

Providing market information to small farmers in Madagascar. Challenging ICTs suitability

Norontsoa ANDRIANDRALAMBO ⁽¹⁾, H  l  ne DAVID-BENZ ⁽²⁾, Noro RAHELIZATOVO ⁽³⁾

(1) Universit   d'Antananarivo, ESSA, ED GRND, EA AM2DT Ankatso, 101, Antananarivo, Madagascar;
norontsoaannie@gmail.com

(2) CIRAD, UMR MOISA, TA 60/15, 73 rue J.-F. Breton, 34398 MONTPELLIER cedex 5, France ;
benz@cirad.fr

(3) Universit   d'Antananarivo, ESSA, Mention Agro-Management, Ankatso, 101, Antananarivo, Madagascar
nraheli@hotmail.com

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ABSTRACT

Market Information Systems (MIS) have massively adopt ICTs since the 2000s, in order to improve agricultural markets performances providing a better access to information. However, their effective use by farmers remains marginal. How far is information dissemination via ICTs adapted to the context and the needs of small farmers in developing countries? Two main Malagasy MIS, on rice and vegetable, have recently adopted mobile phone and radio to disseminate price information. A few months after the introduction of these new technologies, first feedbacks from the recipients were collected. Results highlight that the level of farmers' access to market and to information differs according to the crop, the livelihood assets and the degree of remoteness. Most farmers who have received the information acknowledge the interest of getting updated prices via SMS. They are rather confident about the quality of the data and are even ready to pay for it in the future. However, the main constraints are: (i) rapid "disappearance" of the recipients due to changes in phone numbers or a loss of the phone itself, (ii) technical constraints such as difficulties to refill the battery and/or poor phone network and radio coverage, (iii) cognitive limits of the farmers, with low level of education and limited practice of SMS. The role of an informational "mediator" (farmer leader, field staff), as well as more comprehensive knowledge on market situation transmitted through complementary communication tools appear fundamental to enhance the farmers' ability to take advantage of the dissemination of information by SMS.

Keywords: Market information system, ICT4D, rice, vegetables, Madagascar

Code JEL: Q12, Q13

1. INTRODUCTION

Asymmetry of information among actors along the value chains is frequently mentioned as limiting the efficiency of agricultural markets in developing countries (Fafchamps and Gabre-Madhin 2006). Farmers are generally the most affected by this asymmetry. To overcome this failure, Market Information Systems (MIS) have been designed to improve market performance providing a better access to information to farmers and to all actors involved in the market, in order to increase their spatial and temporal arbitration capacity as well as their market power (Arias et al. 2013; David-Benz et al. 2012; Shepherd 1997). MIS were strongly promoted in developing countries in the 1980s and 1990s, along with agriculture market liberalization (Galtier et al. 2012). Since the beginning of the 21st century, the spread of information and communication technologies (ICTs) over rural areas, notably mobile phone and Internet, brought a wave of renewal among the MIS (David-Benz et al. 2012; Garuku et al. 2009; Subervie and Galtier 2012). Albeit an all range of innovations were developed to reach farmers and to provide them with efficient information tools, the use of this second generation of MIS remains very marginal among farmers (Galtier et al. 2014). Their efficiency appear limited and controversial (Fafchamps and Minten 2012; Goyal 2010).

Why are farmers reluctant to adopt these MIS? How do they perceive regularly disseminated market information? According to Galtier et al. (2014), the disappointing achievements of the second generation of MIS derives from (i) the lack of monitoring and evaluation of the fast and divers innovations, and (ii) the still limited access of small farmers to ICTs. Moreover, MIS can only be effective if the dissemination tools mobilized are in line with the needs and capacities of the recipients (Burrell and Oreglia 2015; Garuku et al. 2009).

The purpose of this communication is to address these assumptions and more specifically to question the adequacy of the use of ICTs to disseminate information to smallholder farmers. It is based on light surveys of farmers and outreach staff after initial tests of dissemination of information and market training by the Rice Observatory (Odr) and the Vegetable Economic Information Service (SIEL), the two main MIS in Madagascar. The communication is divided in 3 main parts: (i) the state of the art about MIS in developing countries and their impact on farmers; (ii) the materials and methods that present the case study with the different components and steps of data collection; (iii) the results regarding the level of farmers' access to market information, the recipients' feedbacks on dissemination and training tests and the main constraints linked to these devices.

2. LITTERATURE REVIEW

A wide range of studies have stressed the positive impact of ICT on economic development in rural areas, and notably their capacity to improve access to market information (Dixie and Jayaraman 2011; Musingafi and Zebro 2014; World Bank 2012). But the difference between the impact of using a mobile phone per se and that of mobile services providing market information is not always very clear. The Agricultural MIS collect, process and disseminate information on agricultural markets. They are basically focused on prices, but the range of information can be wider (availability of products, individual offers, buyers/sellers contacts etc.). In developing countries, many MIS were set-up in the 80's and 90's, as part of supporting programs to the agricultural market liberalization (Egg and Galtier 1998; Shepherd 1997). They target both actors directly involved in agricultural chains and in policymaking. Regarding the first ones, the objective is to improve market efficiency, by reducing information asymmetries. As for the seconds, the objective is to contribute to agricultural trade policy making and monitoring (David-Benz et al. 2012; Galtier et al. 2014).

