Does use of ICT-based market information services (MIS) improve welfare of smallholder farmers? Evidence from Kenya

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ABSTRACT
The need to provide agricultural information to farmers has led to emergence of numerous ICT-based MIS projects in developing country. These projects aim at promoting commercialization of smallholder agriculture and subsequently their welfare. This study examines the welfare effects one such project in western Kenya. It uses household food security and access to medical health services as proxies of welfare. The study finds that farmers that use ICT-based market information are more food secure and have better access to medical health services than their counterpart. It discusses policy implications of these findings.

1. INTRODUCTION
The on-going technology revolution in developing countries has caused considerable excitement in recent years over the role that information and communication technologies (ICTs) can play in economic development. The technology revolution encompasses new ways of capturing, processing, storing and displaying information and is capable of increasing productivity and competitiveness through information provision (Mangesi, 2010). Increased productivity and competitiveness is expected to foster greater linkage of smallholder farmers to market opportunities and to the rest of national and global economy. Consequently, several public-private sector interventions have emerged that target provision of market information services (MIS) to farmers using ICT-based technologies. The proliferation of ICT-based MIS is especially greatest in Africa where rapid penetration of cell phones has created interest in the opportunities that exist in applying ICTs in agriculture.

The interest in the application of ICT tools in agriculture arises from the perennial problems farmers face in accessing agricultural information (Okello et al., 2009). Smallholder farmers, who form the majority of farming
community in developing countries, tend to be poor in terms of access to agricultural production and market information services (Okello et al., Forthcoming). Linking such farmers to markets therefore continues to be a major challenge. This information-poverty has in turn led to low levels of agricultural commercialization among the smallholder (Poulton et al., 2005; Barrett, 2008). Information poverty traps farmers in subsistence farming, thus preventing them from adopting profitable production alternatives and also keeps them supplying low-paying marketing outlets (Ashraf et al., 2006). Information increases the transaction costs making the costs of doing business unaffordable to majority of smallholder farmers (Shiferaw et al., 2007). Smallholder farmers respond to the high costs of agricultural exchange by being autarkic or by selling their produce at the farm gate rather than travelling to the market where they could get better prices (Fafchamps and Hill, 2005). Such village markets however tend to offer low prices and are characterized by significant price variation (Gabre Madhin and Fafchamps, 2006; Aker, 2008).

Information poverty stifles progress in smallholder farm sector because of a number of factors. In the absence of market information, opportunistic behavior (by traders and other market actors) tends to develop. Such behavior encompasses cheating on quality and quantity (especially scale) which in turn results into the failure of traders to establish long-term business relations with farmers and other traders (Fafchamps and Gabre-Madhin, 2006). Opportunistic behavior between buyers (traders) and sellers (farmers), causes actors to prefer relational exchange (i.e., selling only to those previously known and hence trusted). Such exchange tends to involve small volumes and is based on visual inspection. The tendency for transactions to involve visual inspection precludes long distance, non-personal transactions and typically increases the cost of trade (since actors must travel long distances to verify quality of traded commodity during the buying process).

In theory, the use of ICT-based MIS is expected to reduce the costs of agricultural exchange and spur commercialization thus improving the welfare of the farming communities. Such gains are expected to be greatest among the smallholder farmers who tend to be most constrained by information poverty. Recent studies document widespread application of ICT tools in agriculture, especially the new generation ICTs such as the internet, mobile phones and interactive video/CD-ROMs (Munyua, 2008). Majority of these applications target smallholder farmers. The shift in focus to ICT-based MIS is driven by the role they can play in communicating knowledge and information to rural farmers, reducing transaction costs, improving smallholder farmers’ access to markets and agricultural credit and empowering farmers to negotiate better prices. What is the impact of the application of these new generation ICT tools on the smallholder agricultural households?

Recent studies suggest that the use of ICT-based MIS facilitate the linkage of smallholder farmers to input and commodity markets (Aker, 2008; Chigona et al, 2009; De-Silva, Forthcoming). Such studies have involved the use mobile phones and internet-based platform to improve smallholder farmers’ access to input and output markets in Kenya, and the use of mobile phones and computer-based market information network to synchronize production practices with export market requirements in Colombo (Okello et al, Forthcoming; De-Silva, Forthcoming). However, little is still known about the actual benefits to smallholder farmers of the use of ICT-based MIS. This study examines the effect of the use of ICT-based MIS on smallholder farm household’s welfare. It specifically examines whether the use of ICT-based MIS improved household food security, access to healthcare, and investment in human capital.

