic Information System of Vegetables	SIEL	2nd G	Madagascar	ES
3	Zambia National Farmers Union SMS 4455	ZNFU	2nd G	Zambia	LR+ES+CS[3]+ M[4]
	State or Public-based MIS				
4	Integrated Agricultural Marketing Information System	AGMARIS	1st G	Philippines	LR
5	Agricultural Market Information Center	AMIC		Zambia	LR+ES+CS
6	Ethiopia Commodity Exchange MIS section	ECX	2nd G	Ethiopia	LR+ES+CS
7	The Fruit and Vegetable Market News – USA	FVMIS	1st G	USA	LR
8	The Indonesian Horticultural Market Information Service	IHMIS	1st G	Indonesia	LR
9	National Agricultural Statistics Service	NASS	1st G	USA	LR
10	Siarm	Siarm	1st G	Senegal	ES
11	Agricultural Market Information System	SIMA	1st G	Mozambique	LR+ES+CS
12	Information System of Agricultural Markets	SIMA	1st G	Niger	ES
13	Information Systems on Livestock Markets	SIML	1st G	Niger	ES
14	System of Agricultural Information Products Guinea (SIPAG)	SIPAG	1st G	Guinea Conakry	ES
	Private-based MIS				
15	Esoko Ghana	Esoko	2nd G	Ghana	LR+ES+M
16	Infotrade	Infotrade	2nd G	Uganda	ES

Table Continued on next page

Table 3(Continued)

	Name of MIS	Acronym	Generation	Country	Method
17	KACE Market and Information Linkage System	KACE	2^{nd} G	Kenya	LR+ES+M
18	Reuters Market Light	RML	2^{nd} G	India	LR+ES
	Trader organization and NGO-Based MIS				
19	Afrique Verte International	AVI	2^{nd} G	Burkina Faso Mali, Niger	ES+M
20	Rice Observatory	OdR	2^{nd} G	Madagascar	ES+M
21	Regional Agricultural Trade Intelligence Network	RATIN	2^{nd} G	Kenya	ES+M

1. LR=Literature review; 2. ES= Email Survey of MIS providers; 3. CS=case studies; 4. M=Meeting during workshop; 1^{st} = First-generation MIS; 2^{nd} G=Second-generation MIS.

3.5.2 Global Review of Literature

This involved a review of documents about MIS from different countries. For each model, the review focused on the following characteristics of interest: (1) the organization's perceived mandate (aims, objectives, and clientele served); (2) information provided, frequency, and modes of diffusion (including use of ICT); (3) data collection and quality control methods; (4) the institutional home and links with policy analysts, (5) feedback mechanisms from users, (6) and the funding model for financial sustainability. The process of literature review marked the beginning of compiling 0—in essence the beginning of data collection and tabulation for the qualitative analysis conducted in this chapter. The appendix is therefore a major source of information used in the qualitative analysis in this dissertation. Subsequently, a summary of the characteristics of each MIS was tabulated and entered into a database together with other information collected during the case studies explained in section 3.5.2 and the e-survey described in section 3.5.4. The analysis of the information in the database consisted of tabulating the number and percentage of the overall characteristic of interest by MIS types (e.g., aims and objectives by government and non-government MIS) and sub-classification of non-government MIS by their types (e.g., farmer organization-based MIS, private MIS, and trader and NGO-based MIS), and examining whether these characteristics clustered by MIS types. Note that the sample size was small and therefore not sufficient to make any statistical tests and inference on several characteristics (variables), and this weakness is pointed out in the sections 1.5.5 and 3.5.2.

3.5.3 Case Studies

This section gives the case study preparations and implementation including the units of analysis, MIS selection criteria, data collection methods used within the case studies, advantages and disadvantages of case studies, and the analysis conducted in the case studies.

Units of analysis: The units of analysis in the case studies are three types of MIS: (1) Two government MIS- the Mozambique Agricultural Market Information System (SIMA), and the Zambian Agricultural Market Information Center (AMIC); (2) public-private sector (autonomous) MIS - the Ethiopian Commodity Exchange; and (3) a farmer organization-based MIS—ZNFU 4455 SMS MIS under the Zambia National Farmers Union.

MIS selection criteria: No random sampling was used to select the MIS to be included in the case studies. Instead, the MIS were purposively selected to obtain a broad experience of the different MIS that epitomize each MIS category in SSA. The ECX was the nearest proxy to a private MIS (replacing KACE Market Linkage, which demanded research fees as one of its funding strategies for sustainability), although it is a private-public autonomous MIS.

Data collection methods used in the case studies: The case study interviews in Mozambique, Ethiopia, and Zambia were conducted with MIS personnel, especially data collectors, who have interacted with MIS stakeholders over several years. Interviews were also conducted with farmers, farmer group leaders, donors, large-scale traders, governments, and food assistance organizations. Also, the study used direct observation of during field visits. The 4 case studies vary in stakeholders covered and what commodities the MIS covered. Therefore, a summary of characteristics of information users, background information, and methods used in each country is given in section A. 2 of 0. None of the case studies included consumers as a stakeholder group. The information needs of consumers from previous studies, where available, are included to give some insights.

Advantages and disadvantages of case studies: The case study approach was taken because it can help identify factors (especially non-technological ones) that influence the performance of MIS, but cannot accurately be estimated by sampling from a probability distribution. In other words, no statistical inference is claimed in the case studies because of small sample sizes and several unique features in many MIS. The disadvantages with case studies are that they require much time and money to conduct, and also face the problems of lack of generalization of results from one case study to another. The counter argument to lack of generalization is that case studies can contribute to the development of theories (induction as opposed to deduction), just like scientists generalize results from experiments to theories (Yin, 2003).

During the case studies, selection and appointments with farmers and small-scale traders were made with the assistance of MIS staff, NGOs, farmer organizations, and local government officials. This may have introduced selection bias on one side, because MIS staff, NGOs, farmer organizations and government officials could have selected farmers and traders who can give favorable answers. On the other side, however, the study targeted ideal information users who could give an informed opinion on the topics of interest related to the information they receive. Interpreters were used to translate responses from local languages to English for respondents who could not speak English. This could also be a source of bias, if the interpreters translated the questions incorrectly.

Analysis in the case studies: The case studies use qualitative analysis consisting of three general approaches (Yin, 2003): (1) defining and relying on theoretical propositions, (2) defining and testing rival explanations from the case studies[3], and (3) developing a case description from the case studies. More specifically, the analysis in the study uses pattern matching, explanation building, and cross-case synthesis. Cross-case synthesis applies when analyzing an issue across two or more countries, for example, whether the use of SMS to transmit and diffuse information increases timeliness of receiving it by users across all MIS models.

These case descriptions from the four case studies and some qualitative analysis unique to each MIS are included in 0. The main characteristics (structure and conduct issues) from the case studies were also summarized and included in the database of MIS together with information from the global review described in section 3.5.2, the email survey described in section 3.5.4, and from the meetings and workshop presentations with practitioners in described in section 3.5.5. The analysis of the database of MIS is the same as that described in section 3.5.2. It consists of tabulating the overall characteristic of interest by MIS types and examining whether these characteristics clustered by MIS types.

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[3] Rival explanations means looking at rival hypotheses that may also affect the performance outcome under analysis.

3.5.4 Email Survey Design

This section gives the design details of the email survey including the population frame, mail questionnaire development, MIS selection, interview timing, response rate, the advantages and disadvantages of the mail questionnaires, and the data analysis conducted on the collected data.

Population frame: For the E-survey, a list of MIS practitioners (population frame) was constructed through contacts with people who have worked on MIS in Africa and Asia. This list was complemented with a list from the Technical Centre for Agricultural and Rural Co-operation ACP-EU (CTA), which had a mailing list of some MIS practitioners.

Main questionnaire development: The questionnaire, the English version of which is included in APPENDIX B, had the following sections: (1) MIS identification; (2) aims, objectives, and clientele of the MIS; (3) products covered, information collected and geographical coverage of the MIS; (4) methods of transmission and quality control; (5) information provided, frequency, and method of diffusion; (6) other services provided; (7) organization and institutional aspects; (8) funding; (8) feedback; (9) changes; and (10) additional comments.

MIS selection, interview timing, and response rate: No random sampling of MIS was done, in essence making the exercise a census of MIS. The period of the e-survey lasted from November 2009 to February 2010. The data collection period was long because non-respondents were followed up multiple times. A questionnaire, mostly consisting of pre-coded questions in English and French, was sent to 77 MIS initiatives, out of which 31 questionnaires were returned.

Not all returned questionnaires were useful, functional, or met the criterion of what is defined as MIS in this dissertation as defined in section 1.3. Thus, only 17 out of the 31 returned questionnaires are used in this analysis. The misunderstanding of the definition of the MIS is a major issue that is discussed among MIS practitioners (CIRAD-UMR-MOISA, 2010) and featured prominently in the workshop of MIS practitioners discussed in section 3.5.4 below. This lack of an updated and standard definition of an MIS also contributed to the long population frame, by including initiatives that are not really MIS, and motivated the redefinition of what is an MIS in section 1.3.

Other reasons for the low return rate could have been (1) interview fatigue among MIS; (2) no longer existing MIS, which can also be considered as an indicator of lack of sustainability of MIS; or (3) no longer existing MIS, which can also be an indicator of free entry and exit in the MIS business (i.e., indicator of a competitive MIS sector). The third reason is theoretically possible but not practically the case. Some MIS did not want to respond, probably thinking that the study was an evaluation, or due to interview fatigue.

Advantages and disadvantages of email questionnaire: The advantage of the email questionnaire is speed and low cost of data collection. The disadvantage of the emailed questionnaire is that there is no direct observation of the interviewees to verify observable activities like in the case of an interviewer-administered questionnaire. Also, self-reporting used in the E-survey can induce the respondents to give biased information (e.g., to report answers that align to those included in the project proposals, especially when respondents know that the results will be shared with their donors, or if the study is mistakenly considered as an evaluation). Although this advantage can apply to any survey of the MIS, even one administered by an enumerator, being physically present in the country can enable the enumerator to observe some of the things reported (e.g., one can buy a newspaper or tune into a radio and verify diffusion of market information reported by an MIS).

Data analysis: The information from the e-survey was entered in an access database and later exported to Excel and merged with the information from the literature review described in section 3.5.2 and from the case studies explained in section 3.5.2. The analysis of the database of MIS is the same as that described in section 3.5.2. It consists of tabulating the overall characteristics (structure and conduct design issues) of interest by MIS types and examining whether these characteristics clustered and their percentages by MIS types. Also, the sample size was small and therefore not sufficient to make any statistical tests and inference on several characteristics (variables) and this weakness is pointed out in the sections 1.5.5.

3.5.5 Meetings and Workshop

The researcher attended meetings with key informants with experience on MIS in Africa and also attended presentations of 6 MIS providers during a workshop on "Agricultural Market Information Systems in Africa: Renewal and Impact" in Montpelier, France from March 29-31, 2010. Details of this workshop can be found at http://www.sim2g.org/. The three main themes of the workshop were: (1) Overview of agricultural MIS in sub-Saharan Africa; (2) Inventory of innovations within the MIS based on presentations of specific cases; 3. Results (methodological or empirical) concerning the impact of MIS (CIRAD-UMR-MOISA, 2010). The main contribution from the meeting was to refine the premises that are analyzed in this chapter, and to fill in the details that were missed in the literature review, e-survey, and the case study field visits.

3.6 Generic Structural Design Issues Facing Any MIS

The key generic structural design issues include: (1) the MIS's perceived mandate (aims, objectives, and clientele served), (2) institutional home and related organizational and coordination features, and (3) the nature of the commodities covered by the MIS (e.g., staple, cash, or perishable commodities). The results presented below are the stated responses of the MIS, which may or may not reflect reality.

3.6.1 MIS Perceived Mandate

The MIS perceived mandate relates to the aims and objectives of the MIS and its main clientele. Understanding the perceived mandate of the MIS is essential in analyzing how well it serves its intended clientele. One of the premises of supporting the creation of second-generation MIS was that they would help to attain transparent and efficient markets, and that public MIS had not achieved this objective. How do the aims and objectives and the key targeted clientele of MIS models vary? What evidence is there that supports the premise that non-government MIS are more likely to help attain efficient markets than government-supported MIS?

Main Observation

Most first-generation MIS stated their main aims as attaining efficient marketing, gathering information for making better policy formulation and for food security planning and monitoring, and attaining "fairer" markets. In contrast, second-generation MIS mostly saw their aims as attaining efficient marketing, linking producers to markets, and enabling farmers to negotiate for better prices with traders (attaining "fairer" markets.) Both first- and second-generation MIS consider farmers, traders, and governments as their main clientele.

Comparison between MIS Models

Based on the literature review, e-survey, and case studies, it appears that most public MIS state that they aim at attaining efficient marketing (82%); gathering information for making better policy and monitoring (73%); attaining transparent markets and for food security planning and monitoring (55%); and attaining "fairer" markets (45%). In contrast, it appears that most non-government MIS state that they aim at attaining efficient (competitive) marketing (50%), attaining transparent markets (60%), linking producers to markets (40%), and enabling farmers to negotiate for better prices with traders and for food security planning and monitoring (30%).

Total Overview

The most stated aims and objectives of MIS reported in Table 4 for 21 MIS include: attaining efficient (competitive) marketing (67 %), attaining transparent markets (57%), making better policy and monitoring (48%), and food security planning and monitoring (43%). Some of these aims and objectives given by the MIS are related. For example, attaining efficient (competitive) marketing is equivalent to attaining transparent markets. Also, attaining "fairer" marketing is related to enabling farmers negotiate for fair prices with traders. When attaining efficient (competitive) marketing and transparent markets are considered as one objective, 18 out of 21 MIS aim at attaining efficient or transparent markets. A detailed breakdown of the aims and objectives of MIS by MIS types is given Table 4 and a breakdown by individual MIS is included in Table 41 is in section A. 9 in 0.

Table 4: Objectives of Selected MIS Models

	Government		Non-government MIS								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Efficient (competitive) marketing	9	82	2	67	1	25	2	67	5	50	14	67
Attain transparent markets	6	55	3	100	3	75	0	0	6	60	12	57
Making better policy and monitoring	8	73	1	33	0	0	1	33	2	20	10	48
Food security planning and monitoring	6	55	1	33	0	0	2	67	3	30	9	43
Fair marketing	5	45	1	33	0	0	0	0	1	10	6	29
Monitor market performance	3	27	1	33	0	0	1	33	2	20	5	24
Linking producers to markets	0	0	2	67	2	50	0	0	4	40	4	19
Negotiate for better prices with traders	1	9	2	67	1	25	0	0	3	30	4	19
Make markets Secure/ reduce risks	2	18	0	0	1	25	0	0	1	10	3	14
Increase productivity	0	0	0	0	1	25	1	33	2	20	2	10
Provide price collection and distribution technologies	0	0	0	0	1	25	0	0	1	10	1	5

Source: Literature review, case studies, and E-survey; N=Number; %=Percentage.

Table 5: Clientele of Selected MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Farmers/ Growers (small-scale)	11	100	3	100	4	100	3	100	10	100	21	100
Farmers/ Growers (large-scale)	10	91	3	100	4	100	3	100	10	100	20	95
Traders (crop and input small scale)	10	91	3	100	3	75	3	100	9	90	19	90
Government policy analysts/makers	11	100	2	67	3	75	3	100	8	80	19	90
Traders (large-scale)	8	73	3	100	3	75	3	100	9	90	17	81
Food Assistance Agencies	8	73	2	67	3	75	3	100	8	80	16	76
Consumers	6	55	2	67	3	75	3	100	8	80	14	67
Donors	5	45	3	100	3	75	3	100	9	90	14	67
NGOs	6	55	2	67	3	75	3	100	8	80	14	67
Farmer associations / cooperatives	5	45	2	67	3	75	3	100	8	80	13	62
Chamber of commerce	5	45	2	67	3	75	3	100	8	80	13	62
Chamber of Agriculture	4	36	2	67	3	75	3	100	8	80	12	57
Value Chain Actors (inter-professional)	4	36	2	67	3	75	3	100	8	80	12	57
Researchers and education	6	55	1	33	3	75	2	67	6	60	12	57
Banks	4	36	1	33	2	50	2	67	5	50	9	43
Exporters / shippers	3	27	1	33	0	0	1	33	2	20	5	24

Source: Literature review, case studies, and E-survey; N=Number; %=Percentage.

Key targeted clientele of MIS

Identifying key potential clients and their information needs is crucial to the sustainability of the MIS since it is the clients who contribute financial resources or political support that induces government or donor financial support for the MIS. Table 5 shows there is not much difference between the stated clientele of government and non-government MIS. For example, all government and non-government MIS stated that they consider smallholder farmers as one of their most important clientele. Also, 91% of government and 90% of non-government MIS stated that they consider traders as one of their most important clientele. How well these MIS serve their stated clientele is not captured in this study. A detailed breakdown of the MIS clientele by individual MIS is included in Table 42 is in section A. 9 in 0.

What evidence is there that supports the premise that non-government MIS are likely to help attain efficient markets than government-supported MIS?

This question is related to assessing the impact of MIS, which is a challenge for several reasons thus (Staatz, et al., 2010). (a) The first challenge is that measuring the effect of second-generation MIS on market efficiency requires identification of the relevant efficiency indicators (which are part of the performance indicators). Other challenges include (b) identifying the pathways through which improved market information affects the efficiency dimensions (and other performance indicators in general), (c) establishing a reliable baseline against which to measure improved efficiency, (d) distinguishing between investments in MIS and general improvements in information availability, (e) assessing the contributions of complementary investments and policy changes that frequently accompany the creation of MIS, (f) establishing a credible counterfactual concerning the market situation that would have prevailed in the absence of the MIS, and (g) interpreting the validity of stakeholders' statements and governments' revealed preferences regarding the utility of MIS (Staatz, et al., 2010).

For example, as discussed in 2.4.5, the provision of information by public MIS is complementary to other services such as infrastructure development, and its benefits are endogenous with those from other government policies that also affect the welfare of farmers, traders, and other stakeholders. Also, if information from public MIS improves government policies that in turn improve market performance, then some other stakeholders such as farmers and traders may also benefit from the MIS. In some countries such as the US, private MIS also use some of the information provided by public MIS. Therefore, it is difficult to determine which users benefit or which users are hurt from the different MIS models due to the attribution and spillover problems. It is also difficult to isolate the contribution of government and non-government MIS on market efficiency especially when they co-exist, as is the case in some countries like Zambia where there is AMIC and ZNFU 445S SMS MIS.

What are the implications of MIS mandate on their performance?

For all MIS models, their mandates influence the information provided, the frequency of provision, whether the MIS produces its own information or concentrates on distributing information produced by others (or some combination of the two), and the ICT used in diffusion of information. Under different scenarios, the perceived mandate of any MIS might influence its performance differently. For example, in terms of information provided and frequency, many public MIS focus on providing structural and time series information for government use in policy making and food security analysis. Since policy analysis takes place at less frequent intervals, the MIS issue analytical reports at less frequent intervals. When government-supported MIS provide only structural and time series information, they may perform well in terms of timeliness to government policy analysis but not for private traders who need some types of information more frequently. However, when the government-supported MIS provide both current market information more frequently, and structural and time series information at less frequent intervals (e.g., in Mali and Senegal), they may perform well for both public and private information users. This same scenario can occur for non-government MIS.

Whom do the different model(s) serve and how well?

Based on stated mandate and clientele served, public MIS more frequently see public policy information needs as part of their mandate than do non-government MIS. For the other main aims and objectives of helping to attain efficient and "fairer markets, no MIS seems to have any specific niche in terms of clientele. They target all stakeholders such as farmers and traders, depending on their mandate and the resources the MIS have at their disposal.

In which areas are different MIS models complementary or competitive to each other?

In terms of mandate, all MIS models compete with each other in the objective of providing information to attain efficient and fairer markets among market participants, especially farmers and traders.

What is the likely evolution of the mandates of MIS over the next 5-10 years?

The aims and objectives of public MIS (e.g., of gathering information for making better policy formulation, and for food security planning and monitoring) and hence their key clientele (especially policy makers and farmers) are not likely to change in the next 5 to 10 years due to the persistence (slow changes) of some of the environmental factors in which the MIS operates. For example, there is persistent future price uncertainty in many countries (e.g., the food crisis of 2007/08 and the current high-level of world food prices), there is persistent variance in inflation in many sub-Saharan African countries, and there is growing unpredictable agro-climatic conditions (cf. present debate on climate change), and lack of effective demand for improved market information by some users. These factors in the environment in which MIS exist are likely to create additional demand for market information for policy analyses—particularly on the links between international and domestic markets. Also, as incomes grow, there is likely to be an increased demand for processed foods, and consequently a likely change in MIS mandate. Processing firms will have specific information needs they will need filled, or are they may vertically integrate and collect/diffuse their own information. Some of the information that farmers or groups of farmers may need to participate in these more tightly coordinated markets include grades and standards, food safety procedures and regulations, and traceability compliance.

3.6.2 Institutional Home, Organizational Features, and Coordination Forms

Institutional home relates to whether the MIS is housed in the public sector, private sector, farmer organization, trader organization, or in an NGO. Using these criteria, second-generation MIS are mostly based in the private sector, farmer organizations, trader organizations, NGOs, and other professional bodies. The premise was that locating the MIS in non-government institutions would come with high-powered market incentives that would enable MIS to be responsive to client needs, unlike the first-generation MIS that were located in hierarchical organizations (government departments, ministries and autonomous organizations) with low-powered hierarchical incentive structures.

Organizational features relate to whether the: (1) parent institution or the MIS provides other complementary services, especially those that generate information as a byproduct or increase the value of information; (2) the geographic coverage (e.g., part of a country, national, or regional) and range of commodities; (3) design of incentives for MIS staff, such as level of staff salaries, level bureaucracy, and nature of resource sharing rules; and (4) the profit orientation of the MIS. Assuring coordination among information production stages relate to whether the MIS is (1) vertically integrated, (2) conducts specialized activities, and (3) centralized or decentralized.

3.6.2.1 Provision of Complementary Services

Many MIS or the institutions in which they are housed provide complementary services, some of which generate information as byproducts or increase the value of information among users.

Main observation

Based on a qualitative assessment and examples, all types of MIS or institutions in which they are housed provide complementary services, some of which generate information as byproducts or help increase sustainability, reliability, and timeliness of information among users. It appears that non-government MIS provide more categories of complementary services compared to public MIS, although the performance outcomes vary depending on the specific complementary services provided by MIS and not by MIS types as a whole.

Comparison between MIS Models

Table 6 shows the number and percentage distribution of other complimentary services provided by government and non-government MIS. The table shows that the percentage of other complementary services provided by the MIS or organizations in which they are housed is higher in non-government MIS than in government MIS (apart from issuance of agricultural import, export, and transit permits, which is only done in government MIS).

Total overview

Table 6 shows that out of the 21 MIS or institutions in which they are housed, the most commonly provided complementary services include: training to users (62%), market studies (52%), extension services and advice (48%), and organization, management, and marketing services to producer organizations (43%). A detailed breakdown of the services provided by selected MIS Models is included in Table 43 in section A. 9 in 0.

Table 6: Services Provided By MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Education/training	6	55	2	67	3	75	2	67	7	70	13	62
Market Studies	5	45	2	67	2	50	2	67	6	60	11	52
Extension services (advise)	3	27	3	100	2	50	2	67	7	70	10	48
Producer organization support (organization, management, marketing)	3	27	2	67	2	50	2	67	6	60	9	43
Provision of input/seeds	2	18	2	67	2	50	2	67	6	60	8	38
Storage support	3	27	1	33	1	25	2	67	4	40	7	33
Coordination Activities	3	27	2	67	0	0	2	67	4	40	7	33
Stock / commodity exchange	2	18	1	33	0	0	2	67	3	30	5	24
Provision of warehouse receipt	2	18	1	33	0	0	1	33	2	20	4	19
Agricultural import, export, and transit permits	1	9	0	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number; %=Percentage.

What are the implications of provision of complementary services on MIS performance?

Based on a qualitative assessment and as illustrated in the following paragraphs, the provision of some complementary services increases sustainability, reliability, and timeliness of information provided by the MIS. More specifically, provision of some complementary services: (1) increases the sustainability of the MIS through reduction in the some data collection and diffusion costs; (2) increases reliability (accuracy) of information, as they generate market information as a byproduct; (3) increases the reliability (relevance) of some market information products; and (4) increases the timeliness of releasing information products.

Public MIS

For example, the ECX in Ethiopia (categorized as a public MIS) provides a trading floor system among traders, warehouse delivery centers, commodity handling facilities, storage, and grading of agricultural commodities. These activities generate market information as a byproduct, implying lower information production costs, and thus higher sustainability potential. Generating information as a byproduct of transactions also increases accuracy because it is based on real transactions. This may, however, lead to biased prices if the volume traded on the exchange is a small proportion of that traded in other marketing channels.

In Nampula province in Mozambique, SIMAP diffuses market information together with extension information from the extension unit in a weekly 30-minute agricultural radio program. In this case, market information complements extension information, e.g., on contacts of sellers of inputs such as fertilizer and farm implements, which increases the relevance of information to users on one hand, and reduces dissemination cost faced by the MIS on the other.

Farmer organization-based MIS

In Zambia, the ZNFU (a farmer organization) trains farmers on grades they should provide to millers to avoid disagreements over quality so as to bargain for higher prices. Farmers are trained in workshops and through radio programs on the grades and standards of maize required by traders. This also illustrates the importance of having complementary services to just price information.

In some situations, however, relating MIS activities with other units offering complementary services hurts the timeliness of releasing MIS bulletins. For example, in Zambia, AMIC staff is sometimes deployed to distribute fertilizer, which encroaches on the time dedicated to MIS activities, leading to untimely diffusion of market information. Also, when the MIS or the institution housing the MIS also issues import, export, and transit permits, or collects taxes as is proposed in Mozambique, there will be incentives for traders to under-report the prices and the volumes of the traded items. Thus, like any other business, MIS have to identify the mix of outputs it makes most sense to produce—i.e., identify areas where there are economies of scope rather than diseconomies. This is the type of analysis any business that produces multiple products needs to undertake.

Whom do the different model(s) serve and how well?

The performance outcomes vary depending on the specific complementary services provided by MIS and not by MIS types as the whole. This is because the nature of complementary services provided varies between individual MIS, even within the same category of MIS. This means that no generalization can be made as to whether private-, public-, farmer organization-, or trader and NGO-based MIS serve farmers, traders, government or donors better based on the complementary services they provide.

3.6.2.2 Geographic Coverage and Range of Commodities Covered

Two structural features of early MIS were that they: (1) collected information over wide geographic areas and (2) on a wide range of commodities.

Geographical coverage: Government MIS in the sample have a more national coverage (91%) compared to non-government (60%). More non-government MIS in the sample (50%) cover only part of a country than do government MIS (9%). In terms of regional coverage, 36% of government MIS covered more than one country while 30% of non-government MIS covered more than one country. In total, Table 7 shows that out of the 21 MIS examined, 76% have a national coverage, 29% cover only part of a country, and 33% have a regional coverage (more than one country).

Table 7: Geographical Coverage and Centralization or Decentralization in Processing by MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Geographical Coverage												
National level	10	91	2	67	3	75	1	33	6	60	16	76
Part of a country	1	9	1	33	2	50	2	67	5	50	6	29
Regional level (Many countries)	4	36	0	0	1	25	2	67	3	30	7	33
Centralization or Decentralization												
Centralized Processing	6	55	2	67	3	75	3	100	8	80	14	67
Decentralized Processing	1	9	0	0	0	0	0	0	0	0	1	5
Both Centralized and Decentralized	4	36	1	33	1	25		0	2	20	6	29

Source: Literature review, case studies, and E-survey; N=Number; %=Percentage.

Range of commodities: In terms of number of crops covered, only one MIS (ECX) predominantly collects and disseminates information on one cash crop (coffee). Both first- and second-generation MIS cover several staple commodities compared to cash crops. The number of commodities covered by MIS varies unsystematically between MIS types: some government MIS monitor a smaller number of commodities than do non-government MIS and the converse is true. For example, Esoko reported that it monitors 150 commodities, which is much higher than the 18 agricultural commodities monitored by AMIC in Zambia and the 25 agricultural commodities monitored by SIMA in Mozambique. A within-country comparison in Zambia shows that the range of commodities covered by AMIC (a public MIS) of 18 agricultural commodities and 9 inputs is higher than the range of commodities covered by the ZNFU 4455 SMS MIS (a farmer based MIS) of 14 commodities. Therefore, there is no evidence to suggest that first-generation MIS cover a higher number of commodities than second-generation MIS—within our sample, the coverage varies widely within each category of MIS.

Number of markets monitored: The number of rural and urban markets covered by MIS varies unsystematically: some, but not all, government MIS monitor more markets than do non-government MIS. For example RML (a private MIS) reported that it monitors 1,200 rural markets—much higher than all government and farmer organization-based MIS. It is noted, however, that RML is in India, where the geographic density of markets is much greater than in sub-Saharan Africa. This illustrates the importance of the country setting in which the MIS exists. The details of geographical coverage, the range of commodities, and the markets covered by individual MIS are included in Table 44 in section A. 9 of 0.

What are the implications of geographic coverage and range of commodities covered on MIS performance? And whom do the different model(s) serve and how well?

The geographic coverage and range of commodities covered by an MIS affect the timeliness of releasing market information bulletins and the costs of data collection, which affect sustainability. Some of the reasons MIS cover wide geographic areas may be: (1) to gain economies of scale in collection and diffusion; (2) to obtain relevant information that reflects the diversity in production, market conditions, and food security within countries; and (3) the profit orientation of the MIS in relation to the size of country of operation and density of the population.

Who benefits from gain in economies of scale? All MIS models can potentially gain economies of scale in collection and diffusion from covering large geographical areas and a wide range of commodities. Depending on the data collection methods, the larger the geographical area and the wider the range of commodities an MIS covers, the higher the total cost of data collection and monitoring, for example, in form of fuel and staff allowances to go and monitor data collectors. However, once the fixed costs of setting up an MIS to collect information from a given geographical area and for a given number of commodities are met, the marginal cost of covering an additional area and additional crop are relatively small. For example, once a data collector goes to a market to interview a trader of one commodity (say about maize prices), the marginal cost of interviewing the same trader about another commodity (say beans), or to interview another trader in the same market are lower than the average costs. Thus, covering a larger geographical region and a wider range of commodities leads to economies of scale in information collection and dissemination of certain types of information, resulting in a lower unit cost of information collected or per client served. From section 2.2.1 on indivisibility, how well an MIS that attains economies of scale serves different users depends on whether it becomes an efficient monopolist that charges a price equal to marginal cost, or one that exercises its market power and charge a price higher than the marginal costs. If there are economies of scale and the MIS charges marginal costs, then it won't cover its total costs. So then the question becomes, who pays the infra-marginal costs? It is noted, however, that there may be an optimal point beyond which diseconomies of scale come into play. For example, some of the MIS clientele may demand more customized information and analysis that increase the marginal costs of processing and analyzing the extra data. For example in Mozambique and Zambia, the WPF would like the MIS to collect information from more districts where WFP conducts its activities and the MIS does not currently cover but is aware of the financial implications of this demand on part of the MIS. WFP conducts sample surveys that cover some of the districts where SIMA does not cover. In this example, the marginal costs of the MIS can start to increase as the MIS expands beyond the optimal size.

In deciding how large a geographical area to cover, the MIS faces a make-or-buy decision—whether to gather the information itself or to cooperate with other MIS covering other areas and exchange information. The latter is the approach that has been taken by West African MIS, which have organized into a regional network (RESIMAO) to promote exchange of information among MIS and to gain economies of scale in developing improved methods for market monitoring.

Governments, donors, and poor farmers and traders benefit when they obtain information that reflects the diversity in production, marketing conditions and food security within countries. Governments have a mandate to ensure food security throughout the country either through production or markets. Since different parts of the country produce different commodities and have different food security situations, it follows that public MIS such as SIMA and AMIC, and those MIS supported by government, such as OMA, have to cover wide geographical areas and a wide range of commodities. Related to this point is that if one wants to interpret changes in market conditions at one level in a value chain (e.g., price variation in consumer markets), it is often necessary to understand what is going on at other levels in the value chain (e.g., price variation at the farm level for both substitutes and complementary crops). These are some of the reasons why many government supported MIS cover wider geographical regions and a wide range of commodities. In contrast, private MIS and traders' organization-based MIS mostly aim at promoting market transparency in areas where trade occurs. This partly explains why the geographic coverage and range of commodities of some private MIS is smaller. With greater market integration, the geographical scope of private MIS (or their links with MIS in other countries) is likely to expand in the next 5 to 10 years. Some farmers and traders also benefit from the information from MIS that cover wide geographical areas, as diversity may open scope for spatial arbitrage.

The interest in monitoring food security and market performance is not confined to governments and government MIS. For example, two major reasons why donors invested in MIS activities under the International Institute of Tropical Agriculture (IITA

FOODNET MIS) in Uganda in the late 1990s up to 2000s were: (1) monitor the performance of cassava technology transfer programs and their effects on food security, and (2) to guide and monitor the effects of commodity monetization so as not to distort markets and domestic production of some crops such as oil seeds due to monetization of cooking oil. In Uganda, cassava is widely grown as an important food security crop but is not widely commercially processed for marketing. Donors were interested in monitoring how the breeding and multiplication of mosaic virus-resistant cassava varieties and the promotion of cassava processing technologies led to an increase in cassava production and how the increase in production affected cassava prices and the prices of other substitutes (e.g., sweet potatoes and maize) and complements (e.g., millet, sorghum, and beans). This objective implied that the MIS had to cover a wider range of commodities to facilitate the monitoring of substitutes and complementary effects of technology development and diffusion. In relationship to the second objective, the MIS produced customized information consisting of wholesale and retail prices, new market entrants, and new varieties of cooking oil and wheat products for monetization purposes. The Uganda example also illustrates how the mandate of the MIS influences its sustainability. When the mandate of the MIS ended (i.e., when there was no more need for monitoring technology transfer and monetization of crops by the main funders), the MIS ceased to be sustainable (i.e., there were no stakeholders with effective demand).

Profit orientation of the MIS: In low-income countries, MIS that are profit oriented, especially private MIS such as RML in India and KACE in Kenya, may be better-off in terms of cost recovery when they cover small geographic areas with high population densities where there is likely to be higher effective demand for information (e.g., through use of SMS requests) than covering areas with low population densities. The problem, however, is that information will be under-provided (from a social-cost perspective) to some users in some part of the countries with low population densities and where some users such as poor farmers have no effective demand for information.

In which areas are different MIS models complementary or competitive to each other?

Government-supported MIS may collect information from rural areas and on crops not covered by private MIS, while non-government MIS collect information from urban areas with high trade activity. Alternatively, governments and donors could subsidize non-government MIS so that they can provide information to users without effective demands if the government and donors judged that a non-government MIS could do this more efficiently than government MIS. In practice, this was not done within the sample of MIS covered by this study.

3.6.2.3 Assuring Coordination among MIS Activities and Production Stages

Given the characteristics of information and the environment in which MIS operate, what does theory suggest about ways of coordinating information production activities such as collection, analysis, and dissemination? For example, what are the advantages and disadvantages of maintaining the activities of MIS in a single organization compared to when activities are conducted in different organizations (integration or specialization in MIS activities)? What are the tradeoffs of centralizing or decentralizing MIS activities? What are the advantages and disadvantages of maintaining the production of all market information products within a single organization compared to when information products are produced by different organizations (integration or specialization in information products)?

3.6.2.3.1 Vertical Integration of MIS Activities

In the context of MIS, vertical integration means that data collection, analysis, and dissemination are done in one organization. There seems not to be a difference between government and non-government MIS in terms of the degree of integration of MIS activities such as collection, analysis and diffusion of market information.

Comparison between MIS Models

From case study interviews, first-generation MIS such as AMIC in Zambia and SIMA in Mozambique are integrated in a sense that they collect, analyze, and disseminate market news. However, some types of information such as international prices are obtained from other organizations. In Mozambique, SIMAP gives the MIS bulletin to the communication unit for dissemination. This is analogous to separating collection and analysis of market news from diffusion of market news. In this example, SIMAP can be considered to be integrated in collection and analysis, and the communication unit diffuses the information. Second-generation MIS also have a tendency to be integrated in the collection, analysis and dissemination of some types of information and not in other types of information. For example, some private MIS such as KACE and RML produce some information from within the MIS and obtain other types of information such as weather information and agronomic information from external organizations.

What are the implications of integrating MIS activities on MIS performance?

Within the MIS, minimizing the involvement of many independent organizations in the production of a perishable commodity (time-dependent information) by integrating reduces the possibility of hold-up by strategic partners. For example, to some information users such as farmers and traders of perishable crops, information is needed at very frequent and time-specific intervals. Failure by the MIS to provide them with market information on time can result in a loss of money or reputation. In this case, coordinating all MIS activities (collection, analysis and diffusion) in one organization (integration) increases the speed of producing information, and thus solves the problem of perishability of information (temporal specificity). The MIS, however, may become too large, develop bureaucratic procedures, and fail to produce information products at a rate needed by users, thus reducing the reliability of the information generated. One way of trying to attenuate these problems arising from integration is to decentralize, which is discussed in section 3.6.2.3.2. Also, some types of information needed by users such as weather forecasts, evaluation of factors driving future supply and demand, information on government policies, are unlikely to be produced by a single organization, thus the need to "buy" or "get it from someone else" decision instead of "make" or "produce the information itself".

Also, the separation of data collection and diffusion activities can introduce delays and hold-up problems. For example, in the case of Mozambique SIMAP, the communication unit might be more interested in disseminating information on extension, and therefore allocate less time to market information.

Whom do the different model(s) serve and how well?

Private-, public-, farmer organization-, and trader and NGO-based MIS can be vertically integrated ("make" or "produce the information itself") or rely on the market ("buy" or "get it from someone else") for some of their activities. This means that the advantages and disadvantages of vertically integrating MIS activities apply to all MIS models, irrespective of their institutional home (MIS type), and to their stakeholders.

It is not clear whether there is any difference in the ease with which different types of MIS can adopt a “buy” or “make” decision. It depends on the type of information and who produces it, or the service the MIS wishes to “buy” or “make”. For example, in case of metrological information collected by another government department, the public MIS may have easy access to metrological data (“buy” or “get it from someone else”). However, private MIS may also easily “buy” or “get it from someone else” as is the case with metrological information and agronomical information obtained from government agricultural research organizations by RML in India. Also, with the exception of ECX in Ethiopia, public MIS such as AMIC in Zambia and SIMA in Mozambique have not been able to get free broadcast time from public radio.

3.6.2.3.2 Centralization vs. Decentralization of MIS Activities

MIS can be centralized, where all the coordination of the production activities (collection, analysis, and disseminated) are done from one central place, or decentralized, where these activities are done in different locations. This is also related to the question of horizontal coordination of MIS activities. In this context, decentralization is not necessarily in terms of financial and administrative autonomy, but in terms of information flow from the source to the end-users. Thus, private-, public-, farmer organization-, and trader and NGO-based MIS can be centralized, decentralized, or both centralized and decentralized in analysis and dissemination; but centralized in terms of budgets and administration.

Main observation

Table 7 shows that more non-government MIS (80%) stated to be centralized than government MIS (55%) in information processing and diffusion. Also, 1 of the 9 government MIS stated that it was decentralized and no non-government MIS reported to be decentralized in information processing and diffusion. Furthermore, more government MIS (36%) are mixed (both centralized and decentralized) in information processing and diffusion than are non-government MIS (20%). In total, Table 7 shows that out of the 21 MIS examined, 67 are centralized, 1 is decentralized, and 29% are both centralized and decentralized in information processing and diffusion. The details of how individual MIS are centralization or decentralization in processing are included in Table 44 in section A. 9 of 0.

What are the implications of centralization or decentralization on MIS performance?

In terms of conduct, the advantages of decentralization are the increased capacity to obtain feedback on local user needs. In terms of performance, decentralization together with availability of ICT enables the MIS to provide customized reports to specific users or regions, thus increasing relevance of the information. Moreover, decentralization also increases the speed at which the MIS gets to collect and disseminate information—factors that help MIS to provide relevant information to users. A decentralized MIS is also able to tap local resources such as personnel in local administrative offices, office space, and access to local radio, thus reducing the running costs of the MIS.

The weakness of dissemination from within a decentralized MIS is that there might be omission of information from other areas that might be of interest to users in a local area. This limits comparison of local information with that from distant markets, which limits the potential to encourage spatial arbitrage among market actors. These problems can be dealt with by networking the local MIS offices to each other and to the central office, as in Mali.

The advantage with centralization is gain in economies of scale in processing and dissemination, and producing more standardized information products from the MIS. Also, information from a centralized MIS might have more information from distant markets, thus promote spatial arbitrage. The disadvantage with centralization is that the MIS may make the data collection and dissemination operations large, bringing in agency problems due to lack of proper monitoring. The monitoring problem is compounded with some cultural factors discussed in section 2.3.7 such as when there are many languages used to disseminate information.

Whom do the different model(s) serve and how well?

Like in integration and specialization in MIS activities, all MIS models can be centralized or decentralized. This means that the advantages and disadvantages resulting from centralization and decentralization apply to all MIS models, irrespective of their institutional home (MIS type), and to their stakeholders. It is not clear whether there is any difference in the ease with which different types of MIS can decentralize MIS activities. It seems like government-supported MIS can decentralize with ease compared to non-government MIS model because of existing government investments such as offices, personnel, and in some cases transport facilities in most parts of the country. This means that the start-up investment costs at a decentralized level (e.g., a district or county) are lower for an MIS that is government-based than one that is not.

Instead of decentralization, non-government MIS may remain centralized in data collection and diffusion, but collaborate with NGOs working in different areas of country, and with government departments at provincial and district levels to reduce the costs required to invest in decentralized MIS. For example in Uganda, the MIS relied on WFP facilities to email information from West Nile and on AVSI (an Italian NGO) facilities to email information from North East Uganda, which reduced the need to invest in communication facilities in those areas, in exchange for market information from other districts to WFP and AVSI. These areas also happened to be unstable due to the LRA war. The MIS also collaborated with district agricultural-, trade-, cooperatives-, extension-, and production officers in different districts. This reduced the data collection costs, since the MIS did not pay for office space, nor the full salaries of these officers, but rather facilitated them with a small allowance as an incentive to do work they were supposed and probably liked to do anyway.

3.6.2.3.3 Specialization in the Production of MIS Products

Another coordination method is to have the production of different MIS products conducted under different organizations. For example, one organization can specialize in production of market news, and another in the production of market analysis, and another in the production of business reports. The alternative is to have two or more information products produced in the same organization (integration of the production of information products). Most MIS in sub-Saharan Africa included in this study are not specialized in the production of MIS products than are those in developed countries.

Specialization in market news: For example, in the USA, the Fruits and Vegetables Market News (F&VMN) collects and disseminates price data, the National Agricultural

Statistics Service (NASS) collects and disseminates supply and demand estimates, and other organizations such as private firms and universities conduct more specialized analysis on the data to produce market analysis for different users.

Specialization in market analysis: In the USA, market analysis such as forecasting is done through publicly supported research institutions (e.g., USDA and land-grant universities). This approach can also be done in developing countries, where the data collected by public MIS is given to public universities or research units within government to conduct market analysis for policy and food security analysis. Once the public institutions finish analyzing the information, they disseminate it to users, including the MIS. The MIS can also than disseminate the market analysis to other stakeholders.

Specialization in business reports: Presently, none of the MIS surveyed provide business reports. Business reports include information that can help stakeholders identify reliable trade partners, including their creditworthiness, sources of credit and interest rates, and commissions paid by buyers. Theoretically, all MIS types can provide business reports. Some complementary MIS activities, however, generate information that can be amalgamated to make business reports. For example, ECX obtains more private information (e.g., commissions paid by buyers and disputes among buyers and sellers) that can be used to make credit reports. Such MIS would have the comparative advantage of producing business reports compared to organization that don’t produce this kind of private information. In some situations, some actors may be unwilling to provide information they consider not good if they think such information could go into credit reports or other business reports.

Integration of the production of information products: There has to be coordination between what policy issues are analyzed and what data are collected to analyze those issues. Thus, coordination of the production of market news and market analysis may be smoother within a single organization than across different organizations. This coordination issue applies to many types of information, not just policy issues alone. For example, as new products enter the market, there has to be coordination between the needs of business people for information on these new products and the decision about whether to collect data on them.

What are the implications of specializing in MIS products on MIS performance?

Advantages: The advantage of specialized products is that it leads to gains in comparative advantage because each product is produced by an organization that has expertise in doing it. For example, having public MIS specialize in provision of basic market news and other public institutions specializing in production of market analysis leads to gains in comparative advantage in market news provision by public MIS.

Disadvantages: The separation of the provision of market news, market analysis, and business reports can introduce potential delays and hold-up problems in the release of market analysis and business reports that can make information perishable among some users who need frequent information. The other disadvantage with separation of the provision of information products is the risk of collecting data on issues that are no longer relevant for many actors and miss collecting information on emerging products/actors/issues important for business and policy makers because the needs of these people for information are not effectively communicated to the agencies collecting the data.

Whom do the different model(s) serve and how well?

Any MIS model can specialize in an MIS activity (collection, analysis, and diffusion) of different MIS products (market news, market analysis, or business reports) and the resulting advantages and disadvantages of specializing apply to all MIS models, irrespective of their institutional home (MIS type), and to their stakeholders such as farmers, traders, government, and other information users. It is not clear whether there is any difference in the ease with which first- or second-generation MIS can specialize in the production of information products. MIS in high-income are relatively specialized in the production market news and other organization in the production of market analysis and business reports than those in low-income countries. This may reflect the presence of a larger corps of trained personnel in high-income countries than low-income countries. In the latter, there may be relatively few analysts who understand the dynamics of agricultural markets, and they may be concentrated in the MIS.

3.6.2.4 Designing Incentives for Staff to be Responsive to Client Needs

Two sources of problems in early generation MIS were poor incentive structures and sharing of resources without clear sharing rules. For example, one of the reasons why some stakeholders have pushed for private-sector MIS is to deal with the shirking problems due to lack of aligned incentives that are often present in public-sector organizations. In organization theory, it is important to align incentives, including noneconomic inducements, to achieve enterprise viability (Williamson, 1981). Williamson notes that there are high-powered incentives and low-powered incentives. High-powered incentives are mostly provided by the market while low-powered incentives are mostly provided by hierarchies. High-powered incentives go directly to transacting parties, implying that efficiency gains from such transactions flow directly to transacting parties. Low-powered incentives do not directly go to transacting parties, although there might be long-term gains such as promotions and salary increments. While in general high-powered incentives may promote efficiency, they may also promote dishonesty (Williamson, 1985).

From case study observations, examples of poor incentive structures used by the MIS or the institutions in which they are housed include: (i) low staff salaries; (ii) fixed staff salaries to MIS employees with no residual claimancy of generated revenue by the MIS; (iii) excessive bureaucracy, which leads to a nonflexible hiring and firing of employees; and (iv) shirking and absence of output-based monitoring (e.g., demanding for an MIS bulletin or a recorded MIS radio program) but instead reliance on behavioral monitoring (e.g., good performance based on signing attendance books irrespective of work done). The examples below illustrate how poor incentives affect the performance of selected MIS categories.

Comparison between MIS Models

In Nampula Province in Mozambique, it is difficult for SIMAP to increase staff salaries. The same applies to SIMA in Maputo, and to AMIC in Zambia. Contracts with low remunerations retain less motivated personnel with low wage reservation utilities. More motivated and experienced employees with high wage reservation utilities seek employment with other employers who offer higher wages such as NGOs. This reduces the capacity of MIS to retain high skilled workers who can produce high quality market analytical and business reports. One of the constraints to raising wages is the low budgets of the MIS. The low budgets reflect the low effective demand for quality market information from government and donors. So the fundamental problem remains of how to build demand, which in turn requires producing a relevant and timely product.

Limited evidence suggests that lack of wage flexibility is likely to be a bigger problem in government MIS than non-government MIS. In Mali, during the restructuring of the MIS from public to a farmer organization-based MIS, the MIS had to draw new terms with the MIS workers, and some decisions involved negotiating with MIS staff to accept contracts with lower salaries and benefits to reduce MIS costs and increase its capacity to be financially sustainable and to make it attractive to be funded by external donors. This would probably have been very difficult if the MIS was purely in a government ministry or parastatal and is an example of wage flexibility in a farmer organization-based MIS. From the authors' personal experience working with the IITA FOODNET MIS in Uganda (categorized as an NGO-based MIS), the MIS negotiated with 16 MIS staff to take a 33 percent reduction in data collection allowances for six months towards the end of the first round of the donor funded project as a new round was being negotiated. Once the new project was approved, the data collection allowances were reinstated to the previous levels. This is another example that shows wage flexibility in a non-government MIS.

The personnel in SIMA in Mozambique and AMIC in Zambia are paid fixed monthly salaries. In Mozambique, when SIMA gets consultancies, the money goes to the treasury and comes back as low fixed salaries to employees. The MIS workers (as agents) do not become the residual claimants of the revenue from consultancies and do not face risk of loss of income when they reduce their efforts in the production of market information. This payment structure encourages shirking, since employees benefit from the full marginal utility of the reduction in effort and almost no disutility when they fail to produce market information bulletins.

In Mozambique SIMAP and in Zambia AMIC, there is centralized hiring and posting of staff through the central government. This means that the MIS cannot, due to the bureaucratic rules, hire enumerators to replace those who are transferred, die, or abscond. Also, the MIS cannot easily dismiss non-performing enumerators; thus there is minimum threat of dismissal due to non-performance. Although the level of bureaucracy in a public MIS is likely to be higher than in a private MIS, some private MIS also have restrictive policies (such as failure to offer higher wages to some staff as indicated in the example of Ethiopia above) that may hurt the performance of an MIS in a similar manner to bureaucracy in public MIS. In the Nampula SIMAP, monitoring of provincial MIS personnel is based on attendance and not outputs, probably because attendance is less costly to monitor.

Another cause of problems in MIS is from sharing resources such as cars, telephones, and budget-lines without prior resource-sharing rules. Sharing resources reduces average costs, but without clear sharing rules and transparency, it can cause inefficiencies and hidden action among MIS stakeholders. For example, in Nampula province in Mozambique, one reason for the failure to use radio equipment and telephones to call data collectors and to use pool cars for field supervision is because these resources are also used for other administrative work, which is probably considered more important than collection of market information. Also, lack of transparency and accountability may lead to re-allocation of budget lines and equipment meant for MIS activities such as data collection and supervision to other uses. This affects the timeliness of the information, and in the long-run, the sustainability of MIS by discouraging potential funders such as external donors.

What are the implications of the poor incentive structures on MIS performance?

The above poor incentive structures contribute to some of the problems faced by MIS such as irregular collection and diffusion of information, limited supervision of data collection, and the speed of adjustment by the MIS to changes in market structure such as collecting information on new commodities and from new businesses or new markets.

And whom do the different model(s) serve and how well?

Poor incentives can be found in any MIS model, implying that the advantages and disadvantages of having good or poor incentives can apply to any MIS model, irrespective of their institutional home (MIS type), and to their stakeholders. It seems however, that non-government MIS face more "high-power incentives" than public MIS to deal with poor incentive problems, such as such as low staff salaries, fixed staff salaries, excessive bureaucracy, shirking, and reliance on behavioral monitoring instead of output-based monitoring. Failure to deal with these problems will quickly lead to lower revenue, and therefore lack of MIS sustainability (viability).

3.6.2.5 Profit Orientation of the MIS

Profit orientation of the MIS relates to whether the MIS is designed to be a profit making venture. Both government and non-government MIS may be profit-oriented, although it seems like private MIS are more profit oriented than public-, farmer organization-, and trader and NGO-based MIS. Most private MIS such as KACE and Esoko are designed to be profit-oriented. In contrast, most public- and farmer organization-based MIS are not profit-oriented.

What are the implications of the profit orientation of the MIS on their performance? And whom do the different model(s) serve and how well?

Whether the MIS is designed to be a profit making venture affects its funding strategies such as charging user fees. This is facilitated by the increase in ICT, which enables MIS to turn some information products from being high exclusion cost goods to a low exclusion cost goods, as discussed in section 2.2.2.

The advantage of an MIS being profit oriented is achieving sustainability through revenue generation. Another potential advantage is the capacity of profit oriented MIS to offer "high-powered" incentives to deal with the shirking behavior and bureaucratic problems discussed in section 3.6.2.4. As noted in section 3.6.2.4, however, there is need to study further the incentive structures in non-government MIS compared to government MIS.

One disadvantage of an MIS being profit oriented is the potential to under-provide information by covering only part of a country or by covering a narrow range of commodities where the MIS activities are profitable. Another disadvantage is that charging user fees affects accessibility to the information the MIS diffuses, especially by poor farmers and small-scale traders who lack the effective demand to pay for the information from a profit oriented MIS.

3.6.3 The Nature of Commodities Covered

The nature of commodities covered relates to whether the MIS provides information on cash crops or staple crops.

Comparison between MIS Models

Nearly all types of MIS reviewed deal in several staple crops. Only ECX predominantly deals with one cash crop (coffee).

What are the implications of the nature of commodities covered on MIS performance?

