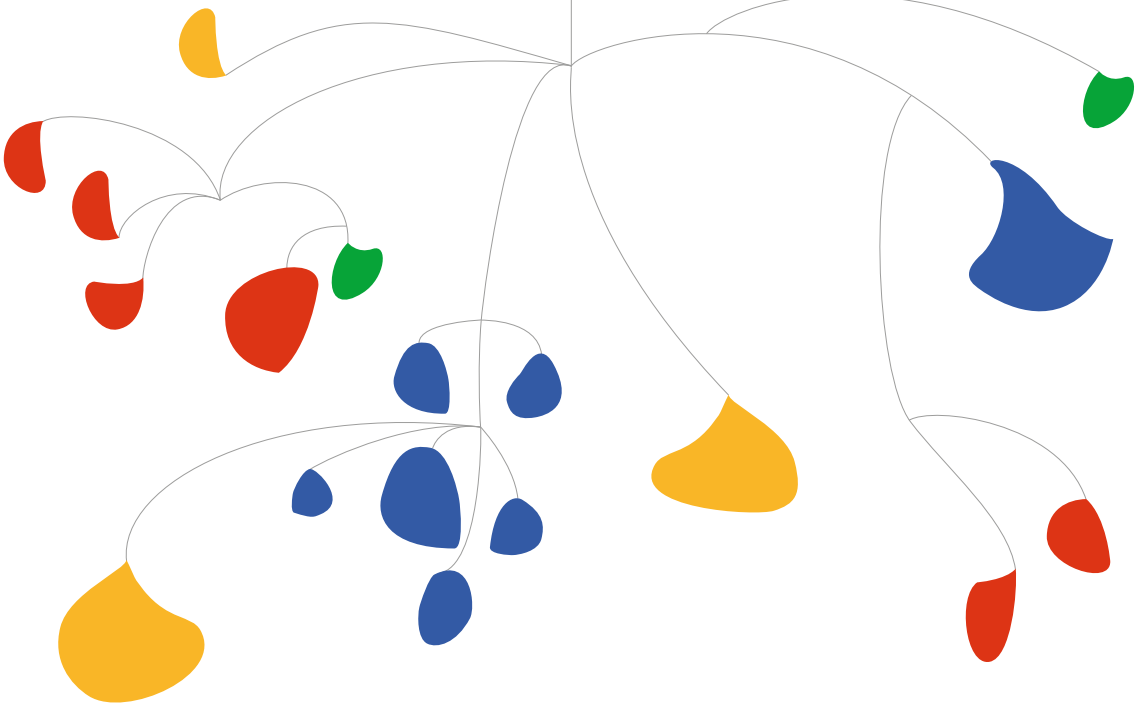
Food and Agriculture Organization of the United Nations

BUILDING AGRICULTURAL MARKET INFORMATION SYSTEMS:
A literature review



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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Acronyms

AMIS	Agricultural Market Information System(s) or Service(s)
APCAS	Asia and Pacific Commission on Agricultural Statistics
BMZ	*Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung* (Federal Ministry for Economic Cooperation and Development, Germany)
CIRAD	*Centre de coopération internationale en recherche agronomique pour le développement* (France)
CTA	Technical Centre for Agricultural and Rural Cooperation (EU-ACP)
FEWSNET	Famine Early Warning Systems Network
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (Organization for International Cooperation, Germany)
GSMA	Global System for Mobile Communications Association
GTZ	*Gesellschaft für Technische Zusammenarbeit* (Organization for Technical Cooperation, Germany)
ICT	Information and Communication technology
IFPRI	International Food Policy Research Institute
IVR	Interactive Voice Response
MIOA	Market Information Organization of the Americas
MIS	Market Information System(s) or Service(s)
MISTOWA	Market Information Systems and Traders Organizations in West Africa
NGO	Non-Governmental Organization
OMA	*Observatoire du Marché Agricole* (Mali)
OPAM	*Office des Produits Agricoles du Mali*
RATIN	Regional Agriculture Trade Intelligence Network (East Africa)
RESIMAO	*Réseau des Systèmes d'Information des Marchés en Afrique de l'Ouest* (West African Market Information System Network)
RONGEAD	*Réseau des ONG Européennes sur les Questions Agroalimentaires et le Développement* (Network of European NGOs on Agrifood and Development Questions)
RML	Reuters Market Light (India)
SMS	Short Message Service
USDA	United States Department of Agriculture
2GMIS	Second-Generation Market Information Service

Preface

The food crisis of 2007/08 clearly indicated an urgent need to improve the Agricultural Market Information Systems (AMIS) for price data collection and dissemination. This Literature Review aims to contribute to such an effort by reviewing the literature currently available on such systems. While primarily addressing AMIS in developing countries, the Review will also touch upon literature related to information services in more developed countries.

Market information can play an extremely important role in promoting agricultural development, especially for small-scale producers. In theory, sound market information can help to enhance transparency, competitiveness and the more equitable sharing of benefits among key players in the marketing system, although, as shall be seen, the studies conducted on such potential benefits have not always reached definitive conclusions. Nevertheless, an effective Market Information System or Service (MIS) can increase competitiveness, reduce information asymmetries and improve market efficiency. Additionally, while rarely (if ever) the primary reason for establishing an MIS, the information gathered can make a significant contribution towards improving food security, by enabling the identification of price trends that may signal emerging food problems, whether relatively short-term deficits or longer-term structural problems. A good MIS is also useful in enhancing governments' capacity to take appropriate policy and planning decisions in support of agricultural growth.

With regard to small farmers, an MIS can contribute towards strengthening their bargaining power and improving their awareness of market opportunities and options. However, learning how to interpret market information often requires external assistance. As for traders, market information can help them to identify areas where produce is available for purchase, markets where there are good arbitrage possibilities and, sometimes, farmers and other traders with whom they can trade.

This Literature Review seeks to review all features relating to MIS development, with a particular focus on information on market prices and on the use of new technologies for price data collection and dissemination. It aims to identify the majority of the relevant publications on the topic. A detailed list of References is provided at the end of the document, including, where available, URLs to the resources. Readers are encouraged to refer to the original documents wherever possible: indeed, this Review does not attempt a detailed summary of the documents cited, but rather seeks to emphasize the principal sources in the vast literature available. Similarly, while many of the most important MIS around the world are noted, this Review is not intended as a compendium thereof and does not, therefore, list them comprehensively.

Section 1 provides background information on MIS and their historical evolution. Papers that evaluate the impact of MIS are considered. Publications that address the important aspects to be taken into account in designing an MIS are reviewed in Section 2. Section 3 discusses data collection and dissemination, particularly in light of the opportunities arising from recent developments in Information and Communication Technology (ICT).

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1

Market information systems for agriculture

Agricultural Market Information Systems (AMIS, referred to hereafter as MIS) are designed to collect, analyse and disseminate data on the status and the dynamics of agricultural market prices. In developed countries, they have been in use for approximately a century; in most developing countries, they were not fully promoted until the 1980s, although there were early pioneers in, for example, Indonesia, Nepal and the United Republic of Tanzania (Mawazo *et al.*, 2014). Described as an essential part of the reform process (Coulter and Poulton, 2001), the development of MIS in the 1980s was partly a response to the market liberalization and structural adjustment policies that aimed to promote a greater role for the private sector by reducing the role of state-owned marketing bodies, particularly for the marketing of staple crops (Inter-réseaux, 2008). However, some of these new MIS also covered horticultural crops, roots and tubers, and livestock. Certain others, particularly in Asia, were developed outside the context of structural adjustment, such as the GTZ's efforts to expand Indonesia's MIS (Schubert *et al.*, 1988; Shepherd *and* Schalke, 1995).

Initially, MIS were developed mainly by the public sector, with considerable donor support. However, the twenty-first century has witnessed the development of a number of private services, such as Reuters Market Light (RML) in India and Esoko[1] in Africa. The commercial viability of these services is yet to be demonstrated. Indeed, even in some countries of the Organisation for Economic Co-operation and Development (OECD), market information is considered a public good. An example is the Market News Service operated by the United States Department of Agriculture (USDA).

[1] "Soko" means market in Swahili.