This study focuses on an ICT project that targeted the smallholder sunflower farmers with input and output information to facilitate their linkage to better-paying markets. The project, known as DrumNet, used mobile phones and a computer based platform to link the various value chain actors and provide them with production and market information. It also helped farmers to access input credit under interlinked credit scheme and also negotiate fairer prices for their produce under a production and marketing contract. The rest of this paper is organized as follows: Section 2 presents the study context while Section 3 discusses the conceptual framework. Section 4 presents the DrumNet project and discusses its impact on smallholder farmers. Section 5 concludes and provides policy implications of the findings.

2. STUDY CONTEXT

DrumNet consisted of two projects implemented in two regions of Kenya namely, Western province and Central provinces, focusing on sunflower and French bean farmers, respectively. This study focused of the Western Kenya project. The province is one of the major producers of sunflowers in Kenya. However, the area is characterized by dense population that has reduced farm sizes significantly. The average farm size of majority of smallholder farmers
in the province is 1.4 (Dose, 2007; Okello et al, 2009). The major cash grown by both small and large scale farmers is sugarcane. However several food crops (maize, beans, cassava, peanuts, sweet potatoes and vegetables) are also grown. Although the province is an important grower of sugarcane, smallholder farmers have not benefited much from it (Odhihambo, 2009). Majority lease out their land to larger farmers for sugarcane production hence not directly integrated into the local economy. Consequently poverty rates are quite high in the many areas of the province (Okello, 2009). More than 57 percent of the households in the areas targeted by the DrumNet project live under absolute poverty (Dose, 2007).

Farming is the main occupation in the province and major source of income. However, farmers earn income from a variety of other sources (Figure 1). The other sources of income include off-farm small business and remittances from family members living away from home.

Majority of smallholder farmers practice semi-subsistence agriculture characterized by production of small surpluses for sale to meet petty cash needs. All households produce most of their food needs and only use markets to supplement shortfalls in household food needs. Consequently, land is allocated to the production of cash crops, such as sunflower, only when the household feels that it has sufficiently catered for its food needs.

Smallholder farmers trade in local markets usually in small volumes (Poulton et al, 2006). Exchange in these markets is personalized. Most buyers physically inspect the produce when buying because there are no well-defined quality grades and standards in such markets. The trade in small volumes in these village markets has given rise to thriving business for intermediaries. The rural assemblers collect and bulk produce from smallholder farmers and sell to other intermediaries who sell to urban brokers. The urban broker then sells to urban traders which could be urban wholesaler or retailer. Thus the value chain involving smallholder farmer transactions tends to be long and fragmented. The margins received by such farmers are thus quite low (Okello et al, Forthcoming).

The DrumNet project was intended to shorten the value chain by proving “one-stop shop” where farmers and the buyer can transact business directly. It essentially connected the smallholder farmers with the various actors in the value chain (namely the service providers and buyers) thus forging a network of linkages (partnerships) that integrate the smallholder farmers into the sunflower value chain (see Figure 2). These linkages were aimed at resolving the idiosyncratic market failures facing the smallholder farmer and ultimately enabling the farmers to adopt “farming as a business”. The overriding goal of the project was to improve the welfare of the smallholder farmers by increasing household incomes hence reducing the incidence of poverty in the project area. As shown, mobile phone play a crucial role in networking the partners under the DrumNet project. Did this mobile phone-mediated MIS have a positive impact on smallholder farm households? We return to this question after presenting the conceptual framework with which we analyze the DrumNet MIS project. The framework draws from the transaction costs theory.
3. METHODS FOR ANALYZING IMPACT OF ICT-BASED MIS ON WELFARE

3.1 Conceptual framework

One of the factors impeding the magnitude of returns smallholder farmers make from their produce is the high transaction costs. Transaction cost is the cost of doing business or cost of exchange between two trading partners, in our case farmers and buyers (Okello et al, Forthcoming). The transaction cost theory posits that difficulties in economic exchange between farmers and buyers arise because of three exchange related problems namely, asymmetric information, bounded rationality and opportunism.