But the effectiveness of the first generation of MIS in providing services to market players appeared soon limited (Egg and Galtier 1998; Robbins 2000; Shepherd 1997; Tollens 2002). MIS have been facing technical challenges (lack of reliability of data, transmission delays, different quality of products not taken into account ...), institutional ones (lack of reactivity associated with public institutions), and financial ones (unsustainable funding, based mainly on projects). Egg et al. (2013) stress that they also bump into more fundamental problems related to the truly functioning of the markets, that was not

really taken into account in their design (information circulation between agents, institution arrangements between seller and buyers...). From the late 90s, the rapid penetration of mobile phone in developing countries and a growing concern to improve farmers' access to markets have sparked off a renewed interest in MIS. New MIS were developed in Africa, Asia and Latino America, whereas many of the older ones engaged in deep changes: a new generation of MIS emerged, named 2GMIS (David-Benz et al. 2012).

The innovations developed, thanks to mobile phones technology, have brought about real improvements from a technical point of view. They have broadened the range of products and markets covered, as well as the categories of information available. The time lag between data collection and information availability for users has been dramatically reduced. These improvements strengthen the potential of MIS to meet more efficiently the needs of market players.

However, the use of mobile phone has several limits: first of all, it increases the gap of access for the poorest (sparse coverage in rural areas, difficulty to use SMS for the illiterates, cost). MIS based solely on mobile phone might reinforce inequalities, rather than improve market access for the poor (Galtier et al. 2014). Dissemination by radio makes it possible to reach a wider audience, but its success is strongly linked to the involvement of local communities in the definition of the program content (Sulaiman et al. 2011). Furthermore, Gakuru et al. (2009) highlight that agricultural farmers cannot be considered as mere consumers of information; in-depth knowledge about the communities are needed both to define their needs of information and to promote learning, based on dialogue and exchange. In addition, the more communication media are sophisticated, the more the users need a support to understand the information and the way it can be used. Such dimension is currently inadequately taken into account by MIS (David-Benz et al. 2012). Burrell and Oreglia (2015) argue that "abstracted information often loses its usefulness once it is extracted from actual trade relationships"; the value of information is then directly linked to the credibility of its source and the quality of the relationship with the source (which implies that it should not be limited to the supply of a supposedly "neutral information").

Several authors have attempt to measure MIS impact on market participants, particularly on farmers. Most of them found a significant impact on the farmers' income (Courtois and Subervie 2014; Goyal 2010; Kizito et al 2012; Nakasone 2014; Svensson and Yanagizawa 2009). In other cases, the impact is much less noticeable or not significant (Fafchamps and Minten 2012; Mitra et al 2013). However, the econometrics methods that are used (propensity score matching, randomized control trial) bump on methodological challenges when applied to MIS (Staatz et al. 2014). Moreover, they focus mainly on measuring impact on income (selling price, quantity sold) but they don't bring much understanding of the determinants of adoption vs. non-adoption (where as one of the main issue is often that the actual users of MIS are very few). More qualitative assessment by users and light monitoring, less heavy to implement, could be useful to guide and adjust the dissemination of information, but they are seldom mobilized.

3. MATERIAL AND METHODS

3.1. Material

Three factors are behind the choice of the case studies: (i) rice and vegetables are contrasted food-crops (bought in terms level of self-consumption and perishability), for which market information can lead to different categories of arbitration; (ii) the two oldest Malagasy MIS are covering these crops; and (iii) these two MIS have recently adopted mobile phone and internet technology.

3.1.1. Rice and vegetables sectors

Malagasy farmers grown rice mainly for self-consumption. It is the staple food in Madagascar, with an average of 97 kg/pers./year (INSTAT 2011). Rice is grown primarily to cover the needs of farmers' households. Conversely, vegetables are mostly grown as cash crops. Rice can be stored and commercialized on long distances, whereas most vegetables are highly perishable and not storable. Rice fields are only dedicated to rice (at least during the rainy season), whereas vegetables can be

mutually substitutable in the cropping systems. Therefore, these crops can illustrate different potential uses of market information: temporal arbitrage, spatial arbitrage, and changes in cropping systems or seasonal cycles.

3.1.2. The two main and oldest Malagasy MIS

In Madagascar, the development of MIS started in 2005 with the OdR (for *Observatoire du Riz*, or Rice Observatory) and the SIEL (for *Service d'Information Economique des Légumes*) or Vegetable Economic Information Service. The first one has been mostly disseminating French written bulletins through Internet (thereby reaching mostly institutions and large traders) when the second has been displaying weekly prices in blackboards disseminated in rural markets and broadcast market news through local radios (targeting mainly farmers). Both systems recently introduced mobile phone in the collection and the dissemination of market information: in 2014 for the OdR and in 2016 for the SIEL.