According to Galtier *et al.* (2013), MIS have primarily been conceived as tools for fulfilling two related objectives:

1. Improvement of public policies through an increased awareness of market realities;
2. Enhancement of market transparency, to bring about a fairer and more efficient allocation of resources.

However, Shepherd (1997) considers the provision of "current" or up-to-date commercial information as the prime purpose of an MIS. This information could subsequently be used to generate "historical" information, which is of value to both value chain actors and policymakers.

MIS users are thus defined by their need for information for decision making, whether in the short term (when and where to sell, at what price) or in the longer term (what and when to plant or, in the case of governments, how to support agricultural development). Potential users therefore include farmers, farmer organizations, traders, market wholesalers, food processors, local and central policy analysts and policymakers, researchers, educational institutions, extension officers, other private companies, donors and, sometimes, consumers (Kizito, 2011). Kizito also notes that different environmental features (e.g. government policies, macroeconomic and social characteristics, level of ICT use) can affect the impact of an MIS.

All actors involved in agricultural value chains can theoretically benefit from improved MIS. Farmers can use market information to decide to whom to sell and at what price, plan their production and harvest and, in some cases, select the optimal market channel. The availability of market information should facilitate negotiations with traders. As for agricultural traders, improved MIS provide support in making efficient decisions on where to trade. MIS also provide fundamental inputs into assessments of food security and enable issuance of early warnings of impending problems, as they can help to identify areas of possible shortage and signal whether prices are below or above seasonal trends (David-Benz *et al.*, 2011).

1.1 Past, present and future of market information systems

Early attempts at operating MIS[2] in developing countries followed a fairly standard format. Government bodies would collect information (usually only prices) and arrange for this to be disseminated via newspapers and radio stations (Shepherd, 1997). As David-Benz *et al.* (2011) and Galtier *et al.* (2014) observe, these "first-generation" MIS were mostly based on a single model, regardless of the market considered, the type of product covered and the country concerned. They often covered only one category of product (cereals, livestock, etc.), focused exclusively on price information, relied on project-based funding and were inevitably implemented by public bodies, such as marketing boards and ministries. Indeed, most early

[2] Throughout this publication, the words "service" and "system" are used synonymously. This reflects current standard practice, although it could be argued that a "system" develops the information, which is then provided to users as the "service".

MIS were established within ministries of agriculture rather than within statistics divisions, as this was considered more appropriate.

MIS have been given various definitions. According to a definition used by FAO to assess the Indonesian horticultural MIS, MIS are:

> *"[a] service, usually operated by the public sector (Ministry of Agriculture or a dependent agency or institute), which involves the collection on a regular basis of information on prices, and in some cases quantities supplied, of widely consumed agricultural products, from wholesale markets, rural assembly and retail markets, as appropriate, and dissemination of information on a regular basis through various means (bulletins boards, radio or television bulletins, newspapers, etc.) to farmers, traders, Government officials policy makers and others" (Shepherd and Schalke, 1995).*

The early MIS suffered from several problems. An early critic was Bowbrick (1988), who argued that market information was, in fact, of little use for spatial arbitrage, that the data quality was usually very poor, with little consideration of grades, and that establishing good relationships between buyers and sellers would lead to better returns than those possibly derivable from playing the market in response to price information. Bowbrick further noted that agricultural ministries had few resources; allocating these to MIS involved a high opportunity cost.

While not criticizing basic MIS theory, Shepherd (1997) surveyed a large number of MIS in developing countries. He concluded that the information provided was often inaccurate and usually reached farmers too late to be of practical use. Governments frequently sought to please all parties involved by attempting to cover far too many locations, which entailed a high cost. Many services had more of a statistical orientation than a commercial one. Invariably, many MIS either collapsed, after initial donor assistance ended, or struggled along with little impact. Twenty years after Shepherd's publication, the situation does not appear to have changed significantly, with MIS continuing to close down on a regular basis.

The World Bank (2011) endorses this view, noting that government-run MIS were criticized due to their poor accuracy and lack of timeliness and concluding that they resulted in low economic impact. While generally considered to carry out price analysis satisfactorily, weaknesses were displayed in price gathering. According to the World Bank, the major criticism was that the information did not reach farmers on time, if at all.

Notable exceptions included Indonesia's MIS, which had been set up by GTZ only after lengthy research into the needs of the country's agricultural marketing chains (Schubert *et al.*, 1988).

By the end of the 1990s, the diffusion of cell phones and of the Internet led to the possibility of a new generation of MIS. These improvements in the ICT sector made it possible to shorten both the time lag in transmitting price data from collection points to central processing units,

and in disseminating information to the intended recipients. MIS using ICTs became known as the "Second Generation" MIS, or 2GMIS for short (David-Benz *et al.*, 2011; David-Benz *et al.*, 2012; Galtier *et al.*, 2014).

Today, real-time information can be delivered within a few hours. Data is no longer limited to prices, but may also include information relating to trade (local trade flows, imports and exports, contacts of buyers or sellers, etc.), and to production and policy measures. In addition to providing market information, new-generation MIS are sometimes associated with complementary services intended to reduce market risks, such as storage facilities and credit lines, warehouse receipt systems (CTA, 2013) and commodity exchanges (Mukhebi *and* Kundu, 2014; Katangeza, 2012). Indeed, where market transactions are all recorded at the time they are carried out, such as in a commodity exchange, providing more or less instantaneous MIS updates should be a rather simple task.

Galtier *et al.* (2012) argue that the power offered by new ICTs makes it possible to:

1. Improve the supply of information to meet data users' actual needs;
2. Improve user access to information; and
3. Link MIS to other, related, information systems and thus enhance use of the data disseminated.

If MIS are to be relevant, they must disseminate useful information that key market players cannot access through other channels. In this sense, new technologies enhance their capacities for interactivity, i.e. for generating feedback on the end uses of information and thus on users' actual needs. However, as will be discussed in subsequent sections, many of the previous difficulties remain under the 2GMIS, such as those concerning data accuracy and sustainability in light of cost implications.

As seen below, the availability of timely, accurate and relevant market information is critical to an efficient early warning system on food security. Official food price statistics, as opposed to prices issued by an MIS, are typically available only after a considerable period, by which time the information has lost much of its value. Several countries and international organizations are currently studying methods to exploit big data to "nowcast" food prices of relevance to consumer price indices and food security (Dubey *and* Gennari, 2004), such as by accessing price information from supermarket scanners or using crowdsourcing. Whether such approaches can be transferred to the prices of agricultural products in markets remains to be seen, although in this respect, crowdsourcing may be a possibility (see Section 3.1).

1.2 Studies of market information systems

Numerous studies of MIS have been conducted around the world. Although some are now rather obsolete, they still provide useful information and practical pointers for those wishing to establish new MIS or improve existing ones. For example, Mendoza (2006), working with the Market Information Organization of the Americas (MIOA), established a list of 24 "Best Practices" (MIOA, 2006) and assessed MIOA members according to these criteria. Among

the best practices identified were the following:

- A written manual is available and compliance with it is ensured;
- An adequate budget has been allocated to carry out planned activities;
- Norms for the validation of the information obtained have bene established;
- Data collection activities are carried out on the basis of previous studies of the most appropriate sources;
- Manuals on data processing exist and staff knows how to use them;
- The software programme used is fit for purpose and the programme can be modified;
- Reports can be generated easily and are simple to understand;
- Staff have been trained on how to promote the service;
- Reports are distributed to those who supply the data and a registry of information suppliers is kept up-to-date;
- Users or customers are classified according to their preferred means of dissemination;
- The MIS's website is easy to use and up-to-date; and
- Procedures are in place to obtain user feedback.

The MIOA evaluation found that the USDA Market News Service was the best performing MIS, followed by those of Chile, Mexico, Colombia and Canada. Detailed country assessments are available at the MIOA website[3].

In Asia, FAO's Statistics Division collaborated with the Asia and Pacific Commission on Agricultural Statistics (APCAS) to assess the status of agricultural price collection by APCAS members (APCAS-FAO, 2010). While this was mainly a survey of agricultural statistics departments, rather than of MIS, it was assumed that price information generated by MIS would have been available for use for statistical purposes. The survey found that only half of the APCAS members reported producer prices to FAO, and for only half the number of commodities for which information was requested by FAO. Given the availability of prices at various levels and the various institutions involved in managing price data, the report recommended improvements to the networking efforts conducted among these institutions. It was also proposed to launch regular training activities covering the principles and best practices of price data collection.