The nature of the commodity covered by the MIS influences its funding strategies and sustainability. For cash or export crops such as coffee that pass through only a few export points, it is possible to control the marketing channels and tax the commodities, or charge service fees to fund MIS activities, which contributes to financial sustainability of the MIS. For example in Ethiopia, dealing with a cash crop (coffee) enables ECX to charge membership seat fees, annual maintenance fees, transaction fees, and warehouse fees on the commodity exchange to sustainably pay for all the running costs of the MIS, which would not be possible for staple crops that have several informal marketing channels.

Also, MIS that deal with perishable commodities (e.g., horticultural commodities and dairy products) need and often provide information at more frequent intervals, and use different information collection and dissemination strategies (e.g., use of cell phones) because of the perishability of such information compared to those that provide information in staple cereal commodities such as maize.

Whom do the different model(s) serve and how well?

As already stated, nearly all types of MIS reviewed deal in several staple crops and only one dealt with predominantly one cash crop. Although the MIS that dealt with only one cash crop is in the public sector, it could also be in a private sector, or in a trader organization. This means that the advantages and disadvantages resulting from the nature of commodity covered given in the section above can apply to any MIS model.

3.7 Generic Conduct Design Issues for Any MIS

The key conduct design issues are: (1) the information products provided and frequency at which they are provided, (2) the ICT used in transmission and diffusion, (3) funding strategies, (4) the data collection methods, (5) quality control methods used, and (6) the feedback mechanism used by the MIS.

3.7.1 Information Provided and Frequency of Provision

One of the main problems of early generation MIS identified in section 1.2 was that they often failed to meet the informational needs of the stakeholders because they collected and provided mostly price information and in an untimely way. Second-generation MIS were meant to provide more information products beyond mostly prices and quantities traded in markets, and provide information at more frequent intervals compared to public MIS.

Main observation

All types of MIS surveyed provide market news, especially wholesale prices (76%) and retail prices (71%). In terms of market analysis such as reasons why prices change, 27% of public MIS (AMIC in Zambia, ECX in Ethiopia, and SIMA in Mozambique) provide market analysis while 30% of non-government MIS provide market analysis. Within non-government MIS, only one farmer organization based MIS (OMA in Mali), which is a government-supported MIS, and 67% of trader and NGO-based MIS provides market analyses, while private firm MIS typically do not provide market analysis. None of the

MIS in the sample provide business reports that include information such as credit reports and the creditworthiness of traders.

In total, Table 8 shows that out of the 21 MIS included in the study, the 4 most common types of information provided and the number of MIS providing them are: wholesale prices (76% of MIS), retail prices (71% of MIS), information on qualitative assessment of traded volumes (52% of MIS), and supply and demand estimates (5% of MIS). Beyond the price and quantity information typically reported by MIS (and which some actors say that they can get more reliably from other sources), the surveys identify the following kinds of information that most MIS do **not** currently provide:

a. Prospective information about how the market is likely to evolve, such as price forecasts, crop harvest or production forecasts.
b. Analytical information about the major factors moving the market
c. Stock and inventory information
d. Information regarding major contracts and conditions needed to fulfill them
e. Quality requirements, grades and standards, and phytosanitary specifications information.
f. Information about how to access supporting services – transport costs credit sources
g. Regulatory information
h. Information about production technology that will allow farmers to respond to new market opportunities, weather information, and agronomic information.

The information that users report they need is described in detail in section A. 2 of 0.

Table 8:Information Provided by MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Information Products												
Market News	11	100	3	100	4	100	3	100	10	100	21	100
Market Analysis	3	27	1	33	0	0	2	67	3	30	6	29
Business Reports	0	0	0	0	0	0	0	0	0	0	0	0
Information provided												
Wholesale price	8	73	2	67	4	100	2	67	8	80	16	76
Retail price	8	73	1	33	4	100	2	67	7	70	15	71
Traded volume (qualitative assessment)	8	73	1	33	0	0	2	67	3	30	11	52
Supply & demand estimates	7	64	1	33	1	25	2	67	4	40	11	52
Producer price (or rural market)	6	55	2	67	0	0	2	67	4	40	10	48
Traded volume (quantitative estimation)	7	64	2	67	0	0	1	33	3	30	10	48
Traders stock	6	55	1	33	1	25	1	33	3	30	9	43
Contacts of buyers and sellers	4	36	2	67	2	50	1	33	5	50	9	43
Grades & standards	5	45	1	33	1	25	1	33	3	30	8	38
Exchange rates	4	36	0	0	2	50	2	67	4	40	8	38
Harvest or production forecasts	5	45	0	0	0	0	3	100	3	30	8	38
Price forecasts	4	36	0	0	2	50	2	67	4	40	8	38
Agricultural policy information	4	36	1	33	1	25	2	67	4	40	8	38
Price CIF	5	45	0	0	0	0	2	67	2	20	7	33
Production costs	3	27	1	33	1	25	2	67	4	40	7	33
Marketing costs	4	36	0	0	1	25	2	67	3	30	7	33

Table continued below

Table 8 (continued)

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Offers and bids	2	18	1	33	2	50	2	67	5	50	7	33
Price FOB	4	36	0	0	0	0	2	67	2	20	6	29
Import volumes	3	27	1	33	0	0	2	67	3	30	6	29
Regulations	5	45	0	0	0	0	1	33	1	10	6	29
Commercial policy information	4	36	1	33	0	0	1	33	2	20	6	29
Export volumes	3	27	1	33	0	0	0	0	1	10	4	19
Food aid information	2	18	1	33	0	0	1	33	2	20	4	19
Marketing extension	2	18	1	33	0	0	1	33	2	20	4	19
Buy and sell information	1	9	1	33	0	0	1	33	2	20	3	14
Phytosanitary specs.	0	0	1	33	0	0	1	33	2	20	2	10
Weather information	0	0	0	0	2	50	0	0	2	20	2	10
Agronomic Information	0	0	0	0	1	25	1	33	2	20	2	10
Credit sources	0	0	0	0	0	0	0	0	0	0	0	0

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

Table 9: Frequency of Information Diffusion by Selected MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Weekly	8	73	3	100	1	25	2	67	6	60	14	67
Daily	4	36	2	67	2	50	1	33	5	50	9	43
Monthly	4	36	0	0	0	0	3	100	3	30	7	33
Annually	5	45	0	0	0	0	0	0	0	0	5	24
Quarterly	3	27	0	0	0	0	1	33	1	10	4	19
Longer intervals	3	27	0	0	0	0	0	0	0	0	3	14
Real time	1	9	0	0	0	0	0	0	0	0	1	5
Tri-weekly	1	9	0	0	0	0	0	0	0	0	1	5
Bi-weekly	0	0	0	0	1	25	0	0	1	10	1	5
Bi-Monthly	1	9	0	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

The information in the appendix shows that in many cases, the information needed by users is actually provided by the MIS, but some users do not receive it because of lack of access to the MIS's diffusion channels or because some potential users listen to radios at different times than those in which information is broadcast.

Comparison Frequency of Provision between MIS Models

In terms of frequency, Table 9 shows that 73% of government MIS provide weekly information, 36% provide daily and monthly information and 45% provide annual information. In contrast, the table also shows that 67% of non-government MIS provide weekly information, 43% provide daily information, 33% provided monthly information, and 24% provided annual information. These result imply that there are no clear patterns to suggest that non-government MIS provide more market news and analysis than government MIS nor that non-government MIS provided the information more frequently than public MIS where bureaucracy is likely to be higher. A detailed breakdown of the frequency of information diffusion by individual MIS is included in Table 46 in section A. 9 in 0.

What are the implications of information provided by MIS on their performance and whom do the different model(s) serve and how well?

For MIS that do not provide market analyses and business reports, users who need this information do not receive them. In terms of market news, it is clear that all MIS can provide it. There is no information, however, on how the quality of the reports differs by MIS type. In terms of market analysis, only government-supported MIS provide it for uses that benefit many stakeholders (e.g., through improved food security in the whole country), but other MIS could also develop the capacity to provide it if there were effective demand articulated to them. In practice, this does not appear to be the case, either because these MIS have not sought out this market or those who have such demands prefer to operate through government-supported MIS. In terms of business reports (e.g., with credit sources and credit worthiness of traders), none of the surveyed MIS provide them.

3.7.2 ICT used in Transmission and Diffusion of Market Information

Market information and ICT are complementary goods, implying that MIS need ICT to use in their information collection and diffusion strategies. On the one hand, MIS face a problem of minimizing costs of transmission and disseminating information, and on the other hand, maximizing the number of recipients of information directly or indirectly by choosing the right combination of ICT to use in transmission and diffusion of information. In this dissertation, ICT is divided into two categories (traditional and modern ICT) for two major uses (transmission and diffusion). Transmission refers to conveying information from markets to the MIS information processing center. Diffusion refers to conveying information from the MIS to users.

Traditional ICT includes landline telephone for voice use, fax, post office, radio equipment, and hand delivery of information. Modern ICT includes the internet (for web and email use) and cell phones (for SMS and voice use). Second-generation MIS were meant to have more technological invitations in terms of ICT used in diffusion and dissemination. The premises were that (1) reliance on the internet and mobile phones for transmission-timelines and reduction in errors, and (2) increased dissemination through the internet and to some extent the cell phones would also improve on timeliness and frequency of the data and cost recovery of some production costs by enabling exclusion of free riders.

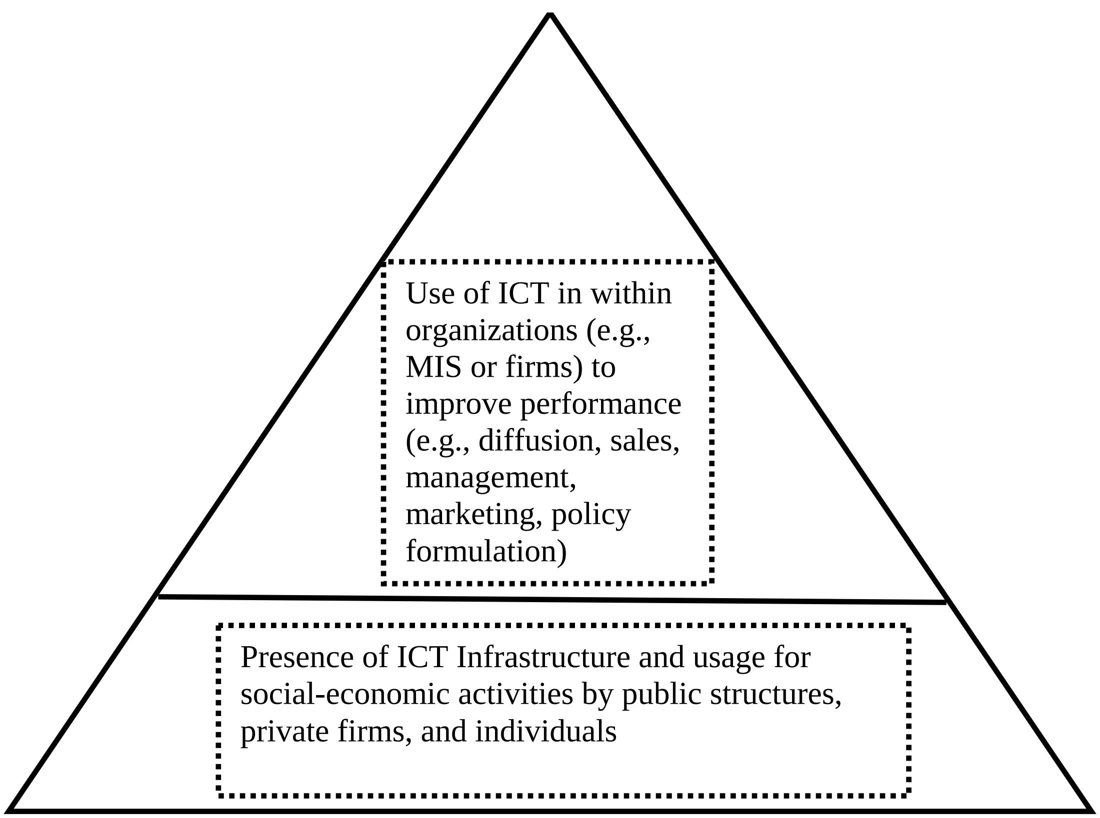
Main Observations

- Most non-government MIS started after 2005 after the increase in availability usage of cell-phones in low-income countries, suggesting that the increase in availability and usage of cell phones was a major factor that contributed to the start of these MIS models in low-income countries.
- Most government MIS use traditional ICT to transmit information from markets to the MIS, while non-government MIS mostly use modern ICT to transmit information.
- Most government MIS use both traditional and modern ICT to diffuse information, while non-government MIS mostly use SMS and websites (modern ICT) to diffuse information.

Some key issues about the role of ICT in provision of market information

The current information and communication technology for development (ICT4D) literature is silent about the complementarities between traditional and modern ICT in transmission and diffusion of market information. Also, limited analysis has been conducted on how different ICT is used to improve MIS performance, such as sustainability, accuracy of the information, and accessibility of information among different stakeholders. Most studies concentrate on the lower base of the ICT pyramid as shown in the Figure 1 below, where they examine the role of ICT (especially cell phones) in facilitating exchange of information in society on market performance. Examples of studies that examine how the presence of cell phone networks among market actors improve access to information and the resulting improvements in market performance include one among grain traders in Niger by Aker, one among fishermen in Kerala India by Jensen, and another among small holder vegetable small holders in Sri Lanka by Silva and Ratnadiwakara (Aker, 2008, Aker, 2010, Jensen, 2007, Silva and Ratnadiwakara, 2008). In these examples, market actors exchange information because of the introduction of cell phones, without focusing on an established MIS. This phenomenon also occurs in other countries such as Mozambique, Uganda, Mali, and Zambia, where traders call other traders to obtain market information. Other studies analyze the role of ICT in the upper pyramid, such the studies reviewed by Donner and Escobari on the role of cell phones on the development of enterprises (Donner and Escobari, 2010).

Figure 1: The ICT4D Pyramid Showing the Role of ICT within Organization Compared to Within Society



Increase in usage of cell-phones and increase in MIS models in low-income countries

The question of how increase in ICT has contributed to the increase in the number of MIS is analyzed using statistics on ICT availability in comparison with the start years of different MIS models. Table 10 shows that the usage of cell phones in Ghana and Kenya was above 10 users per 100 people in 2005, while it was above 10 users per 100 people in Mali, Mozambique, Zambia, and India in 2006. A review of the start date of MIS in SSA included in Table 4 indicates that most public MIS in Africa such as AMIC in Zambia, SIMA in Mozambique, SIMA and SIML in Niger, SIPAG in Guinea Bissau, and government-supported OMA in Mali started in late 1980s and the early 1990s, before cell phone use was above 10 users per 100 people. In contrast, farmer organization-based MIS such as SIEL in Madagascar and the ZNFU 4455 SMS MIS, together with most of the private MIS such as Esoko in Ghana, Infotrade in Uganda, and RML in India started after 2005 when cell phone use was above 10 users per 100 people. This shows that the start of most farmer organization-, private-, and trader and NGO-based MIS coincided with the increase in usage of cell phones in low-income countries, suggesting that the increase in the availability and usage of cell phones in these countries was a major factor in contributing to the start of many private, farmer organization- and NGO-based MIS.

Table 10: Telephone Lines, Cellular Subscribers, and Internet Users per 100 Inhabitants in Selected Countries from 1998 - 2008

	Main (fixed) telephone lines per 100 inhabitants										
	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Ethiopia	0.26	0.3	0.35	0.42	0.51	0.57	0.67	0.82	0.95	1.12	1.11
Ghana	0.72	0.84	1.09	1.22	1.34	1.39	1.46	1.47	1.59	1.65	0.62
India	2.14	2.59	3.11	3.63	3.84	3.83	4.15	4.44	3.55	3.38	3.21
Indonesia	2.79	3	3.25	3.47	3.68	3.77	4.79	6.16	6.68	8.69	13.36
Kenya	0.97	0.95	0.93	0.96	0.97	0.97	0.86	0.8	0.8	0.7	0.63
Mali	0.27	0.33	0.37	0.47	0.51	0.54	0.57	0.64	0.68	0.64	0.64
Mozambique	0.43	0.44	0.47	0.48	0.43	0.39	0.34	0.33	*0.33*	0.36	0.35
Philippines	3.34	3.8	3.94	4.18	4.1	4.06	4.1	3.94	4.17	4.44	4.51
United States	63.98	66.6	66.88	65.83	64.37	61.61	59.27	57.86	54.78	51.32	49.62
Zambia	0.78	0.81	0.8	0.8	0.8	0.79	0.8	0.81	0.78	0.75	0.72
	Mobile cellular Subscriptions per 100 inhabitants										
	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Ethiopia	-	0.01	0.03	0.04	0.07	0.07	0.21	0.55	1.13	1.54	2.42
Ghana	0.22	0.37	0.67	1.22	1.89	3.8	7.91	13.12	23.25	33.25	49.55
India	0.12	0.18	0.34	0.62	1.21	3.07	4.69	7.97	14.47	20.06	29.36
Indonesia	0.53	1.1	1.79	3.13	5.55	8.66	14.02	21.4	28.75	41.57	61.83
Kenya	0.04	0.08	0.41	1.86	3.58	4.68	7.3	12.88	19.96	30.06	42.06
Mali	0.04	0.06	0.1	0.22	0.42	2.19	3.52	6.44	12.49	20.4	27.07
Mozambique	0.04	0.07	0.28	0.81	1.32	2.2	3.49	7.22	10.96	14.08	19.68
Philippines	2.32	3.74	8.31	15.34	19.04	27.34	39.25	40.68	49.22	64.64	75.39
United States	24.62	30.24	38.03	44.16	48.23	54.1	61.64	70.36	79.1	85.2	86.79
Zambia	0.08	0.28	0.94	1.13	1.27	2.15	4.05	8.09	13.84	21.43	28.04

Table continued on next page

Table 10 (Continued)

	Internet users *per 100 inhabitants*										
	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Ethiopia	0.01	0.01	0.02	0.04	0.07	0.11	0.16	0.22	0.31	0.37	0.45
Ghana	0.03	0.1	0.15	0.2	0.83	1.19	1.72	1.83	2.72	3.85	4.27
India	0.14	0.27	0.53	0.66	1.54	1.69	1.98	2.39	2.81	3.95	4.38
Indonesia	0.26	0.44	0.93	2.02	2.13	2.39	2.6	3.6	4.76	5.79	7.92
Kenya	0.05	0.11	0.32	0.62	1.21	2.94	3.02	3.1	7.53	7.95	8.67
Mali	0.02	0.06	0.14	0.19	0.23	0.31	0.43	0.51	0.73	0.81	1.57
Mozambique	0.02	0.06	0.11	0.16	0.26	0.42	0.68	0.85	0.84	0.91	1.56
Philippines	1.1	1.43	1.98	2.52	4.33	4.86	5.24	5.4	5.74	5.97	6.22
United States	30.09	35.85	43.08	49.08	58.79	61.7	64.76	67.97	68.93	71.83	74
Zambia	0.03	0.15	0.19	0.23	0.48	0.98	2.01	2.85	4.16	4.87	5.55
Source: ITU World Telecommunication/ICT Indicators Database.											

Comparison of the Use of Modern vs. Traditional ICT for Data Transmission

In terms of modern ICT for data transmission, Table 11 shows that out of the 11 public MIS, 36% use email, 27% use SMS, and 36% use web to transmit information from markets to the MIS information processing center. Table 11 also shows that out of 10 non-government MIS, 60% use email, 70% use SMS, and 50% uses the web to transmit information from markets to the MIS information processing center. In terms of traditional ICT for data transmission, Table 11 shows that out of the 10 non-government MIS, 60% use telephones for voice, 20% fax, the post office, and radio equipment to transmit information from markets to the MIS information processing center. It can be concluded, therefore, that the use of traditional ICT to transmit information from markets to the MIS is dominant in government supported MIS compared to private sector MIS, which mostly use modern ICT to transmit information.

Comparison of the Use of Modern vs. Traditional ICT for Information Diffusion

In terms of modern ICT for information diffusion to users, Table 12 shows that out of the 11 public MIS, 82% use email, 64% use the web, 27% use SMS, and 18% use electronic billboards to diffuse information to users. In contrast, out of the 10 non-government MIS, 70% uses email, the web, and SMS, and 10% use electronic billboards to diffuse information to users. In terms of traditional ICT for diffusion, Table 12 shows that out of the 11 public MIS, 55% use rural radio, 64% use national radio, 45% use newspapers, 64% use hand delivery, and 64% use telephone (voice) to diffuse information. In contrast, out of the 10 non-government MIS, 60% use rural radio, 40% uses national radio, 50% use newspapers, and 40% posters and blackboards in markets to diffuse information. It can be concluded, therefore, that for diffusion purposes, private MIS mostly rely on SMS and websites to diffuse information while public MIS use both modern and traditional ICT to diffuse information. Details of how individual MIS use modern and traditional to transmit and diffuse information are included in Table 47 and Table 48 in A. 9 in 0.

What are the implications of using modern vs. traditional ICT to transmit and diffuse information on the performance of any MIS?

The implications of using modern vs. traditional ICT in transmission and diffusion of information on the performance of any MIS in terms of (1) reliability, (2) accessibility, (3) timeliness, and (4) sustainability are thus:

1. Reliability refers to whether the quality and accuracy of the data can be compromised during transmission or dissemination using an ICT. For example, use of email and SMS in data transmission from the field to headquarters will likely reduce transcription errors compared to use of voice over radio equipment or telephone. Also, the use of email ensures that the message is not altered during diffusion (i.e., reduces quality uncertainty), whereas the radio presenters may alter the meaning of the information during a broadcast, thus affecting reliability of the information (thus increasing quality uncertainty).

Table 11: Transmission of Information Using Modern and Traditional ICT by Selected MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Modern ICT												
Email	4	36	2	67	2	50	2	67	6	60	10	48
SMS	3	27	2	67	3	75	2	67	7	70	10	48
Web	4	36	1	33	3	75	1	33	5	50	9	43
Traditional ICT												
Telephone	6	55	3	100	1	25	2	67	6	60	12	57
Fax	6	55	0	0	1	25	1	33	2	20	8	38
Post office	4	36	1	33	0	0	1	33	2	20	6	29
Radio equipment	3	27	1	33	1	25	0	0	2	20	5	24
Hand delivery	1	9	0	0	1	25	2	67	3	30	4	19

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

Table 12: Dissemination Using Modern and Traditional ICT by MIS Selected MIS Models

	Government		Non-government								Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Modern ICT												
Email	9	82	1	33	3	75	3	100	7	70	16	76
Web	7	64	2	67	3	75	2	67	7	70	14	67
SMS (Cell Phone)	3	27	1	33	4	100	2	67	7	70	10	48
Billboards (electronic)	2	18	0	0	1	25	0	0	1	10	3	14
Traditional ICT												
Rural radio	6	55	2	67	2	50	2	67	6	60	12	57
National radio	7	64	1	33	1	25	2	67	4	40	11	52
Newspapers	5	45	2	67	1	25	2	67	5	50	10	48
Hand delivery	7	64	0	0	1	25	1	33	2	20	9	43
Telephone (voice)	7	64	0	0	1	25	1	33	2	20	9	43
Posters in markets	4	36	1	33	2	50	1	33	4	40	8	38
TV	4	36	0	0	1	25	1	33	2	20	6	29
Fax	4	36	0	0	1	25	0	0	1	10	5	24
Blackboards	2	18	0	0	2	50	0	0	2	20	4	19
Post office	2	18	0	0	0	0	0	0	0	0	2	10
CD and DVD (mail)	1	9	0	0	0	0	0	0	0	0	1	5
Pigeonholes	1	9		0		0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

2. Accessibility refers to the ability of different users to have access to information diffused using an ICT. For example, poor and illiterate households may be excluded from information diffused using the SMS (cell phones) and the internet alone due to lack of effective demand, or due to failure to digest the information. In contrast, rich and literate users, such as traders, NGOs and Government workers, are likely to access and understand information diffused through cell phones or internet. However, illiterate and poor households will benefit from completion among other users though spillover effects. In contrast, MIS that use mostly traditional ICT such as radios are more likely to be are accessible to farmers and small-scale traders and to poor and illiterate users. Accessibility may also be in terms of whether the information can be stored and retrieved (accessed) in hard or soft copy for future reference. For example, SMS, newspapers, emails may be stored and refereed to, compared to information diffused via radio. Accessibility is also in form of the capacity of the ICT to transmit and disseminate different information products (market news, analysis, and time series data) to different users. For example, e-mails have the capacity to transmit and diffuse more text than SMS.
3. Timeliness refers to the ability of an ICT to deliver the information to stakeholders when needed for making critical decisions. For example, the use of SMS and email to transmit and diffuse information is much faster than the use of the post office.
4. Sustainability refers the fixed and variable costs incurred, and the economies of scale gained from the use of the ICT for transmission and diffusion on the part of the MIS, and for reception of information on the part of the users. For example, using emails and websites involves lower variable costs than using fax machines and radio to

disseminate information. To poor users, however, radio may be cheaper to use to receive information than using an email or fax. Sustainability also includes the costs of complementary investments (e.g., office space, electricity, and security) needed to use the ICT. It also relates to the potential for the ICT to help recover production costs, for example by excluding nonpaying users and minimizing free-riders. For example, use of SMS has an advantage on potential to recover some costs than use of broadcast radio. Accessibility may also include the costs needed to train MIS personnel, and in some cases users to use the technology used to disseminate information.

Whom do the different model(s) serve and how well?

All MIS models use both modern and traditional ICT for transmission and diffusion of market information. This means that the advantages and disadvantages to different users resulting from the ICT used to transmit and disseminate information can apply to any MIS model. Given that the majority of non-government MIS are donor funded, and that donors are their major clientele, it is possible that their use of modern ICT to diffuse information is donor-driven or has a donor orientation, and not necessarily dependent on the private effective demand of farmers and traders. This suggests that once external donors pull out, such MIS models may be unlikely to be sustainable.

3.7.3 Funding Strategies of MIS

Many public-MIS face funding constraints to support many activities such as collection, transmission, and dissemination of information, which affects MIS performance. For example, in Zambia’s AMIC, there is lack of sufficient financial resources to hire and train enumerators in some districts. This means that information is not collected regularly, or is collected by untrained data collectors in some districts. Irregular collection of data affects the timeliness of the MIS due to irregular transmission of data from the provincial districts to the AMIC headquarters in Lusaka. Also, the use of untrained enumerators affects the credibility and reliability of the information from the MIS among some users.

In Nampula province in Mozambique, SIMAP used to collect information from 13 rural and 3 urban markets in 15 districts. Presently, due to limited resources to hire, train, and to supervise enumerators, information is collected from only 4 districts. In both Zambia and Mozambique, lack of sufficient funding leads to low staff salaries, which contribute to the high turnover of trained staff at national, provincial, and district levels.

Main observations

All MIS types in sub-Saharan Africa stated that they rely on external donors as their major source of funding. No MIS in sub-Saharan countries has been able to wean itself entirely from donor funding and graduate into a purely private sector MIS.

Total overview

Table 13 shows the stated sources of funding of selected MIS in the study. In total, the most stated main sources of funding for the 21 MIS covered by the study include: (1) donor funding (76% of MIS); (2) government funding (57% of MIS); (3) subscriptions fees and information sales (52% of MIS); (4) in-kind contributions and exchange of services (19% of MIS); (5) sponsorships from private companies (19% of MIS); (6) consultancy and training services (14% of MIS); and (7) tie-in-sale of information (5% of MIS).

Table 13: Sources of Funding of Selected MIS Models

	Government		Non-government								Grand Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Donors funding	7	64	3	100	3	75	3	100	9	90	16	76
Government funding	11	100	1	33	0	0	0	0	1	10	12	57
Subscriptions Fees, Information Sales, and SMS Revenue	4	36	2	67	4	100	1	33	7	70	11	52
In-Kind Contributions and Exchange of Services	2	18	1	33	1	25	0	0	2	20	4	19
Sponsorships from Private Companies	0	0	0	0	3	75	1	33	4	40	4	19
Consultancy and Training Services	2	18	1	33	0	0	0	0	1	10	3	14
Tie-in-sale of Market Information and Members Fees	1	9	0	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

Comparison of Sources of Funding Between MIS Models and Implications on Their Performance

Donor funding: The most common source of funding for MIS is from external donors, either directly or through contributions to the government budget. Donor funding also includes funds from charity organizations, NGOs, research institutions, universities, and UN bodies such as WFP and FAO. The specific figure of how much donors contribute to MIS budgets was not established. Table 13 shows that 64% of government MIS and 90% of non-government MIS are funded by donors. At The United Nations Economic Commission for Africa (UNECA) meeting in Addis Ababa in Ethiopia in May 2011, Mark Davies stated that Esoko gets 25% of its funding from donors. The rest is private or self-generated funds. So for Esoko, donors are an important, but not “the major” source of funding.

Government funding: By default, all public MIS are funded from taxpayers’ money from local and central government budgets. In contrast, 10% of non-government MIS stated to receive some funding from government tax money. For example, AMIC is funded by the Government of Zambia, and SIMA is funded by the Government of Mozambique. Some of the funding from government budgets, however, is from donors. Most of the MIS activities in high-income countries have benefited from long-term government funding. For example, the activities of the USDA F&VMN have existed for over 95 years and those of NASS for over 145 years on federal and state government funding. In contrast, only one MIS—Mali’s OMA, which is based in a farmer organization, is also funded by government tax money.

Subscriptions fees and information sales: Table 13 shows that 36% of public MIS receive subscriptions or charge user fees while 70% of non-government MIS receive subscriptions or charge user fees. Charging subscriptions and user fees is made possible by increase in the use of modern ICT such as websites with passwords and SMS, which makes some information a low exclusion cost good. One advantage of charging subscriptions and user fees is that the MIS recovers some production costs when individual users request for information, and how these resources are shared with employees affect incentives for performance as indicated in section 3.6.2.4. Although ZNFU SMS MIS, Esoko Ghana, and KACE in Kenya use ICT that can turn information into low exclusion cost goods, they still receive funding from external donors to support some of their operations. According to the manager of the ZNFU SMS MIS during personal interviews in Lusaka in October 2009, the resources generated from SMS requests cannot cover their operational costs of the SMS MIS. In India, RML has 170,000 subscribers spread in 12,000 villages, which seems to be small percentage of households receiving information in the 8 Indian states in which it operates (Lokanathan and Silva, 2010). It is noted, however, that information received by a few MIS subscribers (e.g., traders) can improve the market competitiveness (e.g., through spatial and temporal arbitrage) in a way that benefits farmers who do not subscribe to information services.

In-kind contributions and exchange of services: Eighteen percent of government MIS and 20% of non government MIS receive in-kind contributions. In-kind contributions refer to contributions the MIS receives from stakeholders, sometimes in exchange of services that lead to cost reductions on the part of the MIS. Some MIS receive in-kind contributions from private sector firms, farmer organizations, and research and education institutions. Examples of in-kind contributions include telephone handsets from cell phone manufacturing companies to MIS. In India, government agricultural institutes provide content to RML; and in Mali, a farmer organization (the Chamber of Agriculture) provides office space to OMA.

Sponsorships from private companies: Private companies can sponsor some MIS activities, especially when such support contributes to the profitability of the private firms. Table 13 shows that at the time of the survey, no government MIS stated to receive sponsorship from private firms while 40% of non-government MIS received sponsorships from private companies. For example, cell phone companies could provide cell phones and data cables for data collection, or facilitate the development of SMS information exchange platforms. The incentives for the cell phone operators are that users would use more airtime to request for market information, which would generate extra revenue for the cell phone companies, the data management companies, and the MIS. For example, in Niger, the MIS has recently signed a 3-way deal with Orange (a cell provider), a data management company, and the SIMA to provide SMS market information on a “pull” basis. The three entities will share the revenue from this service, although it is not clear if Orange is providing any equipment to the SIMA.

Why don’t private companies sponsor as many government MIS as they do with non-government MIS? One possible reason is that MIS workers are not aggressive in negotiating with private companies to sponsor MIS programs as are workers in Non-government MIS.

Also, input dealers could sponsor popular MIS programs in which they air advertisements. Radio stations could provide free airtime to the MIS with the incentives that the MIS information induces listeners to tune in to the radio station. The disadvantage with receiving sponsorships from private companies is that some users may develop negative perceptions about the objectivity and credibility of the information from the MIS. One conclusion from the survey results is that it appears that non-government MIS have been more aggressive in seeking other private-firm sponsorship of their activities than have public-sector MIS.

Consultancy and training services: Some MIS such as OMA generate resources through conducting specialized market research and producing specialized information products demanded by government, donors, NGOs, and the private sector. Providing services is a potential source of revenue for MIS. For example, in Nampula province in Mozambique, some NGOs are interested in sponsoring farmers to participate in MIS training workshops to learn how to use market information to make informed production and marketing decisions. For NGOs to do this, they would like SIMAP to demonstrate that the information it provides can lead to profitable market transactions, a classical uncertainty problem that can cause market failure in the information subsector. In Ghana, Esoko generates funding from designing internet-based information exchange platforms where users can exchange market information using SMS and the internet.

Tie-in-sale of information: An example close to a tie-in sale of market information is in the Ethiopia Commodity Exchange (ECX). The Government of Ethiopia put in place legislation that compels most coffee traders and unions to trade coffee on the exchange at a fee. Part of this fee goes towards supporting the running of the MIS including disseminating market information to all coffee farmers in Ethiopia. This means that as long as trading is sustained, information generation is also sustained. Charging membership fees is possible for cash crops such as coffee with a controllable and a narrow value chain, but not other staple commodities such as maize and beans with many informal value chains, and those not frequently traded on the exchange.

Whom do the different model(s) serve and how well?

All types of MIS can be funded through the sources of funding identified in this section. Even if the private MIS in this study reported not to receive funding from government, governments could still fund them to provide market information to stakeholders if it is determined that they can provide the information efficiently. This means that all advantages and disadvantages resulting from different funding options can apply to all MIS models and to their stakeholders, depending on the environment in which the MIS operates and other structural and conduct issues discussed in this chapter such as technologies used in dissemination which may affect the accessibility of information to some users.

3.7.4 Data Collection Methods Used By MIS

One of the generic problems of early generation MIS were that they had poor data methods. Moreover, data collection is expensive, and MIS need to reduce data collection cost and at the same time maintain the quality of the data in terms of sampling and non-sampling errors. Also, the methods used to collect data affect the reliability, timeliness, and sustainability in terms of collection costs. The premise was that second-generation MIS would use the wiki approach of data collection, where multiple users would contribute information, thereby increasing timeliness of the MIS compared to first-generation MIS that mostly used structured questionnaires with enumerators in the market.

Main observations

Most MIS stated that they use structured questionnaires and interviewer observation (57%) compared to a wiki approach (5%) to collect market information. There is weak or limited supervision of data collection among many public MIS. The wiki approaches, where used, do not use a standard method such as always observing the same grade of product or always reporting actual transactions rather than offer prices, which makes the reliability of such systems suspect in situations where there are relatively few participants.

Comparison between MIS Models

Table 14 shows that out of the 11 government MIS, the most stated methods of data collection are: structured questionnaires (64%), observation by enumerators (55%), and telephone interviews (36%). In contrast, out of 10 non-government MIS, 50% use structured questionnaires, 60% use observations by enumerators in the market, 30% use telephone interviews, and 30% use administrative and secondary sources of information. In total, all MIS mostly use structured questionnaires (57%), observation by enumerators (57%), and telephone interviews (33%). Only one MIS uses a wiki approaches where users SMS or update the web to collect information. The details of the data collection methods used by individual MIS are included in Table 50 in section A. 9 in 0.

What are the implications of the different data collection methods used on MIS performance?

From an industrial-organization point of view, the level of investment in data collection can be viewed as a strategy to control critical assets and inputs, which can give an MIS competitive advantage over new entrants. For example, in India, ‘RML’ incurred substantial overheads to employ data collectors, which resulted in competitive advantage over potential competitors (Lokanathan and Silva, 2010) This acts as a barrier of entry, although it is reportedly intended to improve on quality of information by controlling the collection process. The next subsections give the advantages and disadvantages of different data collection methods.

Table 14: Data Collection Methods Used By Selected MIS Models

	Government		Non-government								Grand Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Structured questionnaires (One-on-one interview by reporters in markets)	7	64	2	67	2	50	1	33	5	50	12	57
Observation by reporters in markets	6	55	2	67	3	75	1	33	6	60	12	57
Telephone interviews	4	36	1	33	0	0	2	67	3	30	7	33
Questionnaires mailed to market participants	2	18	0	0	1	25	2	67	3	30	5	24
Administrative/ secondary sources	2	18	0	0	0	0	2	67	2	20	4	19
Obligatory declaration of information	2	18	0	0	0	0	1	33	1	10	3	14
Wiki approaches (where users SMS or update the web)	0	0	0	0	1	25	0	0	1	10	1	5
Byproduct of transactions on the exchange	1	9	0	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

Structured questionnaires and observation by enumerators: When questionnaires are well conceived and the data collection is adequately supervised, the use of structured questionnaires and observation by field data collectors can lead to reliable (high quality and accurate) information compared to use of telephone interviews and wiki approaches (where users provide information using SMS and web). Telephone interviews and wiki approaches, however, increase frequency (timeliness) of information and are cheaper to conduct on part of the MIS (which increases sustainability). One of the key issues is whether the MIS has a clear methodology regarding definition of different levels in the marketing system where prices are observed and the grades of products to be followed (e.g., how are "assembly markets" or "transit markets" defined? How are "farmgate prices", "retail prices" or "wholesale prices" defined?). Without clarity on these issues, the price data collected in different places in the country are unlikely to be comparable, and a structured questionnaire may be an indicator (but not a guarantee one) that the MIS has gone through a structured process to address these methodological issues, which more informal or wiki approaches may not do. The use of structured questionnaires and observation by field data collectors is expensive because it requires recruiting and training enumerators, transporting them to markets, and supervising them on a regular basis.

Telephone interviews: Collecting information through telephones is cheaper than driving to distant markets when the costs of calling are low. The disadvantage is that there is no direct observation, implying that the information provided is difficult to verify. Thus, the use of telephones to collect data requires a higher level of trust between the MIS and the information providers. Also, telephone interviews cannot be conducted in rural markets where telephone services are not available. In ZNFU SMS MIS, information is collected using telephone interviews with commodity traders. Another method of collecting market information, especially in developed countries such as the US, is the use of telephone interviews through Computer Assisted Telephone Interviewing (CATI).

Postal mail out/in questionnaires and on-line survey questionnaires: In developed countries (e.g., NASS in the USA), MIS mail questionnaires through the post or by email to market participants, agro-enterprises, and farmers who mail back filled forms to the MIS. They also collect information from respondents through internet links to online questionnaires. Although these methods involve lower collection costs, they are not feasible in low-income countries where the postal systems are slow or not available in rural areas, and where the use of the internet is very limited. These methods also require enforceable laws that compel respondents to provide information. For example, in the US, some producers and agribusiness (e.g., in dairy products) are given market information forms which they are obligated by law to fill-in and fax or mail back to NASS. This is also referred to as obligatory declaration of information. Such approaches are more suited to collecting information on variables that change relatively slowly over time (such as inventory levels or negotiated contract prices) rather than spot-market prices.

Administrative and secondary sources: Some types of information are obtained from administrative and secondary sources. Such information includes exchange rates and regional and international prices of commodities. In Mozambique, as a sustainability strategy in terms of reducing data collection costs, SIMAP would like the tax collectors to also collect market information, since tax collectors are there in all markets, and tax collection is a more sustainable activity. There is a tendency, however, for traders to fear giving truthful market information to tax collectors for fear of being overtaxed. Thus, this strategy may reduce the reliability and credibility of information from the MIS.

Wiki approaches: Another approach that MIS use to collect information is the wiki approach. In this approach, information users provide the information, such as their selling prices for commodities, using the web and cell phones. This approach is used by Esoko Ghana, where users can use cell phones to post information on the internet about agricultural commodities they wish to buy or sell. The advantages of this method is that (1) the MIS incur little or no field collection costs, (2) providers post and look for the exact information they need, which increases relevance among users, (3) the approach increases the speed of information collection and dissemination, thereby increasing timeliness. One disadvantage with wiki methods of collecting information is the potential for strategic information contributors to destroy the credibility and reputation of the MIS, for example by providing wrong information about the quality of products they are selling. These potential errors may reduce as the number of users increase. In theory, wiki-based approaches rely on the law of large numbers to help assure quality control—i.e., if enough people contribute information, errors tend to get corrected quickly and information goes towards indicators of central tendency. In sub-Saharan Africa, wiki-based MIS approaches have relatively few contributors of information, so this correction tendency may be weak. Another potential problem with allowing many users to contribute information in wiki approaches is the inconsistent reporting across different grades and standards of the products by different users and levels of the marketing system (farm-gate, assembly, redistribution, wholesale, retail) for which prices are reported. This can also be a problem in questionnaire-based collection systems when questionnaires are not carefully constructed and enumerators trained well about the grades and market levels to monitor.

Information is generated as a byproduct of transactions on the exchange: In Ethiopia, price information is collected on the trading floor as soon as a transaction occurs on the exchange. Once the seller and the buyer agree on a price of a coffee grade and quantity, the information is captured and entered into customized MIS System (customized computer software). Information on grades and standards is obtained as soon as the commodity is received at the ECX warehouse and is entered in to the customized MIS software. In this case, there are no direct collection costs compared to the traditional data collection methods.

Whom do the different model(s) serve and how well?

There is no unique data collection method for any type of MIS. For example, both government and non-government MIS models can use structural and wiki approaches of collecting market information. It is observed that even business models for private-sector systems do not predominantly dependent on wiki type of data collection. This means that the advantages and disadvantages to different data collection methods can apply to any MIS model.

3.7.5 Quality Control Methods Used By MIS

One of the generic problems of early generation MIS was that they often did not pay much attention to quality of the information provided. One of the premises for the support of second-generation MIS was that they would offer superior quality control methods compared to first-generation MIS, as quality control was essential to making their user-supported business model successful.

Main observation

Non-government MIS stated that they used more quality control methods than did government MIS. All types of MIS mostly use verification and inspection of data for errors (67%), refresher training courses for data collectors (62%), and regular supervision and monitoring of collectors (62%) as the main methods of quality control.

Comparison between MIS Models

Table 15 shows that out of the 11 government MIS, the most stated methods of quality control include: verification and inspection of data collected for errors (55%), refresher training courses for data collectors (64%), and regular supervision and monitoring of collectors (55%). Out of the 10 non-government MIS, 80% stated that they use verification and inspection of data collected for errors, 60% use refresher training courses for data collectors, 70% use regular supervision and monitoring of collectors, and 60% use unexpected market visits to monitor the data collectors and data entry control and validation programs (e.g., use of data entry error check programs).

Total overview

Table 15 shows that out of 21 MIS, 67% use verification and inspection of data collected for errors; 62% use refresher training courses for data collectors and regular supervision and monitoring of collectors; and 48% use unexpected market visits to monitor the data collectors, data entry control and validation programs (e.g., use of data entry error check programs), and obtain feedback from user surveys about quality of the information from the MIS. Details of the quality control methods used by individual MIS are included in Table 50Table 51 in section A. 9 in 0.

Some of the MIS in this study use standardized methods for data collection as a method of quality control. Use of standardized questionnaires involves use of pre-coded commodities and their units of measurements, including standardized definitions of different levels in the marketing chain at which data are collected. Some MIS use additional methods of quality control. For example, in Mozambique, the supervisors use their local knowledge about production in the areas to see if the price increases or decreases correspond with the production or supply in the area. They also use multiple respondents in markets to control quality and ensure consistency. In the ZNFU SMS MIS, regional managers verify whether the prices submitted by traders are the ones they actually buying at by calling the traders and asking their buying prices anonymously and comparing them with those offered to farmers. OMA has a monitoring department that ensures that enumerator follow the established methods of data collection. OMA also has technical and oversight committees that guide the MIS in its activities (Diarra, et al., 2004).

Table 15: Quality Control Methods Used By Selected MIS Models

	Government		Non-government								Grand Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and percentage (%) of MIS	11	100	3	100	4	100	3	100	10	100	21	100
Verification and tests after data capture for errors	6	55	2	67	3	75	3	100	8	80	14	67
Refresher training courses for data collectors	7	64	1	33	3	75	2	67	6	60	13	62
Regular supervision and monitoring of data collectors	6	55	1	33	3	75	3	100	7	70	13	62
Unexpected market visits to data collectors	4	36	2	67	3	75	1	33	6	60	10	48
Data entry control /validation programs	4	36	1	33	3	75	2	67	6	60	10	48
Feedback from MIS user surveys	5	45	2	67	2	50	1	33	5	50	10	48
User verification (e.g. in wiki MIS)	2	18	1	33	0	0	1	33	2	20	4	19
Monitoring and supervisory committee	1	9	1	33	0	0	0	0	1	10	2	10
Advice from advisory panel and boards	0	0	1	33	0	0	0	0	1	10	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

The ECX information collection process has instant quality control mechanisms in the sense that the seller and buyer sign the papers after a transaction is done. Both the seller and buyer submit the paper to the counter for entry into the system and the funds are transferred from the buyer's account to the seller's account. There is no room for errors, as these would mean loss of funds by either the buyer or the seller. This increases reliability of the data released by the MIS. Providing information as a byproduct increases timeliness. Also, it increases in sustainability because the MIS does not incur field collection costs.

In the USA F&VMN, quality control in collection is achieved by training market reporters in data collection skills. In NASS, quality control is mostly ensured in the data collection process by (1) careful selection and training of enumerators, (2) use of detailed instruction manuals, (3) field supervision,(4) questionnaire checks, (5) comparison of reported acreage with those measured on the aerial photographs, and (6) and follow-up visits to some segments (NASS, 2009).

What are the implications of quality control methods for MIS performance?

From theory given in section 2.2.4, quality uncertainty makes risk-averse users under-invest in information acquisition. This means that MIS need to assure high quality information to users so as to create and maintain demand for its information products.

Whom do the different model(s) serve and how well?

The quality control methods can be adopted by any MIS depending on the resources available. This implies that there is no sufficient evidence to claim that one type of MIS model has better quality control methods than another. It also implies that the advantages and disadvantages associated with different quality control methods can apply to all MIS models and their stakeholders.

3.7.6 Feedback Mechanisms Used By MIS

One of the frequent criticisms is that, as bureaucratic organizations, public MIS had no incentive to take stakeholders' views into consideration during the design of MIS and had limited feedback from users. This was one of the reasons why some stakeholders called for more private-organized MIS, which presumably would have stronger incentives in this regard. One of the premises for the support of second-generation MIS was that they offer better feedback methods compared to first-generation MIS.

Main Observations

Non-government MIS reported using more feedback methods compared to government MIS.

Total Overview

Table 16 shows that out of the 21 MIS, the most stated feedback mechanisms used include: users' assessment or needs surveys (57%); customer satisfaction surveys, meetings with users (including farmer or trader groups), and from monitoring or analysis of information downloaded from websites or SMS requests (43%); and external evaluations by donor, government, or third party(ies) (38%).

Comparison between MIS Models

Out of the 11 public MIS, the main feedback mechanisms include: users' assessment or needs surveys (55%), customer satisfaction surveys and meetings with users (36%), and from listenership groups (27%). Out of 10 non-government MIS, the main feedback mechanisms include: users' assessment or needs surveys and external evaluations by donor, government, or third party(ies) (60%), monitoring or analysis of information downloaded from websites or SMS requests (80%), and customer satisfaction surveys and during meetings with users (including farmer or trader groups) (50%). The details of feedback methods used by individual MIS are included in Table 52in section A. 9 in 0.

Some MIS use unique feedback mechanisms. For example, the ECX receives feedback from reviews from regulators (the Ethiopia Commodity Exchange Authority), review of information from the customer service center hotline, information collected in the compliance section of the exchange, and its public awareness programs.

In Monze district in Zambia, the MIS receives feedback from meetings with farmer groups, through telephone calls to the radio program from listeners, and from farmers who visit the MIS office. Also, MIS that disseminate information through SMS and the web, such as Esoko, KACE, and the ZNFU, analyze SMS requests and webpage hits and make inferences about usage. A high number of hits indicate users like the information and a few hits indicate users do not like the information. The ZNFU conducts raffles at district farmer shows where they quiz the farmers to gauge their knowledge of the SMS MIS and whether they use the information.

Table 16: Feedback Mechanism Used By Selected MIS Models

	Government		Non-government								Grand Total	
			Farmer org.		Private firm		Trader org. and NGO		Total			
	N	%	N	%	N	%	N	%	N	%	N	%
Total Number (N) and Percentage (%)	11	100	3	100	4	100	3	100	10	100	21	100
Potential MIS users' assessment /needs surveys	6	55	2	67	3	75	1	33	6	60	12	57
Customer satisfaction surveys	4	36	2	67	2	50	1	33	5	50	9	43
Meetings with users (including farmer or trader groups)	4	36	0	0	3	75	2	67	5	50	9	43
Monitoring of information downloaded (SMS and website)	1	9	2	67	3	75	3	100	8	80	9	43
External evaluations (by donor, government, or third party)	2	18	1	33	2	50	3	100	6	60	8	38
Listenership groups	3	27	0	0	1	25	0	0	1	10	4	19
Suggestion boxes	1	9	0	0	0	0	0	0	0	0	1	5
Reviews from regulators	1	9	0	0	0	0	0	0	0	0	1	5
Customer service center hotline	1	9	0	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; N=Number of MIS; %=percentage.

What are the implications of feedback methods for MIS performance?

Obtaining feedback helps the MIS to evaluate the changing user needs and the evolution of markets so that it evolves with the market and continues to supply useful products. For the MIS to be effective in anticipating and responding to changing information needs, the analysts need to understand the market structure, either through their own studies or through obtaining such information from others, including users. For example, feedback helps the MIS to understand the types of information users need, their preferred channels and frequencies of receiving the information, and the types of value chains in which they engage in.

Whom do the different model(s) serve and how well?

The conclusion from the various feedback methods used by different MIS is that non-government MIS use more feedback methods compared to government MIS. One reason for this is could be that non-government MIS are closer to the users and hence get feedback from users than do government MIS.

3.8 Summary of Key Observations and Conclusions from the Synthesis

3.8.1 Summary of Key Observations

The main objective of this synthesis was to analyze the premises that gave rise to the "second generation" MIS models and how they deal, relative to the "first-generation" MIS models, with the generic design issues facing any MIS. The sample used in this study is not representative of all MIS, and is primarily focused on Sub-Saharan Africa. Therefore, the conclusions in this section are drawn based on the characteristics of the MIS surveyed. The presentation of the main observations follows the analytical framework used in the synthesis.

A. Generic Structural Design Issues Facing Any MIS

1. Perceived mandate

a. Most first-generation MIS aim at attaining efficient marketing, gathering information for making better policy formulation, for food security planning and monitoring, and attaining "fairer" markets. In contrast, second-generation MIS mostly aim at attaining efficient marketing, linking producers to markets, and enabling farmers to negotiate for better prices with traders (attaining "fairer" markets.)

b. Both first- and second-generation MIS consider farmers, traders, and governments as their main clientele.

2. ***Institutional Home, Organizational Features, and Coordination Forms***

a. **Provision of complementary services:** Based on a qualitative assessment and examples, all types of MIS or institutions in which they are housed provide complementary services, some of which generate information as byproducts or help increase sustainability, reliability, and timeliness of information among users. It appears that non-government MIS provide more categories of complementary services compared to public MIS, although the performance outcomes vary depending on the specific complementary services provided by MIS and not by MIS types as a whole.

b. **Geographic coverage and range of commodities covered:** Government MIS have a more national coverage (91%) compared to non-government (60%). More non-government MIS (50%) cover only part of a country than do government MIS (9%). There is no evidence to suggest that first-generation

MIS cover a higher number of commodities than second-generation MIS—within our sample, the coverage varies widely within each category of MIS. The number of rural and urban markets covered by MIS varies unsystematically: some, but not all, government MIS monitor more markets than do non-government MIS.

c. **Assuring coordination among MIS activities and production stages**:

   i. **Vertical integration of MIS activities:** There seems not to be a difference between government and non-government MIS in terms of the degree of integration of MIS activities such as collection, analysis and diffusion of market information. On the one hand, both first- and second-generation MIS are vertically integrated in a sense that they collect, analyze and disseminate some types of market news themselves, using a "make" or "produce the information itself" model. On the other hand, both types of MIS are specialized in collection of some types of information and get other types of information (e.g., weather and agronomic information) from outside organizations analogous to the "buy" or "get it from someone else" model.

   ii. **Centralization vs. decentralization of MIS activities:** More non-government MIS (80%) stated that they were centralized than did government MIS (55%) in information processing and diffusion. Also, one government MIS stated that it was decentralized and no non-government MIS reported to be decentralized in information processing and diffusion. Furthermore, more government MIS (36%)

are mixed (both centralized and decentralized) in information processing and diffusion than are non-government MIS (20%).

iii. **Specialization in the production of MIS products:** Most MIS in sub-Saharan Africa included in this study are not specialized in the production of MIS products than are those in developed countries. MIS in high-income are relatively specialized in the production market news and other organization in the production of market analysis and business reports than those in low-income countries.

d. **Designing incentives for staff to be responsive to client needs:** It seems that non-government MIS face more "high-power incentives" than public MIS to deal with poor incentives problems such as low staff salaries, fixed staff salaries, excessive bureaucracy, shirking, and reliance on behavioral monitoring instead of output-based monitoring.

e. **Profit orientation of the MIS:** Most private MIS such as KACE and Esoko are designed to be profit-oriented. In contrast, most public- and farmer organization-based MIS are not profit-oriented.