3.1.3. The main production areas as investigation sites

For the rice case study, two among the most important rice growing areas of Madagascar were chosen:

- The neighbouring districts of Soavinandriana and Miarinarivo in the Itasy Region (that account for 8% of the national rice production), which have an easy access to the capital city of Antananarivo, and relatively limited rice price fluctuations (an average increase of 53% between harvested prices and lean prices – 2011-2013);
- The district of Bealanana in Sofia Region (that account for 7% of the national rice production), extremely landlocked and where seasonal price fluctuations are very high (an average increase of 90% between harvested prices and lean prices – 2011-2013).

For the vegetables case study, the investigation area is the large peri-urban belt of Antananarivo, which is the intervening area of ASA¹ program (radius of about 30 km). Eight from the sixty communes around the capital city covered by the ASA program were selected for the baseline survey. The feedback survey covered almost all the communes that benefit from the program.

In both cases, the choice of the surveyed communes or villages aims at illustrating the different degrees of isolation and ease of access to the market. The assumption is that the contrast of situation in terms of isolation and accessibility leads different choices in terms of marketing strategies.

3.2. Methods

3.2.1. Baseline survey on structures and strategies

To analyse the structural features of farm households and understand their marketing practices, we mobilized an approach based on the Sustainable Livelihoods (Scoones 1998; DFID 1999). The questionnaires were focused on the structural characteristics, the marketing strategies and constraints, the access to information, and farmers' perceptions and expectations towards MIS. In each of the three production areas, a two-stage purposive sampling was carried out (based on the choice of the villages and that of the households), in collaboration with local partners of the Inforiz project and the ASA program.

For the rice study, within each region, we selected 5 to 6 communes with different degrees of isolation and availability of agriculture services. Only farmers producing more than their family expected consumption needs were targeted (ie. farms with at least 0.5 ha of rice area). The survey was carried out between November and December 2013. A total 582 farms were surveyed: 280 in Sofia and 302 in Itasy. In the case of vegetables, 220 farm households were surveyed from mid-September to mid-October 2016. Among them, farm leaders and direct beneficiaries of the ASA program account for 40%, household heads close to them (same farm organization or family/ friendship proximity) and benefitting from the project through training provided by them form the 37%, the remaining

¹ ASA: *Agro-Sylviculture autour d'Antananarivo*, a development project funded by the UE, which sponsors the SIEL.

households are non-beneficiaries farmers from the same villages. SMS recipients represent 48% of the whole sample.

3.2.2. Dissemination of price information and educational modules

With the support of the project Inforiz (2013-2016) for OdR and of the ASA program (2016-2018) for SIEL, a selection of prices was sent weekly via SMS to a sample of farmers. Relevant markets and rice varieties / types of vegetables were selected for each site, based on the first results of the baseline surveys, and on previous studies on local markets (Arimoto et al. 2013; Orbell, 2015; Perry and Randriambololona 2010). For rice, SMS on a selection of 12 prices were initially sent weekly to a sample of 140 farmers and 60 extension staffs from April to December 2014. The recipient farmers were chosen among those interested in receiving market information, according to the baseline surveys, benefiting or not from the support of a project. For the vegetables, 353 recipients were chosen by the field staff of the ASA program, according to their expected capacity to understand and use market information.

Additionally to the SMS sending, weekly radio programs of about five minutes each, have been broadcasted in the two rice growing areas. The most popular local radio stations and preferred listening hours were identified during the baseline surveys: 1 radio for Itasy and 2 radios for Bealanana. The radio programs presented the prices of the week (on the same selection of markets and types of rice as for the SMS), the trend compared to previous weeks, and some explanations and contextualization. These programs were broadcasted weekly from April to December 2014. For vegetables, extension staffs received weekly price information and monthly economic outlooks via e-mail from SIEL, to strengthen their capacity to support farmers in the marketing component.

Through Inforiz project, four training modules about rice market and marketing² have been designed to better understand the functioning of the market and the possible use of market information. The assumption was that elementary information on prices only would be insufficient to assist farmers' decision-making. Extension staff of the local partners was trained in each area. They in turn had to train 50% of the farmers that received SMS. Thirty of the surveyed farmers followed the marketing training modules. Educational modules were held half days, under an incompletely forms yet. Among the partners of the Inforiz project, 53% of the local technicians were trained on the four educational modules.

3.2.3. Feedback surveys on early appraisal of farmers and outreach staff

After a few months of weekly dissemination of price information, feedbacks from the recipients were collected. The training modules on rice market were also evaluated, surveying the trained farmers and trainers (the projects extension staff). The objective was to have an early appraisal of the new dissemination methods in order to be able to rapidly adjust rapidly the provided service. The questions were related to the effectiveness of the reception and understanding of the disseminated information and knowledge, the relevancy of the chosen products and markets, the perception of the reliability and usefulness of the received information and the willingness to pay for it.