Binayee (2005) carried out a study on MIS in Nepal, India, Pakistan and Bangladesh to inform the development of an MIS in Lao PDR. The study included a review of the MIS that were supported by development organizations and were targeted at farmer communities. These had proved difficult to sustain, when they were not integrated into an appropriate existing institutional system after project support was over. Binayee also examined government-run services, such as AGMARKNET[4], as well as at largely fee-based services, such as Agriwatch (both in India[5]). Hoang and Moustier (2005) provide detailed descriptions of several MIS in Viet Nam, as well as those in Cambodia and Laos, while Moustier *et al.* (2014) describe the operations of a particular MIS in Hanoi, Viet Nam.

[3] http://www.mioa.org/en_US/members/mis-assessments/.
[4] http://agmarknet.gov.in/.
[5] http://www.agriwatch.com/.

An Expert Consultation on MIS organized by the CTA discussed presentations on the MIS of countries of the Caribbean, Ghana, Kenya, Malawi, Senegal, Uganda, and the Pacific Islands, as well as regional MIS in Eastern Africa (Regional Agriculture Trade Intelligence Network – RATIN[6]) and West Africa (Réseau des Systèmes d'Information des Marchés en Afrique de l'Ouest – RESIMAO[7] and Market Information Systems and Traders Organizations in West Africa – MISTOWA[8]). The main findings of the consultation were that addressing the (information) needs of smallholder farmers is paramount in improving their ability to engage with the market and thereby improve their livelihoods. However, market information may or may not rank very high in relation to the farmers' other needs. In planning to supply good quality information, it is essential to recognize and understand regional and national differences in the state of development of MIS around the world. Public–private sector collaboration was recommended. However, concerns over sustainability could influence the type of collaboration ultimately formed (CTA, 2006).

Ferris and Robbins (2004) described the development of the Foodnet MIS in Uganda, one of the first services to utilize cell phones. Another study conducted in Uganda (Kato *and* Nkonya, 2005) found that radio was the preferred source of information at the time, for all crops and commodities. Robbins (2000) reviewed the MIS in Botswana, Ethiopia, Ghana and Zimbabwe. This study reported that government-run services were underfunded and overly bureaucratic and lacked the participation of stakeholders from the agricultural sector, and recommended an approach to collection and dissemination that was based more on the local level. IFPRI (2013) studied the MIS in Malawi, finding that farmers considered factors such as convenience, certainty of selling, speed of selling, availability of items to buy, safety and established relationships – all of which reduced the potential utility of market information. Traders also reported that they did not use MIS data, but, rather, had developed their own methods for collecting information, mainly by establishing a network of contacts with other traders and friends whom they could contact to obtain price information as required. Before responding to price signals, traders also considered the costs of carrying out arbitrage and the risks of not selling or not buying enough. Their ability to choose particular markets to visit was also constrained by the resources available to them.

David-West (2010) reviewed Esoko, the privately owned Ghanaian MIS, which had received the 2009 UN World Summit Award (WSA) for E-Content and Creativity. Mabota *et al.* (2003) reviewed the operations of the MIS in Mozambique, while Mawere (2008) carried out research into the access to and use of market information in Kabwe District, Zambia. Linking market information provision to commodity exchanges – where these exist – can enhance the accuracy and relevance of data and reduce collection costs. Mukhebi (2004) and Mukhebi and Kundu (2014) have reviewed Kenya's KACE information service.

David-Benz *et al.* (2016) analysed a sample of 582 households in two main rice-producing areas of Madagascar. Different ways to disseminate market information were tested. The majority of producers believed having better access to market information was necessary,

[6] http://www.ratin.net/.
[7] http://www.resimao.net/?lang=en.
[8] Now no longer active.

and that the greater the farmers' involvement in the market, the greater was their need for personalized information delivered via cell phones. However, the number of producers demanding information through this medium was limited, and many farmers did not own a phone. Among those that did, there was a rapid turnover of phone numbers. The authors concluded that there was a need to diversify the communication means, including through use of radio and bulletin boards.

Zoltner and Steffen (2012) reviewed several national and regional MIS in Eastern and West Africa: Agricultural Marketing Information Services (Cameroon); the Agricultural Input Market Information and Transparency System – AMITSA (Eastern Africa); the privately operated Esoko (many countries in Africa); the Infotrade Market Information Services (Uganda); Lima Links (Zambia); the Livestock Market Information System – LMIS (Ethiopia); MFarm (Kenya); Nokia Life Tools (Nigeria); RATIN (Eastern Africa); and the service operated by the Zambia National Farmers Union – ZNFU. The study concluded that even the most established MIS continued to face challenges in delivering market information to farmers profitably without ongoing government or donor support. The services' sustainability would largely depend on providing poor farmers with services that enable them to increase their incomes and therefore justify the payment of a fee. Additional information on RATIN is provided by Ngombalu and Masila (2014).

1.3 The impact of market information provision and of improved communications

From an economic perspective, market performance depends on the quality of the circulation of information between the various actors involved in the agricultural value chains. However, in practice, economic agents (traders, producers, and government authorities) often have incomplete and sometimes inaccurate information. This difference in the access to information was assumed to lead to inequitable price formation, often to the disadvantage of producers (Inter-réseaux, 2008). Hence, the driving idea behind MIS was to enable the market system's core stakeholders to make better decisions on when (temporal arbitrage) and where (spatial arbitrage) to buy and sell. This, in turn, was assumed to lead to a more integrated market and more stable prices (Galtier *et al.*, 2013).

An early attempt to argue the theoretical case for market information in terms of its impact on the arbitrage between markets was made by Lutz *et al.* (1997). However, it should be noted that Bowbrick (1988) had previously argued that an MIS signalling high prices in one market could rapidly cause a glut in the same market, if all traders responded to the same price signals. The adverse consequences of chasing the price is also clear in the context of farmers tending to plant crops that were sold at high prices in the previous season, thus leading to a glut in the following season. Such a boom-and-bust cycle is common, despite efforts to warn farmers of its dangers.

The prevailing view remains that MIS in developing countries can be beneficial for farmers and traders alike (Tollens, 2006; David-Benz *et al.*, 2011). In recent years, some detailed

field research has been carried out, in many cases to assess the impact of a combination of improved market information and cell phone availability. While some positive effects have been recorded, the conclusions on MIS utility are still far from unequivocal. Some of the studies conducted are described briefly below:

- Aker (2010) examined the impact of cell phone availability on price variability in markets in Niger. The phones were used to access price information from other traders rather than from an MIS. The study discovered a significant reduction in variability across markets. Phones were found to be more useful when markets were further apart. It was concluded that the reduction in search costs and in inter-market price dispersion led to improvements in trader and consumer welfare. However, more recent studies performed in Niger by Aker and Fafchamps (2014) have concluded that while mobile phone coverage reduced spatial producer price dispersion by 6 per cent for cowpea, a semi-perishable commodity – with these effects being strongest for remote markets and during certain periods of the year – there had been no effects on producer price dispersion for millet and sorghum. A possible explanation for these results was the fact that farmers resorted to greater storage for storable commodities such as millet and sorghum.
- A study conducted in the Philippines (Labonne *and* Chase, 2009) found that farmers using cell phones reported improved relationships with their trading partners, possibly because the ability to compare prices led them to trust their buyers more.
- With reference to the United Republic of Tanzania, Molony (2008) argued that the ability to communicate using cell phones did not significantly alter the trust relationship between buyers and sellers. It was inferred, rather, that farmers often had to accept the price offered because their buyers were also their creditors. Therefore, many farmers were unable to exploit new cell phone-based services to seek information on market prices and potential buyers in other markets, as this risked harming long-term trust relationships with buyers who were willing to supply credit precisely due to their established business relationship. However, Molony considered that there was some scope to involve these traders as agents, to connect farmers to other credit sources using cell phones.
- In an early study conducted in China, Egglestone *et al.* (2002) found that villages equipped with telephones actually obtained lower prices for agricultural products than those without phones. In Sri Lanka, De Silva (2005) reported on an innovative electronic system for capturing price information in a large wholesale market in the centre of the country, with dissemination both within the market, on large screens, and outside, by phone. Anecdotal evidence pointed to positive results, particularly for younger farmers.
- In a well-known study that also examined the use of cell phones independent of any MIS, Jensen (2007) observed the impact on fishermen of the introduction of a cell phone service throughout Kerala, a state in India with a large fishing industry. Phone signals could be picked up at sea, and fishermen were able to contact buyers on the coast. Jensen showed that the adoption of mobile phones by fishermen and wholesalers was associated with a dramatic reduction in price dispersion, the complete elimination of waste, and a near-perfect adherence to the "Law of one price". Both consumer and producer welfare increased. In another study conducted

in India, Goyal (2010) found that the introduction of free Internet kiosks showing daily agricultural information (e-Choupal), combined with the entry of a new corporate buyer, significantly increased average market prices for soybeans in Central India.