3. **The nature of commodities covered:** Nearly all types of MIS reviewed deal in several staple crops. Only ECX predominantly deals with one cash crop (coffee).

B. Generic Conduct Design Issues for Any MIS

4. **Information provided and frequency of provision:** All types of MIS provide market news. In terms of market analysis, 27% of public MIS and 30% of non-government MIS provide market analysis. None of the MIS in the sample provide business reports. Non-government MIS do not engage market and policy analyses

compared to government supported MIS, but could provide data to units that do. Currently they do not provide such information to policy analysis units. These results imply that there are no clear patterns to suggest that non-government MIS provide more market news and analysis than government MIS nor that non-government MIS provided the information more frequently than public MIS where bureaucracy is likely to be higher.

5. **ICT used in transmission and diffusion of market information:** Most non-government MIS started after 2005 after the increase in availability usage of cell-phones in low-income countries, suggesting that the increase in availability and usage of cell phones was a major factor that contributed to the start of these MIS models in low-income countries. Most government MIS use traditional ICT to transmit information from markets to the MIS, while non-government MIS mostly use modern ICT to transmit information. Most government MIS use both traditional and modern ICT to diffuse information, while non-government MIS mostly use SMS and websites (modern ICT) to diffuse information.
6. **Funding strategies of MIS:** All MIS types in SSA still heavily depend on external donor funding as their sustainability strategy. Also, it appears that non-government MIS have been more aggressive in seeking other private-firm sponsorship of their activities than have public-sector MIS. Also, no MIS in sub-Saharan country has been able to wean itself entirely from donor funding and graduate into a purely private sector MIS.
7. **Data Collection Methods Used By MIS**: Most MIS (both first- and second-generation) stated that they use structured questionnaires and interviewer observation

(57%) compared to a wiki approach (only one of the MIS surveyed) to collect market information. There is weak or limited supervision of data collection among many public MIS. The wiki approaches, where used, do not use a standard method such as always observing the same grade of product or always reporting actual transactions rather than offer prices, which makes the reliability of such systems suspect in situations where there are relatively few participants.

8. **Quality control methods used by MIS:** Non-government MIS stated to use more quality control methods than government MIS. All types of MIS mostly use verification and inspection of data for errors (67%), refresher training courses for data collectors (62%), and regular supervision and monitoring of collectors (62%) as the main methods of quality control.
9. **Feedback mechanisms used by MIS:** Non-government MIS stated to use more feedback methods compared to government MIS.

3.8.2 Conclusions from the Synthesis

1. There is great heterogeneity among MIS in terms of their structure and conduct design issues as indicated in the summary above.
2. Whether or not an MIS is government-based explains very little in terms of its performance. The key conclusion seems to be that just changing the institutional home does not guarantee that the basic design dilemmas of an MIS are addressed. Rather, those need to be addressed in any MIS, and the key issues are internal principal-agent issues within the organization. These can be addressed in any type of MIS, but often may be easier to address in a non-government MIS because they provide *high-powered market incentives* compared to government MIS that provide

low-powered hierarchical incentives. At a minimum, financial and managerial autonomy appears to be a precondition for the better performance of both types of MIS.

3. There is a rapidly evolving market environment in terms of (a) market actors, and (b) ICT availability and usage.
4. One cannot analyze the key design issues of MIS independent of overall environment in which they operate.

3.9 Implications for Stakeholders in Terms of Promoting and Supporting Different Types of MIS

1) Specialization in the Production of MIS Products

In SSA, public MIS can be designed to provide basic market news (i.e., specialize in market news) needed by all users such as market prices and quantities supplied in critical stages of value chains; and other MIS types and organizations (e.g., private- and farmer organization-based MIS, universities, and private firms) provide more customized information and specialized market analysis and business reports a fee to users with effective demand. This arrangement would ensure that poor farmers who do not have effective demand receive basic market news; users with effective demand receive market analysis and business reports; and private MIS that produce market analysis and business reports recover some production costs.

The public MIS does not have to conduct primary collection of all types of “missing” market news. Instead, it can link with organizations (both public and private) that collect other types of information and get it for free or for a cost depending on the types of information. This would compare with specialization (“make”) to produce basic information and relying on other outside sources ("buy") for other types of market information. For example, public MIS can get weather forecast from public metrological offices and agronomic information from public agricultural research organization.

2) Designing Incentives for Staff to be Responsive to Client Needs

There is need for the MIS to offer efficient wages so as to retain good quality staff at national, provincial, and district levels; and to increase incentives of MIS workers so that they collect and disseminate information regularly (reduce shirking).

a) **Increasing wages:** One of the institutional changes may be for government to allow MIS personnel to work for fewer days in a week (e.g., 3 work days in a week). This would be equivalent to an increase in wages to workers, and leave them with some extra time to engage in alternative activities to supplement their incomes. The limitation of reducing work days is that enumerators usually carry out other activities at the province or district such as provision of extension services and distribution of fertilizer; thus they might be needed for the full week. The equivalent action is to increasing wages, which would enable the MIS hire good staff since it offers an efficiency-wage, but the question becomes how to finance this. Given the financial constraints of the MIS, the first option seems easier to implement than the second one.

b) Autonomy and residual claimancy: One solution is to give the MIS some level of financial and managerial autonomy. Financial autonomy will enable MIS generate revenue, and to allow the MIS to become the residual claimant of extra revenues generated through consultancies like in Mali's OMA. From a principal-agent perspective, contracts with residual claimancy can deal with the shirking problem better compared fixed-wage contracts (Hayami and Otsuka, 1993, Ray, 1998). Managerial autonomy can enable MIS to make hiring and firing decisions and use of resources like vehicles, telephones, and computers. There is need to develop clear rules for sharing resources by MIS that are funded by government and donors. Managerial autonomy also implies that rules for sharing resources are developed.

c) **Hiring locally**: MIS may also be encouraged to hire enumerators from within the areas they are located. Local enumerators are likely to be sustained on a lower salary or allowance since they are residents and may have homes and already engaging in other income generating activities in their own localities. Other institutional changes would be to contract staff on a short basis, where the threat of not renewing contracts may induce employees to use more effort.

d) **From behavioral to output monitoring:** An option is to change from monitoring based on attendance to monitoring based on output in form of a weekly MIS bulletin.

e) **Training MIS staff:** Effective market information requires knowledge of the structure and functioning of the markets, which is essential both to the design of good price reporting systems, interpreting the price patterns in the MIS reports, and to effectively communicate the MIS outputs to different users. Therefore, there is need to train MIS personnel to (1) produce market analysis that can feed in policy design, and (2) produce useful products to stakeholders such as farmers, NGO, and traders. These stakeholders who benefit from such information can then lobby the government, external donors, and charity organizations to support the MIS.

3) Information Provided by MIS

Provision of price and quantity forecasts: One of the findings in this synthesis is that most MIS do not provide price and quantity forecasts yet this information is needed by many users. There is need for the MIS to provide price forecasts, especially during the peak marketing months to enable farmers make arbitrage decisions. Unfortunately, most MIS do not forecast and do not like to venture into forecasting. The reason is that when forecasts do not come true, the MIS risks loss of credibility among users. Some of the solutions to this problem are: (1) facilitating training and capacity building of MIS staff to acquire better forecasting techniques and skills in reporting price and quantity forecasts to information users of different skill levels and (2) educating information users on how to interpret price and quantity forecasts.

Specialization in market analysis: It seems users need more specialized information products, many involving higher analytical content, such as prospective information about how the market is likely to evolve (e.g., price forecasts, crop harvest or production forecasts), analytical information about the major factors moving the market (market dynamics), and regulatory information. This is much more information than what many MIS in sub-Saharan African countries currently provide. This implies (1) a need for capacity strengthening in MIS to provide these specialized information products, or (2) developing stronger links to other units that have that analytic capacity. The first option is dealt with under the implication on training MIS staff under the section on designing incentives for staff to be responsive to client needs above. In the second option, the MIS can provide information to public universities or research units within government to come up with these kinds of specialized information products, including market analysis for policy formulation and food security analysis. For this to work and gain the support of many stakeholders (which increases sustainability), the universities would need to conduct the analysis in a useful way that meets the needs of the most stakeholders (e.g., smallholder farmers, small-scale traders, local government extension officials, NGO workers, local policy analysis, and policy makers) and not focus on technical analysis that meets the needs of academic journals.

4) Funding Strategies of MIS

Providing information subsidies: Governments and donors may subsidize information on behalf of the poor farmers. This could be done either through direct funding of government- or farmer-organization based MIS or through contracting with private MIS to do so.

4 EFFECTS OF RECEIVING IMPROVED AGRICULTURAL MARKET INFORMATION ON THE MARKETING BEHAVIOR OF FARMERS IN MOZAMBIQUE

4.1 Introduction and Research Questions

This chapter analyzes factors that influence the reception of improved agricultural market information from the MIS and other sources among farmers in Mozambique; and how the reception of improved agricultural market information affects the marketing behavior of farmers. In many sub-Saharan African countries, it is common that two nearby villages, districts or markets have significantly different farmgate, assembly, wholesale, or retail market prices for the same quantity and quality of agricultural produce. This can be caused by many factors, such as lack of market information, poor roads and bridges between the markets and/or villages, thin or near missing markets, insecurity, or policies and actions that impede the flow of goods within and between countries. One of the several possible actions that can help reduce price differences between locations at the same marketing level (e.g., farmgate, assembly market, or urban wholesale prices) is the provision of improved agricultural market information.

Agriculture is an important contributor to Mozambique's GDP. According to World Development Indicators from the World Bank, in 2008, the percentage of value added to GDP from agriculture was 29 percent, and 63 percent of the population in Mozambique lived in rural areas. In Mozambique, many studies point out the importance of market information in improving market participation, sales revenue, and crop income (Boughton, et al., 2007, Mabota, et al., 2003, Mather, 2009, Mather, et al., 2008).

However, no study has empirically studied factors that influence the reception of market information by small-and medium-holder farmers in Mozambique. This chapter seeks to fill this gap. The rationale is that farmers obtain value when they make informed production and marketing decisions based on better information, such as decisions about size of areas to cultivate, what crops to grow, and whether to engage in spatial and temporal arbitrage. From economic theory, improved market information helps improve market efficiency, redistribute welfare, or reduce the cost of being off-the equilibrium price and quantity (Aker, 2010, Aker and Mbiti, 2010, Hayami and Peterson, 1972, Jensen, 2007, Jensen, 2010, Kizito, 2009, Staatz, et al., 2010).

It is hypothesized that farmers who receive price information are more likely, keeping other factors constant, to receive higher prices than do farmers without information. Higher prices from the sale of staple food crops lead to higher sales revenue, higher household incomes, improved food security, and reduction in poverty levels. The higher prices, however, are obtained at a search cost, and theory suggests that farmers will search up to that level where the marginal benefit equals the marginal cost of search (Stigler, 1961), or until they get a price lower or equal to their reservation price (Varian, 1980). Therefore, the specific research questions addressed in this chapter are:

1. What factors influence the reception of improved agricultural market information from the MIS and other sources among medium and smallholder farmers?
2. Keeping other factors constant, is receiving improved agricultural market information positively associated with market participation in staple crop marketing?

3. Keeping other factors constant, are farmers who receive improved agricultural market information more likely to receive higher maize prices compared to farmers who do not?
4. How do the benefits from receiving improved agricultural market information compare with the costs of searching for it for an average Mozambique farmer who participates in the market as a maize seller?

The rest of the chapter is organized as follows. Section 4.2 gives the study hypotheses. Section 4.3 describes the source of the data, the sampling design, and study coverage. Section 4.4 presents the Market Information Systems in Mozambique between 2002 and 2005. Section 4.5 presents the indicators used to measure the impact of market information. Section 4.6 presents the sources and channels of obtaining information in Mozambique. Section 4.7 presents the theoretical and empirical models of reception of market information and price received, and discusses how the main econometric and statistical concerns are addressed in the analysis. Section 4.8 gives a descriptive and econometric analysis of factors that affect the reception of market information. Section 4.9 gives a descriptive and econometric analysis of the effects of reception of information on market participation. Section 4.10 gives a descriptive and econometric analysis of reception of information on prices of maize received. Using results from the descriptive and econometric analysis and other parameters observed during the field visits in Northern Mozambique, Section 4.11 conducts an analysis of the benefits and costs of information search with examples of radio, cell phones, and word-of-mouth search modes. Section 4.12 summarizes the main findings and their implications for MIS improvements and design. Finally, section 4.13 presents the limitations of the models and identifies areas of further research.

4.2 Hypotheses

1. Factors that are hypothesized to be positively associated with reception of market information by farmers in Mozambique include commodity(ies) produced, ownership of a radio, presence of a cell phone signal (network) in the village, and availability of tapped[4] electricity in the village from electricity transmission lines (to power cell phones, radios, and TV, although some farmers use old car and motorcycle batteries to power radios and television, and type D and AA batteries to power radios in rural areas). Other factors hypothesized to be positively associated with reception of market information include ownership of a bicycle (which facilitates attending extension meetings and going to markets where information is disseminated), membership in farmer associations, and access to extension services. Also, household size, age of household head, and the education level of the household head (assuming some type of information and education are complementary goods-illiterate farmers cannot read printed information) are hypothesized to be positively associated with receiving market information. Other factors hypothesized to increase the probability of reception of market information include geographical region and the agro-ecological zone in which the household is located. Factors hypothesized to reduce the probability of reception of market information include distance to the

[4] In many African countries, untapped electricity lines pass through many villages, implying that such villages do not use the electricity transmitted through their villages.

nearest road with public transport, distance to village administrative post, distance to district headquarters, and a household being headed by a female.

2. Households that receive improved market information are more likely to participate in staple crop markets, keeping other factors constant. To address reverse causality (endogeneity or simultaneity), market participation and reception of market information are estimated as a recursive biprobit model, with reception of market information appearing in the structural equation of market participation. The reverse-loop effect of market participation on reception of market information is not the focus of this chapter.
3. Receiving market information is positively associated with higher maize prices received among households in Mozambique.

4.3 Data, Sampling Design, and Study Coverage

The above research questions are analyzed using panel data collected in the National Agricultural Surveys conducted by the Directorate of Economics/ Department of Statistics in Ministry of Agriculture in Mozambique called *Trabalho de Inquerito Agricola* (TIA). Two-year panel data for 2002 and 2005 is used. The survey used a stratified, cluster sampling design in both periods and covered 4,908 rural small- and medium holder households from 80 out of 130 districts in both years (Mather, 2009). This study analyses data from four provinces in Mozambique, namely Manica, Sofala, Zambezia, and Nampula. These provinces are in the Northern part of Mozambique, which is the main production area of the four main marketed staples (maize, common beans, large- and small groundnuts). The northern provinces in Mozambique are the main production areas in Mozambique; probably because they have better rains, high rural populations and are near regional markets in neighboring countries such as Zimbabwe, Zambia, and Malawi (Boughton, et al., 2007).

The survey data was triangulated by field study observation by the researcher, who visited Mozambique and interacted with employees of the Agricultural Market Information System (SIMA) in Maputo, employees of the Provisional Information System for Agricultural Markets (SIMAP) in Nampula Province in Northern Mozambique, farmers and farmer group leaders in Murrupula District in Nampula Province, local and international Non-Governmental Organizations (NGOs), food assistance organizations, donors, and traders in formal and informal market who utilize market information from SIMA and other sources.

4.4 Market Information Systems in Mozambique between 2002 and 2005

Agricultural Market Information System (SIMA) of Mozambique

The Agricultural Market Information System (SIMA) of Mozambique started in 1991 with the aim of providing agricultural market information to farmers to enable them negotiate for better prices with traders, for food security planning, and to make better policy decisions. SIMA is decentralized and each province in Mozambique is supposed to have a provincial market information system (SIMAP). Some provinces do not have functional SIMAPs. The main commodities on which information is reported are white maize grain and flours, common beans, cowpeas, rice, large and small groundnuts, wheat flour, edible oil, and dry cassava. SIMA provides (1) market analysis covering opportunities and outlook for selected commodities in selected provinces; (2) transportation costs incurred by traders to move commodities between markets; (3) producer, wholesale, and consumer weekly price levels and percentage changes in the previous two weeks in major markets; (4) estimated quantities of commodities available for sale and their percentage changes from the previous week in major wholesale markets; (5) prices of white maize grain in non-standard local units by location; and (6) regional and international FOB prices, future prices of major commodities, and foreign exchange rates of neighboring and major countries' currencies (Mabota, et al., 2003, SIMA, 2009).

The main modes of diffusion used by SIMA at national level include email, national Radio Mozambique, national television, website, and newspapers. The main modes of diffusion used by SIMAP at provisional levels include local radio, email, notice boards, blackboard, hand-delivery, and through mail bins (pigeon holes) at the province headquarters once a month. Copies of the bulletin are given to local NGOs so that they can distribute the information through their extension agents. Also, the provisional officials take the market information bulletin with them when they go to visit the rural areas in districts. In addition, some district enumerators in provinces are expected to distribute the information they collect to the rural community radios. More about SIMA is included in 0, section A.3.1.

INFOCOM

INFOCOM in the Ministry of Commerce provides price information for a range of consumer products from urban areas, primarily focused on the formal sector of supermarkets and stores, but it does not cover some of the staple crops and the rural markets covered by SIMA. The information from INFOCOM is published in the main local newspaper, *Noticias* every Friday

FEWSNET

In Mozambique, FEWSNET provides information on cross-border trade focused on volumes of trade for key agricultural commodities crossing the borders informally. It does not capture formal trade. FEWSNET gets secondary data from SIMA as well. The information from FEWSNET is disseminated to recipients with emails such as NGOs, Farmer associations, WFP, the World Bank, and individual users.

4.5 Indicators Used to Measure the Impact of Market Information

This section presents the indicators used to measure the impact of market information, drawing on recent literature. The section also presents how the indicators relate to some concepts in economic theory on the role of market information systems in agricultural marketing. The review is limited to recent studies (mostly 2007 and beyond) that measure the impact of market information or ICT on agricultural market performance. The section also presents the way information is measured in the modeling to capture its effects on impact indicators used. The section ends with a discussion of the differences in the approaches used in the reviewed studies compared to that used in this chapter.

4.5.1 Market Participation and Crop Revenue or Income

Mabota et al. (2003) studied the relationship between reception of market information and revenues from the sale of cereals, beans, and peanut in the north, central, and southern provinces of Mozambique. The economic rationale in the study was that agricultural market information is important in increasing household revenue, which consists of sales volumes and prices received by sellers. In this study, increased sales volumes (output) is based on the assumption that better information leads to greater allocative efficiency in production by transmitting incentives to producers to produce specific products. In addition, higher prices received represent a redistribution of income towards producers and a movement towards more competitive prices, which also implies a reduction of dead weight loss. The study also highlights the importance of the information from the MIS to the design better food policy reforms in liberalized economies. Using household-level survey data, the study used graphs to show that households that received market information also received higher sales revenue than those without market information (Mabota, et al., 2003). This descriptive study did not control for other factors that might influence sales revenue.

Boughton et al. (2007) studied the role of market information on agricultural crop income in maize, tobacco, and cotton markets in Mozambique. The economic theory in this study is that access to market information as a "public good" enables farmers to obtain higher crop revenue by reducing transaction costs, which enables them to move from autarky towards specialization. When farmers' transaction costs reduce, they get the opportunity to specialize according to their comparative advantage and enjoy welfare gains from trade. This study measures reception of a market information as a dummy variable which shows that the village received market information. Using household-level data and the Heckman's two-step procedure, they found a positive correlation of reception of market information with participation in high-return (cash crop) markets (i.e., cotton and tobacco) and an insignificant relationship in low-return (staple crop) markets (i.e., maize). The study did not find market information to significantly increase the value of maize, cotton and tobacco sold (Boughton, et al., 2007).

Another study by Mather (2009) used a first-difference model to analyze the effect of reception of market price information on the change in net crop income from all crops sold by Mozambique households in 2002 and 2005. The study found that households that received market price information increased household crop income by 23 percent in the central and 31 percent in southern regions of Mozambique (Mather, 2009).

The above studies show that reception of improved market information is associated with higher sales revenue and incomes among rural households in Mozambique, yet only 40 percent of rural households reported receiving market price information. Moreover, one study has observed that some of the market information disseminated is of limited practical use to farmers because they lack the capacity to act on the information because of a lack of group marketing, lack of price forecasts, and the failure to involve farmers in deciding the information to be collected by the MIS (Whiteside and Lucas, 2006). This means that more research is needed to find factors that affect reception of market information among farmers so that households can be helped to receive more improved market information. The study by Mather (2009) recommends more funding to MIS, an increase to the frequency of dissemination through radio, improvement of the content and analysis of information, and provision of province-specific information so that more households can obtain and use market information.

4.5.2 Changes in Price Dispersion or Variation

The impact of information is also measured in some studies as the reduction in price dispersion through measures such as coefficients of variation, standard deviation, variance, ranges, and absolute price differences of prices offered by buyers or received by sellers between similar levels in different markets or geographical regions.

For example, Goyal (2010) measures the impact of market information as changes in the coefficient of variation and standard deviation in the monthly price modes of soybeans across *mandis* (government regulated wholesale agricultural markets) in the Indian state of Madhya Pradesh. The economic theory driving Goyal's study is that providing information to farmers from a market information service through radio programs increase profitability, increase the incentives to produce and improve quality through the reduction of the appropriation of monopoly rents by intermediaries, and thus leads to income distribution from buyers to sellers. This study shows that reception of market information reduces price dispersion, which can arise for reasons other than monopoly power. Therefore, the study also demonstrates how improved market information among sellers helps the movement from "off-equilibrium" towards equilibrium prices—a process that reduces deadweight loss among sellers and buyers. Market information is measured as the a dummy variable that represents the introduction of an information kiosks that provide daily wholesale prices of soybean offered by a private buyer (soybean processor) and those offered in *mandis*. The Goyal paper assumes that sellers go and check information at kiosks before they deliver produce to markets or to the processor.

Using aggregated monthly price data from 1999 to 2006 in 37 districts, Aker measures the impact of access to information as the absolute difference of prices of millet between markets. The economic theory is that the introduction of cell phones—a technology that facilitates the flow of information—reduces search costs and facilitates arbitrage, which in turn helps to reduce price dispersion and contributes to overall market efficiency and improvements in welfare. The variable associated with market information is the presence of cell phone coverage in markets, which is measured with a dummy variable equal to 1 for each month when there is cell phone coverage in a pair of markets and zero otherwise (Aker, 2008, Aker, 2010). This study finds that introduction of mobile phone service in Niger markets reduced grain price dispersion up to 10 to 16 percent.

In a study among fishing communities in the Indian state of Kerala, Jensen (2007) computes the impact of access to information as changes in the spread of the maximum-minimum prices and the coefficient of variation in prices when search costs reduce as a result of introduction of cell phones in fishing communities. The economic rationale is that the introduction of cell phones—a technology that facilitates the flow of information—facilitates arbitrage, reduction in waste of outputs, and reduces information asymmetries. Arbitrage leads to gains in efficiency and reduction in information asymmetries increases the welfare of both sellers and buyers in supply chains. Using weekly micro-level survey data (implicitly an aggregated time series data set), the dummy variable representing access to market information is presence of a cell phone network in a region and zero otherwise. The study shows that there was a reduction of up to 5 rupees per kilogram in the average of the maximum minus minimum price spread when mobile phones are introduced in coastal fishing regions. The study also shows that there was a 38 percent reduction in the coefficient of variation when cell phones are introduced in fishing regions.

4.5.3 Marketing Margins and Profits

The impact of reception of improved agricultural information on market performance could also be measured as reduction in marketing margins, thus reducing the cost of food (retail prices) on the consumer side, and to increasing the farmgate price of staple food crops among rural agricultural households on the production side. This process leads to economic efficiency and increases the welfare of both producers and consumers because it improves their real incomes. This process can also be viewed as an improvement in the food security of both rural and urban households (Diarra, et al., 2004, Holtzman, et al., 1993). Changes in profits received by sellers could be another impact measure of reception of information in market performance. Changes in profits (which is revenue from crop sales minus production-, marketing-, and transaction costs) can be viewed as (1) an increase in prices received by sellers (which is an increase sellers' welfare); (2) an increase in quantity sold (which is an increase in allocative efficiency in production), and (3) a reduction in costs among sellers due to reception of improved agricultural market information.

4.5.4 Consumer Surplus, Producer Surplus, and Dead Weight Loss

The benefits of access to information can also be measured by the changes in producer surplus and, consumer surplus, and deadweight loss when consumers and producers respond to market information in form of price or production news or forecasts from the MIS (Goyal, 2010, Hayami and Peterson, 1972, Kizito, 2009) or with the introduction of new technologies which facilitates the exchange of information (Aker, 2010, Jensen, 2007) In this approach, the economic theory is that access or reception of improved market information leads to overall economic efficiency and an increase and redistribution of welfare among market actors. For example, the Jensen (2007) study computes the welfare changes among consumers and producers of fish when search costs reduce. The study shows that on average, consumer prices reduced by 4 percent, producer prices increased by 8 percent and consumer surplus in consumption areas increased by 6 percent (Jensen, 2007).

The benefits of access to improved market information can also be measured as the reduction in the cost of being off the equilibrium price and quantities (reduction in dead weight loss) when producers obtain and act on improved market information in form of price forecasts (Kizito, 2009). Kizito measures the potential payoffs of providing improved agricultural market information to producers and consumers of maize, millet, sorghum and paddy rice in Mali as the reduction in dead-weight loss (a gain in welfare by both consumers and producers) when farmers and small-scale traders with rational expectations respond to hypothetical improved price forecasts from the MIS. The study finds that potential benefits from improved information, are greater when there is high uncertainty about future prices, high own-price elasticity of supply, low own-price elasticity of demand, and high value of crop output (Kizito, 2009).

4.5.5 Elimination of Waste

The Jensen (2007) study also measures the impact of information as change in waste (unsold fish in markets with high supply) when an ICT (cell phone coverage) that facilitates exchange of information is introduced in fishing regions. The study shows that waste is reduced by 4.8 percentage points when mobile phones are introduced in coastal fishing regions.

4.5.6 Household-level Prices Received by Sellers

Using household level panel data, Svensson and Yanagizawa measure the impact of market information as the changes in the standardized households farmgate prices received when households access information. The economic theory in Svensson and

Yanagizawa is that access to market information reduces asymmetric information, thereby increasing bargaining between farmers and traders and improving farmers' choices of what to produce. This then leads to a redistribution of welfare from traders to farmers. The study uses household ownership of a radio and a household living in a district in which the MIS disseminated information as proxies for reception of market information (Svensson and Drott, 2010, Svensson and Yanagizawa, 2009).

4.5.7 Aggregated Prices Paid By Traders in Markets

Using monthly data, Goyal (2010) measures the impact of market information as the changes in the average of the mode, minimum and maximum monthly aggregated prices in *mandis* (Goyal, 2010). Conceptually, the difference between Goyal's approach with that used by used (Svensson and Drott, 2010, Svensson and Yanagizawa, 2009) is that Goyal uses aggregated market-level data, while the later use more micro-household-level survey data. The Goyal study finds that the presence of information kiosks, which is the variable used to measure access to market information, increases the average of mode, minimum and maximum monthly prices in *mandis* in the Indian state of Madhya Pradesh.

4.5.8 Sales Volumes

The Goyal (2010) study also measures the effects of the presence of kiosks that provide information on volumes of soybeans sold in government controlled markets in the Indian state of Madhya Pradesh (Goyal, 2010). The paper did not find the presence of kiosks to reduce the volumes of soybeans sold in *mandis*. This implies that information did not redistribute volumes from government controlled markets to the private buyer, but seems to have induced an increase in marketed volume.

4.5.9 Integration of Markets

The impact of market information can also be measured as the level of market integration, measured as the volume of trade that occurs between markets and correlation of prices between markets (spatial arbitrage). Due to limited data on trade flows in developing countries, market integration is usually measured by the correlation or cointegration of prices between two or more markets during a specified time period instead of the flow of homogeneous goods between them. Market integration is frequently measured using cointegration regression models (Shahidur, 2004). The weakness with market integration analysis is that markets can be integrated when they are not efficient, and in some occasions, when there is even no physical trade between them.

4.5.10 Number of New Markets and Entrants into Value Chains

Measures of sales volumes in new markets, sales of new agricultural products and numbers of new market entrants can also be used as indicators of the impact of market information (Aker, 2010, Dembélé, et al., 2000, Jensen, 2007). For example, Jensen shows that once cell phone towers where introduced in fishing regions, fishermen started selling their fish in new markets where they could obtain information from (Jensen, 2007). Also, Aker shows that grain traders in Niger expanded their markets because of the introduction of cell phones that enabled then get information from near and far markets (Aker, 2010).

4.5.11 Effects on Production Decisions or Output Response

The impact of information can also be measured through its effects on production decisions measured as changes in area planted, production, yield, and switching crops grown. For example, Goyal (2010) analyzes the impact of the presence of an information kiosk that provides information on the buying prices of soybeans in a government controlled market and by a private buyer on the area planted, production and yield of soybeans, rice, maize and groundnuts in the Indian state of Madhya Pradesh. The study finds that the presence of the kiosk increased the area planted under soybeans, reduced the area planted under rice, and increased the production of soybeans.

4.5.12 Decision-Theoretic Approaches

This method measures the benefit of improved market information as the difference between the expected utility from information and the cost of obtaining the information. The method uses subjective states of nature and their probabilities of occurrence to estimate the expected utility from information. The method requires obtaining a utility function, the wealth of information users, and the costs at which they receive information (Eisgruber, 1978, Nicholson, 2002).

4.5.13 Revealed and Stated Preferences

The revealed preferences approach can be used to predict the value of market information systems to stakeholders. When farmers or governments choose to invest in MIS rather than other services in a bundle of services, then they reveal their preference for information to the other services in the bundle. The bundle of marketing related services may consist of provision of communal storage facilities, setting up a cooperative credit saving scheme, setting up a marketing management practices training service, or providing market information. Thus, such a choice would imply that market information is directly revealed to be preferred to other services. In the stated preferences approach, information users would state their preferences from a bundle of marketing services put together. Empirically, these can be computed using willingness–to-pay and willingness-to-accept models. Willingness to pay (WTP) is the maximum amount of money individuals would be willing pay for information products. Willingness to accept (WTA) is the amount of money individuals would accept to be compensated to forego the market information service. WTP or WTA would then be aggregated to estimate the value of information to smallholder farmers. One of the weaknesses of these methods is that users may over- or under-estimate their willingness to pay or accept depending on their perceived benefits from the survey. No study on the impact of agricultural market information was identified by the author to have used this approach.

4.5.14 Difference in the Approach Used In This Dissertation with Those in Existing Literature

Using household panel survey data, this dissertation measures the factors that affect reception of market information from any source and through any channel among farmers in Mozambique. The dissertation then measures the effect of reception of information by individual households on individual-household-level maize prices received. The general economic theory and the modeling style guiding the analysis in this dissertation is that improved agricultural market information help farmers to make better production and marketing decisions. In terms of production decisions, market information is a non-physical input that helps farmers to decide how to use other inputs in the production possibility set. In terms of marketing, improved agricultural market information helps to reduce information asymmetries (increased market transparency or reduction in transaction costs), increases market participation (linking farmers to markets) and increases the capacity of farmers to negotiate for better prices with traders. When informed farmers participate in markets, they earn an information rent or information premium. Thus, this study focuses on how the provision of improved agricultural market information benefits the sellers, in the form of higher prices, but does not address whether that increase in higher prices comes at the expense of buyers or through an increase in overall economic efficiency. Therefore, higher prices received are used here as an indicator of the impact of market information on sellers' welfare, but not necessarily overall economic efficiency. Improved information helps move the price and output levels closer to those of a competitive market and "leveling the playing field" and income redistribution. Furthermore, reception of information leads to reduction in risk and efficient allocation of productive resources (assuming that farmers are risk averse). The main difference in the approach used in this study—and in essence its contributions to MIS evaluation literature—from those used in recent literature are discussed below.

Many studies use proxies such as availability of a cell phone network (Aker, 2008, Aker, 2010) or ownership of radios or a household living in an area where there are information broadcasts from an MIS (Svensson and Drott, 2010, Svensson and Yanagizawa, 2009) as a measure of access or reception of information. Such studies assume that access to these ICT implies reception of information. This is a weakness because many households receive information (e.g., from friends, relatives and neighbors) without owning a cell phone or a radio and many households do not receive information even when they have radios and cell phones. This implies that these studies may miss the spillover effects onto others of the ownership of cell phones or radios by friends and neighbors. Also, the estimating the effects of information on market performance using proxies increases attenuation bias and gives less precise estimated results because there is no direct link between the reception of information and the measured outcomes as would be the case when the variables used is reception of market information by an individual household as is done in this dissertation.

The assumption that living in a district were an MIS was diffusing information implies access or reception of market information, as was done in(Svensson and Drott, 2010, Svensson and Yanagizawa, 2009), creates an aggregation bias problem. This is because all households in a region where the MIS diffuse information are assumed to be treated (received information) and that those in regions without information broadcasts not to be treated (did not receive information). Based on survey data in Mozambique and on information obtained during field study visits in Ethiopia, Zambia, and Mozambique, households that report to receive market news live in the same villages as with those that report not to receive market news, even in areas covered by MIS broadcasts. This situation most likely occurs in several other sub-Saharan African countries. Therefore, studies that aggregate the treatment at higher meso levels (e.g., at market, district, or state level) only estimate "intent to treat" effects or indirect treatment effects, and not the "average treatment" effects or direct treatment effects. This dissertation identifies the treatment at individual household level (reception of information) and thus gives a more precise measure of the effects of reception of market information on the outcome than studies that aggregate the treatment a higher level (e.g., at the district or market level).

Another weakness of papers that use market-level aggregated data such as prices offered in markets and reported at market level (e.g., (Goyal, 2010)) is that they capture less heterogeneous effects compared to when household-specific prices are used, as is done in this dissertation. Moreover, the use of mode, minimum and maximum, but not the mean, does not capture and therefore explain the full range of variation in the prices paid by traders in the market. Thus, the advantages of using individual household-level data is that it captures more heterogeneous effects and avoids aggregation problems as is the case when meso data, which assumes all households in the delineated areas of the study received the same prices.

In the Jensen and Aker studies, there is no direct presence of MIS in providing information. This implies that these studies measure the effect of the presence of ICT that can be used to search for information, and not necessarily the impact of reception of information from an MIS or other sources as done in this dissertation.

All the reviewed paper do not directly capture the role of an MIS and several other sources of market information, such as other traders and professional networks, relatives, friends, extension and NGOs staff as sources of information. Also, the reviewed papers do not capture the role of other channels such as the printed press and word-of-mouth though meetings with friends, relatives and market actors in access or reception of information. This means that these models do not fully internalize the spillover problem or externality of receiving information from other secondary sources and using other alternative channels on the impact variables.

Also, considering only one ICT as the channel through which information is diffused leads to a lot of attribution bias because market actors use several channels to receive information. For example, using the presence of cell phone network alone or ownership of a radio alone as proxy for measuring the effects of reception on market information on market performance indicators without controlling for other channels thorough which households obtain information and other sources of information does not give an independent effect on the measured impact indicators. This is because the included proxy captures the effects of other sources of information and channels through which information is received. Therefore, another main distinction between the approach used in this dissertation and other studies is that this dissertation measures the direct role of reception of market information while other studies measure the impact of owning or presence of an ICT on performance. The use of difference in difference estimators, natural experiments, and matching methods may reduce attribution bias. Another solution is to caution the readers that the measured outcome indicator shows associative effects and not independent effects of the included single proxy.

In summary, this dissertation recognizes that there are other several channels through which information is transmitted to different information users for private and public decision making in addition to cell phones and the radio, which are the most studied ICT through which information is diffused in recent literature. The study also recognizes that there are several sources of information rather than the MIS. Thus, a major distinction between this study and the above studies is that this study analyses the effects of reception of information by household irrespective of the channels used to receive the information and sources of information. This then solves many of the estimation problems encountered in impact assessment literature such as unobserved treatment effects, attribution bias problems, and spillover effects or externalities as explained in the last paragraph of section 4.6 below, and attenuation bias, which makes the analysis simple and straightforward.

Furthermore, the literature review in this section shows that there are many indicators used to measure the impact of information and ICT on market performance. This dissertation measures the impact of reception of market information on prices received by household using household-specific survey data. The reason for using prices obtained by individual households, unlike other studies, was to avoid masking the heterogeneity in the prices received by individual household, which is the reality in rural villages in Mozambique, and in other countries in sub-Saharan Africa in general. A positive impact of the reception of market information on the household-specific price obtained measures the average increase in price (information premium or information rent) by households in Mozambique. Other ways of looking at the outcomes is that information reception increases household income; improves food security (if one considers that the increased income may be used to purchase other consumables from the market); helps to reduce poverty among rural farmers; improves the returns to farmers as sellers—but not overall efficiency—in the market; and leads to welfare gains among farmers who sell maize. Also, there are implicit welfare gains among consumers of maize or its processed products.

Thus, another key difference between this dissertation and studies that look, for example, at the impact of market information on price dispersion is that this study's focus is on the impact of improved agricultural market information on sellers' welfare (a focus of many funders who are interested in connecting farmers to more efficient markets), but not the impact of the information on overall market efficiency.

4.6 Sources and Channels of Obtaining Information in Mozambique

What are the sources of market information and what channels are used to diffuse information in Mozambique? In this study, sources of information and modes through which information is diffused are separated. This separation has important implications on measuring the impact of MIS on selected performance indicators through avoiding complication related to spillovers and attribution bias. Sources of information refer to the organization, firm, or person that collect and provide market information. An MIS is just one of these sources. Others include traders, extension and NGO workers, neighbors, friends, and relatives.

Modes or channels of diffusion refer to the methods used to disseminate information to users such as radios, word-of-mouth during meetings, cell phones, and the internet. Moreover, reception of market information implies access to market information, but access to market information does not imply reception of market information. For example, owning a radio or cell phone implies access to, but not reception of market information. Reception of information from any source using any channel and its effects on marketing behavior at household level is the focus of this chapter.

In the 2005 household survey, the following question was asked about market information. *During the last 12 months, has the household received any information about agricultural prices (1=yes, 2= no) through: (1) radio, (2) association, (3) rural extension agent, (4) publication, (5) NGO, and (6) other sources?* Note that (1) there was no distinction between "sources" and "channels" through which information was received in the survey; (2) a household could report receiving information from more than one source or channel; and (3) information received from all the different sources and channels could be from SIMA and other sources, implying that it is difficult to separate information from SIMA and other sources. For example, information from extension agents, NGOs, and associations could be from SIMA or from other sources such as traders. Also, the information diffused though radio, TV and publications could all be from SIMA or other sources.

Table 17 shows that 37 percent of all households reported receiving price information in Mozambique in 2005. Without distinguishing between “sources” and “channels”, 3 percent of all households received information from associations, 7 percent from extension agents, 4 percent from NGOs, 7 percent from other sources, 3 percent from publications such as newspapers and magazines, and 29 percent via radios. Other sources include information from social networks such as neighbors, friends, relatives, and traders, normally through word-of-mouth. Note that the total of “sources” and “channels” of information is 53 percent yet the percentage of households that received information is 37 percent. This is because households could report more than one source or channel through which they received the information.

From observations during the case studies in Mozambique, households in Mozambique receive market information from farmers, farmers’ associations, traders, traders’ associations, rural extension workers, publication, and local and international NGOs. In some cases, this is information originally generated by SIMA.

From observations during the case studies in Mozambique, in addition to radio and publications, other channels through which market information is disseminated include posts on notice boards at administrative headquarters, blackboards in urban markets, and through meetings or contact with provincial extension and NGO workers. The urban markets where information is disseminated are located near district headquarters (i.e., in municipalities). Extension and community meetings are conducted in trading centers, or near areas with commercial activities (e.g., shops and commodity stores), administrative activities (e.g., district or village headquarters), or at community amenities (e.g., at schools and churches). In more rural districts, some community and extension meetings are conducted under large trees near junctions of main and feeder roads.

Because there are many sources and channels through which households can receive information, this study argues that it is better to simply analyze the effects of receiving information from all possible sources (including the market) and using all possible channels on marketing behavior and market performance other than trying to analyze the effects of receiving information from one source (e.g., the MIS or extensions agents) or from one channel (e.g., cell phone or radio). The advantages of this approach are that the analysis avoids (1) the spillover effects problem in terms of different sources of information and (2) the attribution problem in terms of which dissemination channel contributed to better performance than the other.

Table 17: Sources and Channels Used To Receive Price Information in Mozambique in 2005

	Nampula (N=510)		Zambezia (N=603)		Manica (N=392)		Sofala (N=307)		Total (N=1812)	
(0=No, 1=yes)	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Received Information[1]	0.59	0.49	0.27	0.44	0.25	0.43	0.49	0.50	0.37	0.48
Sources										
Association	0.06	0.24	0.01	0.11	0.00	0.06	0.04	0.19	0.03	0.16
Extension agent	0.09	0.28	0.06	0.24	0.03	0.17	0.15	0.35	0.07	0.26
NGO	0.04	0.19	0.06	0.24	0.00	0.00	0.02	0.15	0.04	0.19
Other sources	0.09	0.29	0.06	0.24	0.02	0.14	0.14	0.35	0.07	0.25
Modes/ Channels										
Publication	0.05	0.22	0.03	0.16	0.02	0.16	0.05	0.21	0.03	0.18
Radio	0.51	0.50	0.18	0.39	0.22	0.41	0.36	0.48	0.29	0.45

Source: *Trabalho de Inquerito Agricola* 2005 only – not collected in 2002; 1: this variable was collected in 2002 as well but computed for 2005 data only in this table. The percentage of households that received price information for both 2002 and 2005 is 42% and is given in Table 21. The rest of the variables in this table were not collected in 2002.

4.7 Theoretical and Empirical Models of Reception of Market Information and Prices Obtained

The theoretical framework used in the analysis is based on the agricultural household model (Singh, et al., 1986). Let p be a vector of prices; w a vector of input costs (e.g., marketing and search costs through radio and cell phones); q a vector of quantity sold; X a vector of production inputs such as land labor and capital; Z is a vector of control variables that affect prices received (such as market information, proximity to markets, education, and gender, and agro-ecological zones); $F(q, X; Z) = 0$ is the production possibility set, and information helps farmers decide how to use the inputs in the production possibility set—i.e., it helps determine the production function itself; and θ is the Arrow-Pratt measure of risk aversion that captures production related risks (e.g., due to poor weather). Considering the production side of the household and using the mean-variance model to account for price expectations and production- and marketing-related risks, the farmers' maximization problem using a linear function of profits and profit variance is:

$$\max \pi(p, w, Z) = \max_{q, X}\{E(pq - wX) - \theta / 2Var(pq - wX) : F(q, X; Z) = 0\} .$$

The first order conditions with respect to quantity sold, and inputs used are:

$$p_i - \theta q_i \sigma_p^2 - \lambda \frac{\partial F(q, X; Z)}{\partial q_i} = 0$$

$$- w_i - \lambda \frac{\partial F(q, X, Z)}{\partial X_i} = 0 ;$$

where σ_p^2 is the variance of the prices received by farmers and captures price expectations and production related risks. Solving the FOC from the above equation leads to the following inverse function for output supply, and input demands:

(1) Inverse of output supply: $p_i = s(q, w, \sigma_p^2, Z)$

(2) Input demand: $X_i = X(p, w, \sigma_p^2, Z)$

From the model, it is observed that the amount supplied and the input demands are both function of the variance of prices. From the FOC, farmers require a higher price than a higher variance, which implies that input demand is negatively related to the variance of prices. Thus, if farmers receive better market information, the perceived variance of prices decreases, increasing both supply and input demand. At estimation though, since information cannot be incremented because of the difficulty in measuring quantities of information, instead, the probability of reception of information is computed.

4.7.1 Model of Receiving Information and Its Impact on Market Participation

The factors that affect the reception of market information and the effects of reception of market information on market participation are estimated using a recursive bivariate probit model because their error terms are likely to be contemporaneously correlated.

(3) $I_{it} = \Phi(Z_{it}\alpha_1) + \mu_{1it}$

(4) $S_{it} = \Phi(Y_{it}\gamma_1 + \gamma_2 I + \gamma_3 T + \gamma_4 I * T) + \mu_{2it}$

$$E(\mu_{1it}) = E(\mu_{2it}) = 0;\ Var(\mu_{1it}) = Var((\mu_{2it}) = 1; Cov(\mu_{1it}, \mu_{2it}) = \rho$$

In the reduced form equation (3), I_{it} is a binary variable equal to zero when a household did not receive market information and equal to one when it received market information. Φ is the cumulative density function for the standard normal distribution, and α_1 is the vector of estimated parameters for Z_{it} -the vector of exogenous variables that affect reception of market information.

In equation (4), S_{it} is a binary variable equal to one when a household sold maize, large groundnuts, small groundnuts, or common beans, and zero otherwise. Y is a vector of all exogenous variables that affect market participation other than market information, and T is a time dummy. Equation (4) gives the expected probability that a household participates in the market given that it receives market information. Holding other factors constant, the estimated coefficient, γ_2 in equation (4) give the sign of the partial effects of access to different sources of market information on the probability of a household to participate in the market as sellers of any of the four commodities in the study (maize, small groundnuts, large groundnuts and common beans). Of importance are the partial effects $\Delta\hat{P}(S=1|I) \approx [f(\gamma_2 I_i)\Delta I_i]$. Equations (3) and (4) imply that information search and market participation are simultaneous decisions. The strength of this model is that it recognizes that farmers receive information from multiple sources and through multiple channels, and thus does not suffer from spillover effects (in terms of what was the source of information) and attribution problems (in terms of which dissemination channel contributed to better performance than the other) encountered if one attempts to measure reception of information from one source or using one channel as is discussed in section 4.5.14 and in the last paragraph of section 4.6.

4.7.2 Model of Receiving Information and Its Impact on Prices Received

The following structural model is used to measure the impact of market information on prices received.

(5) $$p_{it} = \beta_0 + \beta_1 I + \beta_2 T + \beta_3 I * T + \beta_4 Z_{it} + \nu_{it}$$

where i=1,.., N households; p is the price of maize received; I is a market information dummy, T is a time dummy, and Z_{it} is a vector of control variables (other than access to information) that affect prices received. For policy analysis, and in a pooled cross section over time data structure, the estimated coefficient β_3 on the interaction of year and information dummies is also called the difference-in-difference (DID) estimator (Wooldridge, 2002). The variables in Z_{it} include quantity of maize sold, growing other complementary or supplementary staple crops such as groundnuts and common beans, distance to main roads with public transport, distance or administrative centers (where most markets are located), ownership of a bicycle, education levels, gender, dummies for agro-ecological conditions, availability of a cell phone network in the village, and provincial dummies. Also, Z_{it} contains the total number of drought days during the main growing season and price variance at the district level to capture production related risks, and $\nu_{it} = a_i + \varepsilon_{it}$ is the composite random error term, i.e., the sum of unobservable effects a_i and the idiosyncratic error ε_{it} that affect prices received. Typically, ν_{it} contains the known and unknown effects (e.g., missing variables and unobserved effects) that affect prices received. The assumptions are that a_i

and ε_{it} have a zero expected mean and a constant variance. Before discussing the results, a description of how some econometric concerns were dealt with is given.

4.7.3 Econometric and Statistical Concerns

These econometric concerns address both structural models of market participation and prices received. The information reception and market participation model is conducted on all growers of any of the four staple crops, while the prices received model is conducted for only households that sold maize alone. In Table 20 and Table 21, the sample size for the information reception and market participation is 3624. The reason for including the four crops in the model of reception of market information and market participation was because SIMA disseminates information on these commodities, which can influence a farmer's decision to grow and market any of the four commodities.

The price model can only be conducted for households that participated in the market (i.e., have positive prices and quantities sold). The price model was estimated for only maize because it is the most traded staple crop in Mozambique. Also, from Table 20, this sample could be 924 households that sold maize, 185 that sold large groundnuts, 376 that sold small groundnuts, 97 that sold common beans, and 1275 if one attempted to create "super" variables of prices and quantities sold that includes all households that sold at least one of the four crops. The problem of creating the super variables is that these are different crops with different underlining factors that influence their production. This is therefore not attempted. An alternative approach could have been to estimate a system of 4 equations—one for each crop. This, however, was not done because the data for prices and quantities sold for common beans, large groundnuts, and small groundnuts, as can be seen from the above figures, individually represented smaller samples, which could have led to substantial loss of degrees of freedom if one attempted to conduct a system of equation estimation (i.e., one would end up with only 97 observations). For these reasons, the structural model of prices received is conducted for only maize. Even from the only the 924 households that sold maize, part 3 of Table 20 shows that only 836 households had a positive price and quantity sold. Therefore, the econometric model for prices of maize received in Table 23 is conducted for N=836 households. Imputations for the missing prices and quantities sold are not done to avoid the potential to introduce imputation bias in the estimates.

4.7.3.1 Endogeneity

Endogeneity means that one of the explanatory variables is related to the error term and may be caused by (1) measurement errors (in the dependent and or independent variables); (2) simultaneity, which means that one of the dependent variables is determined together with the independent variable; and (3) omitted variables that are correlated to the included variables (unobserved variables that are time-constant or time-varying). Each of these sources of endogeneity when observed was dealt with as follows.

4.7.3.1.1 Measurement Error in Prices Obtained—a Dependent Variable

The price data was suspected to have measurement errors due to use of non-standardized units of measurements such as modified liter tins (see below for details), in addition to allegedly kilogram bags of varying weights. In many sub-Saharan countries, buyers alter the shape of tins (or containers) by expanding the sides so as to pay a lower per unit cost to sellers. In contrast, sellers contract the sides of tins so as to obtain a higher per unit price from buyers. After examining the stem-and-leaf displays, the histogram, and the results from the *grubbs* procedure in STATA during the analysis of maize prices, 37 observations (4 percent) of households that sold maize were dropped because they were unusually high, which resulted in the following outcomes. Comparing the original and cleaned pooled data on prices of maize received by households in Table 18, the sample mean reduced from 3.1 to 2.8, the sample variance from 5.2 to 1.7, the skewness from 3.8 to 1.1, and the kurtosis from 25.2 to 4.8, representing a 66 percent relative gain in precision and a significant improvement in the distribution of the data towards normality. Normally distributed data has skewness of 0 (perfectly symmetric around the mean) and kurtosis of 3 (flatness of the distribution). Precision is the inverse of the variance of survey estimates; and sample estimates with low sample variances denote high precision. The relative gain in precision (GP) between estimators θ_0 and θ_1 is defined as

$GP = \dfrac{(1/\operatorname{var}(\theta_1)) - (1/\operatorname{var}(\theta_0))}{(1/\operatorname{var}(\theta_1))} * 100 = \left[\dfrac{\operatorname{var}(\theta_0) - (\operatorname{var}(\theta_1)}{\operatorname{var}(\theta_0)}\right] * 100$ (Kish, 1965). For the pooled sample, the relative gain in precision resulting from the reduction in the sample after removing outliers is computed as $gp = \left[1 - \dfrac{s_1^2 n_0}{s_0^2 n_1}\right] * 100$; where s_0^2 and s_1^2 are the pooled sample variances of prices received before and after correcting for measurement errors; and n_0 and n_1 are the sample observations before and after correcting for measurement errors respectively. From a survey sampling point of view, trading off 4 percent of the sample observations for movement towards normality and a 66 percent relative gain in precision is an excellent way of dealing with non-sampling errors. Thus, the simple action of removing 37 observations parsimoniously addresses most of the problem of measurement errors in the maize price data.

The stem-and-leaf displays, the histogram, and the *grubbs* procedure in STATA did not support or identify small prices as outliers. Indeed, it was observed that as one removed the largest prices, the data converged towards a symmetric bell-shape (i.e., less skewness and less kurtosis), yet as one removed the smaller prices, the data would move away from normality—i.e., the kurtosis and skewness become absolutely larger. Therefore, there was no justification to remove small observed prices since they did not, in absolute terms, increase the skewness and kurtosis of the data as the big prices did.

Table 18: Weighted Summary Statistics of Original, Cleaned, and Deleted Maize Prices Received in Nampula, Zambezia, Manica, and Sofala Provinces in Mozambique

Maize prices	n	min	p25	p50	p75	max	mean	sd	var	skew	kurt
Original Price	873	0.10	1.98	2.72	3.45	23.47	3.10	2.27	5.16	3.77	25.17
Cleaned Price	836	0.10	1.96	2.64	3.34	8.00	2.76	1.30	1.69	1.06	4.79
Deleted Price	37	8.16	9.00	10.12	11.99	23.47	11.78	3.96	15.70	1.76	5.23

Table 19: Test of Difference in Mean Prices between Households Disaggregated by Information, Years, and Units of Measurements in Nampula, Zambezia, Manica, and Sofala Provinces in Mozambique

Disaggregation Variable	Without Information, 2002, or Liter Tins			With Information, 2005, or Kilo Bags			Difference Between Groups[1]	
Part 1: Original Price	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Diff.	P>|t|
Information (No=0, Yes=1)	451	3.04	2.37	422	3.18	2.15	0.14	0.43
Year (2002=0, 2005=1)	452	2.79	2.19	421	3.43	2.31	0.64	0.01
Measurements units (0=liters tins, 1=kg bags)	294	2.78	1.97	579	3.26	2.39	0.48	0.01
Part 2: Cleaned Price	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Diff.	P>|t|
Information (No=0, Yes=1)	431	2.66	1.34	405	2.87	1.25	0.21	0.03
Year (2002=0, 2005=1)	438	2.51	1.01	398	3.03	1.51	0.52	0.00
Measurements units (0=liters tins, 1=kg bags)	283	2.51	1.02	553	2.89	1.40	0.37	0.00
Part 3: Deleted Price[2]	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Diff.	Pr(|T| > |t|)
Information (No=0, Yes=1)	20	12.07	3.90	17	11.02	3.70	1.05	0.407
Year (2002=0, 2005=1)	14	13.59	4.80	23	10.37	2.41	3.22	0.010
Measurements units (0=liters tins, 1=kg bags)	11	12.03	4.23	26	11.40	3.66	0.63	0.649

1: P>|t| is the two-tailed significance probability under the null hypothesis that the means by the disaggregation variables are equal. 2: The summary statistics and t-tests on deleted data in part 3 do not use weights because of single observations in some strata which would not allow estimation of standard errors, and consequently the test of differences in means using the method used in part 1 and 2.