For rice, a rapid qualitative field survey, conducted in May and June 2014, provided preliminary feedbacks about the shape and the understanding of the messages (Chimirri 2014). These first feedbacks were collected from 30 farmers and 15 field staff. Following this first investigation, the SMS were simplified and made more explicit. Flyers presenting briefly the OdR and explaining the abbreviations have been dispatched to all recipients. A second survey (using a closed questionnaire) was implemented between November 2014 and January 2015. Such survey targeted 70 farmers and 35 extension staff (including as much as possible the ones which have already been interviewed during the first feedback). For vegetables, data were collected from 129 SMS recipients: 90 via field surveys and 39 via light telephone interviews. After clearing outliers, 109 observations were actually analysed.

² (i) Value chain and price structure from the farm to the consumer ; (ii) Rice storage ; (iii) Rice production cost ; (iv) Instability of the domestic rice prices.

4. RESULTS

4.1. Farmers' access to information about the market situation

4.1.1. Farmers' level of insertion into market

Malagasy farmers grow rice mainly for self-consumption. According to different national sources, the marketable surplus is around 20 to 27% of the national production (World Bank 2011). As our sample targets rice farmers with more than 0.5 ha, which potentially produce more than their family needs, they sell more than the national average, with a share of 56% of the rice harvested (excluding the farmers that also collect rice, and thus sell more than what they produce). Previous analysis show that their marketing strategies are determined by their livelihood assets (notably the rice-cultivated area, the number of permanent and hired workers, the access to credit and the membership to farmers' organizations) as well as their physical constraints to access the market such as remoteness (David-Benz et al. 2016). Farmers with better assets endowments tend to sell larger quantities of rice, and are able to store it in order to sell when prices get higher. Moreover, they look more actively for market opportunities. Conversely, the ones with rather limited assets usually sell straight away after harvest time at low price, and at the farm gate. Isolation plays in a more unexpected way: in remote areas, farmers have much larger growing areas and sell larger quantities of rice. Their strong physical constraints to access market push them to look for buyers and for information about market situation.

Vegetable production in the peri-urban area is more directly oriented towards markets. However, the orientation differs strongly among products. For example, 40% potato production are for self-consumption, whereas it is about 11% for green beans and as low as 4% for tomatoes or onion. The majority of the farmers in the sample sell directly on the field or on farm (54%), while 17% sell on the village market and 29% on larger markets. The proximity of the road has a major impact on marketing options: in the most remote sites, no farmer goes selling to local or urban markets, whereas in villages located along main roads, the share of farmers selling in urban markets goes up to 73%.

4.1.2. Farmers' type and source of market information

Most farmers have a good knowledge about prices on their nearest market but much fewer get information about prices in the main cities. However, vegetable growers in the suburbs of Antananarivo differ in the sense that they are rather well informed about prices in the capital city (see Table 1). A minority has a broader view of the market, such as the best-selling periods or the availability of products in the markets; even among vegetable growers around the capital, for whom the problem of market glut can sometimes be critical. It can be noticed that farmers are much more aware about quality issues in the case of vegetable than in the case of rice.

Table 1 Market information access for farmers

Site/ crop	Prices in the nearest market	Prices in Antananarivo markets	Prices in distant markets	Best / worst period to sell	Availability in the markets	Availability in other production areas	Quality requirement
Sofia/ rice	98%	40%		29%			29%
Itasy/ rice	96%	17%		90%			13%
Peri-urban/ vegetables	80%	65%	15%		18%	36%	90%

Source: The baseline surveys.

Direct communication is by far the main source of information. Farmers communicate either with neighbours who have the opportunity to circulate or with collectors they met in the village or at the market. For the most remote area in the Sofia Region, where farmers have rather large quantities of rice to sell, some rice producers get information from their relatives in town as well. Only 5% of farmers in the Itasy Region said that they get market information through the radio and 4% of those in the peri-urban area obtain it from the MIS. Actually, radio is mostly used for entertainment, and agriculture related programs are scarce.

4.1.3. Farmer's needs of market information

According to the baseline surveys, the needs for market information come after those on production techniques and input providers. Farmers are mainly interested in getting more market information on the types they are lacking (see Table 2).

Table 2 Priority market information of interest to farmers

Site/ crop	Priority	Type of information
Sofia/ rice	1	Contacts of buyers
	2	Prices in the production areas
	3	Prices in urban markets, and availability in production areas
Itasy/ rice	1	Prices in urban markets
	2	Contacts of buyers for non-collector farmers, and Prices in production areas for collector-farmers
	3	Consumers' preferences for non-collector farmers, and Contacts of buyers for collector-farmers
Peri-urban/ vegetables	1	Prices in urban markets
	2	Contacts of buyers
	3	Prices in the production areas

Source: The baseline surveys.

Farmers in the Bealanana District mainly request information on market opportunities such as contacts of buyers. In a lower priority, they focus on prices in competing production areas, on market prices as well as on product availability in production areas.