- In Uganda, Muto and Yamano (2009) used longitudinal panel data to test the hypothesis that cell phone coverage expansion increased market participation. They found that the expansion of the phone network had a greater impact on the market participation of banana farmers in areas farther away from district centres. However, for maize, which is much less perishable, the expansion of the phone network was not found to have any impact. Ferris *et al.* (2008) found similar benefits in the case of the Ugandan MIS, Foodnet. Using the Uganda National Household Survey 2005, Svensson and Yanagizawa (2009) compared the impact of access to market information (proxied by access to FM radio stations) and concluded that farmers equipped with radios in areas where market information was broadcast received 15 per cent more for maize than farmers without access to market information.
- Ogutu *et al.* (2013) compared farmers in Kenya with access to ICT-based market information to those without any such access. They found a positive and significant effect on the usage of purchased seed, fertilizer, labour productivity and land productivity, but a significant decline in the use of hired, family and total labour, which could be attributed to the greater efficiency resulting from market information use.
- Several researchers have conducted randomized trials in which some farmers receive market price information by mobile phone and their responses are compared with those given by a control group that does not receive any information. Camacho and Conover (2011) studied farmers in Colombia, finding less variability in the price that farmers expected to receive, among those who had better knowledge of prices; however, this was not translated into a significant difference in the actual sales price. Knowledge of prices may have led to a reduction in crop losses, although no significant changes were registered in farmers' revenues or household expenditures. In Ghana, Hildebrandt *et al.* (2015) carried out a similar randomized study of the impact of Short Message Service (SMS) messages distributed by the Esoko market information service. The price alerts had an impact on prices received for yam, a crop characterized by high price variability, the absence of a reference "market price" and a high prevalence of bargaining. There was also a spillover effect on farmers in the control group. However, neither direct nor spillover effects were noted for other crops, suggesting that product characteristics and the marketing environment bear a direct impact on the potential usefulness of price information services.
- In Peru, Nakasone (2013) set up a randomized control trial. Selected farmers in random villages were given access to detailed price information for the most relevant local crops in six regional markets through SMS, over a four-month period that began immediately after the harvest. These farmers were found to obtain higher sales prices compared to those in the control group. This result was mostly due to increases in the prices for relatively more perishable crops, for which information could be more valuable. The marketing outcomes of households that did not receive the information but lived in the same villages as the information recipients showed no significant evidence of any spillover effects.
- In India, Fafchamps and Minten (2012) also conducted a controlled randomized

experiment based on SMS price information messages provided by Reuters Market Light (RML). The experiment covered one hundred villages in Maharashtra. While there was some evidence that the market information affected spatial arbitrage and crop grading, the magnitude of these effects was found to be small, without any statistically significant effects. These results were consistent with the take-up rate for the RML service in the districts under study, which had been disappointing. Mitra *et al.* (2013) studied the effects of supplying market information to potato farmers in West Bengal. The farmer's average earnings were unaffected, while both earnings and output sales became more volatile. The authors attributed this in part to limited competition between traders.

- In a study of farmers in Benin, Kpenavoun Chogou *et al.* (2009) found that farmers attached importance to market information but were more likely to use information obtained from other farmers, than that supplied by the government service. However, in nearby Ghana, Courtois and Subervie (2014) tested models of expected response to market information on data sets obtained from farmers and concluded that farmers who benefited from an MIS programme received a 10 per cent price increase for maize and a 7 per cent price increase for groundnuts, compared to the price that they would have obtained if they had not participated. In Mali, Uganda, the United Republic of Tanzania and Ghana, Farm Radio International (2011) developed a radio-based MIS campaign that responded to the smallholders' need to access local and regional markets. MIS radio programmes provided farmers with more than conventional commodity price data, as they also discussed marketing topics. A survey found that 84 per cent of listeners considered the programmes to be "very useful", although no research was conducted into whether this translated into improved incomes. However, the popularity of the service did attract increased private sector sponsorship, suggesting a future model for sustainability.
- From an econometric analysis of a two-year panel household data set for four provinces in Mozambique, Kizito (2011) and Kizito *et al.* (2012) found that the mean price difference per kg of maize sold between households with and without information was 12 per cent. The estimated aggregate marginal gain in income by an estimated 250 000 households that received information and sold maize was estimated at US$723 121 annually in the main marketing season. The authors noted that these gains were approximately six times greater than the operational costs of the Government's MIS in 2002, equivalent to US$130 000.

Therefore, studies on the impact of market information and of growing cell phone coverage without formal MIS seem to show mixed results. The conclusions that could be drawn are that the impact varies considerably, depending on the crop and on the structure of the marketing system. Generally, from the cases cited above, there appears to be evidence that market information is more valuable for farmers of perishables and semi-perishables, rather than for those who grow crops suitable for long-term storage. However, as Staatz (2011), Aker (2011) and Staatz *et al.* (2014) have emphasized, there are considerable methodological difficulties in measuring the impact of MIS and of various dissemination techniques. Clearly, research techniques must be refined further before definitive conclusions can be drawn.

The potential impact of cell phones on enabling farmers to contact buyers directly does raise the question as to whether, in the long term, traditional MIS will be needed. As prices of calls drop, farmers are more likely to prefer direct contact to second-hand information. For example, Reardon *et al.* (2012) report that in Bangladesh, India and China, cell phone ownership by rice farmers varied from 73 per cent in India to 97 per cent in China; usage of those phones to contact buyers ranged from 19 per cent in India to 71 per cent in Bangladesh. Thus, the future for MIS may be as a part of a bundled package of agricultural support available on smartphones, rather than as a separate activity.

MIS have generally refrained from making price forecasts, other than, occasionally, providing rather general observations such as: "based on trends in previous years, prices can be expected to begin to rise in the coming months" or, in the case of export commodities, "an increase in world market prices last week may see local prices increasing in the near future". Two recent projects supported by RONGEAD in West Africa are an exception. The first, undertaken with the West African Grain Network, aims to advise traders on market opportunities and on whether stocks should be held; the other seeks to provide similar advice for farmers and traders of cashew and other products through the N'kalô project[9] (Gonnet *and* Kedja, 2014).

Kizito and Staatz (2014) have examined the potential benefits of forecasts. They conclude that these are likely to be most advantageous 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.

1.4 Market information for early warning of food security problems

Market information (primarily on prices, but also on stocks and trade) is particularly useful in the context of obtaining early warnings of food security difficulties. Analysts are concerned with food availability and food access, which are well indicated by price trends, particularly in countries where government intervention in staple markets is non-existent or kept to a minimum.

FAO (2000) studies the role that prices can play in a Food Security Information and Early Warning System (FSIEWS). FEWSNET (2009), building on earlier work by Chopak (1998), provides detailed guidance on using market information for early warning purposes. This is best achieved by identifying anomalies (defined as deviations from the norm or average) that could point to potential shortfalls in food availability or food access problems. For example, if traders expect an above-average harvest, they may sell stock, which will increase supply and cause a price decline. If a poor harvest is expected, traders may hold more stocks in expectation of higher prices. To use price information in this way, FEWSNET stresses the

[9] http://nkalo.com/.

importance of the availability of historical prices. Monitoring price variations within a country is also useful to emphasize disruptions to trade that are hindering normal arbitrage activities. Fackler and Goodwin (2001) provide advice on spatial price analysis. Price trends for one product may also indicate supply difficulties with another, as consumers may switch from one product to another when the prices of the former are too high. In some countries, livestock prices are a good indication of drought or other food supply problems. Farmers are likely to sell animals when there is no feed for them, and may also sell animals to raise money to buy staples. The World Bank (2005) also examines the management of food price risks, discussing the reason for price variability, particularly in the context of market liberalization.