The use of liter tins (e.g., 20, 10, and 5 liter tins) as units of measurement is likely to bias prices systematically, as the buyers tend to overfill the tins, and the conversion factors do not adequately capture that overfilling. Part 3 of Table 19 shows that the deleted observations were evenly distributed between households without information (20) and those with information (17). Fewer households were deleted in 2002 (14) compared to 2005 (23); and fewer households that used liter tins as units of measurements (11) were deleted compared to those that used kilogram bags as units of measurements (26). Part 3 of Table 19 also shows that the means of the deleted prices are not significantly different when disaggregated by reception of information and units of measurements, suggesting that their deletion does not systematically bias the remaining clean sample in terms of reception of information or units of measurements. Another assumption is that if there is any bias in prices due to errors in conversion factors, then this error is randomly distributed among all farmers who quoted prices using tins of different capacity.

In the econometric analysis, maize prices received are used as a dependent variable and a second assumption is that any remaining measurement errors in dependent variables do not violate any of the OLS assumptions (Greene, 2003, Pindyck and Rubinfeld, 1998, Wooldridge, 2002). Thirdly, the price variable is transformed by taking its natural logarithm. Taking logarithms of continuous variables stabilizes the variance and hence reduces the effect of outliers (some of which result from measurement errors). Also, when measurement errors are present (in addition to heteroskedastic errors), the use of robust regression produces more efficient estimates than OLS.

4.7.3.1.2 Simultaneity

Using a Hausman simultaneity test, information reception was found to be endogenous with market participation, but not with prices received. The test involved estimating a linear probability model of information reception, and obtaining the residuals. The residuals and the dummy variable for reception of information were included in the structural probit model of market participation, and in the OLS structural model of prices received. Using a t-test, the residuals were found to be significantly different from zero at a one percent level of significance in the structural model of market participation, confirming simultaneity between reception of market information and market participation. Additionally, using a t-test, the residuals were not significantly different from zero at a five percent level of significance in the structural model of prices received, confirming that there was no simultaneity between reception of market information and prices received. Endogeneity of reception of market information and market participation is solved by estimating a recursive bivariate probit of reception of market information and market participation.

Could the factors that affect growing any of the four staple crops in this analysis be the same factors that affect reception of market information? We argue that the answer to this question is no for two reasons. First, farmers can receive information whether they chose to search for it or not because they naturally belong to networks in which some information flows—i.e., they voluntarily and involuntarily receive market information. Secondly, many farmers in Northern Mozambique have grown and sold these 4 staple food crops before improved market information started to be provided, although improved information makes them alter their production and marketing decisions.

4.7.3.1.3 Omitted Variables Bias

The price model is also estimated using a fixed effects model. The use of a fixed effects model deals with endogeneity caused by some of the missing variables (e.g., time-constant unobserved effects). In all the models, any unknown or unobserved time-varying independent variables are assumed to be randomly distributed in the sample and left in the error term.

4.7.3.2 Identification

Exclusion restrictions require that there be some overlap of statistically significant exogenous variables in the structural and reduced equations. The structural equation of market participation is identified because the dummy variables for growing maize, cell phone network in the village, the household having received extension services, and the household being located in low-medium agro-ecological zones are excluded in the model of market participation but included in the equation of information reception. The equation of reception of market information is identified because the natural logarithm of distance to district headquarters and the number of drought days during the main growing season at the district level are excluded in the equation of reception of market information but included in the market participation equation.

4.7.3.3 Attrition Bias

The attrition rates between the two surveys in the four provinces covered by this study were 16 percent in Nampula, 17 percent in Zambezia, 18 percent in Manica, and 26 percent in Sofala (Mather, et al., 2008). Overall, 17 percent of the households in the TIA were not re-interviewed in 2005 due to sample attrition. Eighty-three percent of the attrition was due to 4 reasons: (1) households moved away (48.4 percent), (2) members were not available at the time of the interview (16.1 percent), (3) the household was not found in the household listing of the enumeration area (9.9 percent), and (4) death of the household head resulted in household dissolution (8.4 percent) (Mather, et al., 2008). All panel data estimates are made using sampling weights corrected to attrition bias computed by Mather and Donovan using Inverse Probability Weights (Mather and Donovan, 2008).

4.7.3.4 Multi-colinearity and Heteroscedasticity

Variables suspected to be collinear were detected by examining the Pearson correlation matrix and by the variance inflation factors (vif) procedure in STATA. The interaction terms between different sets of regions and crops were tried and dropped because they introduced multi-colinearity and were not significant. Using the Breusch-Pagan test, heteroskedasticity was detected in the linear probability model of reception of information and in the OLS of prices received model; thus, robust standard errors were used.

4.7.3.5 Transformation of Continuous Variables

Some continuous variables were transformed in order to improve on the normality of the data and to stabilize potential outliers. This was done after inspecting the stem-and-leaf plots, kurtosis, skewness, and the probability density functions of the data. In four variables (distance to nearest road with public transport, distance to village administrative post, value of total farm assets, and number of dry days in the main growing season), the missing values generated due to taking natural logarithms of values with zero were replaced with zeros after the transformation. This was because the natural logarithm of zero is undefined and yet zero is a valid observed outcome. So implicitly, original observations of zero were replaced with observations of one, as the natural logarithm of one is zero, therefore slightly biasing the observations upwards.

4.7.3.6 Rural Price Inflators

The 2002 prices were adjusted to 2005 *Meticais da Nova Familia* (MTN – the currency of Mozambique), based on rural price deflators and not the Consumer Price Index because the CPI is constructed using consumer prices from only three towns consisting of Maputo, Beira and Nampula (Mather, et al., 2008). The consumer prices in towns are different from prices received by rural households in Mozambique. The rural price deflators were derived from the consumption baskets identified by the national Household Budget and Expenditure Surveys (Inquérito dos Agregados Familiares -IAF), and prices from the national agricultural market information system (Sistema de Informação de Mercados Agrícolas, SIMA) (Mather and Donovan, 2008).

4.7.3.7 Heterogeneous Effects

It is sometimes necessary to conduct post-stratification and analysis of the data according to some variables of interest (e.g., different administrative regions, agro-ecological zones, or production potential) and to come up with different estimates to account for heterogeneity between strata. When well done, post-stratification increases efficiency of sample estimates. This is not done in this study because analysis is conducted in internally homogeneous strata, where the stratification variable of interest is the high production potential of the four provinces.

4.8 Descriptive and Econometric Analysis of Factors that Affect Reception of Market Information

Table 20 shows the summary statistics of the factors hypothesized to affect reception of improved market information and market participation computed from the pooled data of the 2002 and 2005 TIA surveys for four provinces in Mozambique. The descriptive statistics are discussed concurrently with the econometric results in Table 21. Table 21 show results from a recursive bivariate probit estimation of receiving market information (hhinfo) and market participation (mp) together with the marginal effects after the biprobit. Table 21 includes a column on the hypothesized effects of the control variables on reception of market information, and the estimated coefficients and their standard errors in parentheses. The strength of this estimation method is that it (1) uses Full Information Maximum Likelihood (FIML), which leads to gain in asymptotic efficiency, (2) solves the endogeneity problem of information reception and market participation, (3) gives robust errors and thus accounts for heteroskedasticity in the error terms, (4) accounts for the sampling design used to collect the data, (5) accounts for the panel structure of the data, and (6) corrects for attrition bias if there is any because it uses the attrition bias corrected weights.

The coefficient correlation, ρ between the errors from the two equations is -.53 and the Wald test indicates that it is significantly different from zero at a 0.1 percent level of significance, implying that probabilities of reception of market information and market participation are dependent on each other (mutually dependent) and that estimating the two equations jointly is satisfactory. The econometric model for reception of information correctly predicts “with information” and “without information” 67 percent of the time. The model of market participation correctly predicts “participated in the market” and “did not participate in the market” 66 percent of the time.

Table 20:Summary Statistics of Market Participation and Access to Market Information in Nampula, Zambezia, Manica, and Sofala in Mozambique in 2002 and 2005

Variable Labels, Names Units, and Types of Variables	Without Information		With Information		Pooled sample		
	Obs	Mean	Obs	Mean	Obs	Mean	Std. Dev.
Part 1: Access to Market Information Variables							
HH grew maize (Yes=1, No=0)	2122	0.68	1502	0.76	3624	0.71	0.45
HH grew large groundnuts(Yes=1, No=0)	2122	0.11	1502	0.20	3624	0.15	0.36
HH grew small groundnuts (Yes=1, No=0)	2122	0.26	1502	0.39	3624	0.32	0.47
HH grew beans-common (Yes=1, No=0)	2122	0.06	1502	0.07	3624	0.07	0.25
HH grew at least one of the 4 crops (Yes=1, No=0)	2122	0.78	1502	0.91	3624	0.84	0.37
HH has a radio (Yes=1, No=0)	2122	0.43	1502	0.64	3624	0.52	0.50
Electricity within village (Yes=1, No=0)	2122	0.12	1502	0.17	3624	0.14	0.35
Cell phone network within the village (Yes=1, No=0)	2122	0.17	1502	0.18	3624	0.18	0.38
HH owns bicycle (Yes=1, No=0)	2122	0.29	1502	0.33	3624	0.31	0.46
Distance to nearest road with public transport (Km)	2122	31.97	1502	32.57	3624	32.22	33.19
Distance to village administrative post (Km)	2122	19.99	1502	17.74	3624	19.04	20.17
Distance to district headquarters (Km)	2122	44.38	1502	41.23	3624	43.05	26.90
HH belongs to an association (Yes=1, No=0)	2122	0.03	1502	0.08	3624	0.05	0.22
HH received extension (Yes=1, No=0)	2122	0.07	1502	0.25	3624	0.15	0.35
Female heads HH (Yes=1, No=0)	2122	0.26	1502	0.17	3624	0.22	0.42
Age of HH head	2122	42.17	1502	40.48	3624	41.45	14.09
Household size	2122	4.92	1502	5.16	3624	5.02	2.56
HH members between 15 and 59	2122	2.35	1502	2.48	3624	2.41	1.26
Years of education of HH head	2122	1.94	1502	2.50	3624	2.18	2.41
No formal education (Yes=1, No=0)	2122	0.49	1502	0.36	3624	0.44	0.50
0- 4 years of formal education (Yes=1, No=0)	2122	0.36	1502	0.44	3624	0.39	0.49
5+ years of formal education (Yes=1, No=0)	2122	0.14	1502	0.20	3624	0.17	0.37

Table continued on next page

Table 20 (continued)

Variable Labels, Names Units, and Types of Variables	Without Information		With Information		Pooled sample		
	Obs	Mean	Obs	Mean	Obs	Mean	Std. Dev.
Total land area (hectares)	2122	1.66	1502	1.99	3624	1.80	1.72
Value of total farm assets (05 meticais)	2122	1125	1502	1934	3624	1468	6439
HH in Nampula province (Yes=1, No=0)	2122	0.25	1502	0.56	3624	0.38	0.49
HH in Zambezia province (Yes=1, No=0)	2122	0.54	1502	0.23	3624	0.41	0.49
HH in Manica province (Yes=1, No=0)	2122	0.12	1502	0.12	3624	0.12	0.32
HH in Sofala province (Yes=1, No=0)	2122	0.10	1502	0.09	3624	0.10	0.29
HH in Low Agro ecological Zone (Yes=1, No=0)	2122	0.12	1502	0.06	3624	0.10	0.30
HH in Low to Medium Agro ecological Zone (Y=1, N=0)	2122	0.52	1502	0.53	3624	0.52	0.50
HH in Medium to High Agro ecological Zone (Y=1, N=0)	2122	0.36	1502	0.41	3624	0.38	0.49
Drought days in main growing season	2122	29.98	1502	23.63	3624	27.30	20.69
Time dummy (2002=0, 2005=1)	2122	0.51	1502	0.48	3624	0.50	0.50
Part 2: Market Participation[1]							
HH sold maize (Yes=1, No=0)	1559	0.33	1198	0.34	2757	0.34	0.47
HH sold large groundnuts(Yes=1, No=0)	284	0.30	316	0.32	600	0.31	0.46
HH sold small groundnuts (Yes=1, No=0)	581	0.27	551	0.39	1132	0.33	0.47
HH sold beans-common (Yes=1, No=0)	203	0.29	163	0.24	366	0.27	0.44
HH sold at least one crop (mp)	2122	0.31	1502	0.41	3624	0.35	0.48
Part 3: Maize Price and Quantity Variables[2]							
Quantity of maize produced (kg)	431	562	405	694	836	623.85	944
Season 1 area under corn (he)	431	0.75	405	0.83	836	0.79	0.88
Quantity of maize sold (kg)	431	164	405	269	836	214	520
HH-specific sale price of maize in 2005 meticais[3]	431	2.66	405	2.87	836	2.76	1.30
Units of measurements (0=liters tins, 1=kg bags)	431	0.64	405	0.70	836	0.67	0.47

Source: TIA 02 and TIA 05; 1: Percentages out of total households that grew crops; 2 Variables here cover only households that sold a positive quantity of maize; 3 in 2005, 1 dollar = 23.061 Meticais.

Table 21: Estimated Parameters and Robust Standard Errors in Parentheses from the Recursive Bivariate Probit Model of Reception of Market Information and Market Participation

	Hypothesized Effect on hhinfo[1]	Bivariate Probit		Marginal effects after biprobit (dy/dx)[2]		Mean
VARIABLES		hhinfo	mp[3]	hhinfo	mp	X
HH[4] received market information			0.9369***		0.342	0.42
			(0.190)			
HH grew maize	+	0.3050***		0.117***		0.71
		(0.073)		(0.027)		
HH grew large groundnuts	+	0.3927***	0.2917***	0.155***	0.111	0.15
		(0.071)	(0.081)	(0.0280		
HH grew small groundnuts	+	0.3342***	0.3201***	0.131***	0.120	0.32
		(0.057)	(0.073)	(0.022)		
HH grew beans-common	+	-0.0034	0.5222***	-0.001	0.203	0.07
		(0.096)	(0.097)	(0.038)		
HH has a radio	+	0.4244***	-0.1018	0.164***	-0.037	0.52
		(0.061)	(0.069)	(0.023)		
Cell phone Network in the Village	+	0.2336**		0.092**		0.14
		(0.090)		(0.036)		
Electricity in the Village	+	0.0562	-0.1914*	0.022	-0.068	0.18
		(0.080)	(0.080)	(0.032)		
HH owns bicycle	+	-0.0857	0.0708	-0.033	0.026	0.31
		(0.064)	(0.063)	(0.025)		
Log of distance to nearest road with public transport (KM)	-	0.0914***	0.0518	0.036***	0.019	2.87
		(0.025)	(0.027)	(0.010)		
Log of distance to village administrative post	-	-0.0987***	-0.0067	-0.038***	-0.002	2.43
		(0.028)	(0.028)	(0.011)		

Table continued on next page

Table 21 (Continued)

	Hypothesized Effect on hhinfo	Bivariate Probit		Marginal effects after biprobit (dy/dx)		Mean
VARIABLES		hhinfo	mp	hhinfo	mp	X
HH belongs to an association	+	0.2646*	-0.1394	0.105*	-0.050	0.05
		(0.126)	(0.123)	(0.050)		
HH received extension	+	0.7457***		0.290***		0.15
		(0.077)		(0.028)		
Female heads HH	-	-0.1074	-0.0252	-0.042	-0.009	0.22
		(0.070)	(0.070)	(0.027)		
Log of HH size	+	-0.0425	-0.0666	-0.017	-0.024	1.48
		(0.052)	(0.053)	(0.020)		
Age of HH head	+	0.0161	-0.0210*	0.006	-0.008	41.45
		(0.010)	(0.009)	(0.004)		
Age of HH head squared	+	-0.0002*	0.0002*	0.000*	0.000	1917
		(0.000)	(0.000)	(0.000)		
Head had 1 to 4 years of formal education (Yes=1, No=0)	+	0.1256*	-0.0910	0.049*	-0.033	0.39
		(0.061)	(0.059)	(0.024)		
Head had at least 5 years of formal education (Yes=1, No=0)	+	0.1299	-0.2545**	0.051	-0.090	0.17
		(0.083)	(0.083)	(0.033)		
Log of total land area	+	0.0454	0.1233**	0.018	0.045	0.30
		(0.039)	(0.038)	(0.015)		
Log of value of total farm assets	+	-0.0018	0.0528***	-0.001	0.019	5.50
		(0.014)	(0.014)	(0.006)		
HH in Manica province (Yes=1, No=0)	-	-0.0808	0.2142	-0.031	0.081	0.12
		(0.084)	(0.138)	(0.032)		
HH in Sofala province (Yes=1, No=0)	-	-0.1132	-0.2396*	-0.044	-0.084	0.10
		(0.073)	(0.097)	(0.028)		

Table continued on next page

Table 21 (Continued)

	Hypothesized Effect on hhinfo	Bivariate Probit		Marginal effects after biprobit (dy/dx)		Mean
VARIABLES		hhinfo	mp	hhinfo	mp	X
HH in low-medium agro-ecological zone (Yes=1, No=0)	+	0.4984***		0.192***		0.52
		(0.088)		(0.033)		
HH in medium-high agro-ecological zone (Yes=1, No=0)	+	0.5393***	0.1546*	0.210***	0.057	0.38
		(0.090)	(0.061)	(0.035)		
Year Dummy (2005=1, 2002=0)	+	-0.0902	0.2448***	-0.035	0.090	0.50
		(0.058)	(0.073)	(0.023)		
Log of dist. to district headquarters	-		0.1016*		0.037	3.50
			(0.040)			
HH in Zambezia province (Yes=1, No=0)	-		0.0663		0.024	0.41
			(0.069)			
Drought Days in main growing season	-		-0.0076***		-0.003	27.30
			(0.002)			
Constant		-1.5928***	-1.0441***			
		(0.255)	(0.256)			
athrho			-0.5916***			
			(0.163)			
rho[5]			-.5311***			
			(.117)			
Observations		3624	3624			
Percent correctly predicted		67	66			

+ Positively associated, - Negatively associated with hhinfo; 1. hhinfo=household received market information; 2. dy/dx is for discrete change of dummy variable from 0 to 1; 3. mp= market participation; 4. HH=household; *** $p<0.001$, ** $p<0.01$, * $p<0.05$; 5. Wald test of rho=0: chi2 (1) = 13.1612, Prob > chi2 = 0.0003.

4.8.1 Staple Crops Grown

From Table 20, in the four provinces covered by the study, 71 percent of households grew maize, 15 percent grew large groundnuts, 32 percent grew small groundnuts, and 7 percent grew common beans. Overall, 84 percent of the households grew at least one of the four commodities in the study. From the econometric analysis in Table 21, growing maize, growing large groundnuts and small groundnuts significantly increased the probability of receiving information at a 0.1 percent level of significance. The expected marginal effect resulting from growing maize on the probability of receiving market information is 0.12, while that of growing large groundnuts is .16, and that of growing small groundnuts is .13.

4.8.2 Ownership of a Radio

Table 20 shows that 52 percent of households in the 4 provinces in Mozambique own a radio. In the econometric results in Table 21, owning a radio significantly increases the probability of receiving market information at the 0.1 percent level of significance. The expected marginal effect resulting from having a radio, holding other factors constant, to reception of market information is 0.16. To triangulate this information, during field visits in Nampula Province, farmers reported radio as the main channel through which they receive market information. From interviews with farmer groups in Nampula province, 5 out of 14 farmers interviewed had a radio.

4.8.3 Presence of a Cell Phone Network

In the 4 provinces under study, 18 percent of households had a cell phone network in their village from the 2002 and 2005 panel data. Availability of a cell phone network in the village increased the probability of information reception at a one percent level of significance. From the econometric analysis in Table 21, the expected marginal effect of availability of a cell phone network, *ceteris paribus*, on the probability of receiving market information is 0.09. An alternative variable would have been ownership of a cell phone, but these data were not collected in either round in the household surveys. To the extent that those who own cell phones share information with neighbors, either directly or through their actions in the market that affect other actors' behavior, the presence of mobile telephone network might actually be a better variable, as it picks up some of the spillover effects.

According to World Bank figures, the number of cell phone subscribers in Mozambique increased from 0 per 100 people in 1998 to 20 per 100 people in 2008. It is highly likely that these data are skewed in such a way that the density of cell phone networks is more near urban areas compared to distant villages. From interviews with farmer groups in Nampula, where the researcher conducted a field visit, 1 out of the 7 farmers interviewed had a cell phone. Smallholder farmers and small-scale traders who do not have cell phones can buy air time and use a friend's telephone to call other traders to ask about availability and prices of commodities in production areas and in other markets. Although not included in the econometric analysis, it is worth noting that the number of internet subscribers increased from 0 per 100 inhabitants in 1998 to approximately 2 per 100 inhabitants in 2008. On a few occasions, the internet is used as a transmission channel of market information from the SIMAP in Nampula province to the SIMA headquarters in Maputo, and the internet is a common way for SIMA to communicate information to NGOs, public sector, and others for diffusion. But presumably, few if any farmers received, or are directly receiving information from the internet. To the extent that internet has an effect on farmers' reception or access to information, it would be felt through greater information available through other channels, such as radio (as the radio stations might now get more information via the internet and then broadcast it to farmers.)

4.8.4 Availability of Electricity

In the 4 provinces under study in Mozambique, 14 percent of households have electricity in their villages. Electricity is a complementary good with nearly all ICT equipment such as TVs, radios, computers, and cell phones. Holding other factors constant, the hypothesis that households in areas with electricity can use more ICT gadgets, and therefore have a higher probability of receiving market information than those without electricity was positive but not statistically significant at a 5 percent level of significance. It was observed during the field visit in Murupula District in Nampula Province that farmers use old car and motorcycle batteries as an alternative source of electricity to power their radios and televisions in rural areas, and to charge cell phones. They also use dry cell batteries for their radios, although some complained that their cost of 30 meticais ($1.07 using the 2009 exchange rate) in 2009 per pair was high. These alternative sources of electricity could have reduced the effect of having electricity in the village on information reception.

4.8.5 Ownership of Means of Transport and Access to Roads and Public Amenities

In the four provinces under study in Mozambique, 31 percent of households own a bicycle, and the average distance to the nearest road with public transport is 32 kilometers. The average distance to the village administrative post is 19 kilometers, and the average distance to the district headquarters is 43 kilometers. From the econometric analysis in Table 21, an increase in the natural logarithm of the distance to the nearest road in kilometers significantly increases the probability of receiving market information at a 0.1 percent level of significance, rejecting the null hypothesis that households closer to the roads with public transport are more likely to receive market information. The expected marginal effect resulting from a unit increase in the natural logarithm of the distance to the nearest road with public transport on the probability of receiving market information is 0.04. It was hypothesized that a good road network brings in more agricultural commodity traders who are a source of market information, although some farmers in Mozambique do not trust information from traders. Thus, farmers near roads with public transport, it was assumed, would be more likely to receive market information, in addition to obtaining higher prices for their agricultural commodities than those who are not. The possible reasons for this unexpected outcome could be that distant farmers put in more search to avoid the risks and higher costs of delivering produce to markets when prices are not favorable compared to farmers near roads with public transport. In addition, in areas where markets are more competitive, farmers may rely on the market itself as their "information source", although they probably not report this as a source of market information. The idea here is that the behavior of markets themselves transmits information about supply and demand conditions, and if markets are working well, they are efficient transmitters of this information, making MIS less needed.

In the field study interviews in Murupula District in Nampula province in Mozambique, some farmers and traders reported not being able to afford to transport their produce to markets in which the MIS announces higher prices. This is partly because the transport costs are high and partly because of the low marketed surplus that cannot fetch high enough revenues to cover transport and other marketing costs. Promotion of group marketing may enable farmers to sell in bulk, and thus afford transporting produce to markets in which the MIS reports higher prices.

From Table 21, holding other factors constant, an increase in the natural logarithm of distance to village administrative post significantly decreases the probability of receiving market information at a 0.1 percent level of significance, which is logical. The expected marginal effect resulting from a change in the natural logarithm of the distance to the nearest village administrative post by one unit, on the probability of receiving market information is -0.04. In Mozambique, market information is also disseminated at administrative headquarters (e.g., on blackboards and notice boards in markets and district or provincial headquarters), implying that as households move further from these locations, their probability of getting information, and other services declines. The policy implication is that reception of market information could be improved if the government moved services closer to the people by increasing decentralization of information systems.

4.8.6 Belonging to Farmer Associations

In the provinces under study, only 5 percent of households belong to an association. Membership to farmers' associations increases the probability of receiving market information and is significant at a 5 percent level of significance. From the econometric analysis in Table 21, the expected partial effect of belonging to a farmer association, *ceteris paribus*, on the probability of receiving market information is 0.11. In Mozambique, many international NGOs such as ADRA in Zambezia, CLUSA and CARE in Nampula, and national and local NGOs and organizations such as FELICIDADE, IKURU, and OLIPA distribute the SIMA and SIMAP information bulletins in addition to their own bulletins to farmers through farmer associations. Some smallholder farmers in Murrupula are organized in farmer associations and jointly market maize sometimes. Some farmer groups are legally registered and others are not. Registered farmer associations usually have bank accounts and can sell to World Food Programme (WFP)'s Purchase for Progress (P4P) program, and theoretically earn more money and minimize price risks.

It is not clear what percentages of poorer farmers in Mozambique have a high voice and are active participants in farmer association's activities that can make them benefit from increased reception of market information as are less-poor farmers. During field study visits in Nampula province in Northern Mozambique, it was noted that there were two types of farmer groups or associations as noted in section 4.8.6: The registered and the unregistered associations. It could be observed that farmers in registered and unregistered groups had different sets of characteristics that could affect their ability to receive and act on improved market information. For example, the unregistered farmer association had: no bank account, more female members, less literate members as noted in section 4.8.10, less members with cell phones, less contact with intermediate traders and NGO as described in 4.8.6, sold less quantities of different staples, mostly marketed individually (because they sold different staples at different times), and reported not to use storage facilities even when they were available in the village. In contrast, members of the registered farmer group had: a bank account, more males members, they could all speak and write Portuguese (higher literacy levels), all had cell phones, amalgamated same products (mostly maize and pulse) and sold it as a group to local NGOs and WFP's P4P, and had the keys to- and used the village store. So it seems that if improved information is given to these two types of farmer groups, the registered farmer groups are likely to act on new information and benefit more than the unregistered group members.

4.8.7 Access to Extension Services

In some provinces in Mozambique such as Nampula, market information bulletins are given to the extension unit for dissemination through radio or through meetings. In addition, many national and international NGOs provide advisory services to farmers including market information. In the provinces under study, 15 percent of households received extension services in the 2002 and 2005 pooled data. From the econometric analysis, access to extension services increases the probability of receiving market information and is significant at a 0.1 percent level of significance. The expected partial effect of receiving extension services, holding all other factors constant, on the probability of receiving market information is 0.3. Extension has the largest partial effect in the study, suggesting that improvements in extension services can lead to more information reception among small-scale farmers (assuming causality), or that there have been more investments in MIS where extension investments also occur (complementarily of MIS with other services).

4.8.8 Gender of Household Head

In the 4 provinces under study, 22 percent of households are headed by females, and a household having a female head reduces the probability of reception of market information, although the decline in probability was not statistically significant at a 5 percent level of significance. Household activities impede the capacity of female household heads to obtain market information from sources away from home, such as association and community meetings where market information is disseminated by NGO employees and extension workers. It may be argued, however, that females usually have many domestic activities, which compels them to stay at home near radios compared to males. Prolonged staying at home among female household heads can potentially increase their probability of listening to market information from radio compared to male household heads who work away from home (unless they travel with radios, such as drivers of vehicles with radios).

4.8.9 Family Size and Age of Household Head

The average family size is 5 members, the average age of the household head is 41 years, and the average number of household members between ages 19 and 59 years is 2.4. From the econometric analysis in Table 21, the hypothesis that larger family sizes may be positively associated with larger social networks and therefore increase the probability of receiving market information was rejected at a 5 percent level of significance. From the econometric analysis in Table 21, the hypothesis that reception of information increases with age was not significant at a 5 percent level of significance, but had a positive coefficient. The squared term of age of household head, however, was negative and significant at a 5 percent level of significance. This implies that as the age of the household head increases, the probability of receiving market information also increases and reaches a maximum value at the age of 40 years after which an additional year starts to reduce the probability of receiving market information.

4.8.10 Education and Literacy Level of Household Head

Table 20 shows that the average years at school of the household heads are 2.2. Household heads with no formal education represent 44 percent of household heads in the sample, those with 1 to 4 years of formal education are 39 percent, and those with more than five years of formal education are 17 percent. According to the World Bank World Development Indicators, the literacy rate in 2008 among adults aged 15 years and above was 54 percent.

From the econometric analysis in Table 21, the household head receiving one to four years of education increases the probability of reception of market information at a 5 percent level of significance compared to a household head having no formal education. The expected marginal effect of a household head receiving between one to four years of education, holding other factors constant, on reception of market information is 0.05. This means that households with between one to four years of education and literacy are likely to receive market information than those with a no level of education and literacy. Having 5 or more years of formal education did not increase probability of receiving market information significantly above that of those having no education. It is likely that household heads with more than five years of formal education engage in other non-farm activities or employment and participate in markets as net buyers of food—a group that this study did not analyze due to lack of data on net staple crop food purchases.

Some farmers and traders do not speak and read Portuguese, the official language in which some of the market information is commonly disseminated, although there are some radio broadcasts in local languages. In the case-study interviews, only one out of nine farmers could speak and read Portuguese in one group, and all farmers could speak and read Portuguese in another group of four.

The education levels in some parts of Mozambique and in some age brackets are low because of the civil war, which went on for an extended period of time, disrupting schooling for many people. Although SIMAP in Nampula province uses mostly radio broadcasts in local languages, implying that farmers do not need to read and write Portuguese to listen to market information broadcast on radio, several other channels through which information is diffused need some minimum level of literacy to understand. Formal education and literacy[5] and the use of market information are complementary goods for some diffusion channels. For example, there is some minimum level of education required to read and understand information diffused through newspapers and emails, or to listen to information broadcasts in Portuguese. Even information diffused through SMS and through a scroll bar below a TV screen needs some minimum level of education and or literacy to utilize. For that reason, programs for farmer organizations, such as CLUSA, include literacy and numeracy training in their efforts.

4.8.11 Size of Land Holdings and Farm Assets

The demand for information depends on levels of production, which also depend on factor inputs such as size of land holdings or cultivated area, and farm assets. In the four provinces under study, the average value of total farm assets is 1,468 meticais (64 dollars using the 2005 exchange rate), and the average size of household land is 1.8 hectares. In

[5] Some people may be literate without formal education. So it is possible that some household heads with no level of education are literate and can access and use printed market information.

the econometric analysis in Table 21, the natural logarithm of total land area is positively associated, but does not significantly influence, reception of market information at a 5 percent level of significance. The natural logarithm of the value of total farm assets is negatively associated and does not significantly affect reception of market information at 5 percent level of significance. Variables for land cultivated under maize, beans and groundnuts were not used because they individually represented a smaller sample, which led to loss of degrees of freedom.

4.8.12 Geographical and Administrative Setting

Some provinces have relatively developed infrastructure such as markets, bridges, and administrative facilities, implying that services such as transport, markets, and extension are closer to farmers and traders in some provinces than others. Proximity to some of these services increases the probability of receiving market information. Overall, 38 percent of households are located in Nampula, 41 percent in Zambezia, 12 percent in Manica, and 10 percent in Sofala. Among households that do not receive information, 25 percent are in Nampula, 54 percent in Zambezia, 12 percent in Manica and 10 percent in Sofala. Among households that receive information, 56 percent are in Nampula, 23 percent in Zambezia, 12 percent in Manica and 9 percent in Sofala. From the econometric analysis in Table 21, a household being located in Manica and Sofala reduces the probability of receiving market information compared to being located in Nampula province, although the relationship is not statistically significant at a 5 percent level of significance. During the period covered by this study, the Ministry of Agriculture Provincial Directorate had a price information system with radio broadcasts that could be heard in parts of Zambezia as well as Nampula. There was no such system at the time in Sofala, and the Manica system functioned intermittently. This could be the reason why being located in Manica or Sofala reduces the probability of receiving market information.

4.8.13 Agro-Ecological Zones

Some areas are located in good agro-ecological zones with high production potential, which increases the demand or market information. Three agro-ecological zones are included in the analysis. From Table 20, they include: (1) the low potential agro-ecological zone, where 10 percent of the households interviewed reside; (2) the low-medium potential agro-ecological zone, with 52 percent of households; and (3) the medium-high potential agro-ecological zone, with 38 percent of households. These agro-ecological dummies are constructed from the new 10 agro-ecological zone classifications by the Institute of Agricultural Research of Mozambique (IIAM) based on agricultural potential taking into account (1) altitude, (2) precipitation, (3) temperature, and (4) soil types as shown in Table 22.

The low potential agro-ecological zone is characterized by 500-800 millimeters of rainfall per annum, temperatures ranging from 20.5 to 32.5 degrees Celsius, and variable soils (including sandy, clay, red and heavy texture, and several medium-heavy texture soils). The low-medium agro-ecological zone is characterized with an altitude between 0 to 200 meters above sea level, between 800 to 1000 millimeters of rainfall per annum, temperatures ranging from 24 – 26 degrees Celsius, and has mostly sandy soils.

The medium-high potential agro-ecological zone has the most diverse agro-ecological conditions. The altitude in some areas ranges from 200-500 meters, 200-1000 meters, and more than 1000 meters above sea level. The rainfall in some areas ranges from 500 to 800 millimeters, between 800 to 1200 millimeters, and above 1200 millimeters per annum. Some areas have temperatures less than 22 degrees Celsius, 20.5 to 32.5 degrees Celsius, 20 to 25 degrees Celsius, and 24 to 26 degrees Celsius. This area has a variety of soil types including clay, red and heavy texture soils, and several medium-heavy texture soils.

Table 22: Agro-Ecological Zones in Nampula, Zambezia, Sofala, and Manica Provinces in Mozambique

AEC Zones	IIAM[1] Classification	Province	Altitude (Meters)	Precipitation (Millimeters)	Temperature (Celsius)	Soils
Low	R6	Manica	-	500-800	20.5-32.5	Variable
Low	R6	Sofala	-	500-800	20.5-32.5	Variable
Low	R6	Zambezia	-	500-800	20.5-32.5	Variable
Low-Medium	R5	Manica	0-200	>800	24-26	Sandy
Low-Medium	R5	Sofala	0-200	>800	24-26	Sandy
Low-Medium	R5	Zambezia	0-200	>800	24-26	Sandy
Low-Medium	R8	Nampula	-	800-1000	25	Sandy
Low-Medium	R8	Zambezia		>800	24-26	Sandy
Medium-High	R10	Manica		>1200		Red and heavy texture
Medium-High	R10	Nampula	>1000	>1200	<22	Clay
Medium-High	R10	Zambezia		>1200		Red and heavy texture
Medium-High	R4	Manica	200-1000	500-800	20.5-32.5	Variable
Medium-High	R4	Sofala	200-1000	500-800	20.5-32.5	Variable
Medium-High	R7	Nampula	200-500	800-1200	20-25	Several medium-heavy texture
Medium-High	R7	Zambezia	200-1000	>800	24-26	Variable

Source (1): Institute of Agricultural Research of Mozambique (IIAM)

In the econometric analysis in Table 21, the dummies for the low-medium potential agro-ecological zone and medium-high potential agro-ecological zone capture differences across agro-ecological zones. These dummies significantly and positively affect the probability of reception of market information at a 0.1 percent level of significance, compared to the probability in the low potential areas. The expected marginal effect of a household being located in the low-medium potential agro-ecological zone, *ceteris paribus*, on the reception of market information compared to a household in the low-potential agro-ecological zone is 0.19, and that of a household being located in the medium-high agro-ecological zone is 0.21. These results are consistent with the theoretical argument that the demand for information is high in areas with high production potential and with a high supply response to market information. Production potential and supply responsiveness should be two main criteria for identifying target crops for market information and areas where market information is diffused (Kizito, 2009).

4.9 Descriptive and Econometric Analysis of Reception of Information on Market Participation

From the pooled sample of part 2 of Table 20, 34 percent of farmers who grow maize participate in the markets as sellers, 31 percent of farmers who grow large groundnuts participate in the market as sellers, 33 percent of farmers who grow small groundnuts participate in the market as sellers, and 27 percent of farmers who grew common beans participate in the market as sellers. All together, 35 percent sell at least one of these 4 main staple commodities. In this study, market participation is defined as a household that sold at least one of these 4 main staples. This definition of market participation is different from some definitions which divide market participation into two or three categories - the net-sellers, net buyers, and autarkic for one or a bunch of commodities (Bellemare and Barrett, 2006, Goetz, 1992, Key, et al., 2000) because data on purchasing behavior of respondents was not collected. The analysis in this section only considered sellers of the four staples. This implies that the effect of reception of market information, as stated in the objectives in section 4.1, is analyzed from seller's standpoint, not the buyer's standpoint.

The econometric results in Table 21 indicate that receiving market information significantly increases market participation at a 0.1 percent level of significance. The expected marginal effect resulting from reception of market information, holding other factors constant, on the probability of market participation is .34 when evaluated at the mean of 42 percent of households that received market information. This is in contrast with a study by Boughton et al., (2007), which finds market information not to significantly affect market participation. Some of the reasons why the results differ are: (1) The Boughton, et al. (2007) study used national data for the whole country while this study used data from the 4 main production provinces that also account for 57 percent of the households in the 10 provinces of Mozambique. (2) This study analyzes reception of information among the 4 main staple crops on which SIMA provides information on unlike the Boughton, et al., (2007) study which included cash crops (cotton and tobacco) on which SIMA does not provide price information about and only one staple crop (maize).

Other factors that significantly increase the probability of market participation, and their expected marginal effects (evaluated at their means) on the probability of market participation and significance levels of the estimated biprobit coefficients in brackets include: growing large groundnuts (.11, p<0.001), growing small groundnuts (.12, p<0.001), growing beans (.2, p<0.001), the natural log of total land area (.05, p<.01), the natural log of value of farm assets (.02,p<0.001), a household being located in medium-high agro-ecological zone (.06,p<0.05), the year dummy (0.09,p<0.001), and the natural log of value of distance to district headquarters (.04,p<0.05).

Factors that significantly reduce the probability of market participation, and their expected marginal effects (evaluated at their means) on the probability of market participation and significance levels of the estimated biprobit coefficients in brackets include: presence of electricity in the village (-0.07, p<0.05), age of household head (-0.01, p<0.05), household head having higher than 5 years of education (-0.09, p<0.01), a household being located in Sofala province (-0.08, p<0.05), and the number of drought days during the main growing season at the district level (-0.003, p < 0.001).

It was anticipated that presence of tapped electricity (public electricity network) in a village would increase market participation since it increases the production stages such as processing in the value chain of commodity subsectors (e.g., milling in case of maize). It is not clear why this variable produced counter-intuitive results.

Holding other factors constant, each additional year of the household head age reduces the probability of market participation, reaching the minimum value at the age 53 years, after which each additional year increases market participation. It was anticipated that as age of household head increases, market participation would also increase, reach a certain age and then start to decline —i.e., that age would be concave. There is no apparent conjecture as to why this variable produced counter intuitive results. As for drought, the intuition is that when there is drought, there is less production and therefore less market participation by households as net-sellers, but probably more participation as net staple crop buyers–again, something that this study was unable to analyze.

4.10 Descriptive and Econometric Analysis of Reception of Information on Prices of Maize Received

4.10.1 Econometric Models Evaluation

This section estimates the effects of reception of information on prices of maize received. Table 23 presents the results. To account for other confounders that may affect prices received, the structural model of prices received is estimated using four estimation methods and five equations: pooled OLS (including both a basic pooled OLS and a more detailed model), a fixed effects model, a random effects model, and robust regression. The basic pooled OLS (restricted model) includes reception of information, a year (time) dummy, and the interaction term between reception of information and the time dummy as the only independent variables. The detailed pooled OLS model is also called the unrestricted model.

The random effects model assumes that the unobserved effects are random and puts them in the error term. The fixed effects model assumes the unobserved effects are correlated with the explanatory variables and is used to eliminate the unobservable fixed effects a_i explained in section 4.7.2. The unobserved effects a_i are eliminated by a fixed effects transformation (within transformation) which involves subtracting the means of treatments from individual observations for all variables. When there are only two time periods, as is the case in this model, fixed effects estimation and first differencing procedure serve the same purpose—to eliminate the unobservable fixed effects a_i—and produce identical estimates and inference (Wooldridge, 2002). Therefore, there was no need to use the first-differencing method in this study.

The estimated coefficients on the interaction of year and information dummies in the restricted (basic) OLS, the unrestricted pooled OLS, and the fixed effects model are also referred to as the difference-in-difference (DID) estimators in program evaluation literature. Keeping everything else constant, these DID estimators measure the impact of the “policy change”—in this case of providing market information on prices received—between households that received information (treatment or experimental group) and those that did not receive information (control group) (Wooldridge, 2002) between 2002 and 2005. These coefficients (DID estimators) were not significant in all the models implying that there was no significant change in prices received by households that received and did not receive market information between 2002 and 2005.

The Hausman's specification test failed to reject the null hypothesis that both the fixed and random effects models are consistent, but that the fixed effects model is more efficient than the random effects model. The alternative hypothesis under the Hausman’s specification test is that fixed effects model is less efficient than the random effects model. These results imply that the fixed effects model would be the model of choice.

Robust regression is used because the price data are suspected to be noisy, being observed household-specific survey data, thus the need to compare results from other regression methods with those obtained from robust regression which is considered to perform better when there are outliers and measurement errors in addition to heteroskedastic errors.

The results from the 5 equations in Table 23 are consistent in several aspects. The estimated coefficients on reception of market information and on those which are significant in all of the models have, in general, the same signs, which indicate consistency of the models. The results obtained using robust regression have similar signs with those obtained using the random effects model (apart from quantity of maize produced). Also, the results obtained using robust regression have similar signs with those obtained using the random effects model and pooled OLS (apart from belonging to an association, and quantity of maize produced), suggesting that measurement errors in the price data are not a major problem.

The fixed effects model produces 4 coefficients with unique changes in signs (household has a radio (+), household received extension (+), female headed household (+), and units of measurements (-)) compared to the other three methods (pooled OLS, random effects, and robust regression). The fixed effects model by design drops all variables that are time-invariant such as distance variables, and provincial and agro-ecological zone dummies.

Overall, the models have weak explanatory power as indicated by the low adjusted R^2s, which are 0.04 for the basic pooled OLS model, 0.10 for the expanded pooled OLS model, 0.14 for the fixed effects model, and 0.11 for the robust regression. This implies that there is still a very large amount of unexplained variance in the data.

Table 23:Regressions of Reception of Market Information on Prices of Maize Received

Variable Name	Basic Pooled OLS	Pooled OLS	Fixed Effects	Random Effects	Robust Regression
(1)	(2)	(3)	(4)	(5)	(6)
HH received market information	0.1440**	0.0702	0.1486	0.1131*	0.1010*
	(0.051)	(0.052)	(0.103)	(0.053)	(0.048)
Variance of district price		0.0284	0.0188	0.0280	0.0472**
		(0.026)	(0.051)	(0.022)	(0.017)
HH grew large groundnuts		-0.0881	-0.2490*	-0.0681	-0.0705
		(0.047)	(0.122)	(0.047)	(0.043)
HH has a radio		-0.0614	0.0341	-0.0366	-0.0481
		(0.044)	(0.089)	(0.042)	(0.037)
Cell phone Network in the Village		0.1238	0.1945	0.0891	0.0580
		(0.068)	(0.113)	(0.060)	(0.057)
HH owns bicycle		0.0773	0.1775*	0.0869*	0.0586
		(0.046)	(0.079)	(0.043)	(0.036)
HH belongs to an association		0.1070	0.0883	-0.0765	-0.0137
		(0.077)	(0.131)	(0.093)	(0.072)
HH received extension		-0.0388	0.0136	-0.0282	-0.0394
		(0.046)	(0.099)	(0.047)	(0.044)
Female heads HH		-0.0476	0.4026*	-0.0434	-0.0383
		(0.054)	(0.205)	(0.060)	(0.047)
Units used (0=liter tins, 1= kilogram bags)		0.0832	-0.0621	0.0711	0.0739
		(0.044)	(0.091)	(0.043)	(0.038)
Log of dist. to nearest road[1] (KM)		-0.0079		-0.0210	-0.0219
		(0.024)		(0.021)	(0.018)
Log of dist. to district headquarters		0.0004		0.0247	0.0206
		(0.029)		(0.029)	(0.024)
HH members between 15 and 59		0.0796	0.1349	0.1004*	0.0552
		(0.051)	(0.139)	(0.049)	(0.038)

Table continued to the next page

Table 23(Continued)

Variable Name	Basic Pooled OLS	Pooled OLS	Fixed Effects	Random Effects	Robust Regression
(1)	(2)	(3)	(4)	(5)	(6)
Head had 1 to 4 years of formal education		0.0847*	0.1105	0.0549	0.0563
		(0.041)	(0.076)	(0.041)	(0.034)
log of quantity of maize produced (kg)		-0.0058	-0.0679	-0.0082	0.0222
		(0.025)	(0.054)	(0.022)	(0.018)
HH in Zambezia province (Yes=1, No=0)		-0.2431***		-0.2603***	-0.2445***
		(0.053)		(0.054)	(0.050)
HH in Manica province (Yes=1, No=0)		-0.1984*		-0.2044*	-0.2168**
		(0.096)		(0.080)	(0.074)
HH in Sofala province (Yes=1, No=0)		-0.2144*		-0.1810*	-0.2296**
		(0.084)		(0.080)	(0.074)
HH in low medium agro-ecological zone		-0.0000		-0.0751	-0.0879
		(0.076)		(0.067)	(0.056)
HH in medium to high agro-ecological zone		0.0124		-0.0587	-0.0556
		(0.080)		(0.063)	(0.053)
Log of drought days in main growing season		-0.0153	-0.0035	-0.0329	-0.0151
		(0.023)	(0.033)	(0.021)	(0.019)
Panel data year dummy	0.1960***	0.1480	0.0205	0.2043**	0.1352*
	(0.057)	(0.087)	(0.143)	(0.079)	(0.060)
Interaction of year and information dummies	-0.0662	-0.0600	-0.1004	-0.0608	-0.0486
	(0.078)	(0.080)	(0.145)	(0.075)	(0.066)
Constant	0.7494***	0.8744***	0.9453**	0.9028***	0.8100***
	(0.037)	(0.190)	(0.292)	(0.172)	(0.146)
Observations	836	833	833	833	833
R-squared	0.04	0.10	0.14		0.11
Adj. R-squared	0.03	0.07	0.12	.	0.09
Number of hhid			654	654	

Robust standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05

4.10.2 Descriptive and Econometric Results of Information on Prices Obtained

From part 3 of Table 20, among households that sell maize, the average quantity of maize produced is 624 kilograms, the average area under maize in the main production season is 0.79 hectares, the average quantity of maize sold is 214 kilograms, and the average sale price that the farmers sold their maize at is 2.76 MZN/kg. Moreover, 67 percent of household used kilogram bags as units of measurements, while the remaining 33 percent used tins of different sizes as measurement units.

From Table 23, the basic pooled OLS estimates show that a household that receives market information receives a price that is 16 percent higher and significantly than that which does not receive market information. This figure is 7 percent but not significant using the unrestricted pooled OLS model, 16 percent and not significant using fixed effects estimates, 12 percent and significant using random effects estimates, and 11 percent and significant using robust regression estimates. Using the significant figures, the average percentage difference in prices between households with and without information is thus 12.7 percent.

In general, the modeling in this chapter focuses on sellers, but not buyers, of one commodity-maize. This implies that the effect of reception of market information, as stated in the objectives in section 4.1, is analyzed from seller's standpoint, not the buyer's standpoint. One question from this is: how would the results of this analysis differ for net buyers of maize? Answering this question would need future empirical research. The author's hypothesis, however, is that in the short run, the gains from reception of improved information (e.g., increase in welfare and its redistribution) through increased market participation are captured more by sellers than by buyer for the following reasons:-

- First, households mostly sell maize grain and buy mostly maize flour, unless there are well-developed hammer mills or grinding machines in rural areas, where farmers can buy maize grain and take it to hammer mills for milling.
- Secondly, maize grain and maize flour are very different value chains with different market players (e.g. traders). For example, maize flour is mostly supplied from more competitive markets in urban towns where there are relatively more large millers (e.g., in Zambia and Kenya) or from relatively developed trading centers where there are hammer mills compared to relatively smaller trading centers with small retailers. This, in part, means that there is not much price uncertainty in prices of processed maize flour from urban processors compared to farmgate prices of unprocessed maize grain from smallholder farmers in rural villages. In other words, the prices of maize flour in source markets (i.e., urban areas) are likely to be relatively more competitive and predictable (i.e., with less price uncertainty as measured by indictors presented in section 4.5) compared to the competitiveness and price uncertainty in producer prices in the source markets for maize grain in rural villages, holding processing and marketing costs constant. For example, there are likely to be more retailers of maize flour (i.e. a low seller concentration ratio (e.g., CR-4)) than are buyers of maize grain (i.e. a higher buyer CR-4) in rural trading centers and assembly markets throughout the year.

- Thirdly, although many MIS in sub-Saharan Africa collect producer-, wholesale-, and retail prices of maize grain and retail prices of maize flour, as indicated in the synthesis on information provided in section 3.7.1 and in 0, they mostly disseminate wholesale prices of maize grain and less of retail prices of maize flour. This information is usually targeted to sellers. Therefore; one would expect sellers to benefit more than buyers.
- Fourthly, the value of improved market information is higher when there is high uncertainty of future prices. This uncertainty, measured as price volatility or dispersion as indicated in sections 4.5.2 (measures of price dispersion) and 4.5.3 (forecast errors), is likely to be higher in producer level prices of maize grain in rural villages than at consumer level prices of maize flour—a processed product—in trading centers where there are even likely to be more retailers (i.e., more competition) as noted in the second reason above.

In the long run, to the extent that improved market information leads farmers and traders to invest in more efficient production and marketing systems, it is likely that buyers would also benefit from the MIS. Moreover, even if the net gain from improved market information to individual consumers is small, when the number of consumers is large, then the aggregate net benefits to consumers may become more than those to producers.

Another weakness of this model is that it does not show what part of the benefits that farmers get more is from buyers. The model does not show what part of the benefits from information is a net efficiency gain and what part of it is redistribution of income, say from buyers to sellers. Therefore, one implication of the results from this study is that they give suggestions of willingness of sellers to pay for improved market information, but not the willingness of buyers to pay for improved market information.

This and the next paragraph give factors that significantly affect prices received based on the results from the five estimated regression equations. The regression equations are considered as a panel of judges, and the more a variable is declared statistically significant by the models, the better it is considered to influence prices received. Other factors that significantly and positively affect the prices of maize received across the five estimated models include the district level variance of prices received (from robust regression); household owning a bicycle (in the fixed and random effects models); a female headed household (one of the unique signs produced by the fixed effects model); the log of household members aged between 15 and 59 years (from the random effects model); the household head had one to four years of education (from pooled OLS); and the panel year dummy (from the basic pooled OLS, random effects, and robust regression).

Other factors that significantly and negatively affect the prices of maize received by households include the household's growing large groundnuts (from the fixed effects model); and a household being located in Zambezia, Manica, and Sofala provinces (from pooled OLS, random effects and robust regression).

It was hypothesized that variation in prices may be due to the difference in units of measurement used to sell maize. A dummy variable indicating whether households used kilogram units or liter tins as units of measurements was included in the regressions and was not found to be statistically significant in any of the regression equations at a 5 percent level of significance. This makes intuitive sense. If farmers were systematically getting higher prices selling using one type of container over another, they would probably figure this out over time and shift to selling more using the container offering the higher price. So it appears that over time, the effective price per kilogram has equalized across container types.

The variable on number of drought days in the main growing season was included to control for seasonality effects that might affect prices received. The estimated coefficients on this variable were not significant in the estimated models. It is likely that more commercialized farmers can afford to store and sell in off-peak marketing months (i.e., engage in temporal arbitrage) and thus receive higher prices than less commercialized farmers who most likely sell their entire surplus output during the peak-marketing months (i.e., do not engage in temporal arbitrage). These seasonality effects associated with the peak and off-peak marketing periods between large and small farmers is partly captured by including a quantity-sold variable in the price model. Another variable that could have helped to capture these seasonality effects would be a dummy variable that indicate whether farmers sold in the 4 peak marketing months or in the off-peak marketing months. This variable was not included in the panel data analysis because data on it was only collected in one round of the panel—the 2005 TIA.