For the Itasy Region and the peri-urban sites, the main information requested by the farmers reflects their needs to better understand the demand (prices in urban markets for both, with consumers' preferences for Itasy), but also to develop direct links with buyers (contacts of buyers). Collector-farmers (because they are buyers) in Itasy, as well as peri-urban farmers are also interested in market situation in the other production areas.

4.2. First appraisal by the beneficiaries about market information dissemination and market knowledge

4.2.1. Farmers' understanding of the price information received

A selection of prices from main rural assembly markets and main urban markets were sent by SMS and radio over some weeks before the surveys. The understanding level of the SMS content differs strongly according to the context. In the Sofia and Itasy Regions, the first SMS were sent without any preparation of the recipients. They were in most cases misunderstood. Very few farmers could immediately seize the meaning of the abbreviations (12 prices were introduced, with abbreviations of the names of rice types in 2-3 letters and markets names in 4-6 letters). Having no idea of the source of the messages, many farmers were suspicious and destroyed them without making further inquiries. In a village, rumours of satanic messages have even spread out! The problem was soon identified thanks to the first qualitative survey. Flyers explaining the purpose of the messages, the source of data and the meaning of the abbreviations have been distributed to the recipients and the messages have been simplified (limited to 8 prices, with the name of the rice types and the markets almost fully spelled out and with the indication of the source as "*Observatoire du Riz*"). The rate of understanding significantly improved: from 0% of the farmers to 55% in the Sofia Region, and from 50% to 80% in the Itasy Region (see Fig. 1). In Itasy, where all farmers rapidly got the flyers, the level of reception and understanding was much higher than in Sofia, where the distribution of flyers was scattered and delayed. The initial familiarity with SMS appears to play an important role as well: in Itasy, where

globally 70% farmers are familiar with SMS, 50% of recipients understood the first messages at first sight; in Sofia, where only 48% are familiar with SMS, nobody understood them immediately (see Fig. 1).

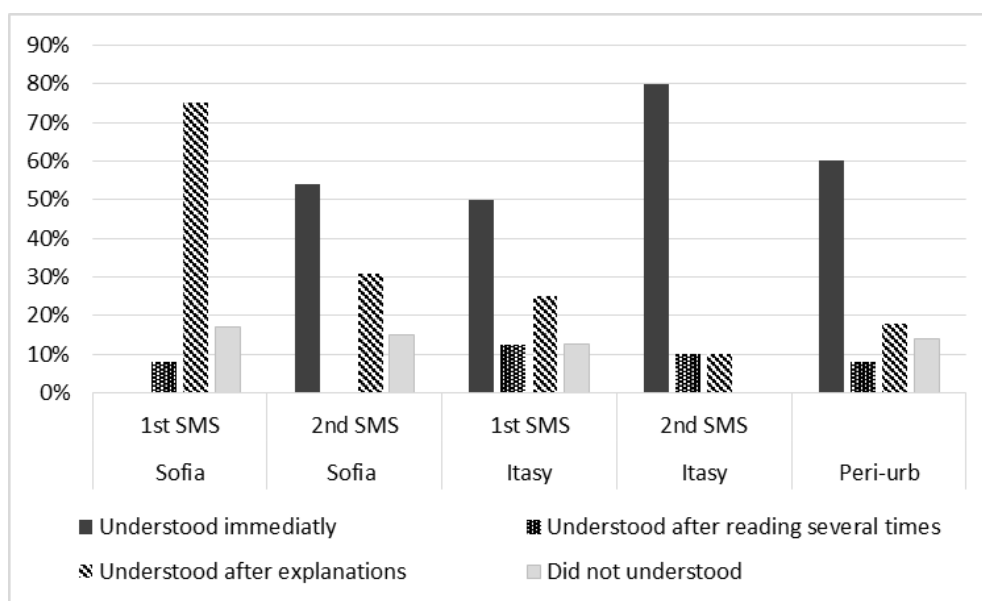


Fig. 1 Level of understanding of price SMS

Source: The feedback surveys

The ease of understanding was slightly better in peri-urban areas than in the Itasy Region and much better than in the Sofia Region, with no preliminary sensitization. This reinforces the trend observed in the two rice growing areas: the more the farmers are familiar with SMS, the more they are able to rapidly catch the meaning of the messages sent by the MIS. Up to 60% vegetable farmers declare that they immediately understood the messages. But, as in the case of rice, there was some misunderstanding about the nature of the messages: in a village, conflicts emerged because some of the leading farmers, who didn't receive the SMS (because they were not in the sample), thought that it was related to mobile money, and was sent by the project to few "privileged" farmers.

In all cases, and mostly where the immediate understanding was very low, as in Sofia, direct interactions with extension staff or between farmers increased the level of understanding.