In small farm situation, asymmetric information arises when either the farmer or the buyer lacks essential information relating to the exchange. The more informed of the parties therefore takes advantage of the exclusively available information to benefit itself, a situation referred to as opportunism. This behavior is known as “self-interest seeking with guile” (Williamson, 1985; Miller, 2005). In agricultural marketing in Africa, smallholder farmers tend to be less informed than the buyers. Buyers thus use the exclusively available information (about price, supply condition, or quality) to their benefit.

Uncertainty of future outcomes means that the buyers, even with a priori agreement on terms of exchange can take advantage of the smallholder farmers by engaging in actions that are contrary to the specifications of the agreement (i.e. abuse the spirit of the contract), a condition known as moral hazard. Alternatively, the buyer may claim ability to meet the terms of the agreement (e.g., buy the entire commodity from the farmer or pay on time) only to fail to do so due to changes in the market, a situation called adverse selection. These conditions prevail in many rural farming environments in which agricultural information is generally unavailable (Mangisoni, 2006) and has been one of the factors behind the push for ICT-based MIS. In the typical smallholder farm environment, these problems may occur when the buyer fails to deliver payment for produce delivered by the farmer as promised and the farmer has to spend time and money to get paid. Conversely, the seller may promise to deliver produce of certain quality but fail to deliver it while blaming some physical environmental factors such as diseases and pest problems.
Lack of information between the farmer and the buyer makes trade more costly (Okello et al, Forthcoming). Farmers who need to sell some produce must search for buyers and screen-off unreliable or opportunistic ones thus incurring search and screening costs (Coase 1937; Omamo, 1998). Once the buyer is identified, the farmer has to negotiate the terms of sale (i.e., price, quantity, quality, time of sale, frequency of sale, etc). The farmer thus incurs costs relating to time spent and financial outlays in negotiating the terms of exchange. A farmer may then have to monitor the buyer to ensure that the latter meets the terms of exchange, and thus incur monitoring costs in the process. The farmer may also have to spend time and financial resources getting the buyer to honor the terms of agreement and hence incur enforcement costs. Lastly, in long-term agreements, changes in production and market condition may dictate adjustments in the terms of exchange such as the sales volume, quality, price, and frequency or time of sale. Such adjustments may be needed even for agreements spanning just two seasons. The farmer, in such cases, incurs monetary or time costs during the re-negotiation of the terms of exchange known as mal-adjustment costs.

The above four categories of transaction costs above are prevalent in both input and output markets in Africa. Poulton et al (2006), Fafchamps (2004), and Fafchamps and Gabre-Madhin (2006) for instance highlight some of these costs in relation to African farmers and traders. These costs can make it too costly for buyers to do business with smallholder farmers. Buyers may have to engage in close monitoring whose cost tends to be too high due to geographical dispersion of farmers (Okello and Swinton, 2007). High information-related transaction costs can also make markets for smallholder farmer’s produce unravel. The unraveling of the market can occur when it becomes too costly for the buyers to search and screen for sellers of produce with acceptable quality. Theoretically, smallholder farmers can forestall the collapse of the markets for their produce by seeking third party certification of the quality of their produce (i.e., signaling). However, this process is often too costly for a small farmer. ICT-based MIS is expected reduce these transactions costs by reducing the asymmetry of information and uncertainty related to trade.

Reduction in transaction costs is expected to increase net incomes earned by farmers (Shiferaw et al, 2007; Stienen et al, 2007). Increase in income, on the other hand, is expected to contribute to greater household commercialization (Shepherd, 1997; Wambugu et al, Forthcoming). Thus the household is able to produce enough for household food needs (which contributes to food security) and have surplus to sell. Increased revenue (from sales) and hence income can be used by households for short-term investment in agriculture (e.g., in the form of increased use of fertilizers, improved seed) or medium to long-term investments (e.g., accumulation of productive assets including human, physical, financial and natural assets). The increased commercialization is in turn expected to provide greater incentives to smallholder farmers to participate in the market. Smallholder integration into the market economy directly affects the welfare of such farmers. There are several ways in which the welfare effect can occur. First, increased involvement in the market economy increases household net incomes which contributes to greater access to food (hence makes the household food secure). Second, increased income boosts household savings which are used to smooth future shocks (Fafchamps and Quisumbing, 1999). Third, improvement in household income can also be invested in education (especially payment of school and college fees) thus resulting in increased stocks of future human capital in the household (Fafchamps and Minten, 1998). Fourth, higher net income from agriculture can spent on meeting household medical needs which amounts to significant expense in the study region (Okello et al, 2009). However, greater integration into the market can also expose farmers to higher risks associated with swings in market prices. For instance, majority of smallholder farmers, following the food price inflation of the 2008/2009, became food insecure. Some of the affected household responded by disinvesting in farming and human capital (Okello, 2009).