The study did not control for the size and number of buyers in the regions. Some provinces such as Manica have relatively larger buyers who may offer relatively higher prices compared to small buyers in other provinces in Northern Mozambique. Also, when there are many buyers, the market is likely to be more competitive, and become an information system itself, thus reducing the need and value of information from an independent MIS. These effects are partly captured by the regional (provincial) dummies that were included in the model. The regional dummy indicating whether a household was located in Manica is significant but negative in all models, which rejects the hypothesis that households in regions with relatively larger buyers (as measured by a regional dummy) receive higher prices.

In conclusion, the econometric analysis implies that holding other factors constant, households are likely to participate in markets and obtain higher prices when governments, external donors, charity organizations, and private sector firms provide more funding and in-kind contribution for the collection and diffusion of improved market information to farmers and small-scale traders. Increased market participation and higher prices received from the sale of surplus staple crops translate into increased incomes and improved wellbeing of households.

4.11 Cost-Benefit Analysis of Information Search

This section deals with research question number 4 in section 4.1 which is: How do the benefits from receiving improved agricultural market information compare with the costs of searching for it for an average Mozambique farmer who participates in the market as a maize seller? The section uses results from the descriptive and econometric analysis to compute the marginal and average benefits of reception of improved agricultural market information by an average maize farmer in Mozambique. The section also estimates the costs of searching market information by an average maize farmer using: (1) radio; (2) cell phone; (3) and word-of-mouth through meetings with neighbors, friends, relatives, traders, and extension and NGO workers; and (4) a combination of the three methods.

4.11.1 Model Parameters

Table 24 gives the parameters used in the benefit and cost estimations. The parameter labels are long and elaborate (including sources of the data or the way they are calculated in brackets) and only row 17 is explained here. In row 17, the travel cost and time of attending meetings with neighbors, friends, relatives, traders, and extension and NGO workers is valued at zero, although some travel time is used. This is done for two reasons. The first is that farmers always travel to trading centers or road junctions where meetings are held to conduct other activities such as shopping and networking. It is their way of life that they interact within the village. Secondly, even when travel is specifically done for searching information, it provides more utility than disutility (i.e., it is more of a benefit than a cost), for example in form of allowances, food, drinks, and social interaction enjoyed when they attend workshops, meetings, or when they visit neighbors. In other words, the costs incurred in this type of search are compensated for with other non-financial benefits from social networking. As a caveat, the marginal cost curve of attending meetings must turn upwards at some point, so the farmers will not be willing to attend an infinite number of meetings.

Note that the radio can be used to listen to other information apart from maize prices. In other words, there is nonappropriability of the costs of use of radio batteries in a sense that the cost of using them to receive information on one commodity is the same as the cost of using them to receive information on many commodities during a market information radio program. In the same way, cell phones are used to receive and send other information other than maize market information.

Table 24: Parameters for Estimating the Benefits and Costs of Information Search in Mozambique

Row	Model Parameters	Value
1	Average HH[1]-specific sale price of maize (05 MZN per kg) without information (TIA data from Table 20)	2.67
2	Average HH-specific sale price of maize (05 MZN per kg) with information (TIA data from Table 20)	2.87
3	Basic pooled OLS information coefficient (column (2) in Table 23)	0.1440
4	Pooled OLS information coefficient (column (3) in Table 23)	0.0702
5	Fixed effects information coefficient (column (4) in Table 23)	0.1486
6	Random effects information coefficient (column (5) in Table 23)	0.1131
7	Robust regression information coefficient (column (6) in Table 23)	0.1010
8	Average Quantity of maize sold (kg) (TIA data (column (5) in Table 23))	214
9[2]	Cost of a pair of type D batteries (PDB) in MZN in 2009 (Field observation by researcher while in Nampula—Mozambique)	30.00
10	Cost of calling from Mcell to Mcell and other networks per minute in MZN in 2010 (http://www.mcel.co.mz)	7.04
11	Cost of calling from Vodacom to Vodacom and other networks per minute in MZN in 2010 (http://www.vm.co.mz/)	6.58
12	Average cost of calling on the two networks per minute in MZN in 2010 ((10)+(11))/2	6.81
13	Cost of SMS from Mcell to Mcell and other networks in MZN	2.11
14	Cost of SMS from Vodacom to Vodacom and other networks in MZN	1.97
15	Average cost of an SMS on two networks in 2010 ((13)+(14))/2	2.04
16	Exchange rate of 1 USD to the MZN in 2005	23.06
17	Travel cost and time of attending meetings with neighbors, extension and NGO workers is valued at zero	0.00
18	Number of smallholder farmers (HHs) in Nampula (TIA 2008)	758,879
19	Number of smallholder farmers (HHs) in Zambezia (TIA 2008)	825,451
20	Number of smallholder farmers (HHs) in Manica (TIA 2008)	272,961
21	Number of smallholder farmers (HHs) in Sofala (TIA 2008)	260,400
22	Total HHs in 4 provinces: Row (18)+…+(21)	2,117,691
23	Percentage of HHs that grew maize (TIA data from Table 20)	71%
24	Percentage of HHs that sold maize given that they grew maize (TIA data from Table 20)	34%
25	Percentage of HHs that received information given that they sold maize=405/836 (TIA data from Table 20)	48%
26	Estimated HHs that received information given that they sold maize in the 4 provinces: Row (22)*(23)*(24)*(25)	244,675

1. HH= Household; 2. The cost of 1 type D battery ranges from 12-15 MZN while 1 smaller AA battery costs 6 MZN. Thus, using 15 MZN is conservative enough.

Table 25: Expected Benefits from Improved Market Information in Mozambique

Row	**Part 1: Marginal Benefits Analysis**	Basic Pooled OLS	Pooled OLS	Fixed Effects	Random Effects	Robust Regression	Average of columns 2, 5,& 6)[1]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
27[2]	Marginal percentage price gain per kilogram due to information	15.5%	7.3%	16.0%	12.0%	10.6%	12.7%
28	Marginal price gain (information premium/ rent) per kg in 2005 meticais	0.41	0.19	0.43	0.32	0.28	0.34
29	Gain in income by one average household (USD)	3.82	1.79	3.95	2.96	2.62	3.13
30	Estimated average population gain in income by HHs that received market information given that they sold maize (USD)	935,329	439,165	967,484	723,121	641,793	766,748

1. Column (7) is the average of columns (2), (5) and (6). It is estimated using only the significant estimators of the coefficients of reception of market information in the price models.
2 The numbering of the rows in this and the subsequent tables is sequential with the rows of the previous table. This is to help make it easier to explain the calculations carried out, as described in the footnotes to the table.

Row 27= (exp (row 3 to 7)-1) x100 for columns (2) to (6)
Row 28= (row 27) x (row 1)
Row 29= ((row 28) x (row 8))/ (row 16)
Row 30= (row 29) x (row 26)

Table 26: Estimated Costs, Cost-Benefit Ratio, and Sensitivity Analysis of Search of Improved Market Information in Mozambique

		Costs and Cost-Benefit Ratios of Information Search Combos: Pairs of D Batteries (PDB), Cell Phone Minutes (CPM), and SMS used							
		Combo 1: 1 PDB, 3 CPM, 2 SMS		Combo 2:1 PDB, 4 CPM, 2 SMS		Combo 3: 1 PDB, 5 CPM, 2 SMS		Combo 4: 1 PDB, 6 CPM, 2 SMS	
	Search Modes	One Month	Two months	One Month	Two months	One Month	Two months	One Month	Two months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
31	Radio using Pair of D Batteries (PDB)	1.30	2.60	1.30	2.60	1.30	2.60	1.30	2.60
32	Cell Phone Minutes (CPM) and SMS	1.06	2.12	1.36	2.72	1.65	3.31	1.948	3.90
33	Meetings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	Radio, Cell Phone, and Meetings	2.36	4.73	2.66	5.32	2.95	5.91	3.25	6.50
35	Cost-Benefit Ratio	0.75	1.51	0.85	1.70	0.94	1.89	1.04	2.07

		Combo 5: 2 PDB, 3 CPM, 2 SMS		Combo 6: 1 PDB, 3 CPM, 5 SMS		Combo 7: 1 PDB 3 CPM, 10 SMS		Combo 8: 1 PDB, 3 CPM, 12 SMS	
		One Month	Two months	One Month	Two months	One Month	Two months	One Month	Two months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
36	Radio using Pair of D Batteries (PDB)	2.60	5.20	1.30	2.60	1.30	2.60	1.30	2.60
37	Cell Phone Minutes (CPM) and SMS	1.06	2.12	1.33	2.66	1.77	3.54	1.946	3.89
38	Meetings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	Radio, Cell Phone, and Meetings	3.66	7.33	2.63	5.26	3.07	6.14	3.25	6.49
40	Cost-Benefit Ratio	1.17	2.34	0.84	1.68	0.98	1.96	1.04	2.07

Row 31, row 36 = (row 9) x PDB / (row 16)
Row 32, row 37 = ((row 12) x CPM + (row 15) x SMS)/ (row 16)
Row 34 = (row 31) + (row 32) + (row 33); Row 35 = (row 34) / (row 29, column 7)
Row 39 = (row 36) + (row 37) + (row 38); Row 40 = (row 39) / (row 29, column 7)

Table 27: Estimated Costs, Cost-Benefit Ratio, and Sensitivity Analysis on Quantity Sold and Search of Improved Market Information in Mozambique

		Quantity minimum, quartiles, maximum, and mean values of quantity sold in the sample					
		min	p25	p50	p75	max	mean
41	Quantity sold (kg)	4	50	100	250	20010	214
42	Average marginal percentage price gain per kilogram due to information	12.7%	12.7%	12.7%	12.7%	12.7%	12.7%
43	Average marginal price gain (information premium/ rent) per kg	0.34	0.34	0.34	0.34	0.34	0.34
44	Average gain in income by one household (USD)= (41)*(43)/(16)	0.06	0.73	1.47	3.67	293.57	3.13
45	Estimated average population gain in income by HHs that received market information given that they sold maize (USD)						766,748
	Pairs of D batteries (PDB) used in search combos						
46	Break-even Pairs of D batteries (PDB)	0 PDB	0 PDB	1 PDB	2 PDB	225 PDB	2 PDB
47	Break-even search costs using radio using Pair of D Batteries (PDB)	0.00	0.00	1.30	2.60	292.70	2.60
48	Cost Benefit Ratio (row 47) /(row 44)	0.00	0.00	0.89	0.71	1.00	0.83
	Cell Phone Minutes (CPM) and SMS used in search combos						
49	Break-even Cell Phone Minutes and SMS Used	0 CPM, 2 SMS	1 CPM, 2 SMS	4 CPM, 2 SMS	11 MM, 2 SMS	993 CPM, 2 SMS	9 CPM, 2 SMS
50	Break-even search costs using Cell Phone Minutes (CPM) and 2 SMS	0.18	0.47	1.36	3.42	293.31	2.83
51	Cost Benefit Ratio (row 50) / (row 44)	3.01	0.64	0.92	0.93	1.00	0.90

Row 41= minimum, quartiles, maximum and mean of quantity sold in sample; Row 42 = (Row 27, column 7); Row 43= (Row 28, column 7); Row 44=(row 41)*(row 43)/ (row 16); Row 45=(row 44)*(row 26); Row 46=[(row 44) / ($1.30)]=[(row 44)/(row 9 / row 16)], where [X] means integer part of the quotient X; Row 47= (row 9)* PDB / (row 16); Row 48 = (row 47) / (row 44); Row 49= [((row 44 x rows 16) - (2 x row 15))/ (row 12)]; Row 50= ((Row 12) x CPM + (Row 15) x SMS)/ (row 16); Row 51= (row 50)/ (row 44).

4.11.2 Estimated Benefits Analysis

- Row 27 in Table 25 shows the marginal percentage price gain per kilogram due to information from the econometric analysis reported in the second paragraph in section 4.10.2. The column 7 of row 27 shows that the average marginal percentage price gain per kilogram due to reception of information is 12.7 percent.
- Row 28 in Table 25 shows the marginal price gain in meticais equivalent and is obtained by multiplying the marginal percentage price gain (row 27) by the price received without information (row 1 in Table 24). The average marginal price gain in meticais (row 28, column 7) is equivalent to about 0.34 meticais per kilogram. This can also be considered as the average information premium or average information rent per kilogram of maize sold by a household that received information.
- Row 29 in Table 25 shows the gain in income by one average household (i.e., a household that sold 214 kilograms of maize) in USD. It is obtained by multiplying marginal price gain (row 28) by the average quantity sold (row 8 in Table 24) and dividing it by the 2005 USD to MZN exchange rate (row 16 in Table 24). The average gain in income by one household (row 29, column 7) from improved market information per household is 3.13 USD over each main marketing season using data for 2002 and 2005. This figure is considered as the benefit of searching market information by an average household in 2002 and in 2005. This gain from information search is about 1% of the estimated average gross total income of the households in the sample in 2005 meticais which was

$361. It is also about 1% of the estimated average value of net total income of households in the sample in 2005 meticais which was $319. This implies that an average farmer can search for information as long as the search costs are less than $3.13 in the principal marketing season of a year using 2002 and 2005 panel data.

- Row 30 in Table 25 estimates the average population gain in income by all households that received information given that they sold maize in the 4 provinces of Nampula, Zambezia, Sofala, and Manica. It is obtained by multiplying the gain in income by one household (row 29) by the number of households that received market information given that they sold maize (row 26 in Table 24). The number of households that received information given that they sold maize (row 26) is estimated by multiplying the number of households in the 4 provinces (row 22) by the probability of growing maize (row 23) times the conditional probability of selling maize given that a farmer grew maize (row 24) times the conditional probability of receiving information given that a farmer sold maize (row 25). The average population gain in income by all household that received information, given that they sold maize (row 30, column 7 in Table 25) is estimated to be 766,748USD per year based on 2002 and 2005 panel data.
- This finding implies that an MIS whose investment cost is less than or equal to 766,748USD per year would be a profitable investment.

4.11.3 Costs, Cost-Benefit Ratios, and Sensitivity Analysis on Search Modes

Table 26 shows the cost of searching information using three methods: (1) radio, (2) cell phone, (3) word-of-mouth through meetings, and (4) a combination of the three methods. Search costs are divided into several *information search combos*, each consisting of (a)

Radio using Pair of D Batteries (PDB), (b) Cell Phone Minutes (CPM) and SMS, and (c) unlimited meetings. The fixed costs of buying a radio and a cell phone are considered as sunk costs. Although two-month estimates are given, the one-month search period is more consistent with the reality of maize marketing in rural Mozambique because sample data, 78 percent of households sell during the 4 peak marketing months and 64 percent of farmers sell most of their output in one transaction.

Sensitivity analysis of the cost-benefit analysis can be conducted on many parameters which can change, such as number of minutes used to call for information search, number of SMS sent for information search, cost of calling using cell phones, cost of SMS, number of pairs of batteries, cost of batteries, exchange rates, quantities produced, and price received. Table 26 incorporates sensitivity analysis of parameters that can rapidly change in the short run (4 peak marketing months) and on which the farmer has considerable influence in the short run, such as number of minutes called, number of SMS used, pairs of batteries used in radios, and number of months in which search is conducted. Table 27 presents sensitivity analysis on quantity of maize sold. Sensitivity analysis is not conducted on parameters that may not change in the short run, such as quantity of maize produced (implying inelastic supply in the short run) or those that are relatively out of the influence of the farmer such as cost of calling using cell phones, cost of SMS, exchange rates, and cost of type D batteries.

- Row 31 shows the search cost of a farmer who uses one pair of type D batteries (1 PDB) per month to listen to information via radio for one and two months. It is obtained by dividing the cost of a pair of type D batteries (row 9 in Table 24) by the USD exchange rate to the MZN (row 16) times the number of months. The estimated cost of searching using radio is $1.30 per month and $2.60 for 2 months. This row shows that the cost of searching using only a radio which uses one pair of D batteries for one or two months is less than the marginal benefits of receiving information in a season for an average farmer which are $3.13 per year (row 29, column 7).

- Row 32 shows the search costs of a farmer who makes three to six cell phone minutes and sends two SMS (3 to 6 CPM, 2 SMS) to search for information for one and two months. Although a farmer can use one SMS for search, the analysis in this study uses a minimum of two SMS so that the analysis is comparable to one of the current SMS based MIS-the ZNFU 4455 SMS MIS. To use the ZNFU 4455 SMS MIS, a user has to use at least 2 SMS plus a phone call of an unspecified duration. Details of how the ZNFU 4455 SMS MIS works are included in section A.4.2 in 0. Row 32 is estimated as the sum of the cost of making a cell phone call times minutes used (row (12) x number of CPM) and the cost of sending an SMS times the number of SMS sent (row (15) x number of SMS), all divided by the 2005 USD exchange rate to the MZN (row 16). The following can be observed and deduced from this row:
  - The estimated cost of searching using three cell phone minutes and two SMS (3 CPM, 2 SMS) is $1.06 per month and $2.12 for 2 months. The estimated cost of searching using four cell phone minutes and two SMS (4 CPM, 2 SMS) is $1.36 for one month and $2.72 for two months. This implies that the costs of searching for information via cell phone are lower than those of searching using radio only when a farmer uses at most three

minutes of voice and two SMS. At the fourth minute, using a cell phone is more expensive than using a radio which uses one pair of type D batteries to search for information. A caveat about the quality or relevance of the information received from the two different sources is given here. The comparison in this paragraph assumes that the information delivered by radio is equally valuable to the farmer as the information delivered by SMS. On the one hand, it is likely that a "pull" SMS system potentially allows the provision of information targeted much more to individual users' needs than a radio program. On the other hand, SMS information is highly restricted to each crop per message compared to a radio, which can be used to receive information for more than one crop and more than price information at no additional cost (e.g., in a market information radio program).

- The estimated cost of searching using five minutes of a cell phone call and two SMS (5 CPM, 2 SMS) is \$1.65 for one month and \$3.31for 2 months. The cost of searching using 10 minutes of voice and 2 SMS (10 CPM, 2 SMS) for one month is \$3.13, and that of using 11 cell phone minutes and two SMS (11 CPM, 2 SMS) for one month is \$3.42 (not included in Table 26). This implies that the cost of searching using only a cell phone for 10 minutes of voice and 2 SMS (10 CPM, 2 SMS) is the upper break-even limit for an average farmer. Beyond this break-even limit, the search costs exceed the marginal benefits (estimated to be

$3.13—see row 29, column 7) of receiving information per season for an average farmer.

- Row 34 is the sum of the three search modes in row 31, row 32, and row 33. The estimated cost of searching using combination ("combo") 1 (1 PDB, 3 CPM, 2 SMS) is $2.36 per month and $4.73 for 2 months. The estimated cost of searching using combo 2 (1 PDB, 4 CPM, 2 SMS) is $2.66 per month and $5.32 for 2 months. The estimated cost of searching using combo 3 (1 PDB, 5 CPM, 2 SMS) is $2.95 per month and $5.91 for 2 months. The estimated cost of searching using combo 4 (1 PDB, 6 CPM, 2 SMS) is $3.25 per month and $6.50 for 2 months. This implies that a farmer can feasibly use combo 1 to combo 3 for only one month because their costs are lower or equal to the benefits from search.
- Row 35 is the cost-benefit ratio of information search. It is obtained as the ratio of cost of searching using any of the search combos 1 to 4 (row 33) over gain in income by one average household (row 29, column 7). A cost-benefit ratio less than or equal to one means the *information search combo* is profitable while a ratio that is greater than one means it is not profitable. With respect to the cost-benefit ratios, "profitable" means that the average gain in income by one household in USD is greater than or equal to the search costs using radio, cell phone, and meetings. Therefore, combos 1 to 3 for one month are profitable because their costs are lower than or equal to the benefits from search.
- Combo 5 (2 PDB, 3 CPM, and 2 SMS) is not profitable because it uses two pairs of batteries, which raise the search costs to $2.60 from radio in addition to 3

minutes of voice and 2 SMS. Combo 6 (1 PDB, 3 CPM, 5 SMS) and combo 7 (1 PDB, 3 CPM, and 10 SMS) are profitable for only one month of search.

In summary, Table 26 shows that the break-even *information search combinations* for an average Mozambique maize farmer (defined as one who on average sells about 214 kilograms of maize) are combo 1 to combo 3 for one month, which involve: (1) listening to a radio that uses one pair of type D batteries a month (1 PDB); (2) placing at most 5 cell phone minutes (5 CPM) and two SMS price requests (2 SMS); (3) attending meetings with neighbors, friends, relatives, traders, and extension and NGO workers in the village; and (4) any combination of all three search modes in the main maize marketing season which lasts between June to September. There is another important caveat that is placed on this analysis. The analysis calculates benefits only on sales of maize. To the extent that getting market information on other crops is complementary to getting information on maize (e.g., listening to the same radio broadcast that reports both maize and beans prices) and that market information also increases the average price received of other products, then the model underestimates the benefits of market information relative to the costs.

Combos 6 and 7 also break-even for one month only. Combo 7 (a superset of combo 6) involve (1) listening to a radio that uses one pair of type D batteries a month (1 PDB); (2) using 3 cell phone minutes (3 CPM) and at most 10 SMS price requests (10 SMS) per month; (3) attending an optimal number of meetings with neighbors, friends, relatives, traders, and extension and NGO workers in the village; and (4) any combination of all three search modes during the 4 peak marketing months. Beyond these search combos, the cost of search would be higher than the marginal benefits of search. The caveat in the previous paragraph also applies to this paragraph.

From the cost benefit analysis, it is difficult to determine whether the use of radio to diffuse market information to smallholder farmers is more effective and efficient than the use of cell phones and vice versa. This is because of: (1) the difficulty to accurately disaggregate the quality or relevance of the information received from radio and cell phones (voice and or SMS); and (2) due to the complementarities of the benefits of getting information on one crop (e.g., increase in average price of maize) on the increase of the average price received of other products (e.g., beans and groundnuts), which potentially leads to underestimating the benefits of market information relative to the costs. In this study, effectiveness is defined as impact (e.g., increase in income) per person times the number of stakeholders (i.e., aggregate magnitude of impact receiving information); and efficiency is defined as effectiveness divided by total costs in terms of money and time (i.e., impact or gain per dollar of cost) (Axinn and Axinn, 1997).

The use of meetings (e.g., between NGO and extension workers and farmers) to diffuse information is not monetarily costly to farmers over the current range of meetings attended, as it is using radio and cell phones. The use of meetings to diffuse information to farmers, however, is costly to governments and external donors.

Another implication of this analysis is the potential role of group action in lowering the cost of information acquisition. For example, in Zambia, many villages have women's "listening clubs" where women get together to listen to a radio program together and then discuss it. When a group owns a cell phone or a radio and uses it to search for information, the cost per person of getting market information drops dramatically than in the individual action used in the estimates of information search in Table 24.

4.11.4 Sensitivity Analysis on Quantity Sold

Table 27 conducts a sensitivity analysis based on different values of quantity of maize sold by farmers. Row 41 includes the minimum, quartiles, maximum and means of quantity sold by households in the sample. Row 42 is the average marginal percentage price gain per kilogram due to information from the econometrics analysis and explained in first bullet in section 4.11.2. Row 43 is the average marginal price gain (information premium/ rent) per kg in 2005 meticais and is explained in the second bullet in section 4.11.2. Row 44 is the average gain in income by one household that sold quantities of maize included in row 41 in USD. It is obtained by multiplying the average information rent (row 43) by the quantity sold (row 41) and dividing it by the 2005 USD to MZN exchange rate (row 16 in Table 24). Assuming a fixed per kilogram gain, this row shows that gains from information increase with level of market involvement by farmers. In other words, more-commercialized farmers obtain higher gains in income due to reception of information than do less-commercialized farmers.

Row 45 in Table 27 estimates the average population gain in income by all households that received information evaluated at the average quantity sold. It is obtained by multiplying the average gain in income by one household (row 44, column 7) by the number of households that received information given that they sold maize (row 26 in Table 24).

Row 46 shows the break-even search strategy in terms of number of pairs of type D batteries to buy to listen to information via radio for one month so as not to exceed the average gain in income by one household (i.e., in order for the search strategy to be break-even). It is the quotient obtained from dividing the average income gain (row 44) by the cost of a pair of type D batteries ($1.30).

Row 47 shows the cost of the break-even PDB. Row 48 shows the cost-benefit ratios assuming the cost of the indicated number of PDB and the average income gains for each level of quantity sold. It shows that the break-even search option for a farmer who sells less than or equal to 50 kilograms of maize is not to buy type D batteries, while farmers who sell more than 50 kilograms of maize can afford search using a radio that uses at least one pair of type D batteries. The break-even search costs (row 47) should be less than the average gain in income by one household (row 44).

Row 49 shows the break-even search strategy in terms of cell phone minutes and 2 SMS used in search for market information for one month so as not to exceed the average gain in income by one household (i.e., in order for the search strategy to be break-even) It is the quotient of obtained by dividing the difference between the average gain in income by one household (row 44 x rows 16) minus the cost of obtaining two SMS (2 x row 15) by the cost of cell phone call (row 12).

Row 50 shows the cost of the break-even cell phone minutes (holding SMS at 2) that can be used from the average income gains for each level of quantity. Row 51 shows the cost-benefit ratios assuming the cost of the indicated number of cell phone minutes and SMS for each level of quantity sold. It shows that the break-even search option for a farmer who sells at least 50 kilograms of maize is to use one cell phone minute and 2 SMS. The number of break-even cell phone minutes increases with quantity of maize sold.

This sensitivity analysis shows that stronger demand for information is likely to be among more commercial farmers than the less commercial ones. This is important and conceptually consistent with section 2.3.8, which states that some users have no effective demand for information because they have a small level of market involvement. Furthermore, based on the ICT used to diffuse information in section 3.7.2, it would appropriate for small-scale farmers to put pressure on government to help support MIS that target less commercial farmers, while more commercial farmers seek information from MIS that mostly use modern ICT, notably cell phones, to disseminate information such as ZNFU 4455 SMS MIS. Farmers pressuring government may entail the implicit or explicit threat not to vote or re-elect leaders unless they provide services, including market information.

4.11.5 MIS Operational Costs in Mozambique

Table 28 shows the total operating costs in SIMA at the national level and in two SIMAPs in Nampula and Manica Province in 2002. The table shows that in 2002, the total operational costs of the system (SIMA and the two SIMAPs), including staff salaries, communication and transport, were around 3.3 billion meticais, or US$130,000 (Mabota, et al., 2003). Based on the number of households that reported receiving improved market information from the TIA (2002), Mabota et. al. (2003) estimated that the national average operational cost of providing market information to each rural household was 2,267 meticais, or about US$0.09.

Table 28: Annual Operating Costs of SIMA in 2002

System	Costs (Mt)	Cost ($US)[1]
National SIMA	2,447,472,934	
Provincial SIMA (Nampula)	749,876,840	
Provincial SIMA (Manica)	82,957,500	
Total	3,280,307,274	130,000

Source (Mabota, et al., 2003) ; 1: 1 One US dollar was equivalent to approximately 25,000 meticais.

Based on the MIS budget, the operating costs of running an MIS in Mozambique was about $130,000 for the whole country, and about $ 30,000 in Nampula province (Mabota, et al., 2003). The average population gain in income by all household that received information given that they sold maize, estimated to be 766,748 USD per year, is 6 times more than the entire operating costs of MIS in Mozambique in 2002. It would have been better to estimate the annual total cost consisting of the investment and operating costs of the MIS. The initial investment costs of the MIS, however, are not known.

4.12 Main Findings and Their Implications for MIS Design

This section presents the main findings and implications from the analysis in this chapter by backward induction thus. From the econometric analysis, average percentage difference in maize prices between households with and without information is 12.7 percent. This translates into an individual marginal benefits or information premium or information rent of $3.13. The main result from the bivariate probit analysis is that, holding other factors constant, reception of market information by staple crops farmers in Mozambique significantly increases their probability of market participation by 34 percent. Therefore, reception of improved information increases market participation, and market participation increases household income.

From the econometric analysis, the study finds that the generic factors that influence the reception of improved agricultural market information include (a) growing maize, large and small groundnuts; (b) owning a radio; (c) presence of a cell phone network in the village; (d) membership to farmer association; (e) access to extension services; (f) proximity to a road with public transport; (g) the distance to village administrative post; (h) level of education; and (i) the agro ecological zone in which the households is located.

These findings lead to the following question: how can the reception of improved agricultural market information be increased among users so that they participate in markets and increase their household income (i.e., so that they obtain an information premium)?

a) The MIS provides information on major marketable staples. Higher reception of market information, and hence higher market participation and increased household income, can be achieved when the MIS provides more information on the major marketable staples such as maize, groundnuts and common beans.

b) MIS prioritize radio as important diffusion channel of market information. Higher reception of market information, and hence higher market participation and increased household income, can be achieved when the MIS make radio an important diffusion channel.

c) Making cell phones an important diffusion channel. The reason for this is the same as the one given in (b) above. This option, however, is likely to benefits more commercialized farmers who are likely to afford to purchase cell phones and to buy airtime to use in search than the less commercialized ones.

d) Making associations an important MIS clientele. It is important for MIS to consider associations and farmer groups as important clientele of MIS for the same reason given in (b) above. It is not clear, however, what percentage of poorer farmers in Mozambique have a high voice and are active participants in farmer association's activities that can make them benefit from increased reception of market information as are less-poor farmers.

e) Making extension an important MIS clientele: The implications are that the benefits from investing in MIS can significantly increase when the MIS provides more information to extension workers and NGO workers to disseminate to users.

f) The econometric analysis also indicated that distance to the nearest road with public transport, distance to village administrative post, a household head receiving between one to four years of education, and the agro ecological zones in which a household is located affects reception of market information. These factors imply that information is useful when users can act on it and that information is complementary with other government programs and policies such as infrastructure development and investment in education. For example, some types of information (e.g., higher prices in distant markets) are more useful when farmers can transport their produce to markets on good feeder roads. Some types of improved market information (e.g., favorable or unfavorable price and quantity forecasts) are more useful when farmers can respond and produce more or less based on their agro-ecological conditions. Some types of improved market information (e.g., those diffused through newspapers, bulletins, SMS, television, and billboards) are useful when farmers have formal education to gain the capacity to read and write, and consequently the capacity to search and use written market information. The capacity of the MIS, however, to influence these factors is limited, since they depend on resource available to governments and donors and their opportunity costs. If resources were available, and governments and donors invested in these complementary services (e.g., universal education—including adult education—and improvements in feeder road infrastructure), then the results in the econometric analysis indicate that more households are likely receive improved market information.

The cost-benefit analysis shows that demand for information is likely to be stronger among more commercial farmers than the less commercial ones. Furthermore, the cost-benefit analysis shows that information search using radio and cell phones is affordable to more commercialized farmers than it is to less commercialized farmers. The main questions are: (1) how can the search costs be lowered so that more households (especially the less commercialized farmers) receive information? (2) What actions are likely to increase the potential payoff of investing in improved agricultural market information systems?

1) Increase competition in the information and communication sector:
    a) License more radio providers to increase competition among radio stations. This is likely to further bring down the costs of market information radio programs, and thus increase the capacity of MIS to pay for radio airtime so as to disseminate more information to the 52 percent of households that own radios. Also, as competition increases among radio stations, they are more likely to sponsor

market information radio programs as they compete for listenership as is the case in high-income countries.

b) License more cell phone providers to increase competition in the communication sector, which in the long run lowers communication and search costs. As search costs lower, more users are likely to receive information and the payoffs from receiving market information are likely to increase.

c) From the cost-benefit analysis, it would be appropriate for small-scale farmers to put pressure on government to help support MIS that target less commercial farmers, while more commercial farmers seek information from MIS that mostly use modern ICT, notably cell phones and the internet, to disseminate information such as ZNFU 4455 SMS MIS or Esoko in Ghana.

d) Subject to resource availability and their opportunity cost, stakeholders with effective demand for information (e.g., governments and donors) could subsidize information for less commercialized farmers and small-scale traders who own radios and cell phones by paying the MIS to provide information to users with no effective demand for information. This would be through administrative funding as explained in section 2.4.1 where the government uses taxpayers' or donor money to fund MIS activities; or through a combination of administrative and donor funding and private effective demand as explained in section 2.4.2. In both options, the provider can be a public-, private-, farmer organization-, trader organization-, or and NGO-based MIS.

2) Promotion of marketing associations and group marketing: The econometric analysis shows that a household head belonging to farmer associations significantly increases

the probability of reception of market information. Group marketing also enables farmers to amalgamate their produce to attain higher volumes. The implication is that there is need to encourage farmers to form or join marketing associations and to market in groups, which is likely to increase reception of market information. Another implication from the cost-benefit analysis is the potential role of group action in lowering the cost per person of information acquisition. When a group owns a cell phone or a crank radio and uses it to search for information, the cost per person of getting market information reduces.

3) Moreover, from the cost-benefit analysis, the use of direct approaches of diffusing information to farmers such as through meetings with extension and NGO workers is not monetarily costly to farmer over the current range of meetings attended by farmers, although costly to governments and external donors. This means that subject to resource availability and their opportunity cost, donors and governments could support more diffusion of information using these direct approaches, especially to poor farmers without effective demand.

4) Another implication from the sensitivity analysis on quantity sold is that stronger demand for information is likely to be among more commercial farmers than the less commercial ones. More commercialized farmers are likely to afford search and to gain more information rent than do the less commercial farmers. Marketing as a group would be as if farmers are getting more commercialized in gross terms (marketing higher volumes), and thus getting better pay offs from market information than when they sell individually which represents a small level of market involvement.

4.13 Limitations of the Study and Areas of Further Research

Market information is highly covariant with other explanatory variables because improvements in the provision of improved market information have often gone hand-in-hand with other market reforms and other investments that are not controlled for in this model. This suggests that some of the attribution of the returns to market information found in this chapter may be attributable to a whole package of actions rather than just market information separately.

Due to data limitations, the models of reception of information, market participation, and prices of maize received consider only recipients of information as sellers (producers), but not buyers (traders and consumers). This means that the marginal effects of reception of information are under-estimated since they are computed based on selling decisions by producers only. Also, the model of prices received is estimated for only maize, yet there are many other staple crops grown and sold in Mozambique on which the MIS disseminate market information. This was because the sample sizes of other commodities were small compared to maize which could lead to loss of degrees of freedom if a system of questions where to be used. This also underestimates the effects of reception of information on the production and marketing decisions of farmers (producers).

The models limit themselves to only the first round effects of information reception on market participation and prices received and do not estimate the general equilibrium effects (e.g., the effects of reception of information on crops grown or area planted) and the second order effects resulting from reception of market information. Taking these general equilibrium effects into account would, however, require much more data than were available for Mozambique and bigger multimarket models e.g., CGE models, which were beyond the scope of this study.

The reverse loop of the effects of market participation on the reception of market information is not estimated, although the endogeneity problem is dealt with by use of a bivariate probit model. This is identified as an area of future research. Also, in the future, the models could be estimated in the "differences", to look at how changes in explanatory variables affect changes in reception of market information, market participation, and prices received. Also, econometric models can be run to determine the effects of reception of market information among farmers on (1) area cultivated, (2) crops grown, (3) temporal arbitrage behavior, (4) frequency of transaction, (5) spatial arbitrage behavior, and (6) choice of forms of vertical coordination. Also, future studies could look at the effects of seasonality on the effect of prices received and demand for information.

5 SUMMARY, CONCLUSIONS, AND AREAS FOR FURTHER RESEARCH

This chapter synthesizes the whole dissertation. It presents (1) the links between the four chapters and the appendices; (2) the consistencies and inconsistencies between conceptual issues and analysis results; (3) the key messages and future research questions; and (4) the key policy and operational implications of the findings.

5.1 The Links between Chapters

Chapter 1 presents the main set of questions this dissertation attempts to answer. These are the following:

1. What evidence is there that supports the premises that second-generation agricultural Market Information System (MIS) models are likely to meet user needs and become financially sustainable relative to first-generation models?
2. How have different MIS models tried to address the generic design issues of any MIS and what are the relative advantages of different models of MIS in addressing those challenges?
3. What factors affect the reception of improved agricultural market information among smallholder farmers in Mozambique; and how does reception of improved agricultural market information affect their marketing behavior?

Chapter 2 presents key concepts in the economics of information and their implications for MIS design and impact. This chapter describes the role of MIS in agricultural marketing and identifies the economic theory through which information affects market performance. This theory drives the conceptual and analytical frameworks used to shape the analysis in chapter 3 and to analyze the performance of MIS among sellers in chapter 4. Chapter 2 also gives the characteristics of information that affect its demand and supply. These characteristics are used to draw the implications for funding and impact of MIS at the end of the chapter. Chapter 2 also presents the environment in which MIS operates. These environment features are used in the analysis of generic structural and conduct design issues that face any MIS presented in chapter 3; and also in the analysis of the effects of receiving improved agricultural market information on the marketing behavior of farmers in Mozambique conducted in chapter 4.

Chapter 3 presents a cross-country synthesis of case studies that examines the premises that gave rise to the second-generation MIS models and how they deal with the generic design issues of any MIS relative to the first-generation MIS models, which are the first two research objectives of the dissertation given in chapter 1. Chapter 3 also looks at the MIS performance from the providers' side (i.e., the MIS side), focusing on the generic structural and conduct design issues facing any MIS. The link between chapter 3 and 2 are the environment features in which MIS operates identified in chapter 2. The link between chapter 3 and 0 is that chapter 3 synthesizes the information needs of stakeholders and experiences of current and emerging MIS models presented in detail in 0.

Chapter 4 analyzes the effects of receiving improved agricultural market information on the marketing behavior of farmers in Mozambique. This chapter looks at the performance of the MIS among one group of users—the sellers. There are two links between chapter 4 and chapter 2 . The first link is in the economic theory driving the analysis in chapter 4. The second link is the way the environment features in which MIS operates given in chapter 2 affects users to receive and act on information.

The link between chapter 3 and 4 is that when MIS perform well by providing information that meet users' needs when they address their generic structural and conduct design issues (analyzed in chapter 3), then their good performance translates into more reception of improved market information by users (analyzed in chapter 4). Reception of improved agricultural market information by users in turn improves market performance among users. The impact of information on market performance is measured in chapter 4 as the changes in individual-household prices received by sellers. The link between chapter 3 and 4, however, is subject to the roles of MIS in agricultural marketing, the characteristics of information that affect its demand and supply, and the environment in which MIS operates identified in chapter 2.

5.2 Consistencies and Inconsistencies between Conceptual Issues and Analysis Results

Many findings in the study illustrate, reinforce, or contradict the conceptual issues developed in chapter two about the role of improved market information in agricultural markets; and about the environment features that affect structure and conduct of MIS analyzed in chapter 3, and on the impact of MIS analyzed in 4. Some of the conceptual issues were not tested due to lack of data or due to the measurement difficulties.

In chapter four, the main findings based on the econometric analysis are that (1) market information increases market participation, and (2) increases household in income—a welfare gain—among sellers. These results are consistent with the observation that providing improved agricultural market information helps to link farmers to markets, improves their welfare, and moves them to more efficient market outcomes, as stated in the economic theory driving the analysis in the dissertation in chapter two.

It is shown in chapter four that several environment features identified in chapter two actually affect the reception of improved market information. These include macro-economic indicators (e.g., the level of transportation and conditions of feeder roads and availability of sufficient electricity), social-economic characteristics (e.g., literacy and education levels), agro-climatic conditions (e.g., agricultural potential in agro-ecological zones), the level of ICT usage in a country (e.g., the ownership of a radio and presence of a cell phone network in the village), and the geographical setting (e.g., provincial dummies).

Also, the SCP analysis illustrates and reinforces several of the conceptual issues in the environment features that affect MIS performance on the supply side (i.e., MIS performance) and on the demand side (i.e. reception or demand for information among users). For example, the results in SCP illustrate that the increase in the availability and usage of cell phones in sub-Saharan countries was a major factor in contributing to the start of many private, farmer organization- and NGO-based MIS. Other environment features that affect performance include macro-economic indicators (e.g., availability of storage and credit facilities), social-economic indicators (e.g., farmer voice), vertical coordination forms and price discovery methods used in the market (e.g., information as a byproduct from exchanges vs. spot markets on accuracy, timing, and sustainability of MIS), cultural factors (e.g., the lack of trust by farmers in the information provided by traders, and the many languages that affect dissemination costs), and lack of effective demand (e.g., money to buy airtime and radio batteries and low levels of market involvement) are discussed in the qualitative analysis in chapter three.

Some of the environmental features were not tested in the SCP analysis and in the econometric model due to lack of data or due to the difficulty to measure them (e.g., in the context of panel data where some government policy indicators do not vary across observations in the sample). For example, some government policies (e.g., regional trade and food price regulations), macro-economic indicators (e.g., inflation, interest rates, GDP from agriculture, and employment levels), indicators of infrastructure availability (e.g., physical market infrastructure, availability of storage facilities and availability of credit facilities) are not included in the econometric model. Some of the results were counter-intuitive or contradict the conceptual issues. For example, one contradiction of the environment features observed was that availability of electricity in the village reduced the reception of market information. Subject to data availability, future research could include more macro-economic and social indicators that were not included in this analysis in order to measure their effects on reception of market information.

5.3 The Key Messages and Future Research Questions

This study identifies two key issues that need further research. These are (1) the incentives problems among government-based MIS and their potential solutions; and (2) the role of market information in linking producers and consumers to markets, how MIS improve producer and consumer welfare, and how they contribute to more efficient outcomes for both producers and consumers.

- **Incentives:** The study finds that government MIS often lack "high-power incentives" to motivate their employees (e.g., low staff salaries, fixed staff salaries, excessive bureaucracy, and their reliance on behavioral monitoring instead of output-based monitoring). There is need for further research that can identify ways of increasing the incentive structure within public MIS. Examples of researchable questions include: (a) How are contracts between non-government MIS and their staff, information providers, and disseminators (e.g., radio stations, cell phone companies, and data companies) structured to reduce the key internal principal-agent issues within the MIS? And (b) can the structure of contracts in non-government MIS be adopted by government MIS?

2) **Linking farmers to markets and efficiency in market outcomes:** The study was not able to measure the magnitude of welfare transfer from consumers (buyers) to sellers and vice versa. Therefore, the main future broadened empirical research questions are: (1) what factors affect the reception of information among sellers and buyers? (2) How does reception on market information affect market participation and prices received by sellers and those paid by consumers? (3) What are the welfare transfers from buyers to sellers or from sellers to buyers? (4) Under what conditions does improved market information help different market participants the most? The modeling in this future research, especially if using time series data, can include more policy variables to measure their effects on the demand and impact of diffusing improved market information.

5.4 Some Policy and Operational Implications of The Findings

The study also identifies some policy and operational implications for the design of alternative MIS models. These include (1) the current lack by all African MIS surveyed of price and quantity forecasts, customized analytical reports, and business reports; (2) the choice of ICT used to diffuse information and its implications on who different MIS serve best; (3) the projected mandate of MIS and implications for investment in public MIS; and (4) the general market evolution and implications for alternative MIS design.

1) **Forecast, analytical reports, and business reports:** One of the findings in the study is that most MIS do not provide price and quantity forecasts, yet many users express need for this information. Also, none of the surveyed MIS provide business reports, and most of the MIS do not provide analytical reports. For the few MIS that provide analytical reports, they are not presented in a way that suits users of different skill levels (e.g., a report that can be understood by a farmer vs. a report that can be understood by a policy maker). There is need for further research and outreach to assess (and develop) the capacity of MIS staff, local universities, and other research institutions in sub-Saharan Africa to conduct and provide forecasts and to report them in suitable ways to users of different skill levels and needs.

2) **The choice of ICT used in diffusion and whom different MIS models serve best:** The results from the synthesis in chapter three indicate that the use of Wiki approaches, where users can contribute information through internet and cell phone updates, are not many in sub-Saharan Africa. Moreover, chapter four shows that the use of mostly modern technology (cell phones and the internet) to search for information is likely to directly benefit more-commercialized farmers, while the use of traditional ICT methods (radio and direct meetings) is likely to directly benefit more less-commercialized farmers. This implies that there is need to invest in MIS that use both modern and traditional ICT for diffusion of information. Alternatively, it is important for MIS that mostly use modern ICT to also use more traditional ICT

such as radio and direct meetings through extension staff and NGOs to diffuse information to less-commercialized farmers.

3) **Projected mandate of MIS and implications for investment in public MIS:** The mandate of MIS (especially for gathering information for making better policy formulation, and for food security planning and monitoring), and hence their key clientele (especially policy makers, donors, and poor farmers) is likely to increase in the next 5 to 10 years due to the persistence of some of the environmental factors in which the MIS operate. Some of these environmental factors include: (1) persistent future price uncertainty; (2) persistent variance in inflation; (3) growing unpredictable agro-climatic conditions; (4) lack of effective demand for improved market information by some users; (5) the increase in regional, international and domestic trade; and (6) the increased demand for processed foods as incomes in low-income countries grow. This implies that there is need for governments to provide more funding for MIS activities to monitor and provide information that will meet the projected needs of users. Also, there is need for governments to provide more funding to address the low incentives in public MIS so that they also help to address some of these issues. Another thing to explore in the future is the scope for contracting between the public sector and the private sector to provide such information and analyses.

4) **General market evolution and implications for alternative MIS design:** The study observes that increased commercialization, the evolution of markets (structure, coordination, and price discovery methods), the spread of ICT, and changes in government policies have implications for the design of future MIS models in the

next 5 to 10 years. For example, what are the nature of current and likely future contracts between MIS stakeholders (e.g., between farmers and traders) when markets evolve (e.g., with increased sales volumes through emerging commodity exchanges, or with more transactions conducted as private treaties and bilateral transactions rather than through open spot markets?). Should MIS be housed in commodity exchanges, where they can obtain information as a byproduct and therefore reduce data collection costs? If so, how representative would such information be given the current and likely future volume traded through commodity exchanges in sub-Saharan Africa?

APPENDICES

APPENDIX A THE INFORMATION NEEDS OF STAKEHOLDERS AND EXPERIENCES OF CURRENT AND EMERGING MIS MODELS

A. 1 Introduction

This appendix examines and synthesizes the unmet information needs of selected stakeholders and the experience of current and emerging models for providing agricultural market information in Africa, Asia and USA. Each model is analyzed with respect to the following characteristics: (1) the organization's perceived mandate (aims, objectives, and clientele served); (2) information provided, frequency, and modes of diffusion (including use of ICT); (3) data collection methods, (4) quality control methods; and (5) the institutional home and links with policy analysts,(6) feedback mechanisms from users (critical to determining whether and how the system evolves over time), and (7) funding model for financial sustainability.

The rest of the appendix is organized as follows: Section A. 2 presents the information received and information needed by stakeholders. Section A. 3 gives the characteristics of public MIS. Section A. 4 presents the characteristics of farmer-organization-based MIS. Section A. 5 presents the characteristics of private MIS. Section A. 6 gives the conclusions from global review and cases studies. Section A. 7 presents the checklist used in the case studies for information providers and user in Mozambique, Ethiopia, and Zambia. Section A. 8 gives the categories, organizations, and location of providers and users interviewed during case studies in Mozambique, Ethiopia, and Zambia. Section A. 9 presents the expanded tables of MIS characteristics.

A. 2 Information Received and Information Needed by Stakeholders

What are the remaining critical unmet information needs of key actors that still need to be addressed? This section explores and illustrates the diversity of the information needed by different MIS users in 7 countries in sub-Saharan Africa (Mali, Guinea, Senegal, Niger, Mozambique, Ethiopia, and Zambia), in light of the rapidly changing nature of product demands (increased focus on product attributes), evolving commodity mix, broadening set of potential market outlets, shift in market structures towards more integrated supply chains, and rapidly evolving production and information technologies. The section discusses the types of information received and the channels/modes used to obtain it. The section then analyzes the types of information needed by the users, how frequently they need the information, and the preferred channels/modes of obtaining it.

A.2.1 Information Received and Needed By Users in Mali, Guinea, Senegal, and Niger

Information from the West African countries of Mali Guinea, Senegal, and Niger was obtained from (1) literature review of existing documents and (2) from an email questionnaire send to the MIS. The information from the literature review was from a surveys conducted by PROMISAM (Project to Mobilize Food Security Initiatives in Mali) and aimed at understanding the information needs of wholesalers with the aim of increasing regional trade in West Africa (PROMISAM_APCAM_MSU, 2008, PROMISAM_OMA_MALI, 2008, PROMISAM_SENEGAL, 2008, PROMISAM_SENEGAL, 2008, PROMISAM_SIMA_Niger, 2008, PROMISAM_SIMA_Niger, 2008, PROMISAM_SIPAG_Guinea, 2008)

This study did not cover the information needs of other users such as farmers and consumers.

Table 29 shows the unmet information needs of wholesalers in four main value chains (cereals, horticulture, livestock, and fishing) in Mali and Niger in 2008. In the table, B means that traders need the information for making buying or purchasing decisions and S for making selling decisions. From the table, examples of information not provided in include supply of commodities from the areas or markets of production or origin, availability of means and cost of transport, prices in areas or markets of production or origin, prices in national markets, prices in regional markers, potential source of financing (credit), quality requirements by the various actors, information about tenders from large-scale and institutional buyers, prices in markets of final destination, demand forecasts in major markets, and demand in national and regional markets. Only actors in the horticultural value chain needed information on prices, technical information on certified seeds, and information on international prices to enable them make buying decisions.

Table 29: Non-available but necessary information to facilitate purchases and sales among selected value chain operators in Mali and Guinea in 2008

Value chain	Cereals		Horticulture		Livestock		Fishing	Other[1]
Country	Mali	Guinea	Mali	Guinea	Mali	Guinea	Mali	Guinea
Supply in areas (markets) of production (origin)	B,S	B,S	B,S	S	B,S		B,S	S
Availability of means and cost of transport	S	B,S	B	S	B	S	B,S	B,S
Prices in areas (markets) of production (origin)	B,S	B,S	B,S	S	B,S			B,S
Prices in national markets	B,S		B,S		B,S		B,S	S
Prices in regional markets	B	B	B,S	B	B,S	B		B
Potential source of financing (credit)	B		B	B	B,S		B	B,S
Quality requirements by the various actors		S	B,S	S	B	S	B	S
Tenders from large-scale and institutional buyers	B,S	B	B	B		B	B	B
Prices in markets of final destination	S		S				S	B
Demand forecasts in major markets	S		S				S	
Demand in national and regional markets					B			B,S
Supply on regional markets	B					B		B
Trade regulations in national and regional markets		S				S		S
Directory of traders in destination markets		S						B
Prices and technical information on certified seeds			B					
Prices in major reference markets		B					S	
Stocks in different levels of the value chains	S						S	
Supply in national markets		B						B
Conservation techniques								S
Prices in international markets			B					
Subsidized selling prices and food aid distribution				S				

1. Includes passion, tubers, onions, coffee and pepper; B=Buying (purchasing), S=Selling; Source:

(PROMISAM_APCAM_MSU, 2008, PROMISAM_OMA_MALI, 2008, PROMISAM_SIPAG_Guinea, 2008).

Table 30 shows that traders in Niger lack information on potential source of financing (credit), prices in regional markets, stocks in different levels of the value chains, and information on tenders from large-scale and institutional buyers to enable them make buying as selling decisions. Table 32 shows that traders in selected value chains in Senegal need information on prices in production areas, final destination markets, and supply information in areas of production.

Table 30: Availability of information for making buying and selling decisions among traders in Niger, 2008

	Available information	Needed Information by some traders	
Information	Available to some traders	Importers and export:	Wholesalers and other market actors
Availability of means and cost of transport	B,S	B,S	B,S
Demand in national markets	B,S		
Potential source of financing (credit)		B,S	
Prices in markets of final destination	B,S		
Prices in markets of origin	B,S		
Prices in regional markets		B,S	
Prices of products in markets			B,S
Stocks in different levels of the value chains		B,S	B,S
Supply in national markets	B,S		
Tenders from large-scale and institutional buyers			B,S
Appreciation (quantity or stocks??) of the countryside (in rural markers??)	B,S	B,S	
Trade partners	B,S		

B=Buying (purchasing), S=selling; Source (PROMISAM_SIMA_Niger, 2008)

Table 31: Information needed for effective planning of purchases and sales by traders in Senegal in 2008

	Domestic traders	Local and regional traders	Local, regional, international
Distribution of traders	50%	12%	38%
Prices in areas of production	B,S	B,S	B,S
Prices in markets of final destination	B,S	B,S	B,S
Supply in the areas of production	B,S	B,S	B,S

B=Buying (purchasing), S=selling ; Source (PROMISAM_SENEGAL, 2008, PROMISAM_SENEGAL, 2008)

From a synthesis of studies of market information needs among traders in 4 west African countries of Mali, Guinea, Niger and Senegal, the following information was deemed useful but not available for increasing transactions among traders: (1) the cost of products on the internal (domestic) and external (regional) markets; (2) the quantity supplied in domestic and external markets; (3) the quantity of produce demanded in internal and external markets; (4) the directory of operators; (5) regulations relating to trade facilitation and possible remedies; (6) information on quality standards and services; (7) information need for certification to import or export produce; (8) information on the various networks and support structures and their roles; (9) information on availability and cost of transportation; and (10) institutional purchases. For all categories of operators, the radio seems to be the preferred channel of diffusion this information (PROMISAM, 2009). This may be related to the low level of literacy in these countries.