Within Inforiz project, radio broadcasts were programmed weekly (in the case of SIEL, radio programs are still under preparation and negotiation). In Itasy, InfoRiz program was broadcasted by the leading rural radio of the area; 53% of the farmers have heard that program. In Bealanana, two of the local radios were selected to broadcast InfoRiz programs but none has a large audience. Thus, only 18% farmers of Bealanana have heard the programs.

However, among the few rice farmers who regularly listen to the selected radio stations, the rate of listening to InfoRiz program was high (100% for Itasy and 66% for Bealanana). For those who have heard the program, the level of immediate understanding is very good (92%), and higher than the SMS understanding (69%). The information provided was seen as very reliable and for almost all the listeners (88%) its content was satisfactory and comprehensive.

4.2.2. Perception of the farmers about market information and market trainings

The opinion of most farmers is positive about the information they received and most of them found it reliable. They perceived it first of all as an improvement of their general knowledge about market; some farmers foresee possibilities of commercial use of it, to better negotiate and build their marketing strategy. To go more into details, the majority of rice farmers saw it just as a way to get a better overview of the market (56% and 50% respectively for Sofia and Itasy), 22% of farmers in Sofia and 35% in Itasy believed that this information can be useful to manage storage, and respectively 17% and 25% to negotiate in better conditions. Only 10% of the farmers considered it as useless. However, SMS

reception or listening to radio programs (see below) would not alter the main sources of information for rice farmers: in Itasy, it is always through the collectors that most members are aware about rice prices, while in Bealanana it is going weekly to the market. Among vegetable growers around Antananarivo, 62% saw the messages just as general information, whereas 27% told that they could use it to better negotiate or to build their commercial strategy. For 15% of the vegetable growers, it is considered as useless.

The messages were sent free but it was asked to the farmers if they were ready to pay to receive them steadily. All the respondents were willing to pay in the case of rice, and 80% in the case of vegetables. But the amounts announced are in most cases very modest, with an average of 1900 MGA per month for rice farmers and 900 MGA per month for vegetable farmers (which is the equivalent of about 0.6 and 1.3 kg of rice respectively). Although these amounts have to be considered very cautiously, as they are only declarative statements, they provide the indication that farmers are willing to pay to obtain price information.

Similarly to SMS, the first utility of these radio programs as perceived by rice farmers is to be aware of the market situation (for more than two thirds of them); to a lesser extent, the farmers mentioned that these programs can help storage management and improve negotiation capacity. A few mentioned using them in paddy collection. Only 4% of the farmers felt that they were of no use. However, SMS reception or listening to radio programs did not alter their main sources of information: in Itasy, it is always through the collectors that most of the farmers are aware about rice prices, while in Bealanana they go weekly to the market.

The marketing training modules were followed by thirty of the surveyed farmers. They were held by half days, with educational leaflets that were still drafts and a limited training of the trainers. More illustrations and more time for practical exercises had been requested, but the interest of farmers was evident, despite the limits underlined. Participants found the training useful first of all to improve their storage strategies. The interest about the module on production cost calculation was also highlighted, to enable forecasting and controlling expenditure and to avoid selling at any price. The module on the value chain has been appreciated for a better understanding of the role of each market participant and of price formation.

4.2.3. Perception of the extension staff about market information and market trainings

From the point of view of the extension staff, SMS is a better way for disseminating market information than radio, given the low coverage of radio and its low listening rate. In addition, the radio broadcasts, too long for some of them, were not attractive enough to capture or hold their attention.

However, some extension workers found that the radio programs are useful and comprehensive since:

- They complement price information received by SMS;
- They contribute to a larger dissemination of information to farmers;
- They provide trends on rice prices at regional and national level;
- The program is easy to understand and not too long;
- The rate of farmers owning a radio is higher than that of a mobile phone.

In the case of mobile phone information systems targeting farmers, extension workers suggest to keep the "pushed" SMS (ie. SMS automatically sent to users); except for the largest farmers and collectors who might be able to manipulate "pulled" SMS (ie. customized SMS sent of the user, following his request). This is in line with baseline surveys. They also consider that for them, as well as for farmers, knowing regularly the market prices can improve the commercialization's conditions.

The market trainings have raised more interest than SMS or radio programs. Farmers participated very actively in the trainings, notably in the discussions, and they had a good level of understanding. The topic that arouse interest of most of them is the one on storage.

Extension workers often face farmers' questions about commercialization but in most cases it is not directly within their area of competence. Farmers have a very rough understanding of the market and

price mechanisms. Most of them still think that the state could set prices. Main concerns of farmers are (i) how to limit the price fall during harvest time; and (ii) how to avoid collectors who take profit of their weakest position.

Extension staff globally appreciated the training modules even though they were still in a rather basic shape. Such trainings enable them to discuss and interact with farmers on possible solutions to improve their marketing strategies of which and above all, storage management (via access to storage credit) and possibly collective action.