### 3.2 Data and sampling procedure

This study used data collected from smallholder farmers located in Kakamega, Butere-Mumias, and Busia districts of Western province. In both districts respondents were randomly sampled from sunflower growers stratified by participation in the DrumNet project as follows: First, a list of all farmer groups participating in the DrumNet project was obtained. In total 56 such groups were listed in the 3 districts. A total of 13 groups were then randomly selected and a list of all the farmers in each group obtained from the group leaders. Second, for every group selected, a list of all neighboring farmers who do not belong in the DrumNet project was drawn. A random sample of 20 farmers was

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then drawn from the two lists using probability proportion to size sampling procedure. Data was then collected from each sampled farmer using pre-tested and revised questionnaire.

4. RESULTS AND DISCUSSION

One of the problems sunflower growers in western Kenya faced was the lack of reliable market for sunflowers. They therefore sold their crop through intermediaries. The number of intermediaries differed in different districts but generally included several rural assemblers, local broker/commission agents, and urban broker/commission agents. At the same time, farmers had to transport the produce to the selling point. The DrumNet (DN) program aimed at linking farmers directly to the buyers by enabling them overcome a number of idiosyncratic market failures and reduce the transaction costs of exchange associated with them. The project worked with farmers organized into groups. In some cases, the project mobilized independent farmers into groups thus helping them overcome their organizational failures (Rich and Narrod, 2005; Poulton et al, 2007). Under these groups the farmers received technical training on farming as a business which encompassed better farming techniques and marketing strategies. In farming, the project emphasized the use of better agricultural technologies (higher yielding seed, fertilizer and credit – where needed). It also provided linkages to sources of these inputs, especially credit and high yielding seed varieties.

The farmers were linked to credit market via a commercial bank known as Equity. This way, DrumNet helped integrate farmers who would usually be rationed out into the formal credit system thus resolving credit market failure (Fafchamps and Lund, 2003). The credit market failure facing smallholder farmers is usually linked to high transaction costs of screening the borrowers, negotiating contracts, and monitoring small farmers. On the other hand the farmers were linked to the buyer (known as BIDCO Ltd) as source of high yielding varieties and also technical advice relating to production and postharvest handling. The direct linkage to the source of technical advice helped resolve the constraints relating to poor access to technical information needed to meet the quality specifications (e.g., oil and moisture content) of the end product namely, the sunflower seeds.

The linkage of the farmer groups to the BIDCO Ltd was through a formal production and marketing contract negotiated by DrumNet and group leaders. The contract specified the quality parameters, the volume contracted, the expected time of collection, and the price that will be paid by the buyer. It also specified the penalties that noncompliance with quality specifications attracted. Under the contract, the buyer also undertook to provide transport services at a fixed fee. The contract with a buyer resolved the constraint of lack of information on reliable markets for produce that smallholder farmers usually face. Lack of market information and the resulting price volatility often force smallholder farmers to produce low volumes of the crop and to depend on intermediaries (brokers/commission agents). Such farmers therefore trade in small volumes which have to be bulked into larger volumes to reduce the per unit transport cost for the buyer. Hence by including a formal marketing arrangement as part of the project, DrumNet provided assurance of better price and resolved “insurance” market failure (Key and Runsten, 1999; Kydd and Doward, 2004). This problem is usually associated to lack of information on price changes in the market.