MIS are therefore an important tool in managing risks relating to price anomalies. The works of Abbott (2012), Antonaci *et al.* (2014) and Galtier (2013) illustrate the importance of reliable national food price statistics, both to facilitate responses to food security problems and to conduct analyses of future policy options that can avert major scares, such as the 2007-08 food price crisis. The multi-donor AMIS, established by the G-20 Group of Countries and headquartered in FAO[10], depends on the reliability of price and other information supplied by contributing countries for its utility (AMIS, 2011).

[10] http://www.amis-outlook.org/.

2

Designing a market information system

Developing a sustainable and efficient MIS is not a straightforward task. Indeed, many aspects require careful consideration. Unfortunately, despite the vast amount of literature that describes and analyses MIS and their impact, only a limited number of publications provide practical advice on how to set up and operate such a service. Schubert *et al.* (1988) was an early example, but is no longer available. The reader is referred to the works listed below; however, there is clearly scope for additional training guides to be produced, particularly in light of the growth of "second-generation" MIS in recent years and the new competencies they require.

- Originally, Poon (2001) was not widely distributed; however, it is now available online. The first chapter provides an introduction to the subject of market information. Chapter Two describes the planning and organization of an MIS; Chapter Three describes the setting up of the collection system for market data; Chapter Four describes the processing of that data; Chapter Five describes dissemination techniques; and Chapter 6 draws all elements of the system together, advises on the staffing of a market information unit and also discusses the monitoring and evaluation of the service. Although written before 2GMIS had been developed, many of the basic data gathering and processing practices described remain relevant, and the guide should certainly be consulted by those aiming to establish or upgrade an MIS. FAO (1980) also provides good advice on price data collection, with a more statistical approach.
- The MIOA's "Best Practices" checklist (2006) does not contain specific operational guidance; however, it is an excellent summary of the issues that MIS must address.
- Weber *et al.* (2005) provide brief advice on establishing sustainable MIS, with particular emphasis on developing strong public-private partnerships.

- El Fadil (2010) wrote primarily with early warning purposes in mind; however, it also contains useful advice for MIS on data handling and processing. For example, it covers data cleaning and rounding, the treatment of inflation, the handling of missing data, and price indices, together with more statistical approaches to data analysis. The publication should be particularly useful for MIS that include data analysis in addition to regular information.
- The Global System for Mobile Communications Association (GSMA), the association that represents cell phone operators worldwide, has published a booklet to help companies and organizations set up an MIS that uses cell phones (Jadhav *et al.*, 2013). The booklet covers the researching of potential users; understanding value chains and the information requirements of marketing system participants; alternative sources of market information; partnerships to assist in data collection; processing and dissemination; techniques for data collection and quality assurance; delivery channels and business models.
- CTA (2015) was written with Africa in mind; however, it also applies to other regions. It consists of twelve short booklets that were initially developed at a "writeshop", which brought together representatives of leading MIS in Africa. While targeted at private organizations that are considering to establish an MIS, the booklets also contain useful information existing private or government MIS could use to upgrade their services. In particular, the following topics are covered: identifying clients and planning services; deciding the business model; choosing the right technology; choosing and working with partners; collecting data; data analysis and packaging; disseminating information to clients; marketing the MIS; ethical and legal issues; and the role of donors and NGOs.
- While most MIS cover food products, such as staples, horticultural crops and livestock, MIS that support commodity farmers have also been shown to be useful. Tollens (2006a) provides guidance on operating a service for cocoa, based on experiences in Nigeria, Cameroon and Côte d'Ivoire.

To plan a service, a MIS must implement the following sequence of activities:

From their very inception, MIS (including those using modern ICTs) are likely to face several technical difficulties relating to the reliability of the information disseminated, the timeliness and speed of dissemination, the need to generate feedback on how the information is used, and the importance of ensuring adequate data analysis. Therefore, the design of an efficient, relevant and sustainable MIS is a complex effort, and several issues must be considered carefully. Shepherd (1997) argues that the more research is undertaken in the beginning, the more likely will the resulting MIS be valuable to its target users.

This chapter reviews some of the aspects to be considered during this key phase of MIS development, as outlined in the figure above.

2.1 Who are the customers?

When designing the MIS, it is important to identify target client groups (in both private and public sectors), their needs, the appropriate means of communication and dissemination, and the system's priorities. Different MIS "customers" will have different information needs and different preferred means of receiving information (Shepherd, 1997). Farmers differ in their perceptions of the agricultural information that they need. Often, farmers require a package of information and their needs and priorities change throughout the production cycle. For example, market information may be of little interest until the start of the harvest (World Bank, 2011).

In this regard, a classic model to follow is that used by GTZ in developing the Indonesian MIS (Schubert *et al.*, 1988; Shepherd & Schalke, 1995); however, this detailed approach followed by GTZ (now GIZ) in Indonesia has been rarely replicated. A recent CTA study (2016) has found that one of the weaknesses with ICT-for-agriculture developments, including those directed at setting up MIS, is that:

> *"[t]oo often, developers look at whether an information and communication technology (ICT) application is suitable for agricultural use without first assessing the demand. No project design should begin without detailed consultations with the intended users, such as farmers, traders and extension workers. Consultations should first aim to identify their agricultural needs and, only after this has been done, should project developers consider whether these needs could be met successfully by ICTs. Further, both demand and impact need to be assessed on an ongoing basis through rigorous monitoring and evaluation". (CTA, 2016)*

It is possible to identify several broad groups of actors along the supply chain, such as farmers, traders and processors, input suppliers, other "service providers" such as banks, microfinance organizations and warehousing companies, as well as government departments and early warning services. All have different information needs (Poon, 2001; CTA, 2015b). Proper targeting and frequent assessment of user information needs are essential factors in building long-term political and financial support for the system (Weber *et al.*, 2005). Ensuring

that users will be able to use the information is also crucial from the outset. For example, it is necessary to ascertain whether farmers are literate and numerate (CTA, 2016), whether they have cell phones, and whether cell phone coverage throughout the area in question is adequate (CTA, 2015a and 2015b). As noted above, it is important to be realistic with regard to the potential offered by technology, to the exclusion of a full consideration of customers' actual needs. There is little point in offering a sophisticated service if the recipients do not really require the information provided.

The way in which MIS distribute information on prices and other related factors depends on the specific operation of the marketing system. Thus, when designing an MIS, it is necessary to perform a careful analysis of the supply chain, to collect information on the flow of products between farms and markets and between markets, as well as on the functions of the various intermediaries.

Information needs also differ significantly between countries and within countries, for farmers producing different products (World Bank, 2011).

Based on the level of the transaction of the commodity, various types of price data may be distinguished. For price observation, the most commonly considered transaction levels are (El Fadil, 2010, adapted by authors):

- **Farm-gate level**: at or near the farm or place of production. Usually, it is the location where a commodity is first exchanged. Gathering information at this level tends to be expensive and impractical except for small, localized MIS.
- **Assembly**: where smaller quantities of a commodity – usually from different farmers and small-scale traders – are accumulated or aggregated. Assembly markets facilitate marketing and movement of commodities, and reduce marketing costs. Prices from these markets are probably the most useful for small farmers. However, they may also involve considerable collection costs.
- **Wholesale level**: usually, this is where traders sell to other traders or agents in the market, who then sell to retailers. Volumes per transaction tend to be larger. It is easiest to collect data at these markets, although farmers may require assistance in interpreting the meaning of wholesale market prices for their own situations.
- **Retail level**: where commodities are sold mainly to end users, especially consumers. Volumes per transaction tend to be smaller. While useful for early warning purposes, retail prices are only useful to farmers when they can access retail markets to make direct sales to consumers.

Analysing the marketing system is also useful in selecting the markets and commodities to be monitored. When designing an MIS, the golden rule is to start on a small scale and then scale up, as resources permit. For instance, depending on the specific country or regional context, it may be desirable to launch a service with information on the prices in a few important wholesale markets, and then gradually expand to include other wholesale centres and some assembly markets. MIS should include commercially important crops, which, in some cases, may have more than one variety. Including too many crops should not be encouraged (Shepherd, 1997).