From the same study of traders in West Africa, a part from price and quantity information needs, traders identified other constraints that hamper the movement of goods and services within and between countries, some of which can be reduced with availability of improved market information. Some of these constrains include: (1) multiple formal and informal checkpoints and charges on the roads (with the accompanied harassment at some checkpoints); (2) lack of information of the paperwork needed to cross boarders; (3) lack of information about access to credit and sources of market information; (4) inadequate operator (traders) training (the topics on which traders need training are not specified in literature); (5) non-functional trader organizations; (6) poor condition of some roads; (7) insecurity on the roads; (8) poor and inappropriate means of transport; (9) scarcity of means of transportation on certain routes; (10) the high cost of transportation (high fuel costs); (11) ban of cross-border movement of commodities in spite of the available rules on free movement of persons and property across borders (unpredictable government regional trade policies) ; and (12) refusal to grant export permits and certificates of origin in some countries (PROMISAM, 2009) .

Consumers in Mali: The information about the information needs of consumer was obtained from a study on identification of information needs of consumers in Mali (Kone, 1999). From a random sample of 360 consumers in the towns of Bamako, Segou, Sikasso, and Mopti, the information needs to make decisions about what market to go to by order of importance were: (1) price of commodities in the market, (2) distance to the market, (3) quality products in the market, (4) quantity available in the market, (5) accessibility to the market. Information needed to make the decisions on choice to buy products in order of importance were: (1) product quality, (2) price, (3) quantity available, and (4) the ease of storage of products. Radio and television were the desired modes of delivery of this information to 57% of the consumers interviewed. Other channels desired were newspapers, newsletters or magazines, and word of mouth (Kone, 1999). With the increase in ICT in Mali, it is likely that the preferred modes of delivering this information have changed over time.

A.2.2 Information Received and Needed By Users in Mozambique

Characteristics of Some Information Users and Background Information

In Mozambique, information was collected from (1) literature review, and (2) case studies. The case study interview focused on stakeholders in main grown and marketed staple food crops consisting of maize, common beans, and large- and small-groundnuts on which the MIS disseminates information. The researcher interviewed 5 MIS workers in SIMAP in Nampula, 3 SIMA workers in Maputo, and 2 NGO/Private sector providers. In order to have some assessment of how the information flows from SIMA and SIMAP to MIS users, interviews were conducted with different categories of MIS users consisting of 13 farmer group members, 2 farmer group leaders, 2 early warning and food security analysis organizations officials, 4 food assistance organizations officials, 1 marketing organization official, 7 NGO personnel, and 8 traders from transit and general merchandise markets. There was no random selection of case study respondents due to the lack of a sampling frame that reflected the heterogeneity of the information users in terms of their activities. Also, there was no time and financial resources to construct a representative sampling frame of the heterogeneous information users.

Farmers: Focus group interviews were conducted with staple crop farmers in Murupula District in the Northern Province of Nampula. Farmers in the visited district are subsistence and mixed farmers who grow several crops. The most common commodities grown in the area include maize, large- and small-groundnuts, and common beans. Other crops grown include pigeon peas, cow peas, soybean, rice, cassava, cashew nuts, sesame, and sweet potatoes. Vegetables such as onions, cabbages, and lettuce are also grown. Farmers also grow sorghum for home consumption. Five of the farmers interviewed sold an average of 250 kilograms of maize each. These characteristics suggest that these were mostly subsistence farmers who sold their surplus output. Nampula province is considered to be one of the most productive provinces in Mozambique. It is not clear, however, from the volume of surplus output sold by farmers that Murupula District is surplus or deficit zones nor whether these farmers are net buyers or net sellers of the four staple crops.

Traders: In Mozambique, three main types of traders were interviewed: 1) small-scale traders, 2) medium-scale traders, and 3) large-scale traders. Each category has the following characteristics:

Small-scale traders operate mostly in assembly and general merchandise markets. Assembly markets are characterized by many traders of several types of commodities ranging from food items, electronics, and second-hand clothes. They are located in relatively rural settings, have mostly temporary structures and some operate daily while others operate weekly. General merchandise markets are also characterized by many traders of several types of commodities such as food items, electronics, and second-hand clothes. General merchandise markets are located in municipalities and cities, have more permanent structures, and operate daily. Examples of a general merchandise market are Mwatala and Mercedo de Matadouro in Nampula. Other common type of market is road-side markets, usually located near junctions of feeder and main tarmac roads. These road-side markets specialize in mostly perishable agricultural produce such as cabbages, onions, sweet-potatoes, and cassava. Road-side markets have small-scale traders who retail and those who wholesale agricultural products to traveling traders or truckers.

Small-scale traders usually sell less than ten 100-kilogram bags of maize and beans in a week. They buy the commodities from nearby villages and transport it on bicycles or pick-up trucks to the market for sale. Others buy the produce at the market and sell to consumers in the very market. Some of the commodities such as maize are delivered on trucks in small quantities (e.g., one or two bag) after offloading other commodities in the market. Some small-scale traders sell their products, e.g., maize and beans on open platforms (stalls) that are about 3 feet high, 4 feet wide and about 6 to 10 feet long. In some markets, there are no storage facilities and these traders cover the remaining stock with a canvas in the evening. Many small-scale traders do not own cell phones but can buy airtime and use a friend's cell phone or the public telephone booth when available. They do not use the internet or fax machines. Many did not know how to use a cell phone to send an SMS.

Medium-scale traders wholesale maize, groundnuts, pulses, and other commodities such as potatoes, beans, eggs, and onions. They operate in transit agricultural markets and have access to storage facilities (kiosks or lock-ups) that they rent monthly or pay for storage costs on a per-bag–per-day basis. Transit markets are mostly wholesale markets, operate daily, are located in municipalities and cities, and specialize in agricultural commodities. Examples of transit markets include Mercado da Gorongosa in Nampula and a section of Xipamanine Market (inside the quadrangle) in Maputo. Medium-scale traders have cell phones but do not have fax machines, email, and internet connections.

Large-scale traders are more formal and have independent premises. They are registered business entities with offices; they buy mostly cereal and pulses in bulk; and have access permanent storage facilities, email, internet connections, fax machines, and cell phones. Some large-scale traders buy from organized farmer associations; they can export or sell to large millers. A few emerging large-scale traders are based in transit markets. These large-scale traders have knowledge of other institutional buyers such as WFP and NGOs, and have interest in receiving information about government agricultural trade policies.

Information Received and Modes Used To Receive It in Mozambique

Table 32 shows the information received and modes used to receive information by users in Mozambique. Farmer group leaders receive information on contacts of buyers and sellers, retail prices and wholesale prices through email, websites, meetings, and television.

Table 32: Information Received and Modes Used To Receive Market Information by Users in Mozambique

Information Received	Farmer organization.	Farmers	Gov't	NGO/ NPO[1]	Trader	WFP/Donors
Contacts of buyers and sellers	X	X				
Producer prices					X	
Retail prices	X	X	X	X	X	X
Wholesale prices	X	X	X	X	X	X
Time series data			X			X
Modes Used To Receive Market Information						
Email	X		X	X	X	X
Website	X		X	X	X	X
Fax			X	X		
Hand delivery (Bulletin)		X	X	X	X	X
Meetings / Technicians	X	X		X		
National radio		X		X	X	
Rural radio		X		X	X	
Telephone			X		X	
TV	X				X	

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: Alternative Models to Provide Agricultural Market Information; X means information received or mode used by group of stakeholders. 1: NPO=Non-Profit Organization

Farmers receive information about contacts of buyers and sellers, retail prices and wholesale prices via national radio Mozambique and rural radios. They also receive information included in SIMAP bulletin via hand delivery and through meetings with local and international organization NGO staff and extension workers, but the information sometimes arrives two months late, and at that time it is not useful. Farmers also receive information from indirect methods such as meetings friends, relatives, and traders. Some of the farmers interviewed do not trust the information from traders because they think that traders can give wrong information in order to buy at a lower price. They stated that if they could receive the SIMAP bulletin regularly, they would not use information from traders.

Government workers receive retail prices, wholesale prices, and time series data through email, website, hand-delivery, telephone, and fax. NGOs and NPOs receive retail prices and wholesale prices from SIMA through most of the channels consisting of email, website, fax, hand delivery (bulletin), meetings, national radio, and rural radio. Small-scale traders receive wholesale, retail, and producer prices from SIMAP and SIMA through national and rural radios. Large-scale traders receive this information through emails, websites, hand-delivery, national and rural radios, telephone and television. WFP and donors such as the World Bank officials in Maputo receive weekly information on wholesale and retail prices through email, and from the website at any time when needed. They can also collect the time series data from SIMA by-hand (hand delivery) when the SIMA email does not work.

Information Needed, Frequency Needed, and Preferred Modes of Diffusion in Mozambique

Farmer group: Table 33 summarizes the information needs and the frequency at which the information is needed as stated by the users interviewed in Mozambique during the case studies. Some of the information some users stated that they need is actuary provided by the MIS as will be noted later. Farmer group leaders need information on contacts of buyers and sellers daily and weekly, and on quality needed by buyers seasonally.

Table 33: Information Needed and Frequency Needed By Users in Mozambique in 2009

Information Needed	Farmer organization	Farmers	Government	NGO/NPO	Traders	WFP/Donors
Contacts of buyers and sellers	X	X		X	X	X
Price forecasts and trend analysis		X	X			X
Stock in markets				X	X	
Quality needed by buyers	X	X				
Prices from markets not covered MIS			X		X	
Prices on horticultural products						X
Harvest or production forecasts		X				
Harvest or production volumes						X
International prices				X		
Producer prices						X
Regional prices					X	
Supply and demand estimates in markets		X			X	
Transport costs		X			X	X
Production volumes						X
Volumes traded						X
Horticultural prices		X				
Cross border trade flows					X	
Storage techniques		X				
Quantities (inventory) with farmers' associations		X				
How to cultivate horticultural crops		X				
Do not need more information from SIMA					X	
Availability and number of traders buying					X	
Need information on potential input providers				X		
Frequency Needed						
Bi-annually			X			
Daily	X					
Seasonally	X	X		X		
Weekly	X	X	X	X	X	X
Monthly		X				
As needed (on demand)						X

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: X means information mentioned as needed by at least one stakeholder. Alternative Models to

Provide Agricultural Market Information; X means information mentioned as needed by at least one stakeholder.

Farmers: Farmers need information on contacts of buyers and sellers, price forecasts and trend analysis, quality needed by buyers, and harvest or production forecasts. Some farmers stated they needed information on supply and demand estimates in markets, and transport costs of produce from rural parts of the district to the city through monthly MIS bulletins. Other information needed include storage techniques, and monthly information on how to cultivate horticultural crops like onions and cabbages from April to September on notice board at association offices. These preferred modes of receiving market information were stated during the focus group discussions. Farmers would like SIMAP to report the quantity (inventory) of produce they have in each farmer association so that traders start to contact them for produce. This information would be like some sort of advertisement to traders on where produce is available. The majority of stakeholders indicated that they wanted to receive the information using the modes they are already receiving the information included in Table 32 above.

Government: Some of the information needed by government policy makers and food security analysis include price forecasts and trend analysis. They also need prices from markets and districts not covered MIS. This information was needed seasonally and weekly.

NGOs and NPOs (non-profit organizations): NGOs and NPOs need information on contacts of buyers and sellers, stocks in markets, international prices of commodities, and prices in neighboring provinces where their farmers can sell agricultural commodities. They also need information on contacts of input providers, and the flow of products in different areas in order to design better selling strategies. Market information is needed more frequently during the marketing season than the production period, and they prefer to receive it by email.

Traders: Small-scale and medium-scale traders in assembly-, general merchandise-, and transit markets need information on contacts of buyers and sellers and stocks in markets, price of commodities in markets not covered by the MIS, and regional prices. They also need information on supply and demand estimates in the markets, cost of transport from production area to towns, and cross border trade flows. Large-scale traders state that they do not need any information from SIMAP because they have cell phones which they use to call other traders for current information. Some private sector companies such as SEVITEL (a private company trying to set up an SMS based MIS) would like to receive prices of agricultural products, and places where the product is available on a daily basis, and transport costs on a bi-monthly basis. It can access this information through the internet or by email.

World Food Program (WFP) and World Bank: WFP needs market analysis and price forecasts on a quarterly basis. It also needs information on contacts of buyers and the price they buy at weekly. WFP would like SIMA to cover more markets in remote districts where it is working, although it understands the financial implication of this demand. WFP would like SIMA to gain capacity to monitor cross-border trade, an activity currently being done by FEWSNET. This information is needed for food security analysis, and WFP prefers to receive it by email weekly or as needed. The WFP has in the past committed financial support to SIMA through the treasury. The World Bank needs information on production volumes, volumes traded, and prices on horticultural products.

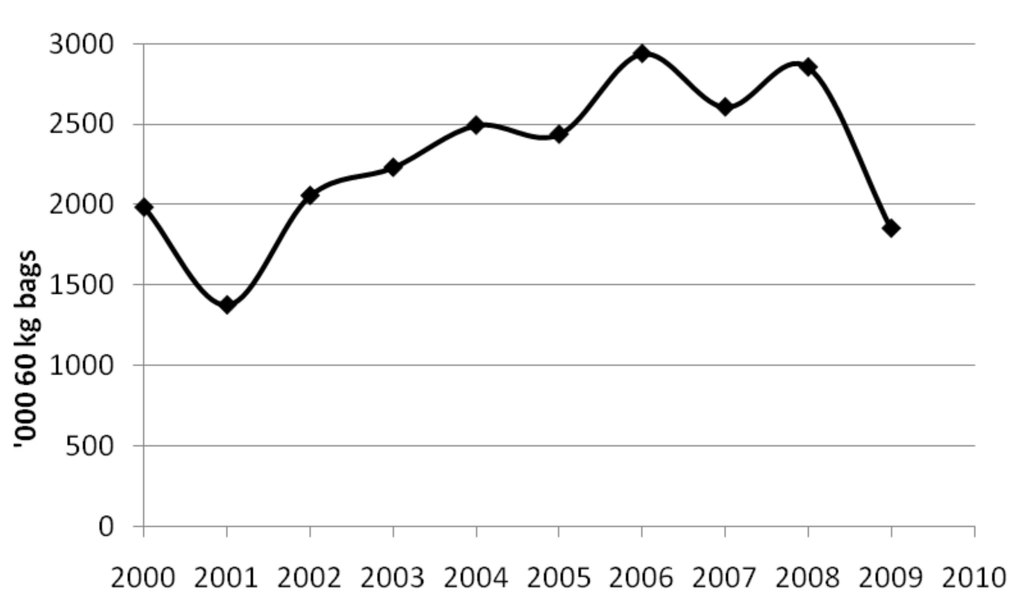
A.2.3 Information Received and Needed By Users in Ethiopia

Characteristics of Some Information Users and Background Information

In Ethiopia, information was collected through (1) literature review and (2) a case study visit to the Ethiopia Commodity Exchange (ECX) MIS section. Coffee, which is a cash crop, was the main commodity traded on the exchange and on which market information was being provided in 2009 when the case study was conducted. Therefore, the study focused mainly on actors in the coffee subsector. The researcher interviewed 4 MIS workers in the MIS section of the ECX. In order to have some assessment of how the information flows from ECX to various users, 2 focus group discussions were conducted with 10 coffee farmers in Leku Woreda (district) located around 38 kilometers south of Hawasa, the main town in Sidama region. Leku Woreda is located in Sidama region, a major coffee-producing region in Ethiopia. Hawasa town is about 260 kilometers south of Addis Ababa. Other information users interviewed included 3 cooperative union officials, 1 educator and researcher, 2 exporters, 2 central government policy makers (officials), 1 journalist, 7 regional government officers, and 3 agricultural commodity traders. There was no random selection of case study respondents for the same reasons given under Mozambique—no sampling frame of the heterogeneous information users, and limited time and money to create one.

Farmers: The farmers interviewed in Leku by the researcher were mostly smallholder farmers, who on average sold 1,133 kilograms of unprocessed coffee each in the 2009 marketing season (year) and were all members of service cooperatives. Other crops grown in the area include *inset* (false bananas), maize, sweet potatoes, and chilies. Most coffee farmers are members of service cooperatives. A group of service cooperatives forms a union (union cooperative). The farmers sell unprocessed red coffee cherries to service cooperatives and share dividends at the end of the year. The coffee marketing channel in Ethiopian villages is concentrated in a sense that farmers mostly sell to service cooperatives. Other individual traders may buy coffee from the farmers but in designated buying centers in the presence of local government inspectors to ensure that the coffee is not adulterated. This creates limited competition between the service cooperatives and the private coffee traders.

Figure 2: Ethiopia Total Coffee Exports from 2000-2009 in '000 60 kg bags



Source of data: International Coffee Organization database

The service cooperatives sell the washed coffee to the unions, and unions sell coffee to ECX. In 2009, some unions could export specialty coffee without selling through ECX. ECX buyers export high quality coffee and sell the rest on the local market. Coffee is the biggest foreign exchange earner in Ethiopia. In 2009, Ethiopia exported 1,851 thousand 60 Kg bags of coffee (see Figure 2), representing about 2 percent of the global coffee exports.

Information Received and Modes Used to Receive it in Ethiopia

Farmer organizations: Farmer organization leaders receive information on buying and selling prices, grades and standards, international prices and traded volumes via electronic billboards, email, fax, hand delivery, national radio, newspapers, television, and website.

Farmers: In Ethiopia, farmers receive information on buying and selling prices, grades and standards, and traded volumes via radio and television. Farmer who are near or visit some urban centers can receive information via electronic billboards.

Government: Government employees receive more detailed and specialized categories of information than other users. Government employees receive buying and selling prices at ECX, exports and domestic sales, international prices, market participants (number of buyers and sellers), regulations, traded volume, training about overview of ECX, warehouse arrivals; and weekly-, monthly-, quarterly-, and annual reports. This information is delivered via CDs, email, hand delivery, national radio, telephone, television, and website.

Exporters and Traders: Exporters buy on the exchange to export and sell the rest of the coffee to local processors for domestic consumption. Traders buy coffee and other commodities such as spices and pulses from farmers and other small-scale traders and sell on the commodity exchange (in case of coffee) and through other marketing channels. Exporters and traders receive information on buying and selling prices at ECX, grades and standards of coffee traded, international prices, regulations, and traded volumes. Exporters receive information through electronic billboards, hand-delivery, television, and websites. Traders receive information through electronic billboards, fax, hand-delivery, national radio, telephone, and television.

Journalist: One journalist interviewed received information on buying and selling prices at ECX, grades and standards, qualitative harvest or production forecasts, regulations, traded volumes via email, hand delivery, telephone, and website.

Table 34: Information Received and Modes Used To Receive Market Information by Users in Ethiopia

Information Received	Farmer organization.	Farmers	Government	Exporter	Trader	Journalist
Buying and selling prices at ECX	X	X	X	X	X	X
Exports and domestic sales			X			
Grades & standards	X	X		X	X	X
Harvest or production forecasts						X
International prices	X		X	X	X	
Market participants (number of buyers and sellers)			X			
Regulations			X	X	X	X
Traded volume	X	X	X	X	X	X
Training about overview of ECX			X			
Warehouse arrivals			X			
Weekly, monthly, quarterly and annual reports			X			
Modes Used To Receive Market Information						
Billboards (electronic)	X	X		X	X	
Data on a CD			X			
Email	X		X			X
Fax	X				X	
Hand delivery	X		X	X	X	X
National radio	X	X	X		X	
Newspapers	X					
Telephone			X		X	X
Television	X	X	X	X	X	
Website	X		X	X		X

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: Alternative Models to Provide Agricultural Market Information; X means information mentioned as needed by at least one stakeholder.

Information Needed, Frequency Needed, and Preferred Modes of Diffusion in Ethiopia

Table 35 shows the information needs as stated by users in Ethiopia. Again, some of this information is provided, but some users seem not to receive it. The information needed by most user categories includes supply and demand estimates, grades and standards, price forecasts and trend analysis, harvest or production forecasts, wholesale prices, and buying and selling prices at the Ethiopia Commodity Exchange (ECX). Some users need unique information.

Farmer organizations: Farmer organizations need information on supply and demand estimates, grades and standards, price forecasts and trend analysis, wholesale prices, buying and selling prices at ECX, producer prices, regulations, retail prices, traded volume, coffee suppliers to ECX and their settlement prices, and weather forecasts. This information is needed annually, daily, monthly, and quarterly through email, fax, rural radio, and websites.

Farmers: Farmers need information on supply and demand estimates, price forecasts and trend analysis, harvest or production forecasts, agricultural policy information, regulations, and stock in market. They need this information daily and weekly through television and national radio.

Table 35: Information Needed, Frequency Needed, and Preferred Modes of Diffusion by Users in Ethiopia in 2009						
	Farmer organization	Farmers	Government	Exporter	Trader	Journalist
Information Needed						
Supply & demand estimates	X	X	X	X	X	
Grades & standards	X		X		X	
Price forecasts and trend analysis	X	X	X	X	X	X
Harvest or production forecasts		X	X		X	X
Wholesale prices	X		X		X	
Buying and selling prices at ECX	X		X		X	
Agricultural policy information		X		X		
Buyers on the ECX				X		
Producer prices	X		X			
Regulations	X	X				
Retail prices	X				X	
Traded volume	X				X	
Causes of poor quality in coffee			X			
Coffee suppliers to ECX and their settlement prices	X					
Commissions given by other coffee traders					X	
Commitment of trade report (quantity sold, bought, prices)				X		
Contacts of buyers and sellers					X	
Exchange rates				X		
International prices			X			
Legal action taken by ECX against members			X			
Market analysis and commentary			X			
Marketing costs				X		
Phytosanitary specifications						X
Production costs				X		
Quantity of coffee exported				X		
Quantity of defective coffee			X			
Stock in market		X				
Weather information / forecasts	X					

Table continued on next page

Table 35 (Continued)

	Farmer organization	Farmers	Government	Exporter	Trader	Journalist
Frequency Needed						
Annually	X					
As actions are taken			X			
As needed				X		
Bi-annually				X		
Daily	X	X	X	X	X	
Monthly	X		X	X	X	
Quarterly	X		X		X	X
Weekly		X	X			
Preferred Mode of Diffusion						
Billboards (electronic)				X	X	
Email	X		X	X	X	X
Fax	X					
Rural radio	X					
Web	X			X		
Television		X			X	
National radio		X			X	

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: Alternative Models to Provide Agricultural Market Information. X means information mentioned as needed by at least one stakeholder.

Government: Government needs information on supply and demand estimates, grades and standards, price forecasts and trend analysis, harvest or production forecasts, wholesale prices, buying and selling prices at ECX, producer prices, causes of poor quality in coffee, international prices, legal action taken by ECX against members, market analysis and commentary, and quantity of defective coffee. In general, regional government employees needed more information than those based in Addis Ababa. This information is needed at different intervals. For example, the government coffee regulatory body needs information on legal enforcement actions taken by ECX against members who violate rules as soon as actions are taken to verify whether the corrective actions are done according to the law and to take remedial measures e.g., through the creation of awareness among members not to make the same mistakes that cost them money. Some type of information is needed daily, monthly, quarterly, and weekly. The preferred mode of diffusion by government employees is email.

Exporters and Traders: Exporters need information on supply and demand estimates, price forecasts and trend analysis, agricultural policy information, buyers on the ECX, commitment of trade report (quantity sold, bought, prices), exchange rates, marketing costs, production costs, and quantity of coffee exported. They like to receive this information as needed (on demand), bi-annually, daily, and monthly via electronic billboards, email, and on the website. Traders need information supply and demand estimates, grades and standards, price forecasts and trend analysis, harvest or production forecasts, wholesale prices, buying and selling prices at ECX, retail prices, traded volumes, commissions given by other coffee traders, and contacts of buyers and sellers. They would like to receive this information daily, monthly, or quarterly via electronic billboards, email, television, and national radio.

Journalist: One international journalist interviewed would like to receive price forecasts and trend analysis, harvest or production forecasts, and phytosanitary specifications on a quarterly basis through email.

A.2.4 Information Received and Needed By Users in Zambia

Characteristics of Some Information Users and Background Information

In Zambia, interviews were conducted with 6 AMIC employees (3 in Lusaka, 2 in Monze district, and 1 in Kabwe district) and one employee in the ZNFU 4455 SMS MIS in Lusaka. Focus group discussions were conducted with two farmer groups in Monze district (about 180 km south-west of Lusaka) in the Southern province, and one farmer group in Kabwe district in the Central Province. The first group in Monze consisted of 11 farmers and the second group consisted of 10 farmers. The group in Kabwe consisted of 8 farmers. Other users interviewed in Zambia included 2 employees of food assistance organizations, 1 employee of food security analysis organization, 2 government employees, 1 researcher, and 2 maize traders. Two large-scale millers declined to give useful information during the interviews.

Farmers: In both Monze and Kabwe, the farmers interviewed mostly grow maize, sweet potatoes, beans, and rear livestock including cattle, goats, and village chickens. Other crops grown include cowpeas, groundnuts, sunflower, and vegetables (rape, cabbages, onions, tomatoes, and eggplants). Overall, 17 out of the 29 farmers interviewed in Monze and Kabwe reported to have produced and sold an average of 62 bags of maize, each weighing 50 kilograms in the 2009 marketing season. Farmers reported to leave some maize for home consumption and to sell the rest.

Most farmers in Kabwe district (Central Province) harvest and sell their crops starting in April to June, which are also the main harvesting months for maize in Zambia. This is in contrast with farmers in Monze (Southern province), who reported the peak marketing months for their crops (mostly maize, groundnuts, sweet potatoes sunflower and cotton) to be between July and September.

It is not clear whether the farmers interviewed were net buyers or net sellers of maize. Research in Zambia indicates that in 2007/08, 26 percent of smallholder farms produced and sold maize; 35 percent of the rural population were net buyers of maize; 10-16 percent of the rural farm population were non-maize producing and buyers of maize; and 23-35 percent of the rural population in areas where maize is the dominant staple crop neither bought nor sold maize (Tembo, et al., 2009).

Traders: In comparison with traders in Mozambique given in section A.2.2, traders interviewed in Zambia consisted of medium-scale traders and large-scale traders. The medium-scale traders interviewed in Kabwe sell the highest volumes of maize (average of 30 tons a day) between May and August. They have small lockups that act as stores. Large-scale traders handled larger volumes compared to medium-scale traders and have bigger storage facilities, offices, and some have fax machines.

Information Received and Modes Used to Receive it in Zambia

Farmers: Table 36 shows information received and the modes used to receive it in Zambia. In Monze district, where the decentralized district MIS is very active, farmers receive information such as harvest and production conditions, improved methods of farming, livestock prices, marketing extension (e.g., how to sell maize across the border or in other provinces), phytosanitary specifications and quality requirements of maize traders, prices of agricultural inputs (fertilizer) by traders, and weather reports in addition to retail and wholesale prices. The information is received via meetings, national radio, and rural private radios. Farmers who belong to farmer associations receive hand-delivered MIS bulletins by district agribusiness and marketing officer.

Traders: Traders in Monze and Kabwe reported to receive information contacts of buyers and sellers, price of maize from millers and grain buyers, retail prices, and wholesale prices. Some of this information was not from AMIC but other sources. Traders receive information via email, national radio, rural radios, SMS, and television.

Government: Government workers receive market news such as import or export bans, market trends of major staples and pulses, retail prices, and whole prices information bulletins through email and by hand delivery.

WFP and NGOs: NGOs and WFP receive retail prices and wholesale prices in from AMIC and other sources through email, hand delivery, meetings, SMS, telephone, and website. SMS requests are used to receive information from the ZNFU 4455 SMS MIS and not for information from AMIC.

Table 36: Information Received and Modes Used To Receive Market Information by Users Zambia

Information Received	Farmers	Trader	Gov't	WFP and NGO
Contacts of buyers and sellers		X		
Harvest or production conditions	X			
Improved methods of farming	X			
Livestock prices	X			
Market news (e.g., on import or export bans)			X	
Market trends of major staples and pulses			X	
Marketing Extension (e.g. how to sell maize across the border or in other provinces)	X			
Phytosanitary specifications and quality requirements	X			
price of maize from Millers and grain buyers		X		
Prices of agricultural inputs (fertilizer) by traders	X			
Retail prices	X	X	X	X
Weather report	X			
Wholesale prices	X	X	X	X
Wholesale prices but not from AMIC		X		
Modes Used To Receive Market Information				
Email		X	X	X
Bulletins on notice boards	X			
Hand delivery	X		X	X
Meetings	X			X
National radio	X	X		
Rural radio	X	X		
SMS		X		X
Telephone				X
Television		X		
Website				X

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: Alternative Models to Provide Agricultural Market Information; X means information mentioned as needed by at least one stakeholder.

Information Needed, Frequency Needed, and Preferred Modes of Diffusion in Zambia

Farmers: Farmers in Zambia (Monze and Kabwe) need information on storage techniques for maize, and buyers' contacts from April to September—the main marketing season—through MIS bulletins on association notice boards.

In Monze district, farmers need livestock prices, and information on sources of water for their livestock. In Kabwe district, farmers needed information on how to grow alternative crops especially vegetables, soil sample tests and appropriate seed suitable for the type of soils in their area, and harvest or production forecasts. This means that providing market information along with extension information, e.g., on soil types and suitable seeds, would benefit farmers in Kabwe district. Farmers need this information monthly through hand delivery and notice boards at association headquarters.

Traders: Traders need information on harvest or production forecasts, price forecasts and trend analysis, market analysis and commentary, grades and standards, terms of payment, regional prices, retail prices, other traders' and millers stocks, transport costs, and weather forecasts. Some traders in Zambia, like in Mozambique, state that they do not need any extra information from Agricultural Market Information Center (AMIC) because they get enough information from other traders and friends. This could also reflect their view that AMIC information is not reliable. Traders need this information daily, monthly, seasonally, and weekly via email, hand delivery, post office mail, SMS (cell phones), and website.

Table 37: Information Needed, Frequency Needed, and Preferred Modes of Diffusion by Users in Zambia in 2009

	Farmers	Trader	Government	WFP and NGO
Storage techniques	X			
Contacts of buyers and sellers	X			
Livestock prices	X			X
Sources of water for livestock	X			
How to grow vegetables	X			
Soil sample tests and appropriate seed for the soil types	X			
Harvest or production forecasts	X	X		
Price forecasts and trend analysis		X		
Market analysis and commentary		X		X
Grades & standards		X		
Terms of payment (trade)		X		
Regional prices		X		
Retail prices		X		
Traders' and millers stocks		X		
Transport costs		X		
Weather information / forecasts		X		
Cross border trade flows			X	
Stock in market			X	
Food Reserves Agency stocks				X
Inputs distributed by NGOs and government				X
Prices and quantities purchased by FRA				X
Prices from markets not covered by MIS				X
Frequency of Diffusion				
Daily		X		
Monthly	X	X		X
Quarterly				X
Seasonally		X		
Weekly		X	X	

Table continued on next page

Table 37(Continued)

Preferred Mode of Diffusion				
	Farmers	Trader	Government	WFP and NGO
Notice boards	X			
Email		X	X	X
Hand delivery	X	X		
Post office mail		X		
SMS (Cell Phone)		X		
Web		X		X

Source: Case study of Market Information Systems in Mozambique, Ethiopia, and Zambia from September to October 2009 under the MSU-FSG-Hewlett project on Strengthening African Regional Trade through Improved Market Information: Alternative Models to Provide Agricultural Market Information. X means information mentioned as needed by at least one stakeholder.

Government: In Zambia, government policy makers need information on cross-border trade flows and stocks in market for food security monitoring weekly through email.

WFP and NGOs: WFP needs information on Food Reserve Agency (FRA[6])stocks, the types and quantity of inputs distributed by NGOs and government, prices and quantities purchased by FRA, prices from markets not covered by MIS, and market analysis and commentary. NGOs and needed information on livestock prices and market analysis and commentary. This information is needed monthly and quarterly through email.

A.2.5 Summary and Implications

In terms of characteristics, some information users are smallholder farmers or small-scale traders, subsistence farmers, mixed or diversified farmers, illiterate, lack storage

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6 The Food Reserve Agency (FRA) is a government parastatal established in 1996 with three main functions of: (1) administering a national strategic reserve, (2) marketing and market facilitation and (3) management of storage facilities. FRA usually buys maize from sellers at a minimum price.

facilities, and lack access to cell phones. Also, some have limited alternative marketing channels.

In terms of information needed, the main observations are that: (1) the information needs of farmers tend to vary depending on the crops they grow. (2) Users have many and varying information needs, with the implication that one MIS may fail to meet all their needs, leading to the need for different MIS models to complement each other. (3) Some types of information are needed by several stakeholders, and some types of information are needed by only a few stakeholders. (4) In many cases, the information needed by users is actually provided by the MIS, but some users do not receive it because of lack of access to the diffusion channels used or because some potential users listen to radios at different times than those in which information is broadcast. (5) The frequency of need and preference on how to receive it also varies by information and users.

It seems like organized farmers (e.g., those in groups) in Zambia and Mozambique, prefer to receive information that is tangible and easily storable, e.g., through bulletins which can be placed on the notice boards at the association offices. This makes sense because it is easier for a group member to carry a market information bulletin, say from the NGO located in an urban town to the village, and later convey this information to other members during meetings or on the notice board than to try to memorize or note down information broadcast over radio or television.

Users receive market information using different modes, suggesting that using one or a few types of dissemination technologies may not deliver information to all users. These observations suggest that small-scales farmers and traders are more likely to receive market information through radio; large-scale traders are likely to receive information through SMS and email; and NGOs and government through email and internet. Thus, market information from government-supported MIS models that use broadcast radio and direct contacts (meetings/extension) are more likely reach to smallholder farmers and small-scale traders. Information from private MIS that use mostly cell phones and the internet to collect, transmit and disseminate information is more likely to reach large-scale and specialized traders. In the next 5 to ten years, more smallholder farmers will more likely be able to receive information through SMS because the number of cell phone subscribers is increasing over time and the costs of cell phones and airtime are likely to reduce over time.

A. 3 Public MIS

A.3.1 The Mozambique Information System for Agricultural Markets (SIMA)

Aims, Objectives, and Clientele Served

The Information System for Agricultural Markets (SIMA) started in 1991 as a joint project between Michigan State University and the Government of Mozambique to facilitate agricultural marketing through reducing information asymmetries between traders and rural farmers, to collect information for food security monitoring, and to provide information to Government of Mozambique for better policy formulation. In 2000, the MIS was taken over by government of Mozambique. SIMA is decentralized and has branches, called SIMAP, in each of the 10 provinces of Mozambique. Nampula province has 18 districts, and the district in which the provincial headquarters is located is referred to as the provincial district. Each SIMAP is also decentralized and is supposed to have a presence in each district in the province (see Figure 3 below). The SIMAP in Nampula was the first to be established, and is considered to be one of the best models among the SIMAPs in Mozambique.

The Provincial Information System for Agricultural Markets (SIMAP) in Nampula started in 1997 with the aim of providing agricultural market information to farmers to enable them negotiate for better prices with traders. The SIMAP also aimed at generating data for use in the computation of national accounts, and to estimate the value of the agricultural sector's contribution to the GDP. In addition, data collected by SIMAP complements the data collected by the provincial unit of the institute of statistics, and is used to compute the level of inflation. The main clientele of both SIMA and SIMAP include farmers, traders, farmer associations NGOs, government parastatals and institutions, local government departments and ministries, municipalities, local markets officials, and individual users.

Information Provided, Frequency, and Modes of Diffusion

SIMA and SIMAP collect information on 25 agricultural products. The commodities on which information is collected vary depending on the level of production and seasonality of crops in the provinces. Price information for each commodity in each market is collected from three traders for consistency. At the national level, information is collected from 16 rural and 6 urban markets at producer, wholesale, and retail levels spread over the nine provincial districts (SIMA, 2009). At the national level, market news and analysis is compiled in a weekly bulletin called *Quente-Quente*.

In Nampula province, SIMAP collects negotiated prices at wholesale and retail levels from 2 rural district markets in Rebawe and Murrupula districts and from formal wholesalers in the cities of Nampula and Nacala (2 urban districts) on a weekly basis. Market news and analysis is compiled into a monthly bulletin branded as *ESISAPO*[7]. In the past, in Nampula province, where the author conducted a field visit, information used to be collected from 15 districts (13 rural districts and 3 urban districts). Due to limited funding to hire, train, and supervise enumerators, SIMAP is currently active in only two rural districts and two urban districts. In rural districts, when there is no facilitation, such as vehicle and fuel, information is not collected. In Nampula town, SIMA collects information weekly from Mwatala market (retail prices) and Gorongosa market (for wholesale prices).

[7] Es*isapo* means negotiated prices in the local Makua language

In Nampula town, quantitative information on traded volume and stocks in terms of number of bags of grain is also collected weekly. Contact information (e.g., names, addresses and telephone numbers), a list of agricultural commodities bought by large-scale buyers, and a list of agricultural inputs sold by input dealers in town are sometimes collected and included in the information bulletin. Other information monitored every week, although not always disseminated, includes transport costs.

Information Provided: At SIMA, the main commodities on which information is reported include white maize, common beans, rice, large and small groundnuts, and dry cassava. A typical SIMA bulletin has information on: (1) market analysis covering opportunities and outlook for selected commodities in selected provinces; (2) the trend of consumer price levels in the past four weeks, (3) transportation costs incurred by traders to move commodities between markets, (4) producer, wholesale, and consumer weekly price levels and percentage changes in the previous two weeks in major markets, (5) estimated quantities of commodities available for sale and purchase, and their percentage changes from the previous week in major wholesale markets; (6) prices of white maize grain in non-standard local units by location; and (7) regional and international FOB and futures prices of major commodities and foreign exchange rates for neighboring and major countries (SIMA, 2009).

In Nampula, a typical SIMAP bulletin has information on the main highlight of the week, such as the general price movements of main crops like white maize, sugar, rice, and beans. The highlights summarize commodities whose prices have remained stable, increased, or declined. The bulletin also includes other news related to marketing, food security or storage of agricultural commodities. It also has contact information for the main buyers of agricultural products such as their fax, telephone, and email contacts. It also has a section on companies that have commodities for sale. Other information provided includes advice to farmers not to sell all their commodities for food security purposes, especially when poor weather (e.g., low rainfall) is predicted, and to diversify and grow alternative crops.

Modes of Diffusion: The main modes of diffusion used by SIMA include email, television, website, and newspapers. In Nampula province, SIMAP information is disseminated through email, notice billboards, blackboard, hand delivery of the bulletins, printing and placing the bulletin in district pigeon holes at the provincial government headquarters once a month, and on the notice board at the entrance of the provincial headquarters of directorate of agriculture at Nampula. Information is also written by chalk on blackboards in the district markets, and at the provincial headquarters. Blackboards in districts without enumerators remain blank, since it is the enumerators who write on the blackboards. Also, the provincial officials such as the Provincial Director of Agriculture take the market information bulletin with them when they go to visit the rural areas and districts. In the past, information was disseminated via two 15-minute broadcasts every Tuesday at 5:30 am and every Thursday at 5: 30 pm on Radio Mozambique in a local language (Makua) after the regular news program. The radio programs, which cost the SIMAP approximately 109,000 meticais ($3,893) every three months, stopped in September 2008 due to limited funding from the province and other donor projects. In Nampula province, the MIS bulletin is given to the unit of communication (under the provincial services of extension) to be aired in a weekly 30-

minute agricultural radio program that includes complementary information on extension and all other agriculture programs.

SIMAP does not send information to the three private radio stations in Nampula City because they have limited coverage, and there is a perception that they do not reach the farmers who are considered the main MIS clients. The SIMAP staff does not recognize that there might be some positive spillover effects of having traders in urban areas having access to information from the private FM stations. District enumerators are expected to distribute the information they collect to the rural community radios. SIMAP prefers to disseminate the bulletin through email because it minimizes the costs of buying paper, printer and copier toner, and the costs associated with hand delivery of information.

Data Collection, Transmission, and Quality Control Methods

Collection and Transmission: District enumerators collect information from market participants using one-on-one interviews and direct observation in markets. The information is recorded on standardized questionnaires. The information is then transmitted to the provincial headquarters using radio equipment by voice, which can lead to transcription errors. In some cases, telephones are used to transmit information. Information is also hand delivered to the provincial headquarters by enumerators from markets in Nampula town.

At the national level, data analysts at the SIMA use mobile phones to call enumerators at the provincial headquarters for market information. The introduction of mobile phones has affected the collection of information by the SIMAP in some positive and negative ways. For example, in Mozambique, the SIMA staff members call enumerators at the provincial districts—bypassing the SIMAP supervisors at the provincial level—and collect information in a short period of time. As a result, SIMAP supervisors at the provincial level don't regularly call district enumerators for data since SIMA analysts no longer demand this information from the SIMAP supervisors and coordinators at the provincial level. The result is that the MIS bulletins are not regularly produced at the provincial level.

Another way of explaining why the bulletin is not regularly produced is that there is no effective demand for the provincial SIMAP bulletins or somehow this demand, if it exists, is not transmitted to the regional SIMAP supervisors. The provincial government is the main clientele of SIMAP. Since the frequency at which the government needs the information is low, the SIMAP staff produces outputs at less frequent intervals that meet the needs of their most important client. Also, information is not collected regularly from some districts due to lack of financial resources to hire enumerators to replace those who are transferred, died, or absconded. In some situations, information is not transmitted because of lack of initiative from SIMAP staff to request information from districts, even when there are fax and radio equipment at the province and the district.

Quality Control: SIMAP reporters interview at least three traders in the market for prices of commodities. This helps them to ensure that the information collected from traders is consistent. The supervisor and coordinator also examine the price trends by comparing current prices with the past week's prices and other historical data. When there is a sharp decline or increase, they send the enumerator back to the market to cross-check the information. The problem with this is that the reporter can report the same prices so that he does not reveal that he had collected the wrong prices in the first instance. The ideal situation would have been the coordinator to visit or call the traders to cross-check the prices and not to send the same enumerator.

The supervisors also use their local knowledge about production in the areas to see if the price increases or decreases correspond with the production or supply in the area. For example, when the price is reported to have increased sharply yet it is the harvest season, this triggers a query, and the enumerator is sent back to the market. This approach assumes that price decreases and increases are mostly due to production and ignores other factors that may lead to price increases such as damaged roads, increase in transportation costs, poor security on the roads, and increased demand from neighboring districts. These factors may lead to a price increase even during the harvest season.

Supervision in the rural districts is limited due to lack of resources such as money for per diems and fuel. Supervision in Nampula city is easy because there is no need to pay per diem. The last supervision was two months from the date of the case study interviews. The supervisor and coordinator of SIMAP staff were trained by SIMA staff at the beginning of SIMAP in 1997.

The Development of an SMS Dissemination Platform in Mozambique

A private firm, SEVITEL, has a memorandum of understanding (MOU) with SIMA to develop an SMS platform to diffuse market information. In the MOU, SEVITEL will not pay the SIMA anything, and SIMA will not pay SEVITEL anything. The SMS platform by SEVITEL is planned to receive daily data directly from the field collectors into the MIS database. It is unlikely that SIMA enumerators will have the capacity to collect market information on a daily basis due to financial constraints and the incentive structure in the MOU unless donors facilitate SIMA to implement the data collection activities. The planned procedure is that field collectors will fill in a predesigned format on the cell phone and send it to the SMS database at SEVITEL.

A similar initiative is also being experimented by Technoserve (Esoko Mozambique) based in Nampula in collaboration with Esoko Ghana. Esoko Mozambique is planning to collect information in collaboration with local NGOs and sell it to users on an SMS platform. There seems to be no collaboration between SEVITEL and Esoko Mozambique, implying that there is a potential duplication of activities, and thus costs if both initiatives take off, but also competition in the market for information.

Institutional Home, Feedback Mechanism Used, and Sources of Funding

Institutional Home: SIMA is a unit under the Department of Statistics in the Directorate of Economics in the Ministry of Agriculture. In Nampula province, the SIMAP is a unit under the Department of Economics, and the Department of Economics is under the Provincial Directorate of Agriculture and Rural Development [8](Figure 3). At the national level, SIMA has four permanent staff and two contract staff. SIMA has a coordinator (the position is not official in the Ministry organogram), two technicians who are graduates and three technicians who are undergraduates (two enumerators and one data cleaner).

At the provincial headquarters in Nampula, the SIMAP has a coordinator, a supervisor who also works as a processor or data analyst, and three enumerators, one of them a dedicated SIMA enumerator. The enumerators at the provincial district collect data from the provincial district. All employees of the SIMAP are permanent employees of the provincial government (and implicitly the central government) since they are paid

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[8] Direcção Provincial de Agricultura e Desenvolvimento Rural de Nampula.

on government budget. At the district level, SIMAP is supposed to have two enumerators. Due to limited resources, many districts do not replace enumerators when they transfer, die or abscond from duty. This is also partly because the provinces can only hire new enumerators with the approval of the central government.

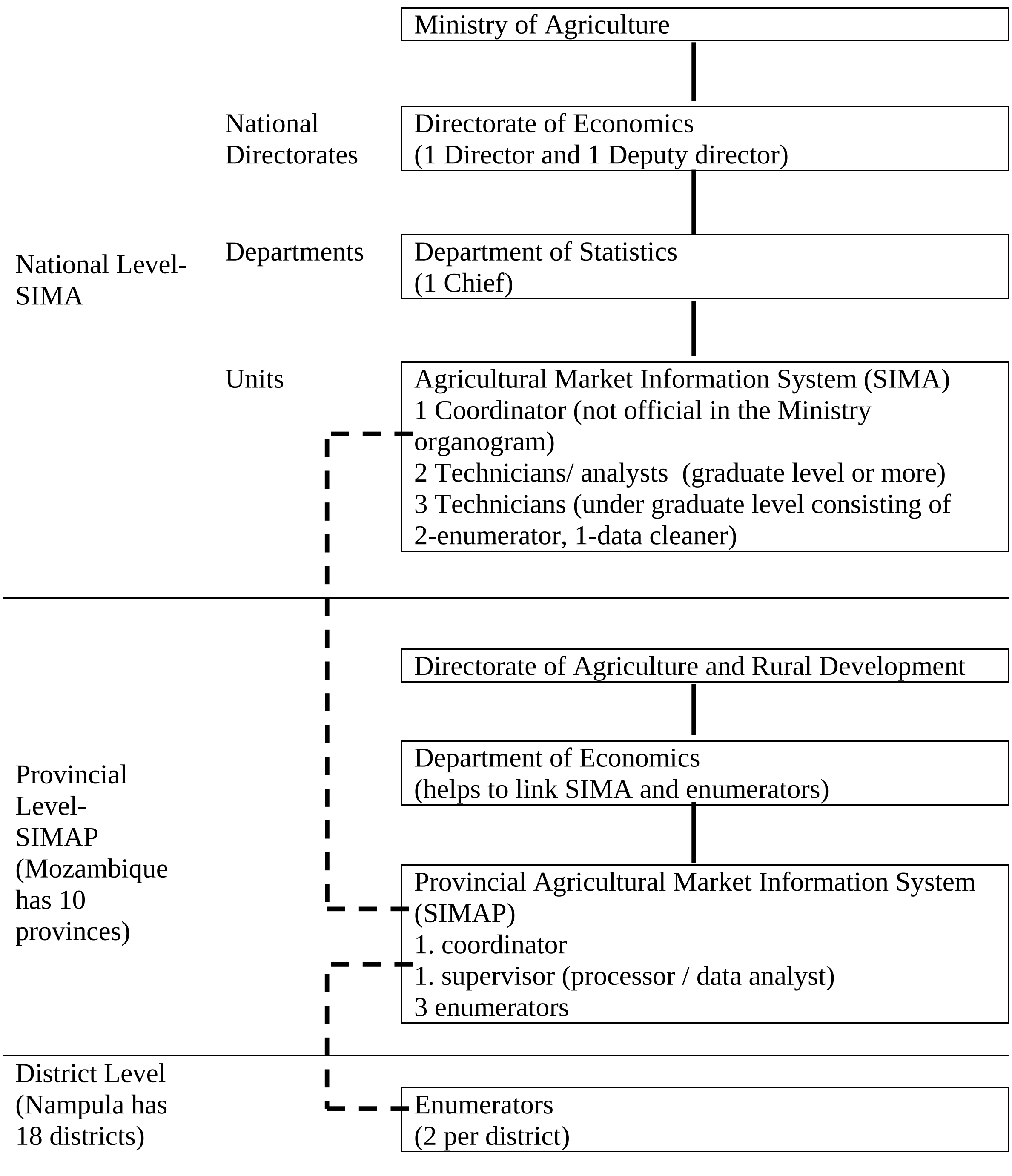
The solid vertical lines in Figure 3 show the hierarchy and the flow of bureaucracy within the national and provincial levels. The broken lines show the linkages and nature of decentralization between SIMA and SIMAP. The performance in terms of timeliness and quality of the data from the districts to the SIMAP and eventually to SIMA depends on the incentives (e.g., data collection allowances) that flow along the broken lines, and not the power of bureaucracy (e.g., threat of contract termination or punishment for failure to deliver data) since the two levels are administratively delinked as demonstrated by the lack of a solid line between the national and provincial levels.

Feedback: Feedback is partly obtained from users during occasional research studies. The SIMA and SIMAP also use the information from the National Agricultural Surveys conducted by the Directorate of Economics/ Department of Statistics in Ministry of Agriculture in Mozambique called *Trabalho de Inquerito Agricola* (TIA). TIA collected information about how farmers receive information and how they find the information to be useful in 2002 and 2005. (This data formed the basis for the analysis in chapter 4.) In the past, farmers and traders reported to the Provincial Director of Agriculture whenever information was not disseminated on radio through the dedicated market information program. This used to be one of the ways for feedback and also made the numerators and the MIS personnel to be accountable to the stakeholders. Since the province stopped funding the dissemination of information, the Provincial Director of

Agriculture (the principal) cannot penalize the SIMAP staff (agents) for failing to disseminate information by radio.

Sources of Funding and Sustainability: SIMA is funded by the government of Mozambique and donors. It also receives technical support from Michigan State University. In 2008, WFP contributed to the national budget with the objective of enabling SIMA to collect more information from more districts where WFP was implementing the P4P (Purchase for Progress) program. As a sustainability strategy, SIMAP would like the tax collectors to also collect market information, since tax collectors are there in all markets, and tax collection is a more sustainable activity. There is a tendency, however, for traders to fear giving truthful market information to tax collectors for fear of being overtaxed. Thus, this strategy may reduce the reliability and credibility of information from the MIS.

Figure 3: Organizational Chart of SIMA and SIMAP in Mozambique



A.3.2 The Zambia Agricultural Market Information Center (AMIC)

Aims, Objectives, and Clientele Served

AMIC started in 1992 following privatization and liberalization of the Zambian economy, with the aim of improving efficiency in agricultural marketing among private-sector actors such as input dealers, farmers, and traders, through the provision of timely and accurate market information. Another aim of AMIC is to collect information for government planning and decision making on food security strategies. AMIC is a decentralized MIS with a presence at each of the nine provinces of Zambia. Each province consists of several districts, and the district in which the provincial headquarters is located is called the provincial district.

Smallholder farmers and small-scale traders are considered to be the most important clients of AMIC. The dissemination strategies of AMIC in Lusaka, however, focus more on government institutions. In Monze District, in Southern Province, where the author carried out a case study, the dissemination strategies focus more on local users such as farmers and traders with radios who are interested in listening to market information. NGOs, a few traders, and private individuals are also included on the AMIC email distribution list of 162 users.

Information Provided, Frequency, and Modes of Diffusion

Information Collected: Information is collected once a week on retail and wholesale prices from two or three traders in each market for selected commodities. The information is collected from at least two markets in each of the nine provincial districts through one-on-one interviews by market data reporters. When the provincial district is small, information is collected from one market. Other non-provincial districts also collect information and submit it to the province headquarters. The Central AMIC in Lusaka, however, uses data only from the nine provincial districts. The national MIS collects data on 18 agricultural commodities and products, 3 fertilizer commodities and 6 seed varieties at the retail and wholesale levels. Given the seasonality of production, not all this information is obtained at any given period of time.

Other information collected at the retail level includes qualitative supply assessment of commodities (i.e., abundant, good, fair, limited, or not available); and hammer mill service costs and the millers' qualitative estimate of her/his capacity utilization (i.e., whether the mill is not operational, operational at 25 percent capacity, 75 percent capacity, or full capacity). At the retail level, the commodities on which market information is collected includes white maize grain, breakfast meal, white roller meal, bread flour, polished rice, beans, and groundnuts. Also, prices of inputs such as fertilizers, seeds and chemicals are also collected. At the wholesale level, some of the commodities on which market information is collected include white maize grain, sorghum, paddy rice, beans, soybean, groundnuts, fertilizer, seed, and chemicals.

At the district level, information on local trade is expected to be collected, but its collection is not enforced. Such information includes names of local traders, trader contact details, their sale prices and the units, barter purchases, terms of transactions, main sources of supply, and main sales destinations. Districts can also collect information on commodities that are important in the districts. For example, in Monze district, the MIS collects daily wholesale and retail prices on *Kapenta* (a small dried fish variety), tomatoes, onions, white maize grain, breakfast meal, white roller meal, goat prices, village chicken, honey, milk, groundnuts, beef, fertilizer, and maize seed.