4.3. Constraints related to the dissemination of market information via ICT

4.3.1. Rural area's coverage by mobile phone, radio and Internet

Considering rural areas, mobile phone is not as well spread in Madagascar as in many other African countries. In 2010, only 17% of rural households had a cell phone (INSTAT 2011). More recent statistics of rural populations are not available, but the World Bank indicators show a slowdown in mobile cellular subscriptions in the recent years. It rose from less than one mobile cellular subscription per 100 people in the early 2000's to 40% in 2011; since then, it stagnated between 37% and 44%. This can be attributed to the economic crises during the political transition period.

Farmers in the sample appear to be rather better equipped with mobile phone than the average Malagasy family farms. Yet, it is still far from being generalized (Table 3). In most family which has at least one mobile phone, someone knows how to use SMS. But it can be the oldest child and not the head of the family. Mobile phone is rather used for personal matter. Very few farmers make use of it to communicate with buyers before selling or to know about market situation. The majority of famers can read and write, but the level of education and the literacy is lower in the more remote area than in peri-urban one. This contrast goes in the same way as for mobile phone ownership and SMS use capacity.

Table 3 Mobile phone penetration and use and cognitive level of producers

	Sofia	Itasy	Peri-urban
Have a mobile phone¹	46%	63%	75%
Know how to use SMS²	48%	70%	89%
Use mobile phone to contact buyers in order to know their prices	11%	11%	0%
Use mobile phone to contact buyers in order to propose an offer	13%	8%	4%
Level of education (number of years)	5,6	6,2	6,6
Literacy (can read and write properly)	74%	88%	89%

¹ At least one mobile phone in the household

² At least one person in the household know how to use SMS

Source: The baseline surveys

In rural areas, radios have generally a poor geographical coverage but in Analamanga (the region of Antananarivo) and to a lesser extent in Itasy the coverage is better. In 2010, 13% of the rural households owns a radio (INSTAT/DSM, 2011). The rice baseline surveys show that only 55% of the surveyed rice famers regularly listen to radio. This information is not available in our peri-urban survey. Radios (especially local ones) have mainly a recreational function: they broadcast mostly music and very few educational programs. Moreover, the capacity of a market program to reach farmers deeply depends on the choice of the radio.

In rural areas, less than 1% households have a computer (INSTAT 2011). But smartphones and tablets are getting popular and Internet connection is getting easier, with prepaid vouchers. The extension staff of ASA project, is for example equipped with tablets and receives market information bulletins sent

by SIEL. But they face problem of security with their equipment, cannot easily refill their battery, and have to pay themselves the cost of Internet connection. Though, most of them are not regularly checking price information they receive by email.

4.3.2. Main challenges faced during the diffusion tests

One of the major initial constraints is the rapid “disappearance” of the recipients. Because either they have lose their mobile phone and then change their phone number, or they have switched to another phone company that makes a better deal, or they have given their mobile to a relative, or they have given someone else phone number when the list of the recipients was set. For rice growers, within less than one year after the baseline survey (where phone numbers were collected and willingness to receive information through mobile phone was checked), almost half of the 70 recipient farmers surveyed said that they had not received the SMS (53% Sofia, 38% Itasy). Among vegetable growers, 40% said they did not receive the messages (or that they failed to notice it). Registering phone numbers of farmers that declare that they are interested in receiving price information or relying on field staff that identify who is potential interested is thus not enough. A periodical follow-up and updating is needed.

Another range of constraints is more strictly technical:

- Rural electrification is still scarce (only 5% rural household have access to electricity; INSTAT 2011) and recharging batteries is often an issue;
- The coverage of mobile phone companies is limited in rural areas; even around the capital city, farmers need to move to specific places to be able to use their mobile phones;
- Some very cheap mobile phones are not suitable for receiving SMS.

The penetration of mobile phone has been steadily increasing in Madagascar, as in other developing countries, but its use is still constrained by the general lack of communication infrastructures. Mobile phone companies, after focusing mostly in urban areas, are increasingly targeting rural areas in recent years, promoting solar energy charging points, power banks and small kits of connection.

Apart from technical problems, learning issues need to be closely considered. SMS with market information are just a succession of more or less abbreviated elementary information. They need to be first correctly read, the meaning has to be understood, confidence in the quality of the content must be gained, and ultimately the appropriate knowledge is required to be able to turn the information into decision and action.

4.3.3. Information channels preferred by the beneficiaries

Despite the hazards of reception, farmers have overwhelmingly approved the use of SMS for the dissemination of market information (97% for rice, 85% for vegetables) and wish to continue to be informed; both those who have received the SMS and those who have not. But it is far from being the only possible way to disseminate prices.

In the two rice areas, radio programs were broadcasted through local radios during the same period than the SMS disseminations. They were more comprehensive than SMS, including the prices of the week, the trends compared to previous weeks, and some explanations or contextualization. In Sofia, where the programs were broadcasted by local radio that have a poor coverage, they were only heard by 18% of the sample. In Itasy, the results were much more satisfying: the market program was broadcasted by the leading rural radio of the area and 53% of the farmers have heard it. The advantage of radio must be acknowledged in term of apprehensibility: for the farmers that have heard the program (taking both regions together), the level of immediate understanding is very good (92%), and higher than the SMS (69%).