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2.2 Planning the services to be provided

Once potential customers have been consulted, an MIS should have a clear idea of the information required. The next step is to work out how this can be provided. First, however, potential MIS must ensure that they are not duplicating other similar services (Poon, 2001). For market price information, the MIS must be certain that the information it supplies is

relevant to particular farmers; this requires a thorough understanding of how local marketing systems function (Poon, 2001). Farmers may genuinely need information from the small urban market located 20 km away from their village. However, it may not be realistic for an MIS to cover 50 markets in a single country. Thus, the MIS must decide on where to collect prices, which prices to collect, the grades of products for which prices should be collected, how to collect them, how frequently to collect them, etc. (CTA, 2015b; Poon, 2001). It is then necessary to consider how information will be transmitted; probably, this will first be delivered to a central location for processing and then to final recipients.

In addition to price information, several other services could be offered to farmers, depending on their location and the products produced. The CTA (2015b) identifies these as:

- Weather, current and forecast: temperature, rainfall, wind strength, humidity
- News: news relating to the commodity in question
- Trade: quantities and volumes traded at selected markets, and across borders.
- Warehouses: location, quality and grades
- Inputs: type and prices of inputs sold (retailer, wholesaler and importer)
- Demand: consumption levels and patterns
- Production: crop types, area planted, stocks, yield levels, crop calendars
- Financial: foreign exchange, tariffs, insurance
- Regulations: taxes, standards, export requirements

2.3 Developing a sustainable business model and identifying partners

In the past, MIS were generally hosted within a public body, which was responsible for all aspects relating to design, funding and implementation. Today, many developing countries have access to a variety of MIS platforms. All types of organizational structure present their own benefits and limitations, which depend on the specific country's context. In addition, the system's autonomy and neutrality must also be preserved: indeed, autonomy is the precondition for MIS flexibility and adaptability, whereas neutrality is necessary to obtain reliable and credible information (Galtier *et al.*, 2012).

The "Business Model" concept (Osterwalder & Pigneur, 2010) facilitates the planning of a new MIS and identification of its potential viability. The CTA (2015c) uses this approach to identify nine questions that should be asked when planning such a service:

1. What is your product or service?
2. Who are your customers?
3. What marketing channels will you use to provide your product to your customers?
4. How will you create and maintain a relationship with your customers?
5. What income streams can you generate?
6. What resources will you need?
7. What activities will you need to undertake, to create the product or service?
8. What business services and partners will you need?
9. What costs will you incur?

The CTA then addresses the question of costs, stressing that a new system will incur considerable upfront costs to plan and develop the system, attract the first customers, and cover running costs before the service starts generating revenue. Initial capital is required to pay for these costs. It notes that MIS have fixed and variable costs. The fixed costs may be high and include gathering and analysing data, software development, licences, office rental, and management. On the other hand, the variable costs of serving each new user are low, which makes it crucial to attract a sufficient number of paying customers to break even. This break-even point must be calculated, recognizing that achieving scale takes time. Given that it is difficult to cut costs, the key is to increase revenue without incurring additional costs (CTA, 2015c).

Giovannucci and Shepherd (2006) argue that the prime considerations in designing an MIS must be its commercial utility and sustainability. Therefore, the MIS should be market-driven, accurate, timely and reactive, and cost-effective. When designing and developing an MIS, ensuring its financial sustainability is therefore one of the biggest challenges. However, while in theory an MIS should be capable of generating profit for its provider, such that the system is financially independent from donor funding, in practice the development of such a business model has proven to be difficult, if not impossible. The CTA (2016) examines this in the context of ICT-for-agriculture projects, including those supplying market information.

Recognizing the difficulty of an MIS being entirely self-funding, Kizito (2011) considers that the sustainability of an MIS depends on:

- how it generates funding internally (e.g. through user fees);
- how it mobilizes support from users, especially farmers, traders and policymakers, and thus exerts "political" pressure on governments to provide financial support; and
- how it controls costs (i.e. managing the organization such that the costs of information collection and diffusion are minimized).

Some government MIS have started to sell information and other types of services, such as analyses and studies. However, given the limited resources of farmer clients, the income generated through the sale of information and the provision of other types of market services usually makes only a minor contribution. Often, it is difficult for government MIS to generate revenue, as there is either no provision for making charges, or all revenue goes to a central account of the country's ministry of finance and cannot be retained by the MIS.

Lack of support for MIS by governments may be due to their discomfort with the private sector's profit motives (suspicion towards the "middleman"). In other cases, concerns have been raised that broadcasting news of rising prices could lead to political agitation by consumers, while news of falling prices could upset farmers. Donors, however, are reluctant to fund projects for more than three to five years, on the assumption that, once successful, the project will be taken over by the relevant government or by the private sector. The CTA (2015k; 2016) argue that donors must rigorously examine the capacity of the hosting organization to continue implementing activities after a project. They should design projects with sustainability in mind, rather than their need to spend a certain budget. Governments should refuse donor support if they feel they cannot guarantee sustainability.

Cost control reduces the funding required by the organization and is also likely to increase the willingness of users, the state or external agencies to provide financial support. However, reducing costs must often be balanced against the level of service it is envisaged to provide.

The absence of a sustainable business model on the basis of which governments can obtain and disseminate price information reinforces this dependence on donors and grants (Zoltner & Steffen, 2013). In this connection, several authors (e.g. Kizito, 2011; Weber *et al.*, 2005; and Galtier *et al.*, 2012) argue that public-private partnerships, in which governments support the private sector's commercial price data collection efforts, in return for the provision of data required for policymaking and early warning, could result in more stable MIS models.

An MIS is likely to require a wide range of partners. These will probably include providers of data, such as data collectors and market managers, other companies who already generate data, and trader associations; service providers, such as Internet companies, mobile phone operators and radio stations; sources of finance; and regulators (CTA, 2015e). However, their willingness to collaborate cannot be assumed and must be ascertained from the outset. Clear written agreements must be made with all partners, as disagreements often arise.

The importance of private-public partnerships to sustain MIS was also emphasized in an expert consultation held by the CTA in 2005 (CTA, 2006). During the consultation, all participants expressed strong support for the idea that MIS should involve, if possible, collaboration and coordination among the private sector, development groups and the public sector.

A principal requirement of an MIS is regular feedback on the end use of the information disseminated by the system. One way to facilitate this type of feedback is to integrate MIS with professional organizations that represent key players in the market (Galtier *et al.*, 2013). Mali's *Observatoire du Marché Agricole* (OMA) service is an example. This MIS was originally based in Mali's Grain Marketing Board (*Office des Produits Agricoles* – OPAM) and was subsequently transferred to a new partner, the national Chamber of Agriculture. The OMA is a decentralized MIS structure that selects the agricultural products and markets to be monitored according to user requests, submitted on a regional basis. This enhances its capacity to address producer concerns (Dembélé *et al.*, 2000; Egg *et al.*, 2014).