Information Provided: AMIC produces a bimonthly market information bulletin. The bulletin includes general price movements of white maize grain, breakfast meal, and roller meal. This information is also graphed for selected districts, usually for a period of 12 months, but not necessarily up to the current month, suggesting that the database is not updated regularly. Other information in the bulletin includes tables of retail prices of maize grain, breakfast meal, roller meal, mixed beans, cassava chips, fertilizer, seeds, and the percentage changes in prices from the previous week. The bulletin also includes SAFEX future prices for white and yellow maize, wheat, sunflower and soya. Foreign exchange rates of major currencies, news in the agricultural sector, and links to important food security websites are also included in the bulletin.
The districts are also expected to come up with independent market information bulletins. In Monze, the district market development officer (DMDO) and his assistant collect price information, enter it into the FAO Agri-market software and print out a table of average prices of food commodities, fertilizer and seeds. A market information price sheet is produced in Kabwe district by the Kabwe Agriculture Market Information Service, but the service is no longer presently active as it was before February 2009.

Radio presenters in Monze disseminate information on prices, weights, and grades and standards of maize required by buyers, and names of buyers and traders in the town. Other information included in the MIS bulletin include terms of transactions such as whether buyers pay instant cash or payments are collected after some time. When funds are available, AMIC provides marketing extension, such as trainer of trainer workshops on how to find markets, and requirements and ways of importing and exporting agricultural commodities. Import, export, and transit permits are also issued within the same department housing the MIS, although that is done by different staff.

Modes of Diffusion: At AMIC in Lusaka, the bulletin is emailed to approximately 160 users, hand delivered to government offices, and faxed to a few users. The AMIC bulletin is also uploaded on the MSU website (http://aec.msu.edu/fs2/test/marketinformation/zambia/amic/). There are plans to start posting the AMIC bulletin on the department website. In the past, market information was disseminated via the national radio and the bulletin was hand delivered to traders and millers who provided market information. This stopped due to financial constraints. In Monze district, market information is disseminated through two local radio stations. Other districts are expected to make arrangements with community radios to disseminate market information.

Frequency of Diffusion: In Monze District, the information is delivered to the FM radio stations, where it is disseminated via two radio programs weekly, each lasting for 15 minutes. One radio program is on Star FM every Tuesday at 18:30, and another program is on Radio Chikuni every Thursday at 18:30. The costs of disseminating information through radio consists of airtime and producer allowances. The costs of disseminating information for six months total to about 8.6 million kwacha ($1870) on Star FM, and around 5.4 million kwacha ($1174) on Chikuni FM.

Data Collection and Quality Control Methods

Data collection methods: Data is collected by the District Marketing Officers and their assistants through one-on-one interviews with traders. The information is then transmitted by fax machines, telephone, or hand delivered to the provincial headquarters.

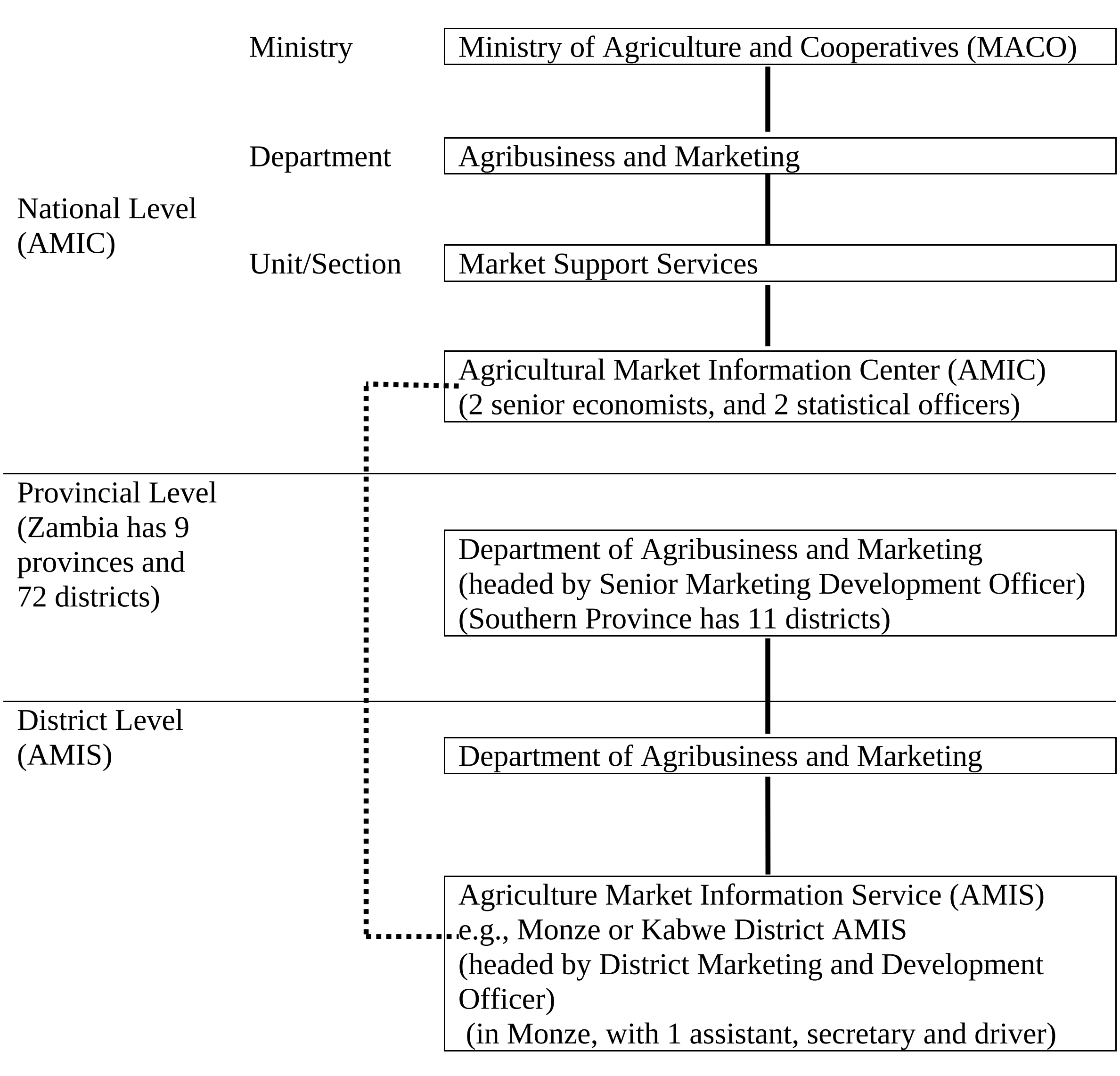
From the provincial headquarters, information is then transmitted to the AMIC headquarters by fax machines, by telephone, or by hand delivery. Some districts with donor support like Monze have the capacity to transmit information to Lusaka by email. AMIC faces an infrastructural problem in terms of sufficient email connections. At AMIC, SPSS is used to capture the data. There is no data entry check program used in SPSS. Transmission of data using voice over the phone can lead to transcription errors and capturing data without a data entry check program can lead to data entry errors.

Quality Control Methods: At AMIC in Lusaka, data is inspected for outliers during data entry. When outliers are found, they are investigated. The supervisors also proofread the bulletin and check for errors before it is disseminated. In the past, with support from the Food Security Research Project (FSRP), AMIC used to train and supervise all enumerators regularly. This is not currently done because of financial constraints.

Institutional Home, Feedback Mechanism Used, and Sources of Funding

AMIC is located in the Market Support Services unit in the Department of Agribusiness and Marketing in the Ministry of Agriculture and Cooperatives (MACO). At the provincial level, the Agricultural Market Information Services (AMIS) activities are located in the Department of Agribusiness and Marketing and at the district level, the District AMIS is located in the Department of Agribusiness and Marketing (Figure 4). At the provincial level, each group of districts within each of the nine provinces is expected to produce a local market information bulletin, but this is no longer done for several reasons such as lack of supervision and financial resources to motivate the workers to conduct the activities. The AMIS in Monze and Kabwe are under the Department of Marketing and Agribusiness of the Ministry of Agriculture and Cooperatives.

Figure 4: Organizational Chart Showing the Position of AMIC and AMIS in Zambia



The dotted lines represent the flow of the data from the district to the National Level. There are no administrative and incentive links between these two levels, which may explain why there are many delays in information flow between the two levels. At the National headquarters in Lusaka, AMIC has one head, two senior economists, and two statistical officers. At Monze and Kabwe districts, AMIS is headed by the District Marketing Development Officer. In Monze, he is assisted by a secretary, a driver and an assistant, who normally collects the information from the markets. All the staff at the national, provincial and district levels are hired through the public service commission and are permanent.

Feedback Mechanisms Used: In the past, when resources where available, AMIC conducted user needs surveys. In Monze district, the MIS receives feedback from farmer focus groups, through telephone calls to the radio program from listeners, and from farmers who visit the district offices for information. According to the information managers, a high number of farmers visiting the office for market information is an indicator that users are not satisfied or not receiving enough information from radio, and a small number of visitors means that users receive and are contented with the market information from radio. The rival explanation for this occurrence is that a small number of visitors could indicate that users think that information from the MIS is useless and hence not worth the trouble contacting the MIS, while a high number of visitors could mean that the users find the information useful and want more.

Sources of funding: AMIC is funded by the Government of Zambia. It has received technical assistance from Michigan State University in form of staff development and in-kind contribution of a fax machine and landline telephone. The FSRP pays for the landline telephone and fax machine bills for AMIC. Other donors facilitate data collection through provision of fuel for data collection. The dissemination budget of the pilot MIS in Monze, Choma, and Livingstone is also supported with funding from the World Bank through the Agricultural Development Support Program

(ADSP). ADSP also provided the MIS with a fax modem that can be used to receive and send emails. The telephone lines bills at Monze are paid by the government of Zambia.

One idea by the researcher on future funding prospect is that under some value chains, such as the maize subsector in Zambia, a possibility of taxing some stakeholders at strategic levels in the subsector (e.g., at miller level) could be introduced. Part of this fee could then be used to supplement the dissemination of market information to users.

A.3.3 The Ethiopia Commodity Exchange (ECX) Market Information Section

Aims, Objectives, and Clientele Served

The Ethiopia Commodity Exchange started in April 2008 with the aims of helping the agricultural market in Ethiopia to become efficient, transparent, secure, and of integrity. The ECX conducts many activities, including offering a trading floor system among traders, warehousing delivery centers, and market information. Other services provided by ECX include handling, storage, and grading of agricultural commodities. This case study covers activities of the market information system in the ECX. At present, most of the information generated is on coffee because the quantities of other commodities (e.g., maize, haricot beans, wheat, and sesame) traded through the exchange are limited and not frequent, most likely because they have alternative unregulated marketing chains.

The ECX's main clientele are the members who can be classified into two groups: (1) members who buy on the trading floor (ECX buyers), and (2) members who sell (ECX sellers or intermediaries). ECX buyers include coffee exporters and traders who buy coffee to sell locally. ECX sellers include mostly private traders and cooperative unions. Farmers are indirect members (clients) of ECX through their membership in service cooperatives and unions. Farmers or traders who do not belong to a cooperative may also be indirect members (clients) of ECX when they become clients of registered ECX intermediaries (traders). There are several recipients and users of ECX information such as NGO's, government departments, donors, banks, researchers, and educational institutions.

Members are also grouped in two types: full members and limited members. Full members have a permanent membership seat which is freely transferable and can trade in any commodity on the exchange. In 2009, when the researcher conducted a case study in Ethiopia, full member seats were not being offered any more. Limited members have a one year membership and can only trade one commodity and in one position (i.e., as buyers or as sellers only) on the exchange. It is not clear why ECX was not offering full membership at the time the case study was conducted. In terms of market efficiency, it seems like it would be advantageous to have full members rather than limited members, as that would ease on both temporal and spatial arbitrage.

Information Provided, Frequency, and Modes of Diffusion

Information provided includes price in Birrs, and volumes in *Feresula*[9] for all the types[10] and grades of coffee traded on the exchange. Other information provided includes regulations, classes of coffee transacted, the New York Coffee closing and future prices, a 30 day price trend for each type of coffee, the market share of coffee type, an ECX coffee index, and a summary of international coffee news.

ECX diffuses information instantly, daily, weekly, and quarterly. ECX uses multiple dissemination modes, including electronic display boards (Rural Electronic Price

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[9] A feresula is a unit commonly used in coffee trading, and it consists of 17 kilograms

[10] The types include ECX washed coffee, unwashed coffee, and ECX local coffee.

Ticker (REPT)), its website, national public radio, private FM radios, newspapers, national and private television, fax, email, telephones (voice), and hand delivery of some reports and bulletins. For example, prices of the day, the closing price of the previous day, and the real time coffee price on the New York Board of Trade are displayed on the electronic billboards within 4 seconds of trade in Amharic and English. In 2009, there were 24 electronic billboards, three of which were in Addis Ababa and 21 in the regions. ECX has a target of installing 200 more electronic billboards throughout Ethiopia to target more rural farmers. This information is also updated on the ECX website instantly and targets all users who can access the internet. All information collected belongs to ECX.

Daily and weekly reports are disseminated by email, fax, and hand delivered to radio stations (Radio Ethiopia, Amahara-Region radio, Dire-Dawa FM and other private-sector based radios), television (Ethiopia Television, Addis TV, and Oromigna TV), newspapers (Addis Zemen, The Daily Monitor and Ethiopian Herald daily, and Capital and Fortune weekly), and ECX members. The reports are written in four main languages (Amharic, English, Oromifa, and Tigregna). Other information, such as market regulations and coffee news is provided at less frequent intervals through the website, in meetings with ECX members, and in a quarterly newsletter called *Its Coffee Time!* More confidential information (e.g., quantities of inventories and warehouse receipts' expiry dates) is disseminated by phone, email, fax, or placed in members' mail boxes. ECX also trains its members through awareness workshops, posters, brochures, and by posting materials on its website on how to trade on the commodity exchange, how to interpret and use market information such as prices and on grades and standards of coffee.

ECX got a one-year concession from the Ethiopia Government to disseminate market information through all government media channels for free. ECX will face full dissemination costs after one year, and this is likely to increase its dissemination budget significantly. It is also unlikely that private companies will pay to disseminate market information to farmers. This is because in Ethiopia, farmers mostly sell coffee through service cooperatives. The main functions of coffee cooperative unions are to buy coffee from member service cooperatives and to import and distribute agricultural inputs and equipment to farmer members. Thus, there is no incentive for cooperative unions to advertise (increase costs at a lower level), and thus sponsor market information radio programs, unless they are really farmer- based cooperatives interested in increasing the incomes of their members. The cooperative unions and local governments, however, are interested in disseminating information on how to improve on quality of the coffee among value chain participants.

Besides, coffee farmers probably do not need a lot of market information because they mostly sell to the service cooperatives, and earn dividends. Coffee farmers can choose to sell to a few private coffee buyers who only operate in designated areas where they can be monitored by local government inspectors to ensure that they do not adulterate the coffee beans. Even if farmers fail to negotiate for higher prices with the service cooperatives, they earn some dividend at the end of the year as long as the management inefficiencies are less than the value of the profit of the cooperative and assuming that all profits go back to members. Instead, it is both the service cooperatives managers as sellers to union cooperatives and union cooperative managers as commission agents for service cooperatives on the ECX who need information most since the competition is between cooperatives and not between farmers. On the one side, the service cooperatives aim at obtaining higher prices from union cooperatives, and are therefore interested in knowing the price at which different grades of coffee are traded at on the exchange. On the other side, union cooperatives compete to buy from service cooperatives by charging the least commission on the sales of coffee on the exchange on behalf of service cooperatives. If the union cooperatives were truly owned by the member service cooperatives and themselves operated as cooperatives, then bargaining between the service cooperatives and the unions would not be a big issue. If the unions got a low price from the service cooperatives and earned a profit, the profit would be rebated back to the service coops. To the extent that bargaining between the service coops and the unions is important, it may reflect that the unions are not acting like a cooperatives or that the gains they make are captured by their management.

On the other hand, getting information on the price differentials for different grades of coffee would be important for the service cooperatives so that they can create incentives for their members to produce higher-quality coffee. Note that prices and grades of coffee traded on the exchange is public information, but the commission charged by cooperative unions and private traders (the ECX sellers) is private information, although it is known by the ECX. There is a potential effective demand for this information among ECX sellers, because they want to compete among themselves to attract sales from service cooperatives and other independent farmers.

Moreover, farmers sell coffee beans to the service cooperatives while the information disseminated is for processed coffee. Although it is likely that the information on processed coffee can be used in formula pricing for coffee beans, formula pricing was not explicitly reported to be used by service cooperatives.

A system to transmit information by SMS and Interactive Voice Response (IVR) in real time is under design. In the proposed SMS dissemination methods, ECX is considering both the "push system," where information is sent to users, and the "pull system," where the users request data at their own time, frequency, and schedule. In the IVR, users will be able to dial a toll-free number and listen to market information. Paid-up members of the exchange will be given passwords to enable them access more detailed (more valuable or more private) information such as inventories, dates when their warehouse receipts expire, and their account balances. Thus, the frequency of diffusion varies by mode of diffusion, the targeted information users, and the type of information.

Another observation was that exporters do not like ECX to publish prices and grades of coffee over the internet, but ECX likes this information to be public so as to promote competition. The exporters do not like this information on the internet because international buyers get to know the prices at which the exporters bought the coffee. It seems like this situation (symmetric information about export coffee prices between coffee exporters and international coffee buyers), weakens the bargaining position of exporters and strengthens that of international coffee buyers.

Data Collection, Transmission, and Quality Control Methods

Price information is collected on the trading floor as soon as a transaction occurs on the exchange. Once the seller and the buyer agree on a price, quantity, and the grade of a commodity, the information is captured and entered into customized MIS application within the trading floor. From that point, the information is instantly ready for dissemination on the billboards and website. There are no market data collectors in the market. The MIS application generates daily and weekly reports ready for dissemination. Information on grades and standards is obtained as soon as the commodity is received at the ECX warehouse and data describing it is entered into the MIS application.

The ECX information collection process has instant quality control mechanisms in the sense that the seller and buyer sign the papers after a transaction is done. Both the seller and buyer submit the paper to the counter for entry into the system, and the funds are transferred from the buyer's account to the seller's account. There is no room for errors, as these would mean loss of funds by either the buyer or the seller.

Until the end of 2009, cooperatives and firms trading in specialty coffee were allowed to export directly without trading through the commodity exchange. The rest of the coffee is by law supposed to be traded through the exchange. This means that ECX is not a thin market because it handles the whole volume of coffee traded, and the price information generated as a byproduct of its exchange activities are representative of the broader trends in the entire coffee market in Ethiopia (excluding specialty coffee by 2009 when the researcher conducted the case study). Specialty coffee has started to be traded through the exchange as well.

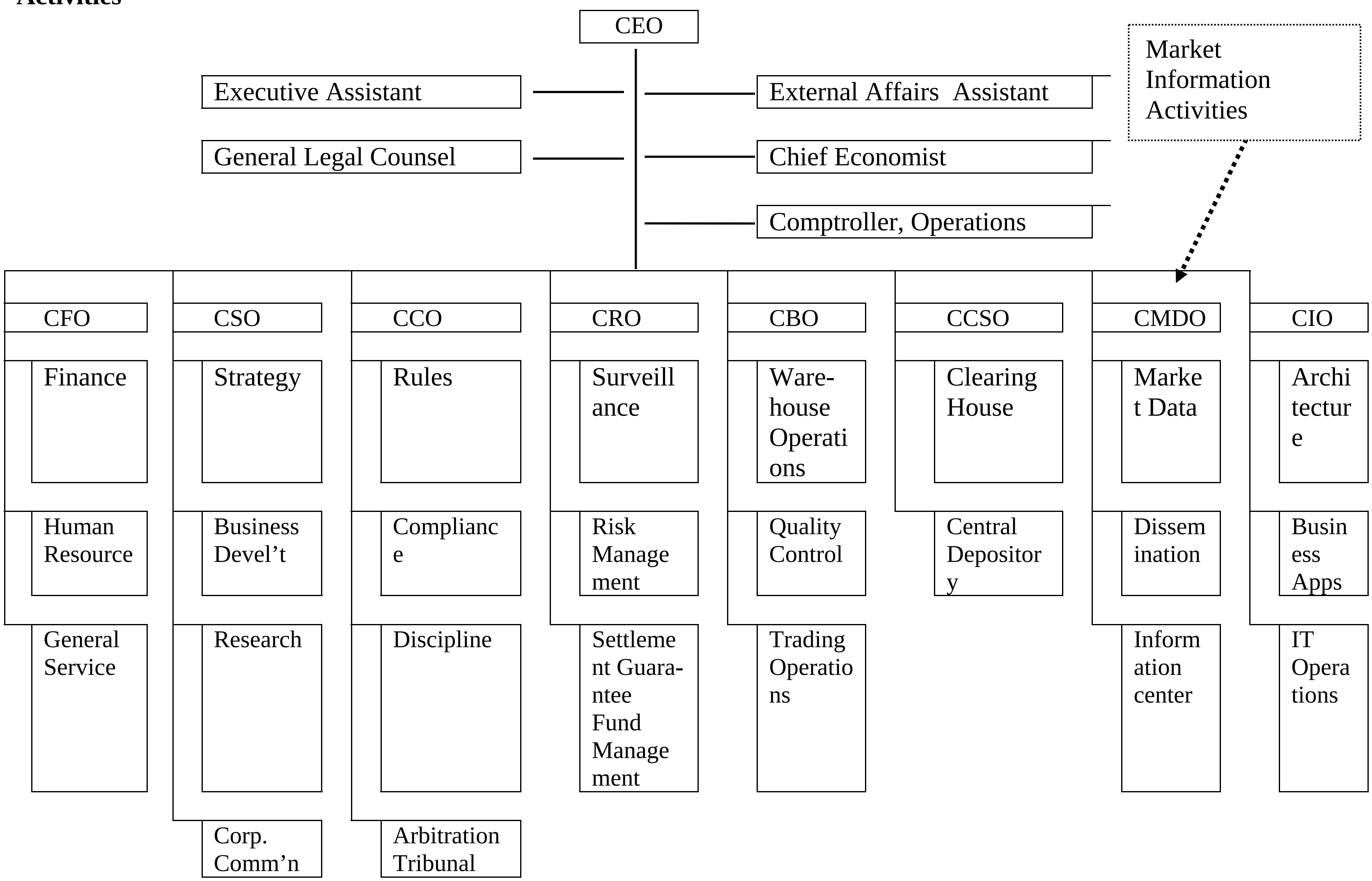
Institutional Home, Feedback Mechanism Used, and Sources of Funding

The MIS is a section or unit under ECX. The ECX is an independent and autonomous public-private partnership enterprise, partly owned by the Government of Ethiopia together with other private owners, with a board of directors consisting of owners and members. At a policy level, ECX has links with the Ministry of Agriculture and Rural

Development, and the Ethiopia Commodity Exchange Authority. ECX is not affiliated to any MIS network at a regional level but has information gathering linkages with several organizations such as Bloomberg and Reuters. ECX is not an organizer of any MIS network. The MIS section is headed by one market data manager. It has three sections: 1) the market data and infrastructure section, 2) the market data research section, and 3) dissemination section.

1. The market data and infrastructure section has four employees who ensure that the dissemination infrastructure such as the electronic price tickers are functioning and running smoothly. This section is in charge of the technical aspects of the SMS and IVR that are currently being designed and piloted.

Figure 5: Organizational Chart of the Ethiopia Commodity Exchange Showing the Position of the Market Information Activities



Adopted from ECX organizational chart

2. The market research section has 3 employees who conduct research on why the prices are going down or high (not shown on the organization chart).
3. The market data dissemination section has three employees who ensure that the information is disseminated via all the channels in an efficient and timely manner. This section is also in charge of the information center and the library.

ECX receives feedback from: 1) a market hotline telephone number to the exchange's information center (information users and members call when the website or the display boards are not working); 2) monthly panel discussions with the members; 3) the member relations section of the exchange, which gets comments from the members; 4) the compliance section of the exchange, which monitors activities of the exchange; 5) feedback about ECX's public awareness programs through the media; and 6) the Ethiopia Commodity Exchange Authority (ECEA) regarding complaints of members.

The money generated by the exchange is used to sustainably pay for all the running costs of the MIS. ECX does not charge a user fee for the data disseminated, but some users, such as members, indirectly pay for the information. Members pay membership seat fees, annual maintenance fees, transaction fees (exchange transfer fees, handling, and product certification), and warehouse fees. In the next phase, the MIS is considering generating resources through SMS subscriptions, from sale of analytical information products from the information center or through web subscriptions to password enabled sections on its website. This may be a source of conflict since ECX enjoys government support and would like farmers and traders to obtain as much information as possible. Secondly, the ownership of cell phones and access to the internet in Ethiopia is still very low.

A.3.4 The Fruit and Vegetable Market News - USA

Aims, Objectives, and Clientele Served

The Fruit and Vegetable Market News (F&VMN) was started in 1915 with the aim of sharing information among growers, shippers, wholesalers, researchers, government and other on supply, demand, and prices to ensure an efficient marketing systems (AMS, 1999, USDA, 2006).

Information Provided, Frequency, and Modes of Diffusion

The F&VMN disseminates market prices, supply estimates, and demand estimates on over 400 fresh fruits, vegetables, nuts, ornamental and other specialty crops. Several reports containing different types of information in various formats are disseminated daily, weekly, annually, and at longer intervals through the website, e-mail, newspapers, radio, television, fax, U.S. mail, and Market News Telephone Recorders. The Customer Service Center in Fresno, CA, also provides customers with market information reports in standardized formats (AMS, 1999, USDA, 2006).

The popularity and availability of each report changes by season. An example of a daily report is the *Shipping Point High/Low Highlights Report*, which includes information on imported and exported commodities through various US border crossing points, the level (tone) of demand and supply, the basis of sale (e.g., FOB), the date of entry, and low and high prices recorded. An example of a weekly report is the *National Fruit and Vegetable Retail Report*, which includes weekly advertised prices by major supermarkets and retail outlets for fruits and vegetables (AMS, 2008). Annual reports include annual price summaries and fresh fruit and vegetable shipments (AMS, 2008, AMS, 1999). Longer period reports include user guidance reports and manuals (USDA, 2006). Reports including rules and regulations related to import requirements for fruit and vegetable are provided at longer intervals, usually more than a year (AMS, 1998).

Data Collection and Quality Control Methods

Data is collected by market reporters through confidential telephone and face-to-face interviews. Quality control in collection is mostly achieved by training market reporters throughout the United States in skills that enable them to collect and provide impartial, current, and reliable information reports (AMS, 1999).

Institutional Home, Feedback Mechanism Used, and Sources of Funding

The F&VMN is part of the Agricultural Marketing Service (AMS) of the United States Department of Agriculture (USDA). Feedback is obtained though (1) daily or almost daily interactions with information providers, (2) customer and user surveys, and (3) regular attendance and occasionally hosting industry events in order to interact directly with the public and information users. Also, a customer satisfaction survey is conducted on the AMS website by an independent company (Foresee Results). Information users who visit the website are selected to fill in the customer satisfaction survey. The system is funded by federal and state governments. Customers who need customized information might be charged a fee depending on the complexity of their data requests.

A.3.5 National Agricultural Statistical Service (NASS) - USA

Historical Overview, Aims, Objectives, and Clientele Served

The collection of agricultural statistics in the USA dates back to the first population census in 1790 which counted 4 million Americans at a time when 9 out of 10 Americans lived on farms (NASS, 2007). At that time, the distinction between consumers and producers was small, and the government needed information on crops planted and how to get good harvests. In 1840, detailed agricultural information was collected through the first census of Agriculture. In 1862, USDA was established and in 1905, the USDA established the Agricultural Statistical Board. In 1961, USDA was reorganized to create a statistical reporting service known as the National Agricultural Statistical Service (NASS). Thus, the roots of NASS fall as back as 1863 when USDA produced its first crop report (NASS, 2007). Presently, NASS disseminates information on crop supply and demand estimates to enable farmers, businesses, policy makers, researchers, and government to make better marketing, production, and storage and investment decisions. NASS's mission is it to provide timely, accurate, and useful statistics in service to U.S. agriculture (NASS, 2010).

Information Provided, Frequency, And Modes of Diffusion

NASS provides information on approximately 27 crop categories disaggregated by state and county level, and for different practices under which the crop is produced. A crop may have several categories (e.g., corn for grain and corn for silage) and different production practices (e.g., irrigated, or non-irrigated corn). Taking corn for grain as an example, data is available for area planted in acres, area harvested in acres, yield per harvested acre in bushels, production in bushels, marketing year average price per bushel received by farmers, and the value of production in dollars (USDA-NAAS, 2008, USDA, 1999). Supply estimates consist of (1) beginning stock, (2) production, and (3) imports. Disappearances include domestic use (food, seed, and feed) and exports. Other information on government farm income- and price-support operations is provided such as (1) income support payment rates per bushel in dollars and (2) program price levels per bushel. Also, international information is published on area, yield, and production in specified countries such as Argentina, Canada, European Union, India, and the Russian Federation. Time series information is available on the NASS website.

Some reports are monthly (e.g. NASS crop production report) and World Agricultural Supply and Demand Estimates (WASDE) released at 8:30 am between 9th and 12th day of each month. Other annual reports are posted on the website (e.g. Agricultural Statistics).

This information implies that NASS does not collect a lot of price data but focuses on general agricultural statistics. For MIS in Africa, one critical question is how they should relate to general statistics units within ministries of agriculture that are charged with producing statistics on agricultural production (similar to NASS).

Data Collection and Quality Control Methods

NASS compiles US crop production data collected by approximately 50 different surveys from farm operations and field observations, and from administrative sources. The types of surveys include (1) Area Frame Samples which use satellite imaginary, aerial photos, and maps to select segments of approximately 1 square mile but having enumerators visit the segments to record information such as crops grown, animals reared, and grain storage; (2) List Frame Samples in which selection of sampling units is based on a list consisting of names, addresses, and telephone numbers of producers and agribusinesses to obtain information on more concentrated commodities that are difficult to locate based on area frame samples e.g., poultry. (3) Multiple Frame Samples which combine area frame samples and list frame samples, (4) Nationwide Enumeration and Integrated Surveys, and (5) Objective Yield Surveys.

The data collection methods vary by survey and commodity. Data may be collected through Computer Assisted Telephone Interviewing (CATI), telephone interviews, postal mail out/in questionnaires, on-line survey questionnaires, faxing back filled in questionnaires, and by enumerators who visit producers and agribusinesses.

Taking corn in the crop/ stock survey as an example, information on what farmers intend to plant is collected in March, information on acreage actually planted and acres expected to be harvested is collected by survey from over 250,000 farmers by 2400 interviewers in June, and actual production data is collected in December mostly through telephone interviews and computer-assisted telephone interviews (CATI). In some states, a grain storage survey (on-farm grain stocks) is done in the first two weeks of December, March, June, and September through telephone interviews and Computer Assisted Telephone Interviewing.

Yield forecast are collected from a yield forecast survey of a subsample of farmers growing crops of interests, and collected in May by enumerator who visit famer fields and count the number of plants, ears, pods and bills.   For some commodities and programs, such as dairy product prices program, information reporting on production and sales is mandatory. Administrative data are also obtained from private and public sources such as area planted data for selected crops under the deficiency payments programs before 1996; and utilization data about imports, exports, and cotton ginning.

Quality control is mostly ensured in the data collection process by (1) careful selection and training of enumerators,(2)use of detailed instruction manuals, (3) field supervision,(4) questionnaire checks, (5) comparison of reported acreage with those measured on the aerial photographs, (6) and follow-up visits to some segments (NASS, 2009).

Institutional Home, Feedback Mechanism Used, and Sources of Funding

NASS is part of the United States Department of Agriculture and is funded by the federal and state governments. Feedback on quality of information is collected through a random customer satisfaction survey conducted by third party provider to the internet visitors. Information users are given email, fax, and telephone contacts to send feedback to NASS.

A.3.6 The Indonesian Horticultural Market Information Service[11]

Aims, Objectives, and Clientele Served

The monitoring of vegetables prices in Indonesia started in 1979 with funding from the German foreign assistance agency GTZ with the aim of helping producers to obtain market information. Lack of market information and price fluctuations were a major problem in horticultural marketing in Indonesia. The main clientele of the MIS are farmers and traders; and government extension workers, planners and policymakers. The monitoring of price information of other commodities in Indonesia started in the 1950s (Shepherd and Schalke, 1995).

Information Provided, Frequency, and Modes of Diffusion

The MIS provides market news consisting of prices of vegetables, quality of the produce, packaging of the produce, and minimum transaction volume. Information is collected at production level (assembly markets) and at wholesale markets daily.

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[11] The information in this review is from two dated reviews (Giovannucci and Shepherd, 2001, Shepherd and Schalke, 1995). There is limited literature on how the MIS is currently operating. The Ministry of Agriculture website has limited information on the MIS activities. The information in this section needs verification.

In 1995, information from markets was transmitted by phone, fax or radio to headquarters. Presently, a method of using SMS to transmit cropped area, harvested area, production, and farm level price data is being piloted. Information collected by SMS is compiled in monthly and annual reports that are targeted for policy planers and policy makers. In 1995, the MIS information was disseminated via local and national radio and notice boards in markets daily. Information was also disseminated through newspapers bi-weekly and on monthly basis[12]. At that time, there was limited feedback on how relevant and useful the broadcast information was to users; there was no market analysis of information at regional and national level for policy formulation, and no feedback and return of analyzed reports from the headquarters to the regions.

Data Collection and Quality Control Methods

Data is collected by enumerators through face-to-face interviews and market observations by reporters. In 1995, the MIS collected data for seventeen vegetables and fourteen secondary food crops in the fourteen provinces. There were occasional failures to collect information due to staff shortages when collectors are not replaced due to budget restrictions. In some areas, there was limited training of enumerators, although the MIS tried to conduct annual training of its staff.

Institutional Home, Feedback Mechanism, and Sources of Funding

By 1995, the National Market Information Service Unit was under the Ministry of Agriculture in the Directorate of Food Crops and Horticultural Economics in the Sub-Directorate of Marketing. At the provincial level, MIS activities were supervised by Director of the Department of Food Crops and Horticulture in the Sub-Directorate of Food

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[12] There is need to verify whether the MIS presently uses email to transmit and diffuse information.

Crops and Horticultural Economics. At the district level, the MIS unit was under the Marketing Section. At the start of the MIS, there were user needs studies. The MIS was funded by government of Indonesia and received financial support from GTZ. There is no recent literature on how feedback is sought.

A.3.7 The Integrated Agricultural Marketing Information System/ Agricultural Marketing News Service (AGMARIS-AMNEWSS) - Philippines

Aims, Objectives, Clientele Served, and Historical Overview

The main aim of the AGMARIS is to provide information to producers and sellers of agricultural commodities to make informed marketing decisions and to provide information to be used by the public sector policy makers for food security planning and monitoring. Agricultural Marketing News Services (AMNEWSS) was stated in 1968 under the Bureau of Agricultural Economics (BAEcon). AMNEWSS provided retail prices mostly to be used by policy analysts in the Department of Agriculture. In 1987, the Bureau of Agricultural statistics (BAS), in collaboration with many projects supported by USAID, strengthened the collection, analysis, and dissemination of information with more emphasis placed on private sector users. AMNEWSS expanded to provide production, stock, and inventory data in addition to price data (Holtzman, et al., 1993). In 1992, at the end of the projects, some of their activities were integrated to create the Agricultural Market Information Systems (AGMARIS). In 1994, AMNEWESS and AGMARIS were merged to create the Integrated AGMARIS-AMNEWSS monitoring system (BAS, 2010).

Information Provided, Frequency, and Modes of Diffusion

Presently, AGMARIS-AMNEWSS provides buying and selling wholesale prices in 66 markets from 55 provinces or cities including Manila. AGMARIS-AMNEWSS also provides retail prices from 105 markets from 81 provinces or cities including Manila three times a week. The main commodity groups on which information is provided include rice, fish, meat and poultry, vegetables, fruits, sugar, and cooking oil. The information bulletins are available on the internet. BAS is one of the projects covered by FAO countrySTAT, and its historical information can also be obtained from the internet.

Data Collection and Quality Control Methods

In the integrated MIS, the AGMARIS data collection method is applied in 30 markets, and the AMNEWSS data collection method is applied in the rest of the markets. AMNEWSS uses purposive sampling within markets, with 5 reporters chosen per commodity three times a week. In the AGMARIS methodology, wholesale traders are stratified by type (e.g., large distributor, provincial assembler, or medium distributor among) and retail traders are stratified by location (e.g., whether they are inside the market, outside the market or on streets). Five traders are selected per commodity to provide information. The dates of collecting information from markets vary by market.

Several quality control methods are used in collection and analysis of the data. These include spot checks of enumerators, data consistency checks, and review of entered forms and questionnaires. During data entry and processing, data is inspected for missing data (completeness), and inspection of tabulated data for any inconsistencies. Other methods include looking at consistency of price with previous price trends and drastic changes in price levels.

Institutional Home, Feedback Mechanism, and Sources of Funding

The AGMARIS-AMNEWSS is housed in the BAS and BAS is under the Department of Agriculture. Funding for the system is from government.

A. 4 Farmer Organization-Based MIS

A.4.1 Observatoire du Marché Agricole (OMA) – Mali

Aims, Objectives, and Clientele Served

The Malian Agricultural Market Information System started in 1989 with the main aim of helping government and donors to monitor how the cereals markets were performing after the liberalization of the cereal markets, and to make informed food security policy decisions. In addition, the MIS aimed at making the market transparent by providing improved market information to private sector actors such as traders, farmers, consumers, and cooperatives to enable them make better production, marketing, and consumption decisions in a liberalized market. Banks are also important clients of OMA. The banks use the price information to value grain inventories when traders pledge inventories as collateral for loans for working capital.

In 1998, the MIS was restructured to ensure that it disseminated more reliable, timely, and relevant information that met the specific needs of users in different localities. The key elements of the restructuring included (1) transferring the institutional home of the MIS from the grain board (OPAM) to a farmers' organization, the Permanent Assembly of the Chambers of Agriculture of Mali (APCAM); (2) decentralization, with the creation of 24 local MIS offices (Unités locales de Collecte et Diffusion-ULCD) around the country that collect and diffuse information; (3) linking the local offices to local radio stations for localized market news broadcasts; (4) linking of the local offices and the headquarters into a national and regional network (Dembélé, et al., 2000, Diarra, et al., 2004, Keita, 2006, Traoré, et al., 2004).

Information Provided, Frequency, and Modes of Diffusion

OMA provides market news consisting of retail-, wholesale-, and producer prices; traders' stocks, and quantities traded; and market analysis to different users at different frequencies using different modes of diffusion. For example, information on current and past week prices and market supply collected from consumer and rural markets are disseminated weekly via rural radios and newspapers to producers, merchants, cooperatives, and consumers in local languages. A hard copy of the information bulletin is hand delivered to at least one rural based radio per ULCD for diffusion in the main local languages such as Bambara, Sarankole, Fulani, Dogon, Bobo, Songhai, Moor, Tamachek, and French some locations. The list of annually contracted private radios diffusing information is included in Table 38. OMA also uses the email and the internet to obtain and disseminate national and regional information in ECOWAS countries' market information networks (Traoré, et al., 2004). OMA is currently setting up an SMS based dissemination platform to provide instant information to users.

OMA publishes monthly market information bulletins with market analysis on how demand, supply and market prices of major crop commodities and livestock products have evolved during the month and in the previous one-year period. The information is provided on over 10 crop and livestock commodity categories. Major crops include millet, sorghum, maize, rice, and horticultural commodities. Livestock and livestock products include cattle, beef, goat, sheep, and poultry. The report also includes information on quantities of crop commodities exported to neighboring countries (OMA, 2009). These reports are disseminated by email and are available on the website.

OMA also publishes special market reports with specialized analysis, such as the effects of government policies, world production, and weather conditions on the performance of agricultural food markets and food security in the country and in the region. The analysis also includes factors that influence trends of market prices and supply of major commodities (OMA, 2008). This kind of analysis targets policy makers, donors, large-scale traders, and food aid agencies, and is mostly used in food security planning.

Table 38: Contracted Private Radios Diffusing Market Information in Mali

	ULCD	RADIO STATION	START MONTH	Number of weekly broadcasts
1	KAYES	RADIO RURALE (RRK)	JULY 2000	1
2	NIORO	JAMANA	AUGUST 2000	2
3	KITA	JIGIYA	AUGUST 2000	1
4	KOULIKORO	JAMANA	MAY 2000	1
5	DIOILA	MARADEME	AUGUST 2000	1
6	KATI	BELEKAN	MAY 2000	2
7	SIKASSO	KENEDOUGOU	JULY 2000	1
8	KOUTIALA	UYESU	JUNE 2000	2
9	SEGOU	FOKO	JUNE 2000	1
10	MACINA	RADIO RURAL 105 MHZ	JULY 2000	1
11	NIONO	RADIO RURAL CESIRI	JANUARY 2000	2
12	MOPTI	JAMANA	JUNE 2000	1
13	BANKASS	SENO	JANUARY 2003	1
14	BANDIAGARA	RADIO BAGUINE	JULY 2001	2
15	TOMBOUCTOU	LAFIA	JULY 2001	1
16	DIRE	BINGHA	JULY 2002	1
17	GAO	ANNIA RFI SANEYE	JUNE 2000	1
18	BAMAKO	BENKAN	JANUARY 2000	1
19	SAN	PARANA	NOVEMBER 2009	1
20	BLA	PARANA		
21	BOUGOUNI	PARANA		
22	NARA	OUAGADOU	OCTOBER 2009	2
23	KOURI	OUAGADOU		
24	DJENNE	OUAGADOU		
25	LERE	LAFIA	FEBRUARY 2008	2
26	KIDAL	LAFIA		
27	ORTM (TV+RADIO)	LAFIA		

Source: OMA

Data Collection and Quality Control Methods

OMA employs 23 permanent and 10 temporary enumerators who collect information from 21 rural and 30 urban markets using face-to-fate interview and observations. The enumerators transmit the information by SMS or by email to the decentralized offices of district chambers of agriculture and to the OMA central office in Bamako.

OMA tries to ensure data quality through use of trained enumerators, automated processing and error check programs during data entry, and close supervision of enumerators. OMA has a monitoring department that works to ensure that enumerator follow the established methods of data collection. The MIS also has technical and oversight committees that guide the MIS in its activities (Diarra, et al., 2004).

Institutional Home, Feedback Mechanism Used, and Sources of Funding

OMA is housed in a farmer organization called the Permanent Assembly of Chambers of Agriculture of Mali (APCAM). The housing of the MIS in the farmer organization has increased its credibility among farmers, who are one of the main clientele of the MIS. The MIS obtains feedback from user needs surveys well as informal interaction with market participants; external evaluation by donors; customer satisfaction surveys; and analysis of SMS and website usage.

OMA is managerially autonomous and is partly funded by the government and from own-generated resources generated through conducting specialized market research at the request of customers such as the government and donors. The proposed SMS platform for disseminating information will also be an additional source of revenue when implemented. The MIS has collaborative links with research organizations in Mali, the West African region; the West Africa Market Information System Network (RESIMAO), for which it serves as the Technical Secretariat; and Michigan State University. These collaborative linkages have facilitated OMA to develop a human capital base that can produce high-value market research products that are used in policy making. This in turn creates demand for its products from government and donors, and consequently contributes to its financial sustainability.

Challenges to OMA

OMA has faced several challenges since the transition in 1998 from an MIS based in a grain board (OPAM) to a farmers' organization. These included long bureaucratic routines, lack of entrepreneurial spirit, too few targeted products towards different users, and lack of a strategy to wean the MIS system from external funding (Staatz, 2007). OMA also faces challenges in meeting the future information needs of users resulting (1) regionalization, (2) the need for market extension, and (3) the need for improved information on grades and standards (Dembélé, et al., 2000) . Regionalization of the Malian agricultural economy implies more inter-regional trade. This means that OMA has to develop a cost-effective ways to provide timely regional market information to Mali's private sector to facilitate regional trade. OMA also has to provide regional information to government for policy and food security analysis such as examining the benefits of regional trade on the potential to design market-compatible safety nets for the poor. OMA also faces a challenge of providing appropriate marketing extension materials and to strengthen its capacity to develop and implement marketing extension programs aimed at enabling information users to make better commercial decisions with the information provided. OMA is also challenged with the need to provide market participants with information on quality requirements in the in the different market segments.

A.4.2 The Zambia National Farmers Union SMS Market Information Services

Aims, Objectives, and Clientele Served

The Zambia National Farmers Union ZNFU 4455 SMS MIS started in 2006 with the aim of providing market information to smallholder farmers so as to increase their bargaining power to negotiate for better prices, and to link them with local and national traders and processors. Other targeted users of the SMS MIS include traders, commercial farmers, donors, and millers.

Information Provided, Frequency, and Modes of Diffusion

The ZNFU SMS MIS collects and disseminates prices and buyer contact information on four livestock and ten crop commodities on a weekly basis. The crop commodities include beans, cassava, groundnuts, honey, maize, rice, sorghum, soybeans, sunflower and wheat. Livestock commodities include beef, goats, pigs and sheep. Information is uploaded weekly and users can request information at any time using a pull SMS system on prices offered by registered traders and their contact details.

Users (sellers) send an SMS to 4455 including a commodity code and location for which market information is needed (e.g., MAIZ PLSK for maize prices in Lusaka). The sender receives a text message indicating the names of registered buyers and the prices they offer for the selected commodity in the selected location. The sellers than send a second SMS to 4455 including a preferred buyer code and receive contact details of the particular buyer. The seller can then call the buyer to negotiate and conclude the transaction. The users can access the data base for SMS information through the Zain and Cell Z network. In 2009, MTN subscribers could not use the system. Price information and trader contact details are also uploaded on the website (www.famprices.co.zm). The system also disseminates market information and information on how to use the service on a radio program.

Due to limited demand, the system planned to increase the number of commodities to include information on vegetable traders, fertilizer and seed companies, veterinary service providers, and transporters. This has not yet been done. The system also advertised its services to increase its popularity among farmers, extension workers, traders, and processors (SHEMP-ADC, 2006, ZNFU, 2007).

Crop-Specific and Seasonal Demand of SMS Information in Zambia

Table 39 shows that from October 2006 to November 2007, maize accounted for 58 percent of the SMS requests, and the top four commodities (maize, soybeans, goats, and groundnuts) accounted for 83 percent of the total SMS requests in the ZNFU system in Zambia. Figure 6 shows that the highest requests for SMS occurred in the month of June, July and August, suggesting that the demand for SMS information is (1) crop-specific and (2) seasonal. Figure 6 shows that the peak request months for maize, soybeans and groundnuts were June, July, and August. These months fall in the middle of the peak harvest and marketing months reported by farmers and traders, which range from April to September, depending on the province.

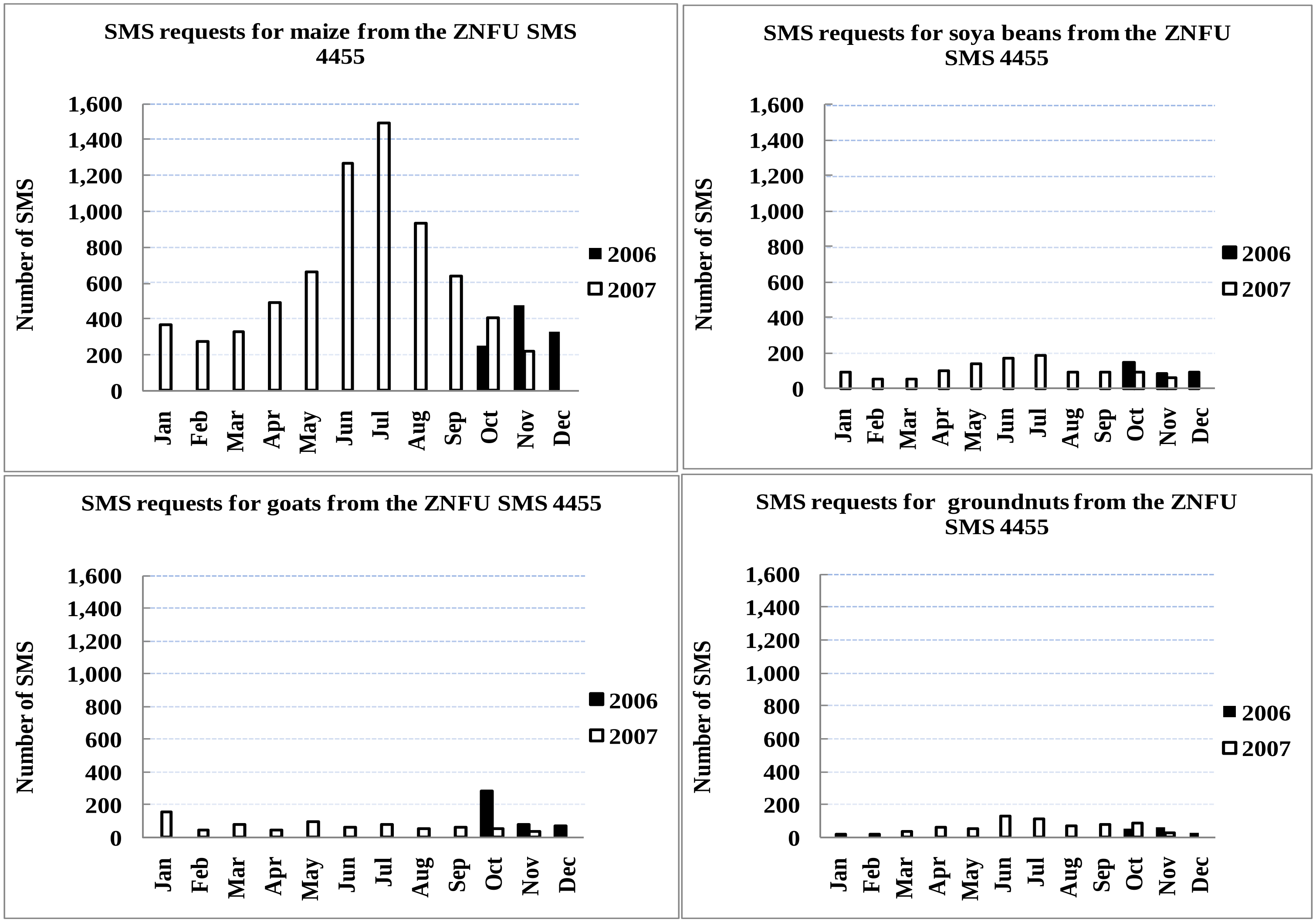
Table 39 and Figure 6 suggest that the design of MIS can be based on (1) demand for market information on specific crops and (2) seasonal demand of market information during the peak marketing periods. For example, ZNFU could consider focusing on providing market information for the 4 commodities for which information requests are the highest. Alternatively, a seasonal MIS could be designed so that there is more frequent collection and diffusion of market news and analytical information in the peak marketing seasons (e.g., May, June, July and August in case of maize in Zambia) and only basic market news from major markets the remaining months. In both alternatives, however, it can be argued that once the fixed costs of collecting market news and conducting market analysis have been covered for the few main crops, the marginal costs of collecting market news for additional commodities or for an additional month are low. Thus, depending on the nature of the costs, it may be profitable for the MIS to continue collecting information on all commodities and to work throughout the year.

Table 39: ZNFU SMS Requests by Commodities from October 2006 to November 2007

Commodity	Hits	Percentage	Cumulative percentage
Maize	8141	57.8	57.8
Soybeans	1456	10.3	68.2
Goats	1230	8.7	76.9
Groundnuts	850	6.0	83.0
Beef	738	5.2	88.2
Pigs	418	3.0	91.2
Sunflower	260	1.8	93.0
Beans	233	1.7	94.7
Cassava	173	1.2	95.9
Honey	146	1.0	97.0
Sorghum	144	1.0	98.0
Wheat	136	1.0	98.9
Rice	81	0.6	99.5
Sheep	68	0.5	100.0
Total	14074	100.0	

Source: ZNFU SMS 4455 data.

Figure 6: Monthly SMS Requests For the Top Four Most Requested Commodities in ZNFU SMS MIS



Source of data: ZNFU 4455 SMS MIS

Table 39 and Figure 6 do not show or identify the geographical variations in demand for market information in different parts of the country. This is partly because it is difficult to tell where users of mobile phones are located when they request for information. It is likely that the location of users could be verified by the SMS (cell phone) service providers, and a future study could look at the geographical variation in demand for information. This information could also guide investments in SMS and other types of MIS by refining the collection and targeting methods so that diffusion follows the geographic and seasonality flow of information demand in various parts of countries with SMS MIS.

Data Collection and Quality Control Methods

The information officer calls traders and millers to inquire about their buying prices. Traders may also send emails or call ZNFU to provide the information on a weekly basis. This information is then uploaded in a database at ZNFU weekly. It should be noted that information users request by SMS may be received instantly but they may receive old information in response, especially when information is not frequently updated on the server.

Institutional Home, Feedback Mechanism, and Sources of Funding

The system is housed in the Zambia National Farmers Union, a farmer organization. The ZNFU conducts other services such as farmer training; input provision (including experimental cell phone distribution among members from cell phone companies); organization, management and marketing support; and storage exchange.

For feedback, farmers are encouraged to write to their regional managers about the quality of the information. The regional managers then present the comments during monthly meetings at the national level. Also, regional managers verify whether the prices submitted by traders and millers are the ones they are actually buying at by calling the traders and asking their buying prices anonymously and comparing to those offered to union members. The MIS has an enforcement code (punishment strategy) for traders or millers who pay lower prices than those reported to the MIS. The punishment strategies include suspending posting of the buying prices of a buyer on the ZNFU 4455 SMS MIS. The problem is that market prices can change in a short interval after a buyer submits information, and this may result in a punishment even when the true market prices have changed. This is especially the case because it is the MIS manager who calls the traders for information and not the other way round. The manager could take longer time to call and update the information on the server. In other words, the MIS does not use a wiki-approach where users can post information on the server. Even if the MIS used a wiki approach, there may be situation where prices change but traders are not be able to update information on the website, such as when there is a power cut, the internet is down, or lack of airtime to update the server with information. Receiving a punishment due to circumstances out of the control of the trader would hurt them.