It was asked to the rice farmers if they would prefer other means of communication than SMS or radio to get market information. Unsurprisingly, as mobile phone penetration and radio coverage are the lowest in the Sofia Region, several alternatives are preferred: 50% suggest billposting and/or face to face communication with farmer leaders (34%), field staff (16%) or traders (13%). In Itasy, SMS or radio are preferred by two thirds of the sample; 16% suggest billposting and the remaining face to face

communication. In the peri-urban area, SMS from a MIS was largely acknowledged as a suitable way to get market information – for 85% of the farmers of the test. About one quarter of the recipients, found that some other means of communication could be more adapted. But only few of them actually suggest other means of communication, like billposting, meetings, radio.

5. CONCLUSION

Our surveys show that the level of Malagasy farmers' market integration differ according to the cultivated crops, the livelihood assets and the degree of remoteness. Vegetables' production in peri-urban areas is more directly oriented towards markets, whereas rice is mainly dedicated to self-consumption. Rice farmers with better assets endowment sell larger quantities, and are able to store in order to sell when prices get higher. Being more integrated into the market, they look more actively for market opportunities. Somehow unexpectedly it can be the case in remote rice growing areas where cultivated area per farm and the quantity sold are larger; the strong physical constraints to access market then push these farmers to look for buyers and for market information.

The early appraisal from recipients after a few weeks of price information diffusion via SMS and radio provides mitigated results. Most farmers who have received the messages acknowledge some interest of getting price information via SMS. They are rather confident about the quality of the data and are even ready to pay for it in the future. Yet, these positive statements need to be balanced.

Firstly, they are only declarative statements, after short-period dissemination: (i) no farmers had actually the opportunity to use the information for cropping or selling decision; (ii) the willingness to pay was just declarative.

Secondly, the use of mobile phone faces several technical constraints in rural areas of Madagascar, especially in the most remote ones. Despite a fast increase in recent years, the ownership of mobile phone is still not widespread among farmers. Moreover, it is very heterogeneous among areas: from 46% of the households in the most remote area (although our sample is focused on the top 50% farms in terms of cultivated land), up to 75% the peri-urban area. Its use for professional matter is marginal. Out of town, mobile phone coverage is often limited to some specific locations and access to electricity is still the privilege of a minority.

Thirdly, the actual rate of reception of the sent SMS is low (globally about 50%), although only farmers with high potential to be interested in price information where selected for the tests. The "disappearance" of recipients demonstrates the very fast turnover of mobile phones and phone numbers. This instability of ownership makes mobile phone users' identification and conservation a main challenge. A close field follow-up of the recipients is required to avoid losing most of them in few months.

Fourthly, learning issues need to be closely considered. SMS with market information are just a succession of more or less coded elementary information. First, farmers need to be familiar with the syntax used and understand the meaning of the message, then they must be confident in the quality of the content, and ultimately they must have the appropriate knowhow to turn elementary information into decision and action. SMS alone cannot be enough. To reach a significant share of farmers, they need to be backed with more comprehensive explanations about the content of the messages, the way to interpret the information, and how to use it. It must be underlined that in the farmers' perception, getting better information on price does not mean systematically getting better selling prices: the majority sees it rather as a source of general knowledge. It then cannot be surprising that no major changes in behaviour and marketing performances are noticeable, at least on the short term. That does not mean that improving knowledge, as a capacity building, is not necessary. However, assessment of the impact of this knowledge implies a much broader view than just measuring differences in selling prices or quantities sold (which is what impact assessment studies of MIS generally do).

Relaying only on mobile phone to disseminate market information would exclude a significant share of farmers who fails so far to have access to such communication tool or are unfamiliar with SMS. The MIS can be a driving force to popularize the use of mobile phones and SMS for business purpose at

farmers' level, but this would require major training efforts. Beyond the technical accessibility and the capacity to use SMS, the enhancement of farmers' ability to understand the meaning of the information spread through SMS is critical. Diverse complementary broadcasting tools are needed (mobile phone, radio, blackboards), as well as a learning process through direct interaction with extension service agents. The latter would have a critical position to consolidate the connection between MIS and farmers: (i) to identify potentially "responsive" farmers, (ii) to check that the reception of information is correct, (iii) to explain the information, and (iv) to increase farmers capacity to understand markets in order to be able to use the elementary information provided by the MIS.

More fundamentally, the possibility of choice needs to exist. Choice in the cropping calendar and the varieties grown, choice between selling on farm to a single collector that comes to the village or going to an active gathering market with more competition among buyers, choice between selling after harvest at low price or storing for some months before selling. Even the best information system would not solve the lack of technical support, the problems of remoteness, the imperfection of credit market, the missing storage facilities, and the lack of collective action between farmers. Indeed, as highlighted by Arias et al. (2013) or Galtier et al. (2014), improving access to market for small farmers must be tackled in a more holistic way.

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