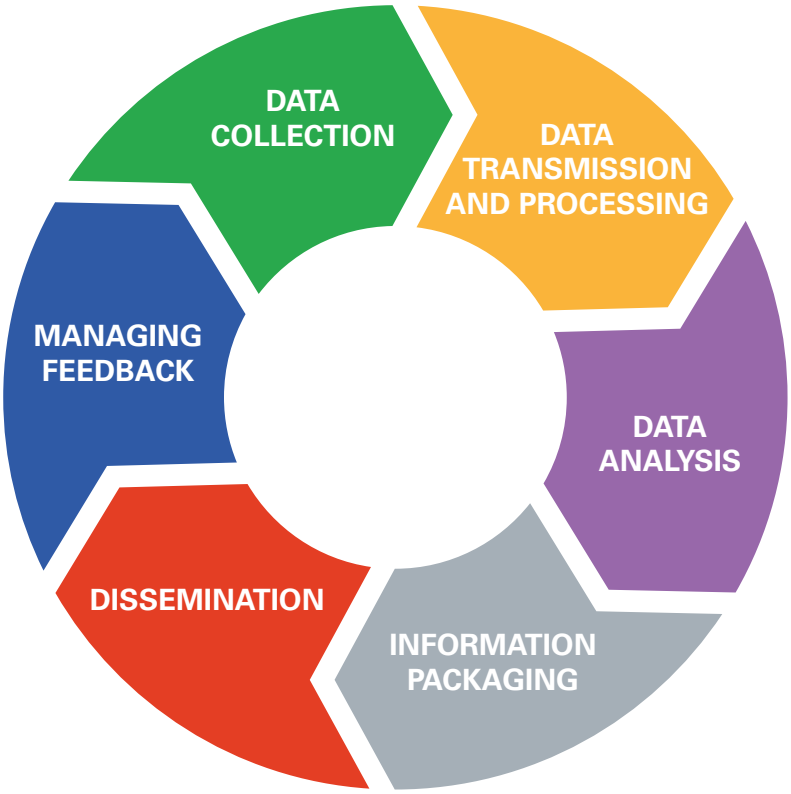
3

Implementing a marketing information system

Section 2 discussed issues relating to the overall design and planning of an MIS, outlining all the aspects that should be considered in its development. This section will focus on the main factors to be borne in mind when implementing an MIS, from data collection to data dissemination and utilization. The main sources are the same as those used in Section 2, i.e. Poon (2001), Jadhav *et al.* (2013), the CTA (2015), and El Fadil (2010).

In the context of the rapid development of the ICT sector across the world, a growing number of market information systems have started to rely heavily on modern ICTs, for both collecting and disseminating information (APCAS-FAO, 2012). Donner (2009) reviews the early deployment of mobile-based systems, including MIS, in Africa. Qiang *et al.* (2011) examine the use of mobile applications (M-Apps) in developing countries, including for market information. They note that M-apps differ markedly in developing countries because they typically run on second-generation (2G) phones rather than smartphones. Van Zyl *et al.* (2014) also review in detail ICT use for agriculture in Africa. With regard to the use of ICTs, however, caution is expressed by – among others – Islam and Grönlund (2010) and the CTA (2016), who find that while new technologies can improve dissemination of information, collecting data in a way that is economical and meets high quality requirements remains a major challenge.

The steps to implement an MIS are summarized below:



Source: Based on David-Benz, H. *et al.* (2011), Galtier, F. *et al.* (2014) and Shepherd, A. (1997).

3.1 Data collection

The value of an MIS depends, to a great extent, on the overall quality (timeliness, accuracy, reliability and relevance) of the data collected. Therefore, in implementing a system for collecting information, it is necessary to develop procedures to ensure that the collected data is reliable and accurate. This can be extremely challenging, due to the specific nature of market prices for food commodities, as prices in a given market may vary among vendors and are also likely to depend on the quality and variety of the product. Quality is particularly difficult for a price collector to evaluate. Furthermore, for some commodities, especially the most perishable ones, prices may vary significantly during the day; in addition, in some markets, it may be difficult to standardize weights and measures. Poon (2001) provides some good advice on handling these issues, while the CTA (2015f) sets out a useful table of issues to be addressed when planning data collection.

When designing and implementing a system for market price data collection, it is crucial to first consider the methodology to be applied. The principal steps are the following:

1. ***Specification of commodities for which data is to be collected***. This is vital to ensure uniformity of data collection in different markets and thus the comparability of the data collected across times and locations.
2. ***Specification, for the selected commodities, of information on the required variety, quality and packaging***. This is an extremely sensitive topic, since data collectors must follow specific standards when they perform their activities.
3. ***Choice of the proper sampling design and number of observations***.
4. ***Timing of data collection***. Depending on the features of the markets monitored and on the perishability of the selected commodities, it is necessary to decide how often and when to collect price information. It is likely that information on grain markets will have to be collected less frequently than that on perishables as, for storable products, prices fluctuate less rapidly.

In most developing countries, data collection has traditionally been carried out using paper-based methods. Such methods are often inefficient, unreliable and prone to error, when prices recorded on paper are subsequently transferred to computer. It is gradually being realized that smartphones, tablets and similar tools can be employed to collect information (see e.g. De Silva, 2005) just as they can be used for information dissemination. Digital data collection is generally faster, more reliable, and more economical than traditional forms. MIS are increasingly looking to smartphones as a means of gathering and collecting information.

Using such tools, data can either be transferred directly for dissemination or first processed and then disseminated. A private company, Manobi, has set up an excellent service working out of markets in Senegal and uploading real-time information through cell phones that dial into the server using Wireless Application Protocol (WAP) technology. Farmers can thus check prices before setting out to sell their produce.

The possibility of obtaining data through crowdsourcing is also considered by, among others, the CTA (2015f), Sharma (2010), Slavova (2009) and Hamadeh *et al.* (2012). The latter report on a World Bank pilot project in eight countries to crowdsource retail prices at supermarkets. Crowdsourcing is defined as *"the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it by making an open call to an undefined but large group of people".* Alemayehu (2015) has proposed a detailed structure for how such crowdsourcing could work for agricultural market information. This has been tested successfully using SMS messages generated by the author; however, it has yet to be field-tested.

3.2 Data transmission and processing

Once the data has been collected from the market, a mechanism must be in place for it to be rapidly transmitted. In some cases, this can be done directly (e.g. from one original source, such as a commodity exchange or a trader); in most cases, where there are multiple enumerators it will have to be checked and further processed, although it is hoped that this will cause only minimal delays. Problems faced in the past include the lack of funds to

pay for the enumerator's transport, to go to the head office with the data sheets. The CTA (2015d) considers the various data transmission options: pen and paper price collection that is delivered to the head office or uploaded on Internet; SMS; Unstructured Supplementary Service Data (USSD); cell phone applications; voice telephony; and the use of images.

Data verification begins when the data are collected. Enumerators must be trained to notice possible mistakes. The enumerator may not identify discrepancies in the field; therefore, where mobile devices are used, software can be programmed to alert users before the data are uploaded. Similarly, data uploaded onto a spreadsheet or database can be verified and cleaned. Software programmes can be programmed to identify elements such as unrealistic prices; great differences between markets; sudden jumps compared to the previous period; missing data; obvious typographical errors; and patterns that may indicate that the enumerator has confused the units of measure, is fabricating the numbers or is simply repeating the prices from previous days (CTA, 2015f).

A significant cost of MIS arises from the software used. In the past, each donor would design a new programme for every project supported; the ability to provide technical support for the software often died with the project. To address these problems, FAO developed FAO-AgriMarket, a database-based software programme. Esoko, the privately operated MIS based in Ghana, has become a major provider of software to other MIS in Africa and is also beginning to work outside the continent.

Generally, data on current prices are summarized using a simple mean (average), a trimmed mean[1] or the mode. However, simple means can introduce a false picture if one price is communicated by a trader who handles 100 kg a day and another, significantly different, price is from a trader who handles one ton a day. Thus, where possible, a weighted average price should be computed (Poon, 2001). An alternative approach could be to present data as a range of prices.

3.3 Data analysis and packaging

Data that is disseminated to end users as quickly as possible can also be used for the preparation of monthly, quarterly or annual reports that present time series and also provide analysis. The CTA (2015g) addresses data analysis and packaging in some detail. It identifies the types of analysis that policymakers require and suggests ways to achieve it, such as by comparing markets or commodities, or preparing a time series. Prices at different stages of a value chain can also be compared, although the type of simplistic conclusion that is sometimes reached by researchers – such as "farmers only get 20 per cent of the consumer price" – is rarely useful without a thorough understanding of all the costs incurred in the value chain. Ways of packaging or presenting information are discussed. Finally, the booklet stresses that the ability to interpret data is essential: MIS should not just provide attractively packaged information, but should also be able to explain it.

[1] A mean calculated after a small percentage of the highest and lowest values has been removed.

3.4 Data dissemination

The major challenges associated with dissemination are related to the need to guarantee the information's accessibility on part of the intended audiences, and simplicity in its presentation. A lack of resources may pose a major constraint upon effective dissemination. Options for dissemination include face-to-face, newspapers, radio and television, notice boards, the Internet, cell phones (voice or SMS) and smartphones. The CTA (2015d and 2015h) provides an excellent assessment of the advantages and problems associated with each approach, while Aker (2011) also reviews dissemination methods for agricultural extension, including for market information. FACET (2011) provides an interesting review of MIS around the world that use ICTs.