The MIS also monitors weekly logs on the website to determine the location of internet-based information users. A high number of hits indicate users like the information and a lower number of hits indicate that they don’t. In addition, the MIS conducts raffles at district shows where they quiz the farmers to gauge their knowledge of the SMS MIS and whether they use the information. They also conduct user surveys where they ask the opinion of users about the MIS.

To avoid disagreements over quality, farmers are expected to supply grade A maize to millers and grain traders. Farmers are trained in workshops on the grades and standards of maize required by traders. Farmers are also encouraged to take a sample of the produce to buyers before they deliver large volumes on trucks. The process of farmers taking a sample to traders declines over time as farmers learn the quality requirements and as traders learn the reputation in terms of quality delivered by different farmers. This is consistent with the hypothesis that the utility of market information is higher when it is provided with other complementary services.

By 2007, the system was funded by the Ministry of Agriculture and Cooperatives with support from IFAD and from other donors such as USAID. Other supporters included Vodacom DRC and AfriConnect/CelTel (Gakuru, et al., 2009). These cell phone companies presumably support the system in the belief that wider use of the system will increase purchases of airtime. Presently, users are charged a fee of about ZMK 500 (approximately US $0.11) per SMS depending on the network provider, although the money obtained from SMS requests cannot meet the running costs such as phone, internet, and administrative costs. Currently, the system is supported by the ZNFU budget, project funding from donors, and some advertisement revenue.

A. 5 Private MIS

A.5.1 Reuters Market Light ('RML')

Aims, Objectives, and Clientele Served

The Reuters Market Light ('RML') started in October 2007 in India with the aim of making agricultural markets more transparent by providing market information to farmers and farmers associations, and consumers. Other users of RML services include traders, chambers of agriculture and commerce, value chain actors, NGOs, researchers, and government. It was anticipated that RML would contribute towards more efficient and fair markets, and increase productivity among farmers in the Indian state of Maharashtra (Thomson-Reuters, 2007). RML was designed explicitly as a profit-making venture and presently provides market information in 13 states of Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, and West Bengal.

Information Provided, Frequency, and Modes of Diffusion

RML disseminates producer prices, quantities traded, weather forecasts, and crop information (e.g., on pest or disease outbreak) through SMS to subscribing farmers every 24 to 48 hours. Other information provided includes export and import volumes, grades and standards, credit sources, harvest and price forecasts, marketing extension, and contacts of buyers and sellers. Initially, RML provided information on soybeans, cotton, wheat, paddy, maize, onion, and gram. Presently RML provides information on more commodities, including poultry feed, cattle fodder, fruits and vegetables, other cereals and pulses, oilseeds, weather forecasts, crop advisory information, and other agricultural news.

RML provides more kinds of information than that provided by African MIS. This is most likely because RML does not produce all this information itself. Rather, it is embedded in a system in India in which it can source such information from other public and private providers. This points out the importance of making the distinction between the system to distribute the information and the system to produce it. It also emphasizes the importance of the capacity of the underlying system of the country in which the MIS is based to generate the basic information.

Data Collection and Quality Control Methods

Data is collected daily by about 200 outsourced reporters from over 1200 rural and 50 urban markets in India and is transmitted entirely by SMS. The collectors are outsourced through an agency and therefore not employees of RML. The quality control methods used include refresher training courses for data collectors (implying that RML does not use Wiki approaches where users SMS or update the web), regular supervision and monitoring of data collectors, unexpected market visits to monitor the data collectors, and data entry control and validation programs and procedures (such as use of data entry error check programs).

Institutional Home, Feedback Mechanism Used, and Sources of Funding

The RML is a private MIS with funding from the markets division of Thomson Reuters, and from user subscription fees. RML is now an integrated part of the Thomas Reuters business, and is no longer an 'innovation project'. Users subscribe to receive information at the local post offices (Arango, 2008, Thomson-Reuters, 2007). The subscription fees are Rs. 175 ($4) for three months, Rs. 350 ($8) for six months, and Rs. 650 ($15) for a year. Subscribed users receive 4 SMS per day for two chosen crops (Mittal, et al., 2010). The RML also gets support from handset manufacturers—e.g., Nokia's Life Tools—and in-kind contribution in form of content from government funded agricultural institutes (Arango, 2008, Preethi, 2009, Thomson-Reuters, 2007). This implies that RML distributes content provided by others, which enables it to provide more types of information to users. Feedback is obtained from the analysis of URL usage and text message requests, meetings with users and through users' assessment and needs surveys, and customer satisfaction surveys.

The challenges to the system include the low percentage of rural farmers with mobile phones and low literacy rates among farmers (Arango, 2008). Another challenge is in translating the information into local languages due to difference in fonts of the different alphabets and lack of software upgrades by cell phone users (Preethi, 2009). Other problems encountered were that there are many varieties of crops grown in the different states, which make designing of the SMS database more difficult in terms of putting the information in formats that can be presented to end users.

A.5.2 Esoko – Ghana

Aims, Objectives, and Clientele Served

Esoko stated in 2005 under the name Tradenet, initially with the aim of linking producers to markets at national and regional levels in eight African countries consisting of Ghana, Mali, Burkina Faso, Nigeria, Ivory Coast, Sudan, Mozambique, and Madagascar. Presently, Esoko-Ghana aims at providing internet-based technologies (software) for price collection and distribution to private and public institutions in several countries.

Thus, the main distinction of Esoko from other MIS is that it is mainly in the business of developing and selling a market information distribution platform to various countries. Only in Ghana does it engage in market information collection itself, and the subsequent description is for Esoko – Ghana only.

Information Provided, Frequency, and Modes of Diffusion

In Ghana, Esoko provides market information (retail and wholesale prices), exchange rates, offers to buy and sell different commodities (inventory of sellers), transport costs, weather disease notification, and extension messages. Esoko uses a push SMS (see below), its website, and email to disseminate information to users. In the push SMS system, market information is compiled in text messages and is sent to subscribing users. The majority of the subscribing users are subsidized by development projects (e.g., Nestle, Unilever, and USAID). The projects distribute phones to users and pay Esoko to disseminate the information of interest to the users (Kutsoati and Bartlett, 2008). This implies that the effective demand for information is mostly from development projects on behalf of farmers. Users can also post information about the commodities they want to sell and buy using an SMS. The information is posted on the website and also sent using the push SMS system to other subscribed users.

Data Collection and Quality Control Methods

Esoko collects data using three approaches. In the first approach, 30 enumerators employed by Esoko collect information by observation in the approximately 30 urban markets weekly. Data processing is conducted by 8 permanent employees. Esoko has a total of 40 permanent staff and 5 contract employees. In the second approach, secondary data from other established MIS in different countries is uploaded to an internet-based database. In the third approach, individual MIS users can use SMS to upload the information about the commodities they wish to sell or buy. Some of the information users can load by SMS onto the internet includes the country where the goods are located, the origin, quantity in metric tons, price, grade, the duration of the offer, payment method, delivery point, delivery time, and the name and telephone contact of the seller. The Esoko system is not similar to the ZNFU 4455 SMS MIS where users obtain only prices and contact information of commodity traders.   The main question in the third approach is on how information provided by users is verified and how conflicts arising from transactions based on wrong information are settled between sellers and buyers. Quality control in Esoko-Ghana is through training enumerators, regular supervision and monitoring of data collectors, unexpected market visits to monitor the data collectors, the use of data entry control and validation programs and procedures, and verification and test after data capture.

Institutional Home, Feedback Mechanism Used, and Sources of Funding

Esoko is a private sector MIS firm. The feedback mechanisms used by Esoko include potential MIS users' assessment or needs surveys, customer satisfaction surveys, meetings with users, and monitoring information downloaded from SMS and websites. Funding for Esoko activities comes from subscription fees from NGOs, and farmers' and traders' organizations, and private firms. Esoko also receives contributions from donors, charity organizations, and generates funds from its other activities. All information on the website can be accessed without restrictions, but users incur their personal internet access costs. Esoko is piloting the following pricing strategy among 4 categories of users for the usage of its information exchange platform: The first category, called the Bronze group, consists of individual traders and researchers. Members in this category are charged up to $25 for 10 SMS alerts per week. The second category, called the Silver group, consists of small businesses and exporters and is charged $250 to use the Esoko information web-based platform and to send 10 SMS alerts to a maximum of 200 members per week. The third category, called the Gold group, consists of farmer groups, businesses and small NGOS and is charged up to $1,500 to use all tools on the Esoko information exchange platform and to send information up to 2,000 members per week. The fourth category, called the Platinum group, consists of large businesses and associations, consumer brand companies, large NGOs, and government and is charged $8,000 use all tools on the Esoko information exchange and to provide information products to an unlimited number of users per week (Davies, 2010). Esoko predicts that it will take it 4 years to become profitable, and its target is to have 6,000 subscribers in the bronze group, 2,000 subscribers in the silver group, 200 subscribers in the gold group, and 20 subscribers in the platinum group. Esoko faces the challenges of lack of empirical ways of evaluating how effective their services are benefiting users. This has probably limited financial support from some stakeholders such as donors, private companies, and government.

The cost of use of the service by individual farmers is likely to be the same as that of individual traders ($25 for 20 SMS alerts per week). It is not clear whether this information covers the subscribers' costs of sending an SMS to request for information or whether it covers the cost of receiving the "push" SMS from the MIS for information users subscribe for only. The use of information per week, however, cannot be generalized to yearly usage because farmers may be selling once or twice in a year (season(s)). This makes comparison of cost per usage and the GDP per capita (estimated at $709 in 2008) difficult.

A.5.3 KACE Market and Information Linkage System – Kenya

Aims, Objectives, and Clientele Served

The Kenya Agricultural Commodity Exchange (KACE) Market and Information Linkage System is a private firm and started in 1997 with the aim of facilitating linkages between sellers and buyers of agricultural commodities. KACE's clientele consists of traders, farmers, importers, exporters, brokers, processors, and consumers (Meuleman, 2007). KACE also aims at increasing market transparency, increasing the bargaining power, and the competitiveness of farmers and traders in agricultural markets.

Information Provided, Frequency, and Modes of Diffusion

KACE provides daily market news (retail, wholesale, and producer prices, exchange rates, offers to sell, and bids to buy) to market participants at different frequencies and using several methods. For example, fax machines, telephones, websites, and emails are used to send information from KACE headquarters in Nairobi to the district-level Market Information Centers (MICs) in Eldoret, Bungoma, and Kisumu, and to rural based Market Information Points (MIPS) in Western, Nyanza, Rift Valley, and Eastern provinces of Kenya. The MICs and MIPs were established by KACE.

The information is then posted on bulletin boards in MICs and MIPS, where farmers can read it. Market information is also disseminated using SMS (SMS Sokoni) at a user fee equivalent to the cost of the SMS. Also, an Interactive Voice Response (IVR) enables users to dial a telephone number into a voice mail to listen to market information. A website with a restricted area where access is at a fee is also used to disseminate information. In addition, market information consisting of price, offers and bids for maize and beans is disseminated weekly through a radio program (Meuleman, 2007, Tollens, 2006). Although the KACE Market and Information Linkage System is linked to an exchange, the prices it disseminates are not a byproduct of the trading activities on the exchange because of low volumes traded and low frequency of trade, probably because maize and other staple commodities in Kenya have several alternative marketing channels.

Data Collection and Quality Control Methods

Data is collected by 8 permanent and 2 part-time reporters from 4 rural and 5 urban markets using one-on-one interviews and direct observation. KACE also has 5 employees in the processing unit. Some of the methods used to ensure that data is of good quality are training enumerators, regular supervision and monitoring of data collectors, unexpected market visits to monitor the data collectors, the use of data entry control and validation programs and procedures, verification and test after data capture, and obtaining opinions of the MIS users.

Institutional Home, Feedback Mechanism Used, and Sources of Funding

The KACE Market and Information Linkage is housed in a commodity exchange. The feedback mechanisms used by KACE include potential MIS users' assessment or needs surveys, customer satisfaction surveys, external evaluations by donors and third parties, meetings with users, and monitoring information downloaded from SMS and websites.

KACE was started using personal savings of the director. Other sources of funding include funding from donors, fees paid by bidders to place commodities for sale through the exchange and on accomplished bids and offers by individual farmers and traders. Some resources are obtained from researchers (research fees), subscriptions for information, SMS information requests and use of IVR services. For example, traders or farmers are charged an initial placement fee of about $1.50-$15 per offer or bid depending on volume of the bid or offer. Once the trade occurs, a 0.5 percent to 5 percent commission is charged.   Researchers are charged negotiable fees ranging from $2,000 to $ 4,000 per visit for conducting research with KACE. KACE also charges approximately $500 for time series data on a commodity for a year and information subscription fees of US$ 65 for 6 months and US$ 125 for 12 months (Kundu and Mukhebi, 2010). KACE also transformed or franchised its MIPs into Market Resource Centers with more income-generating activities such as offering storage, fax, computer, and photocopying services at a cost to users (Meuleman, 2007).

The main changes observed by KACE are that communication has been made easier and faster with the increase in mobile phones. The main challenge is that the literacy rate among farmers is still high, which means that some channels of disseminating information that require literacy are not effective. This means the MIS has to use multiple channels to disseminate information, which increases costs. KACE also notes that running the service is expensive and that there is poor infrastructure (e.g., feeder roads), which in some cases makes farmers to fail to respond to useful information.

A. 6 Conclusions From Global Review and Cases Studies

The main issues that come out of the case studies of MIS are that:

1. There is a large range of information beyond price and quantity data that users stated they need, but which most MIS are not providing. Such information includes price

and quantity forecasts, regulatory information, analytical information about market dynamics, stock and inventory information, contracts and conditions needed to fulfill them, quality requirements, grades and standards, and phytosanitary specifications. Other “missing” information includes transport costs, and credit sources.

2. Most MIS reviewed collect and disseminate basic market information on prices on major commodities in the countries but not market analysis and business reports. Most MIS do not provide information on transport costs and transport availability and price forecasts.
3. The information from private MIS is mostly targeted to farmers and traders. In contrast, in addition to providing information to farmers and traders, public MIS provide extra information products, such as market analysis, to governments and donors for policy formulation and monitoring. Public MIS also tend to cover more products, wider geographical areas, and provide more market analysis than private and farmer managed MIS.
4. Private MIS put a lot of emphasis on the use of cell phones in information dissemination. It is not clear, however, whether rural farmers can effectively use cell phones to receive market information. It seems that more organized farmers (e.g., farmer group and associations members) prefer to receive tangible and storable information, which makes bulletins their preferred channel of disseminating information.
5. There is weak or limited supervision of data collection among public MIS. (e.g., Mozambique SIMA and Zambia AMIC).

6. There is weak or lack of effective demand for some of the information products from some of the publically funded MIS by individual users, private sector firms, and farmer organizations (e.g., Mozambique SIMA and Zambia AMIC).
7. Apart from RML, most of the private and farmer organization -based MIS are still substantially subsidized by external donors, projects, and NGOs. It is worth noting that RML operates in India, where the density of potential clients (farmers, traders, and input providers) is much higher than in Sub-Saharan Africa.
8. Radio may still be the most efficient way of disseminating information to farmers and rural based traders, while print media (e.g., bulletins, magazines, and newspapers) can be used to diffuse information to some literate farmers and traders in urban areas.
9. There is need to increase incentives of MIS workers so that they collect information regularly and to for the MIS to be able to retain good quality staff at national, provincial, and district levels.
10. MIS have limited budget support from governments for funding data collection equipment and facilities such as vehicles, computers, phone lines, and motorbikes and allowances.

A. 7 Checklist Used in The Case Studies for Information Providers and User In Mozambique, Ethiopia, and Zambia

Part I: For the Market Information Systems

1. Aims, objectives, and clientele served

a. What are the main objectives of the MIS?
b. Who are the main clientele of the MIS?

2. Information provided, frequency, and modes of diffusion

a. What information is provided to MIS clients?
b. How frequently do you provide each type of information?
c. What are the channels/modes of dissemination of the information to users?
d. What are the advantages and opportunities of disseminating information using each type of dissemination channels/modes?
e. What are the disadvantages and challenges of disseminating information using each type of dissemination channel?
f. How have the costs of disseminating information changed due to the use of different information and communication technologies (e.g., cell phones and the internet)?
g. How has the time duration from collection to dissemination of information changed due to the use of different information and communication technologies?
h. Who is the owner of the information collected by the MIS?
i. What are the other sources of information for the MIS information users?

3. Data collection and quality control methods

a. How is market information collected from the markets
b. Who collects the information?
c. What are the technologies used to transmit market information from the markets to the MIS?
d. How has the introduction of mobile phones and the internet changed the cost of collecting Market information?
e. What quality control methods are used by the MIS to ensure that users obtain accurate, timely, and reliable information during data collection, transmission, and dissemination?

4. Feedback mechanism used and decisions made with the information by stakeholders

a. What is the institutional home of the MIS?
b. What methods are used by MIS to understand the needs of the users?
c. How does the MIS obtain feedback from information users?
d. How are the MIS outputs used by stakeholders (e.g., governments, donors, consumers, traders, farmers) in decision-making?

5. Fund mechanisms to ensure sustainability.

a. What are the different ways in which the MIS generate funds for their activities?

Part II: Check list for MIS Information Users

1. Contact information of user

a. Name of respondents
b. Company
c. Address
d. City/Town
e. Country
f. Email Address
g. Phone Number

2. User characteristics

a. What is your main activity?
b. What are the main commodities you bought or sold in the last one year? *(Question won't apply for non-farming and non-trading information users).*
c. How frequently do you sell or buy agricultural commodities *(Question won't apply for non-trading information users)*:
    i. In a week
    ii. In a month
    iii. In a season
    iv. In a year

3. Decisions made with information from MIS

a. What type of information do you receive from the MIS?
b. What decisions do you make with the information from the MIS?
c. Through what dissemination channels/modes do you receive market information from MIS?
d. What problems do you face with receiving the information through the each of the dissemination channels/modes?
e. What advantages/opportunities do you face with receiving the information through the each of the dissemination channels/modes?

4. Information not provided

a. Apart from the MIS, what are your other sources of market information?
b. What type of information would you like to receive that the MIS or your other sources of information do not provide?
c. How frequently would you like to receive the information not provided by the MIS or from your other sources?
d. What is your preferred channels/modes of obtaining market information?
e. What decisions will you will be able to make in a better way when you receive the information you do not currently obtain?
f. Would you be willing to pay to receive information that you need and is not currently provided?

A. 8 Categories, Organizations, and Location of Providers and Users Interviewed During Case Studies in Mozambique, Ethiopia, and Zambia

Table 40: Categories, Organizations, and Location of Providers and Users Interviewed During Case Studies in Mozambique, Ethiopia, and Zambia

Mozambique Case Study Interviews from August 23 – September 4, 2009		
Category (number)	**Organization (number of respondents)**	**Location**
Providers (10)	Chief of the Department of Economics: SIMAP overseer	Nampula
	CLUSA/ Tecnoserve (Esoko - Mozambique)	Nampula
	Coordinator of SIMAP, Direcao Provincial de Agricultura de Nampula (DPA)	Nampula
	SIMA Coordinator, and 2 enumerators: Ministry of Agriculture	Maputo
	SIMA Supervisor, DPA Nampula	Nampula
	SIMAP Enumerator , DPA (2)	Nampula
	SERVITEL	Maputo
Users (30)		
World Bank (1)	Agricultural Economist, Agriculture and Rural Development	Maputo
Early warning (1)	FEWS NET/Mozambique	Maputo
Farmer group leaders (2)	District Forum of Associations in Malema District (2 by phone)	Malema District
Farmer group members (13)	Associacao Merupane (1)	Murupula District
	Associacao Namiope (3)	Murupula District
	Associacao Produtores de Namiraua (9)	Murupula District
Food Assistance organizations (4)	Disaster Management and Food Security Officer	Maputo
	WFP Programme Officer	Maputo
	WFP Purchase for Progress (P4P) & UN Joint Programme	Maputo
	WFP/Senior Logistics Assistant	Nampula
Food security analysis (1)	Technical Secretariat for Food and Nutrition Security	Maputo
Marketing organization (1)	IKURU (Local farmer organization/ marketing association)	Nampula
NGO (7)	ADRA director (2 by telephone)	Zambezia Province
	CLUSA (3)	Nampula
	SNV (2)	Maputo / Nampula

Table continued below

Table 40(Continued)

Category (number)	Organization (number of respondents)	Location
Traders (8)	Gorongosa, Matadouro and Mwatala (6)	Nampula
	Xipamanine market (2)	Maputo
Ethiopia Case Study Interviews from September 13 - 24, 2009		
Category	**Organization (Number of respondents)**	**Location**
Providers (4)	CEO, ECX	Addis Ababa
	Chief Market Data Officer, ECX	Addis Ababa
	Market Data Research Manager, ECX	Addis Ababa
	Market Data Section, ECX	Addis Ababa
Users (29)		
Cooperative Unions (3)	Sidama Coffee union	Wensho, Yirgalem, Hawassa
	Sidama Elto Farmer's Cooperative Union	Hawasa Ethiopia
	Southern Region Farmers Cooperative Federation	Hawasa Ethiopia
Education and Research (1)	Dean, College of Commerce, Addis Ababa University	Addis Ababa
Exporters (2)	Addis Exporters Limited	Addis Ababa
	KAS International Trading Plc	Addis Ababa
Government policy makers/officials (2)	Marketing Official, Ministry of Agriculture and Rural Development	Addis Ababa
	Senior market surveillance and oversight officer , Ethiopia Commodity Exchange Authority	Addis Ababa
Journalist (1)	Bloomberg Correspondent	Addis Ababa
Regional Government officers (7)	Marketing Process, Marketing Research, Promotion and Linkage Experts (2)	Hawassa
	Ministry of Agriculture and Rural Development Extension Officer	Bedelle Oromia
	Quality Control of Agricultural Products Expert	Hawasa
	Rural Agricultural Marketing Process Expert	Hawassa
	Sidama Zone Cooperative Promotion and Development Process Promoter	Hawassa
	Small Scale Appropriate Technology Quality Control, Supply and Monitoring Expert	Hawassa
Service Cooperative (10)	Holeso Service Cooperative members (7)	Leku Woreda, Shebedido
	Taramesa Service Cooperative (3)	Leku Woreda

Table continued below

Table 40(Continued)

Category	Organization (Number of respondents)	Location
Traders (3)	Jemo General Business Share Co	Addis Ababa
	Private trader (By phone interview)	Mekele
	Hagas Grain Wholesale Plc (by phone)	Nekemte
Zambia Case Study Interviews from October 4-16, 2009		
Category	**Organization (Number of respondents)**	**Location**
Providers (7)	Senior Economist AMIC/MACO	Lusaka
	AMIC Statistical Officers (2)	Lusaka
	ZNFU SMS MIS Manager	Lusaka
	District Marketing Development Officer (DMDO)	Monze District
	District Cooperative Development Officer (DCDO)	Kabwe District
	Monze District Extension Officer	Monze District
Users (37)		
Farmer group members (29)	Kabwe farmers (8)	Kabwe District
	Monze farmers (11)	Monze District
	Monze farmers, near St Mary's Church (10)	Monze District
Food Assistance organizations (2)	VAM Officer	Lusaka
	WFP National program officer – P4P	Lusaka
Food security analysis (1)	Fewsnet	Lusaka
Government officials (2)	MACO Early warning unit (2)	Lusaka
Researcher (1)	MSU FSRP Researcher	Lusaka
Traders (2)	Traders	Kabwe

Note: Names and contacts have been left out of the table to meet the informed consent requirements on confidentiality.

A. 9 Expanded Tables of MIS Characteristics

Table 41: Objectives of Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
Start year & aims and objectives	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Start year	1989	2006	2006	1968	1992	2008	1915	1979	1863	1997	1991	1989	1988	1993	2007	2008	1997	2007	2001	2005	2003	
Efficient (competitive) marketing	1	0	1	1	0	1	1	1	1	1	1	1	0	1	0	0	0	1	1	0	1	14
Attain transparent markets	1	1	1		1	1	0	1		0	1	1	0	1	0	1	1	1	0	0	0	12
Making better policy and monitoring	1	0	0	1	1	0	0	1	1	0	1	1	1	1	0	0	0	0	0	1	0	10
Food security planning and monitoring	1	0	0	1	1	0	0			0	1	1	1	1	0	0	0	0	0	1	1	9
Fair marketing	1	0	0	1	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	6
Monitor market performance	1	0	0		0	0	0	1		0	1	0	0	1	0	0	0	0	0	1	0	5
Linking producers to markets	1	0	1		0	0	0			0	0	0	0	0	1	0	1	0	0	0	0	4
Negotiate for better prices	1	0	1		0	0	0			0	1	0	0	0	0	0	1	0	0	0	0	4
Make markets Secure/ reduce risks	0	0	0		1	1	0			0	0	0	0	0	0	0	1	0	0	0	0	3
Increase productivity	0	0	0		0	0	0			0	0	0	0	0	0	0	0	1	0	0	1	2
Provide price collection and distribution technologies	0	0	0		0	0	0			0	0	0	0	0	1	0	0	0	0	0	0	1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 42: Clientele of Selected MIS Models

	Farmer org.			Government											Private firm				Trader and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Farmers/ Growers (small-scale)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
Farmers/ Growers (large-scale)	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
Traders (small-scale)	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	0	1	1	1	19
Government policy analysts	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	19
Traders (large-scale)	1	1	1	1	0	1	1			1	1	1	1	1	1	1	1	0	1	1	1	17
Food Assistance Agencies	1	1	0	1	1	0	0	1		1	1	1	1	1	1	1	1	0	1	1	1	16
Consumers	1	1	0	1	0	0	0		1	1	0	1	1	1	1	1	1	0	1	1	1	14
Donors	1	1	1		0	0	0			1	1	1	1	1	1	1	1	0	1	1	1	14
NGOs	1	1	0		0	1	0			1	1	1	1	1	1	1	1	0	1	1	1	14
Farmer associations & coops.	1	1	0		0	1	0			1	0	1	1	1	1	1	1	0	1	1	1	13
Chamber of commerce	1	1	0		0	1	0			1	0	1	1	1	1	1	1	0	1	1	1	13
Chamber of Agriculture	1	1	0		0	0	0			1	0	1	1	1	1	1	1	0	1	1	1	12
Value Chain Actors	1	1	0		0	0	0			1	0	1	1	1	1	1	1	0	1	1	1	12
Researchers and education	1	0	0	1	0	1	1		1	0	1	0	1	0	1	1	1	0	0	1	1	12
Banks	1	0	0		0	0	0		1	1	0	1	0	1	1	0	1	0	0	1	1	9
Exporters / shippers	1	0	0		0	1	1			0	0	0	1	0	0	0	0	0	0	0	1	5

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 43: Services Provided By Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
Other Services provided	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Education/training	1	0	1		1	1	0			1	0	1	1	1	1	1	1	0	1	0	1	13
Market Studies	1	0	1		0	0	0			1	1	1	1	1	0	1	1	0	0	1	1	11
Extension services (advice)	1	1	1		1	0	0			0	1	0	1	0	1	1	0	0	1	0	1	10
Producer organization support(organization, management, marketing)	1	1	0		0	0	0			1	0	1	1	0	1	0	1	0	1	0	1	9
Provision of input/seeds	1	0	1		1	0	0			0	0	1	0	0	1	0	1	0	1	0	1	8
Storage support	1	0	0		0	1	0			1	0	1	0	0	0	0	1	0	1	0	1	7
Coordination Activities	1	0	1		0	0	0			1	0	1	1	0	0	0	0	0	0	1	1	7
Stock / commodity exchange	1	0	0		0	1	0			0	0	1	0	0	0	0	0	0	1	0	1	5
Provision of warehouse receipt	1	0	0		0	1	0			0	0	1	0	0	0	0	0	0	0	0	1	4
Agricultural import, export, and transit permits	0	0	0		1	0	0			0	0	0	0	0	0	0	0	0	0	0	0	1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 44: Centralization or Decentralization in Processing, Geographical Coverage, Range of Commodities, and Markets Covered By Selected MIS Models

	Processing & Diffusion			**Geographical coverage**			**Range of commodities**		**Markets monitored**	
MIS Type	Centralized	Decentralized	Both	National level	Part of a country	Regional level (Many countries)	Agricultural products	Number of inputs	Rural markets	Urban Markets
Farmer org.										
OMA (ML)			1	1	0	0			21	30
SIEL (MG)	1	0		0	1	0	5		17	4
ZNFU (ZM)	1	0		1	0	0	14			
Government										
AGMARIS (PH)			1	1		0			66	105
AMIC (ZM)			1	1	0	0	18	9	20	
ECX (ET)	1			1	0	0	1	0		
FVMIS (US)	1	0		1	1	0	400	0		
IHMIS (ID)		1		1		0				
NASS (US)	1			1		1	27			
Siarm (SN)	1	0		1	0	1	13	0	182	174
SIMA (MZ)			1	1	0	0	25	0	6	16
SIMA (NE)			1	1	0	1	16	1		
SIML (NE)	1	0		0	0	1			50	23
SIPAG (GN)	1	0		1	0	0	22	0	12	18
Private firm										
Esoko(GH)	1			1	0	0	150	5		30
Infotrade (UG)	1	0		1	1	0	30	0	17	5
KACE (KE)			1	1	0	0	26	2	4	5
RML (IN)	1	0		0	1	0			1200	50
Trader org. and NGO										
AVI(BF,NE,ML)	1	0		0	1	1	6	0	12	6
OdR (MG)	1	0		1	0	0	14	3		114
RATIN (KE)	1	0		0	1	1	6		5	7
Total	14	1	6	16	6	7				

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 45:Information Provided by Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Information Products																						
Market News	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
Market Analysis	1	0	0		1	1	0	0		0	1	0	0	0	0	0	0	0	0	1	1	6
Business Reports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Information provided																						
Wholesale price	1	1	0	1	1	0	1	1		1	1	1	0	1	1	1	1	1	1	0	1	16
Retail price	1	0	0	1	1	0	1	0		1	1	1	1	1	1	1	1	1	0	1	1	15
Traded volume (qualitative assessment)	1	0	0	0	0	1	1	1		1	1	1	1	1	0	0	0	0	0	1	1	11
Supply & demand estimates	1	0	0	0	0	1	1	0	1	1	0	1	1	1	0	1	0	0	0	1	1	11
Producer price	1	1	0	0	0	0	1	1		1	1	1	0	1	0	0	0	0	0	1	1	10
Traded volume (quantitative estimation)	1	1	0	0	0	1	1	1		1	0	1	1	1	0	0	0	0	0	0	1	10
Traders stock	1	0	0	0	0	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	9
Buyers and sellers contacts	1	0	1	0	1	1	0	0	0	1	0	0	1	0	1	0	1	0	0	0	1	9
Grades & standards	0	0	1	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	1	8
Exchange rates	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	1	0	0	1	1	8

Table continued below

Table 45 (Continued)

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Harvest or production forecasts	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	1	1	1	8
Price forecasts	0	0	0	0	0	0	1	0		1	0	1	0	1	1	1	0	0	0	1	1	8
Agricultural policy infor.	1	0	0	0	0	1	0	0		1	0	0	1	1	0	1	0	0	1	0	1	8
Price CIF	0	0	0	0	0	0	1	0		1	1	0	1	1	0	0	0	0	0	1	1	7
Production costs	0	1	0	0	0	1	1	0		1	0	0	0	0	0	1	0	0	0	1	1	7
Marketing costs	0	0	0	0	1	0	0	0		1	1	1	0	0	0	1	0	0	0	1	1	7
Offers and bids	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	1	1	7
Price FOB	0	0	0	0	0	0	0	0		1	1	0	1	1	0	0	0	0	0	1	1	6
Import volumes	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1	6
Regulations	0	0	0	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0	0	0	1	6
Commercial policy infor.	1	0	0	0	0	1	1	0		1	0	0	0	1	0	0	0	0	0	0	1	6
Export volumes	1	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	4
Food assistance information	1	0	0	0	0	0	0	0		0	0	0	1	1	0	0	0	0	1	0	0	4
Marketing extension	1	0	0	0	0	0	0	0		1	0	0	1	0	0	0	0	0	0	0	1	4
Buy and sell information	0	0	1	0	0	1	0	0		0	0	0	0	0	0	0	0	0	0	0	1	3
Phytosanitary specs.	1	0	0		0	0	0			0	0	0	0	0	0	0	0	0	0	0	1	2

Table continued below

Table 45 (Continued)

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Weather information	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Agronomic Information	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2
Credit sources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned; 1. Information is updated weekly although it can be retrieved at any time by users.

Table 46: Frequency of Information Diffusion by Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Frequency																						
Real time	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Daily	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	1	0	0	1	9
Tri-weekly	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bi-weekly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Weekly	1	1	1[1]		1[2]	1	1	0	0	1	1	1	1	1	1	0	0	0	0	1	1	14
Bi-Monthly	0	0	0		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Monthly	0	0	0		0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	1	1	7
Quarterly	0	0	0		0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	4
Annually	0	0	0		0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	5
Longer intervals	0	0	0		0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned; 1. Information is updated weekly although it can be retrieved at any time by users; 2. The decentralized MIS in Monze, Livingstone and Choma disseminate weekly.

Table 47: Transmission of Information Using Modern and Traditional ICT by Selected MIS Models

	Farmer org			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Modern ICT																						
Email	1	1	0		0	0	0		1	1	0	0	1	1	0	1	1		0	1	1	10
SMS	1	0	1		0	0	0	1	0	0	0	1	1	0	1	1	1		0	1	1	10
Web	0	0	1		0	1	0	1	1	0	0	0	0	1	1	1	1		0	0	1	9
Traditional ICT																						
Telephone	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0	1		0	1	1	12
Fax	0	0	0		1	0	0	1	1	1	1	0	1	0	0	0	1		0	0	1	8
Post office	1	0	0		0	0	0	0	1	0	0	1	1	1	0	0	0		0	0	1	6
Radio equipment	1	0	0		0	0	0	1	0	0	0	1	1	0	0	1	0		0	0	0	5
Hand delivery	0	0	0		1	0	0	0	0	0	0	0	0	0	0	1	0		0	1	1	4

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 48: Dissemination Using Modern and Traditional ICT by MIS Selected MIS Models

	Farmer org			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Modern ICT																						
Email	1	0	0		1	1	1		1	1	1	1	1	1	1	1	1	0	1	1	1	16
Web	1	0	1		1	1	1		1	0	1	1	0	1	1	1	1	0	1	0	1	14
SMS (Cell Phone)	0	0	1		0	0	0		0	0	0	1	1	1	1	1	1	1	0	1	1	10
Billboards (electronic)	0	0	0		0	1	0		0	0	0	0	1	0	0	1	0	0	0	0	0	3
Traditional ICT																						
Rural radio	1	1	0		1	1	0	1	0	0	1	1	1	0	0	1	1	0	0	1	1	12
National radio	0	0	1		0	1	1	1	0	0	1	1	1	1	0	0	1	0	0	1	1	11
Newspapers	1	1	0		0	1	1	1	0	0	1	1	0	0	0	1	0	0	0	1	1	10
Hand delivery	0	0	0		1	1	1		0	0	1	1	1	1	0	0	1	0	0	1	0	9
Telephone (voice)	0	0	0		0	1	1		1	1	0	1	1	1	0	0	1	0	0	0	1	9
Posters in markets	0	1	0		0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	0	1	8
TV	0	0	0		0	1	1		0	0	1	0	1	0	0	1	0	0	0	0	1	6
Fax	0	0	0		0	1	1		0	1	0	0	1	0	0	0	1	0	0	0	0	5
Blackboards	0	0	0		0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	4
Post office	0	0	0		0	0	1		1	0	0	0	0	0	0	0	0	0	0	0	0	2
CD and DVD	0	0	0		0	0	0		1	0	0	0	0	0	0	0	0	0	0	0	0	1
Pigeonholes											1											1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 49: Sources of Funding of Selected MIS Models

	Farmer org			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Donor funding	1	1	1		1	1	0	1	0	0	1	1	1	1	1	1	1	0	1	1	1	16
Government funding	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	12
Subscriptions Fees, Information Sales, and SMS Revenue	1	0	1		0	0	1		1	0	0	1	0	1	1	1	1	1	0	0	1	11
In-Kind Contributions and Exchange of Services	1	0	0		1	0	0		0	0	1	0	0	0	0	0	0	1	0	0	0	4
Sponsorships from Private Companies	0	0	0		0	0	0		0	0	0	0	0	0	1	1	0	1	0	0	1	4
Consultancy and Training Services	1	0	0		0	1	0			0	0	0	0	1	1	0	0	0	0	0	0	4
Tie-in-sale of Market Information and Members Fees	0	0	0		0	1	0			0	0	0	0	0	0	0	0	0	0	0	0	1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 50: Data Collection Methods Used By Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Structured questionnaires (One-on-one interview by reporters)	1	1	0		1	0	1		1	1	1	1	0	1	0	0	1	1	0	0	1	12
Observation by reporters in markets	1	1	0		1	0	0		1	1	1	1	0	1	1	1	1	0	0	0	1	12
Telephone interviews	0	0	1		0	0	1		1	1	0	0	1	0	0	0	0	0	1	1	0	7
Questionnaires mailed to market participants	0	0	0		0	0	0		1	0	0	0	1	0	0	1	0	0	1	1	0	5
Administrative/ secondary sources	0	0	0		0	0	0			1	1	0	0	0	0	0	0	0	0	1	1	4
Obligatory declaration of information	0	0	0		1	0	0		1	0	0	0	0	0	0	0	0	0	0	0	1	3
Wiki approaches (where users SMS or update the web)															1							1
Byproduct of transactions on the exchange						1																1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 51: Quality Control Methods Used By Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
Quality control methods used by MIS	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI(BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Verification and tests after data capture	1	1	0		1	0	0			1	1	1	1	1	1	1	1	0	1	1	1	14
Refresher training courses for data collectors	1	0	0		1	0	0	1		1	1	1	1	1	1	1	1	0	0	1	1	13
Regular supervision and monitoring of data collectors	1	0	0		1	0	0			1	1	1	1	1	1	1	1	0	1	1	1	13
Unexpected market visits to data collectors	1	1	0		0	0	0			1	0	1	1	1	1	1	1	0	0	0	1	10
Data entry control /validation programs	1	0	0		1	0	0			0	1	1	0	1	1	1	1	0	0	1	1	10
Feedback from MIS user surveys	1	1	0		0	0	1		1	0	0	1	1	1	0	1	1	0	1	0	0	10
User verification (e.g. in wiki MIS)	0	0	1		0	0	0			0	0	1	0	1	0	0	0	0	1	0	0	4
Monitoring and supervisory committee	1	0	0		0	0	0			0	0	1	0	0	0	0	0	0	0	0	0	2
Advice from advisory panel and boards	1	0	0		0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

Table 52: Feedback Mechanism Used By Selected MIS Models

	Farmer org.			Government											Private firm				Trader org. and NGO			
	OMA (ML)	SIEL (MG)	ZNFU (ZM)	AGMARIS (PH)	AMIC (ZM)	ECX (ET)	FVMIS (US)	IHMIS (ID)	NASS (US)	Siarm (SN)	SIMA (MZ)	SIMA (NE)	SIML (NE)	SIPAG (GN)	Esoko(GH)	Infotrade (UG)	KACE (KE)	RML (IN)	AVI (BF,NE,ML)	OdR (MG)	RATIN (KE)	Total
Potential MIS users' assessment /needs surveys	1	1	0		1	0	1			1	1	1	1	1	1	1	1	0	0	0	1	13
Customer satisfaction surveys	1	0	1		0	0	1		1	1	0	0	1	1	1	0	1	0	0	0	1	10
Meetings with users (including farmer or trader groups)	0	0	0		1	1	1		1	0	0	1	0	1	1	1	1	0	1	1	0	11
Monitoring of information downloaded (SMS and website)	1	0	1		0	0	0			0	0	0	0	1	1	1	1	0	1	1	1	9
External evaluations (by donor, government, or third party)	1	0	0		0	0	0			0	0	0	1	1	0	1	1	0	1	1	1	8
Listenership groups	0	0	0		1	0	0			1	0	0	0	1	0	1	0	0	0	0	0	4
Suggestion boxes	0	0	0		0	0	0		1	0	0	0	0	0	0	0	0	0	0	0	0	1
Reviews from regulators						1																1
Customer service center hotline						1																1
Compliance section of the exchange						1																1

Source: Literature review, case studies, and E-survey; 1= Yes, 0 or blank =not observed or mentioned.

APPENDIX B Questionnaire for the Survey of Characteristics of Market Information Systems in Africa

Information Providers

The following questionnaire aims to identify the innovations introduced in MIS in recent years. It is a collaboration work between Michigan State University (MSU, USA), the French Agricultural Research Centre for International Development (CIRAD, France) and the National Institute for Agricultural Research (INRA, France).

This questionnaire is part of a research project on 2nd generation MIS. The MIS have generated a renewed interest across the world. In recent years, many innovations have been introduced in MIS and new MIS have emerged. Innovations can be technical (use of Internet, mobile phones ...) or organizational (decentralized MIS, MIS networks, private MIS ...).

Our first objective is to make an inventory of major innovations in MIS and to understand how they have improved the functioning of MIS: to identify the problems which they enabled to solve both on the technical side (delays, cost, reliability ...) and on the problem of the connection between information's supply and demand. The second objective is to facilitate experience sharing between the MIS and with the researchers.

The questionnaire is arranged as follows:

MIS Identification

1. Aims, objectives, and clientele of the MIS
2. Products covered, information collected and geographical coverage of the MIS
3. Methods of transmission and quality control methods
4. Information provided, frequency, and method of diffusion
5. Other services
6. Organization and institutional aspects
7. Funding
8. Feedback
9. Changes
10. Additional comments

The interview will take no more than 30 minutes to complete. Your responses will be summed together within a global analysis and only general averages will be reported.

If you are interested in receiving the results of the analysis, check the box below.

We are interested in receiving a copy of the study: ☐

However, this study is also an opportunity to facilitate information sharing and collaboration between MIS. To do this, we ask your permission to disseminate the information according to the following options:

We allow the team to disseminate the questionnaire:

□ Information concerning the identification of MIS (section 1)

□ Information concerning the identification, the products and variables covered and the distribution channels (sections 1, 2&4)

□ Information of all sections

If you have any questions about this questionnaire, please contact:
Andrew Kizito (English version): kizitoan@msu.edu
Or
Yuanyuan Shen (French version): yuanyuan.shen78@gmail.com

MIS Identification
1. Contact information of respondent and of MIS:

Name:	
Name of MIS:	
Name of institution housing the MIS:	
Web site of the MIS:	
Address:	
Address 2:	
City/Town:	
State:	
ZIP/Postal Code:	
Country:	
Email Address:	
Phone Number:	

1. Aims, objectives, and clientele of the MIS

1.1 When was the MIS created?	

1.2. What are the aims and objectives of the MIS?

Since its creation*	Nowadays

1.3 Who are the most important clientele of the MIS (1: Most Important; 2 Important, 3: Least important)?

	Clients targeted by the MIS			Clients non targeted by the MIS
	1	2	3	
Consumers	☐	☐	☐	☐
Farmers(small-scale)	☐	☐	☐	☐
Farmers(large-scale)	☐	☐	☐	☐
Farmer organization/ association	☐	☐	☐	☐
Traders (small-scale)	☐	☐	☐	☐
Traders (large-scale)	☐	☐	☐	☐
Chamber of Agriculture	☐	☐	☐	☐
Chamber of Commerce	☐	☐	☐	☐
Interprofession (private body representing all the stakeholders of the supply chain)	☐	☐	☐	☐
Government policy analysts/makers	☐	☐	☐	☐
Device for food security	☐	☐	☐	☐
Donors	☐	☐	☐	☐
NGOs	☐	☐	☐	☐
Researcher	☐	☐	☐	☐
Banks	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐

2. Products covered, information collected and geographical coverage of the MIS

2.1What are the agricultural and animal products on which information is collected by the MIS and the number of the quality?

At the beginning*	Nowadays
Products	Products

*NB: Throughout the questionnaire "at the beginning" must be regarded as the start of the system in real life, after a possible pilot test.

2.2 What are the inputs followed by the MIS?

At the beginning	Nowadays

2.3 Which geographical scale is covered by the data collection of the MIS (National level, a part of the nation or regional level)?

	At the beginning	Nowadays
National level	☐	☐
Part of a country	☐	☐
Regional level	☐	☐

2.4 How many markets are covered by the MIS?

	At the beginning	Nowadays
Number of the rural market		
Number of the urban markets		

2.5 What variables regarding prices and quantity are followed by the MIS?

	Since its creation	Nowadays
Retail price	☐	☐
Wholesale price	☐	☐
Producer price (or rural market)	☐	☐
Price CAF	☐	☐
Price FOB	☐	☐
Traders' stock	☐	☐
Traded volume (quantitative estimation)	☐	☐
Traded volume (qualitative assessment)	☐	☐
Other (please specify)		

2.6 What other information is monitored by the MIS?

	At the beginning	nowadays
Export volumes	☐	☐
Import volumes	☐	☐
Production costs	☐	☐
Marketing costs	☐	☐
Supply & demand estimates	☐	☐
Grades & standards	☐	☐
Regulations	☐	☐
Credit sources	☐	☐
Exchange rates	☐	☐
Harvest (production) forecasting	☐	☐
Price forecasting	☐	☐
Food aid	☐	☐
Agricultural policy information	☐	☐
Commercial policy information	☐	☐
Technical extension	☐	☐
Marketing extension	☐	☐
Contacts of buyers and sellers	☐	☐
Offers and bids	☐	☐
Phytosanitary specs.	☐	☐
Other (please specify)		

2.7 What data are collected directly by the MIS and those obtained from another organization?

	Directly collected	Obtained from another organization
Retail price	☐	☐…
Wholesale price	☐	☐…
Producer price	☐	☐…
Price CAF	☐	☐…
Price FOB	☐	☐…
Traders' stock	☐	☐…
Trade volume	☐	☐…
Other (please specify)		…

3. Data collection, transmission, quality control methods

NB: The following sections relate only to information on prices and volumes of agricultural products and animal products.

3.1 At what frequency and methods are the following variables collected by the MIS? (Select methods from the list)

	Frequency	Method 1	Method 2	(Codes for frequency)	(Codes for methods of collection)
Retail price(urban markets)				1. Daily 2. Weekly 3. Bi-monthly 4. Monthly 5. Quarterly 6. Bi-annually 7. Annually 8. other	1. One-on-one interview by reporters in markets 2. Confidential telephone interviews 3. Questionnaires mailed to market participants 4. Observation by reporters in markets 5. Obligatory declaration of information 6. Administrative/ secondary sources 7. Other (please specify)
Wholesale price(urban market)					
Producer price (or rural market price)					
Price CAF					
Price FOB					
Trade volume					
Other (please specify)					

3.2 What methods are used to transmit data from market participants to the MIS, and who transmits the data/information?

	Methods used to transmit		Who transmits the data/information	
Means	At the beginning	Nowadays	MIS Reporters	Producers or traders
Post office	☐	☐	☐	☐
Fax	☐	☐	☐	☐
Hand delivery	☐	☐	☐	☐
Telephone	☐	☐	☐	☐
Radio equipment	☐	☐	☐	☐
Email	☐	☐	☐	☐
SMS	☐	☐	☐	☐
Web	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐

3.3. What quality control methods are used in data and information collection, transmission, processing, and dissemination? (Please check all that apply).

Refresher training courses for data collectors	☐
Regular supervision and monitoring of data collectors	☐
Unexpected market visits to monitor the data collectors	☐
Data entry control /validation programs and procedures (including use of data entry error check programs)	☐
Verification and test after data capture (Data inspection and processing to check errors)	☐
Stock declared	☐
Opinion request from MIS' users (survey, advisory panel/boards)	☐
Monitoring committee / supervisory committee	☐
User verification (e.g. in wiki MIS)	☐
Other (please specify)	☐

4. Information provided, frequency and modes of diffusion

4.1 How does the MIS transmit the information to the users and what kind of information is distributed for each channel?

Diffusion channels	Importance of diffusion method 1. Important 2. Not Important 3. Not used	Main types of data disseminated for each channel
Bulletin		
Email		
Billboards (electronic)		
Blackboards		
Fax		
Hand delivery		
National radio		
Rural radio		
Newsletters		
Newspapers		
Post office		
Posters in markets		
Radio equipment		
SMS (Cell Phone)		
Telephone (voice)		
TV		
Web		
Other (specify)		

4.2 For the market traders, the information supplied by the MIS is:

	Free	Paid	
Types of information		All-in-one payment (specify the cost	Pay by unit (specify the cost)
Real-time price	☐	☐	☐
Serial price	☐	☐	☐
Forecasting	☐	☐	☐

5. Other services

5.1 What are the other services provided by the MIS, by the housing institution of or by other institutions in collaboration with the MIS?

	Provided by MIS	By the housing institution	By partner
Studies	☐	☐	☐
Education/training	☐	☐	☐
Provision of input/seeds	☐	☐	☐
Technical extension	☐	☐	☐
Producer organization support(organization, management, marketing)	☐	☐	☐
Storage support	☐	☐	☐
Provision of warehouse receipt	☐	☐	☐
Stock exchange	☐	☐	☐
Device coordination	☐	☐	☐
Other (please specify)			

6. Organization and institutional aspects

6.1 What's the MIS's institutional home?

	At the beginning	Nowadays
Farmer organization/cooperative/association	☐	☐
Development project	☐	☐
Trader organization/cooperative	☐	☐
Chamber of Agriculture	☐	☐
Chamber of commerce	☐	☐
Interprofession (private body representing all the stakeholders of the supply chain)	☐	☐
Private firm	☐	☐
Government ministry	☐	☐
Government parastatals	☐	☐
Government (local/decentralized)	☐	☐
NGO	☐	☐
Research organization	☐	☐
Other (please specify)		

6.2 How many staff in the MIS? (Processing and dissemination units, investigators)

	Executives	No executives
Processing units		
Collectors		

6.3 What is the staff status in the MIS?

Number of officials :	
Number of contract staff :	

6.4 Is the information disseminated in the covered zones by the MIS?

Identical (same products, same markets)	☐
Different (specified products or markets)	☐
Mixed (common base + specificities according to the zones)	☐

6.5 Is the data processing

Centralized	☐
Decentralized (different data processing units in the zones)	☐
Mixed (central unit and different data processing units in the regions)	☐

6.6 Is the MIS member of a MIS network? No ☐ Yes ☐
If yes specify which one

6.7 Is the MIS organizer of a MIS network? No ☐ Yes ☐
If yes, specify

7. Funding

7.1 Which of the main funders/supporters of the MIS? (Major funder, small funder, not at all)

	Main funder	Minor funder	Not at all
Government central	☐	☐	☐
Government –local/decentralized	☐	☐	☐
Donors (agencies of aid and cooperation)	☐	☐	☐
NGO	☐	☐	☐
Farmers' and traders' groups/associations	☐	☐	☐
Market traders	☐	☐	☐
Research institution	☐	☐	☐
Private firms/companies	☐	☐	☐
Individual farmers and traders	☐	☐	☐
Charity organization	☐	☐	☐
Other (please specify)	☐	☐	☐

7.2 In what way do the funders/supporters fund/support the MIS? (Most important, least important, not at all)

	Most important	Least important	Not at all
Budget	☐	☐	☐
Project funds	☐	☐	☐
Information sales	☐	☐	☐
Subscription	☐	☐	☐
Classified advertisement	☐	☐	☐
Service sales (ex. consulting)	☐	☐	☐
Advertising	☐	☐	☐
Other (please specify)			

7.3 If there are user fees, what actions are taken to ensure that users who cannot afford the information also benefit?

8. Feedback

8.1 How do you know if the MIS has satisfied the information need of users? (Please check all that apply).

Potential MIS users' assessment /needs surveys	☐
Customer satisfaction surveys	☐
External evaluations (by donor, government, or third party)	☐
Listenership groups	☐
Meetings with users (including farmer or trader groups)	☐
Suggestion boxes	☐
MIS information needs monitoring or information downloaded (SMS, website…)	☐
Other (please specify)	☐

8.2 How do you know whether the information supplied by the MIS is used or not?

8.3. For which market participants is the MIS most useful (most useful, little useful, not at all)?

	Most useful	Little useful	Not at all
Consumers	☐	☐	☐
Farmers (small-scale)	☐	☐	☐
Farmers (large-scale)	☐	☐	☐
Farmer organizations / associations	☐	☐	☐
Traders (small-scale)	☐	☐	☐
Traders (large-scale)	☐	☐	☐
Chamber of Agriculture	☐	☐	☐
Chamber of commerce	☐	☐	☐
Interprofession	☐	☐	☐
Government policy analysts / makers	☐	☐	☐
Donors	☐	☐	☐
NGOs	☐	☐	☐
Ministry of commerce and agriculture	☐	☐	☐
Banks	☐	☐	☐
Other	☐	☐	☐

9. Changes

9.1 What are the main changes has the MIS met since its creation?

9.2. What are the problems met and resolved by the MIS?

9.3 What are the problems met still to be solved by the MIS?

10. Other comments or remarks?

Thank you very much for participating in this survey.

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