The DrumNet project helped integrate farmers to high value markets by reducing their transaction costs of exchange. As a result, smallholder farmers substantially increased their margins (Okello et al, Forthcoming). Figure 3 provides the changes in marketing margins associated with participation in the DrumNet MIS project. Prior to joining DrumNet, farmers earned only 65% of the sale price (i.e., price paid by BIDCO Ltd). The rest was taken by the various intermediaries namely transporter (9%), brokers (23%) and others (3%) go towards paying for marketing costs and fees. After joining DrumNet, farmers earned much higher margin (i.e., 86%). Apart from the 9% of the price deducted (by BIDCO) for transportation, the only other cost the DrumNet farmers incurred was the DrumNet commission amounting to 5% of the BIDCO price. In addition, farmers earned much higher and stable price after joining the DrumNet project than before.
How did the increased margins affect the welfare of smallholder farmers that participated in the DrumNet project? A project can affect farmers’ welfare in a variety of ways. In this study we investigated the impact of participation in the DrumNet project on household access to medical health services and food and also on investment on human capital namely, education. First we investigated the effect of participation in the DrumNet project on household expenses on medical health services. Cutting back on medical expenses can result in the deterioration of the medical health status of the household and lead to lower productivity of household labor. It can therefore lead to low investment in productive assets including agricultural land and human capital. This study was conducted when there was tremendous food price inflation in Kenya due to domestic and international factors. Hence many households were cutting down on non-food expenses. Both DrumNet and non-DrumNet farmers were therefore asked whether high cost of food has caused them to reduce their expenses on medical health services compared to same period the previous year. Figure 4 presents their responses. Overall, the high cost of food caused many farmers to reduce household expenses on food. However, fewer DrumNet farmers reduced expenses on food compared to their counterparts. This may be attributed to the higher net income earned from sunflower sales by such farmers than their counterparts. The average amount of money paid towards family medical expenses by DrumNet farmers in the year preceding the study was Kshs 2413 compared to Kshs 2313 for the non-DrumNet farmers.
We also investigated the household food security status of participating and non-participating farmers. A household was classified as food insecure if it borrowed food or received food gifts from friends, family and neighbors. On the other hand a household was classified as food secure if it gave out food as gift after meeting household needs. Results of food security analysis showed that the average quantity of food received as gift or borrowed by DrumNet farmers in the year prior to the study was 0.80kg compared to 41.67kg for the non-DrumNet farmers. In addition, farmers participating in the DrumNet project gave out in 2008 an average of 20.93kg as gifts and donations to others compared to 6.98kg by the participating households. Ability to buy food grains to meet the household food deficit is also used as an indicator of food security. We therefore assessed the household cash expenditure on food grain purchases by the two households. The results indicate that the average expenses by DrumNet farmers during the year prior to the study was slightly higher (kshs 2732) than the expenses on food grains by non-DrumNet farmers (Kshs 2597) over the same period.

5. CONCLUSIONS AND RECOMMENDATIONS

Agriculture remains the engine of growth in many developing countries of Africa. However, progress in the sector has been constrained by lack or poor access to market information resulting in high transaction costs of agricultural exchange. Consequently farmers, especially the smallholders, face high transaction costs in the production and marketing of their produce. Such farmers therefore tend to produce and trade in small volumes usually in local markets that offer poor prices. Yet smallholder farmers comprise the majority of farming community. Progress in agriculture will therefore require the commercialization of smallholder farming. Commercializing smallholder agriculture in turn requires access to market information.

The last one decade has witnessed an increase in the number of ICT-based MIS projects targeting the provision of MIS to smallholder farmers. This study examined the impact of one such project in Kenya, namely the DrumNet project, farmers’ welfare. It uses food security status and access to medical health services as proxies of welfare. The study finds that the project that households of farmers who belonged in the DrumNet project were more food secure than their counterparts. Such households received higher incomes from the sale of their crops hence were able to purchase food when needed. They also produced more food from their farms than their counterparts. It also finds that such households did not reduce their expenses on medical health services even during the period of serious food scarcity in Kenya. These findings are attributed to the higher incomes such households earned. The study therefore provides evidence that participation in ICT-based MIS improves the livelihood of smallholder farmers. The implication of these findings is that there is need to adopt policies that encourage investment in ICT-based MIS. They also underscore the need to develop a system of regulations that promote efficient e-commerce and that protect farmers and traders from opportunistic actors.
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