To a great extent, the means of dissemination will depend on the reason why the information is being disseminated. Providing rapid and up-to-date price information to farmers and traders is likely to require use of radio or phone, while longer-term reports and analyses can be printed and made available over the Internet. The most appropriate media are also likely to vary according to the audience and the state of development of a country. For example, a local MIS could probably make do with publishing prices on a noticeboard near the market. Use of cell phones has developed in some countries, to the extent that they may be sufficient for dissemination purposes; however, this is not the case for other countries, where radio broadcasts may remain the method of choice. Much depends on the cost of calls and SMS messages. A cost comparison for SMS is provided by the World Bank (2011; see Table 9.2). In two countries in the Caribbean – Jamaica[2] and Trinidad and Tobago[3] – the Internet is the main means of price communication. Most MIS, such as that of Kathmandu's wholesale market in Nepal[4], provide information on a website as well as on other channels.

Radio has long been the most popular medium for disseminating price information. Indeed, radio diffusion potentially entails very low costs and is an effective means to disseminate simple market information to farmers (Egg *et al.*, 2014; Farm Radio International, 2011; Shepherd, 2001). However, it has been difficult to develop a presentation format that listeners who are uninterested in market prices do not find tedious. In addition, radio stations usually require payment to broadcast information. According to the CTA (2006), the main limitations encountered in disseminating price information through radio have been the following:

1. in some countries, radio has not been liberalized, and access to information is poor or the broadcasting is not considered impartial;
2. in other countries, there are too many radio stations, which makes it difficult for farmers to follow a single information source;
3. radio is mainly a one-way information flow; and
4. broadcasting costs may be prohibitive.

Over the last decade, MIS have made use of the new information dissemination technologies using cell phone networks (particularly SMS) as an alternative or complement to traditional

[2] http://www.ja-mis.com/Companionsite/home.aspx.
[3] http://www.namistt.com/.
[4] http://kalimatimarket.com.np/home/language/EN.

tools such as radio broadcasting. With SMS, there are two possible approaches: "pull" or "push". The "pull" method requires users to decide what information they want to receive on their phones at any one time. With this system, it is possible to charge users and arrange for the MIS to receive a percentage of the revenue. Farmers and other users either send a message with the product name and location and receive a price in return, or send a code, as done in Zambia (Goudappel, 2009). A danger of using codes is that farmers tend to lose them. MIS are also beginning to explore the potential for information to be pulled by Interactive Voice Response (IVR). This would address the problem of high illiteracy rates, but would mean that farmers would have no record of the response and thus have to rely on their memory.

An alternative approach is the "push" method. The recipients of information are identified on a database and automatically receive the relevant standardized messages. For example, in Cambodia, one message could be sent to selected rice farmers in Battambang Province, and a different one to subscribers in Prey Veng Province. A benefit of this system is that additional information can easily be added to the message, such as communications from buyers or extension information. Bulk SMS messages are much cheaper per message than "pulled" messages; however, the overall cost of such a service is likely to be greater. It is difficult to charge users, although the expansion of the M-Pesa money transfer service[5], first developed in Kenya, may make this increasingly feasible.

A well-known push service from India is RML, which is operated by Thomson Reuters[6]. RML provides price information for 800 agricultural products on 1 350 markets in 13 regions of India. It also provides information on weather forecasts, agricultural advice and information on input prices. Both market and technical information is delivered using customized SMS messages. Farmers receive between 75 and 100 messages a month for a total cost of approximately US$1.50, or US$0.02 per message. The information thus received by each farmer is reportedly passed on to between five and twelve others. Personalized advice can also be obtained by telephone, from a network of specialists associated with RML who cover various fields of production and agricultural marketing. The service can be paid for through a scratchcard distributed by rural shopkeepers (Fafchamps & Minten, 2012).

Among the major advantages of cell phone networks are the improved ability to provide timely information and generate feedback on user needs. These strengths are confirmed by the numerous MIS that are successfully disseminating market information to their stakeholders – including small farmers – through mobile networks (World Bank, 2011). However, there are a number of drawbacks. The amount of information that can be disseminated by SMS or IVR message is limited. Furthermore, network coverage remains poor in many areas, farmers have trouble keeping their phone batteries charged and may not have credit on their phone. Although phone use has certainly increased exponentially, an issue of greater concern is that those who do not have access to information disseminated by phone are also likely to be the poorest farmers. Therefore, some observers consider it advisable to retain traditional means

[5] http://www.safaricom.co.ke/personal/m-pesa.
[6] http://www.reutersmarketlight.com/index.php.

of dissemination, such as radio, together with newer technologies (Galtier *et al.*, 2012; CTA, 2006; Kato & Nkonya, 2005).

However, the rise in the accessibility of new ICTs in developing countries (initially the Internet, and now smartphones) has led to the emergence of MIS in which information on market prices has been integrated with information on other aspects of relevance to agricultural markets, including agriculture extension advice, input price information, weather forecasts and trading platforms linking producers to buyers. These topics are explored by, among others, Karuga (2016); Rowan-Campbell & Tandon (2009); Afimani (2014); FAO (undated); and Bascombe (2014). Several of these are drawn from a CTA publication, ICT Update[7], which specializes in reporting on ICT applications for agriculture.

ICTs provide new means of generating feedback on the end use or – at least – the end users of the information disseminated. By tracking user-selected information (the number of requests sent to the MIS, the products for which information is requested, and the number of downloads), the MIS can evaluate how the information is used. This is a potentially powerful tool in driving improvements through self-evaluation, as it can be used to test new information and evaluate the interest shown by users. However, in practice, MIS rarely use this type of feedback.

3.5 Other factors involved in setting up a service

An issue often ignored when setting up an MIS is how the service is to be promoted. Those involved with an MIS may be agricultural specialists, ICT experts, or economists; however, they rarely have marketing experience. Thus, even though all of the issues raised above may be addressed, the service may still be unused. The CTA (2015i) provides advice on developing a marketing strategy, including defining the product, identifying the marketing goals, researching the market, understanding the competitors, communicating the unique advantages of the MIS, setting a marketing budget and elaborating marketing strategies. It also discusses branding and the visual presentation of content to create an identity.

A final issue to address when running an MIS is the need to consider a range of ethical and legal issues. Relations with data suppliers and other service providers require the MIS to act ethically, or risk losing their support. It may be necessary to sign contracts. Ownership of data is also important. For example, it must be established whether a database of farmers can be sold to other parties. These and other issues are discussed by the CTA (2015j). Guaranteeing confidentiality is essential, and software tools may have to be developed for the purpose. For example, MIS may wish to record stock levels for major staples. Given that some governments respond to food shortages by accusing the private sector of "hoarding", it is important that sources of information are not revealed but rather, preferably, remain anonymous.

[7] http://ictupdate.cta.int/.

3.6 Helping farmers to use the information

It is generally insufficient to supply farmers with market information alone. Shepherd (2011) argues that farmers require assistance with interpreting this information and provides training for extension workers to supply such advice. The areas identified for support include helping farmers to understand why prices change, such as by developing an understanding of supply and demand. The prices broadcast on the radio or sent to farmers by cell phone rarely originate from the markets to which they have access. Farmers must therefore appreciate the costs sustained by traders in transporting produce from the farm gate to urban markets; in addition, they should understand which price is being quoted (e.g. the wholesale buying price or the wholesale selling price), to have a realistic idea of the implications of changes in urban market prices, with regard to the prices that they can expect from traders. They should also understand the qualities and varieties that the MIS prices quoted refer to and, in some cases, their units, when prices are quoted per "bag", "heap" or "bunch". To use market information for longer-term decisions, farmers should be aware of their storage costs, to decide whether to store or not; in addition, they should have an understanding of production costs, so that they can use MIS to plan whether to grow new crops or to move to off-season production.

Farm Radio International (2003) has produced a series of radio programmes, in the form of plays, to help farmers understand marketing. The first instalment of the series discusses how to use market information.

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CONTACT

Agricultural Market Information System (AMIS)
Food and Agriculture Organization of the United Nations (FAO)
Viale delle Terme di Caracalla, 00153 Rome, Italy

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