

THE DEVELOPMENTAL CONTRIBUTION FROM MOBILE PHONES ACROSS THE AGRICULTURAL VALUE CHAIN IN RURAL AFRICA

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ABSTRACT

The most widespread information and communication technology (ICT) in developing countries today is the mobile phone. The majority of people in the least developed countries still live in rural areas and their livelihood depends on the primary industries. This study investigates the use of mobile phones among farmers in rural Tanzania in order to supply empirical data on the developmental role of this technology. The results show that the improved access to communication and information that mobile phones represent affects the entire cyclic farming life during the year and has resulted in considerable changes in the entire livelihood constructs, increased opportunities and reduced risks for rural farmers.

Keywords: Mobile phones, farmers, development, value chain, Tanzania

1. INTRODUCTION

The ‘digital divide’ refers to “the global disparities in access to the Internet and other information and communication technologies that [have] propelled globalization” (United Nations: Year In Review 2005, 2010). The global digital divide is a term often used to describe the gap between more and less developed countries. At the national level, there is often an urban-rural divide. In developing countries in particular, we see clear tendencies of increased concentration of information flow into urban and central areas. Economically disadvantaged countries and rural and peripheral districts within these countries tend to fall further behind in human resource development as well as in economic progress and political participation (Furuholt, 2009).

To create and support development in developing countries, trade, knowledge development and education are important issues and information technology has the potential to support this development (Sein and Harindranath, 2004). The most widespread information technology across the world today, including in developing countries, is the mobile phone. The use of mobile phones has increased rapidly and this technology has spread to the most remote areas of the least developing countries during the last few years (see table 1, below). The table also reveals that mobile technology penetration far exceeds the spread of more complex Internet technology.

Evidence from selected studies carried out by the United Nations Conference on Trade and Development shows that mobile phones have become the most important mode of telecommunication in developing countries (UNCTAD, 2007). For the vast majority of the low-income populations mobile telephony is the sole tool connecting them to the information society. It has continued to be the only ICT use sector, where developing countries are quickly catching up. This is emphasised by The Economist (2010), which claims that:

“The Internet can make agricultural markets more efficient, just as mobile phones can. But whereas the expansion of mobile-phone access is now rapid and commercially self-sustaining—even very poor farmers can benefit from

having a phone and find the money to buy one—the same is not true of the Internet. Its use requires a higher degree of literacy, for one thing and computers cost more than handsets.”

The majority of people in the least developed countries still live in rural areas and their livelihood depends on the primary industries. Tanzania, which is the focus of this research and its East-African neighbours, is among the least developed countries; Tanzania ranks number 151 out of 182 ranked nations, by the Human Development Index (UNDP, 2009) and more than 30% of the 40 million inhabitants are living below the poverty line. According to The World Factbook (CIA, 2010), 70% of the population live in rural areas and 80% of the labour force are working within the agricultural sector. Traditionally, a lack of reliable communication channels for smallholder crop farmers in Tanzania has contributed to low levels of opportunities that translate into high transaction costs and a poor general level of development.

Today, however, we know that many of these people have access to mobile phones. People in rural areas, however, are not advanced users; they use the mobile phone mainly for voice calling and person-to-person SMS (Hellstrom, 2010). A few initiatives have been started to build up extended IT based livelihood services in these areas, like platforms for information sharing, marketing and financial transaction services, but they are still in their pilot phases (Donner, 2009). One such initiative was recently launched by the tobacco industry in Tanzania, where tobacco growers are offered a mobile phone based service for accessing critical agricultural data and make business decisions from their phone devices (Daily News, 2011a).

There has been some research documenting the rapid spread of mobile phones in rural areas of developing countries, but mostly from a supply perspective. Duncombe (2010) has assessed what has been achieved in academic-orientated research directed at Mobiles for Development (M4D) and he suggests that the bulk of studies have focused on assessing readiness, uptake and immediate outputs associated with mobile phones, with only few studies providing evidence of outcomes and broader societal impact.

Two articles (Souter et al., 2005 and Sife et al., 2010) with a specific focus on Tanzania have studied the impact of mobile technology on rural livelihood and poverty reduction in general. Our intention is to study the actual use of this information technology, in order to supply empirical data on the developmental role of mobile phones. We will examine farming more closely, as it is the dominating economic activity in rural areas of developing countries and we have therefore framed our research question:

How does access to information facilitated by the increased use of mobile phones, across the agricultural value chain, contribute to the empowering of smallholder farmers in rural Africa and help them in reducing vulnerability to risk?

We have chosen the Babati district in Tanzania as our research site. The study context is further described in section two, while section three provides a literature review on ICT for development (ICT4D) in general and use of mobile technology within the agricultural sector in particular. In section four, we present our research methodology, while section five describes and discusses the empirical findings. Section six contains our conclusions and recommendations.

2. THE STUDY CONTEXT

The population of Tanzania is young and poor. More than 42% of Tanzanians are younger than 15 years old, with an average age of 18.3. People in Tanzania can expect a life expectancy of 52 years and 36% of the population is defined as poor (CIA, 2010).

With more than 40 million people and an area of 945,000 square km, Tanzania remains one of the least urbanised African countries; the majority of the population (i.e. 75 % of all Tanzanians) still lives in rural areas. According to Tanzania Ministry of Planning, Economy and Empowerment (2006), 2.3 million people are unemployed, but the majority of people are self-employed and most work is seasonal in the agricultural and informal sector. About 75% of the employed labour force (people aged 15 and older who meet the International Labour Organization definition of the economically active population) is engaged in agriculture, including hunting, forestry and fishing (The World Bank, 2011).

The most common agriculture products are coffee, sisal, tea, cotton, cashew nuts, tobacco, cloves, corn, wheat, cassava (tapioca), fruits, vegetables and meat, while coffee, cashew nuts and cotton are among the most important export commodities (CIA, 2010).

As in the rest of the world, mobile phone diffusion has had enormous growth in Africa in recent years. Table 1 shows some key figures describing this trend. The diffusion has brought communication to new groups of users, users that previously were excluded from the telecommunications systems.

Table 1: Mobile Cellular Subscriptions (ITU, 2011)

Country	2000 (Mill.)	2004 (Mill.)	2010 (Mill.)	Mobiles per 100 inhabitants 2010	Internet users per 100 inhabitants 2010
Tanzania	0.11	1.9	21.0	46.8	11.0
Kenya	0.13	2.5	25.0	61.6	21.0
Uganda	0.13	1.2	12.8	38.4	12.5
Malawi	0.05	0.22	3.0	20.4	2.3
Africa	-	88 (2005)	360.0	45.2	10.8
World	-	1,763.0	5,373.0	78.0	29.7

The table shows the number of mobile phone subscriptions, but this is not necessarily the actual number of cell phone users in these countries. That number is probably even higher. Hellstrom (2010) claims that the actual number of people and handsets behind the subscribers can differ quite substantially, mainly due to multiple sim ownership and the way service providers report their subscriber data. He further states that a clear majority of people in East Africa has access to mobile communication, either directly or indirectly through some sort of intermediaries. Daily News (2011b) reports that during 2010 the number of telephone subscribers has continued its rapid increase and at the close of the year had 21,158,364 sim-card holders, pushing the sector to be among the top five contributors to the national economy. The four top phone service providers in Tanzania are Vodacom, with 8.7 million subscribers, Airtel (6.0 million), Tigo (4.5 million) and Zantel (1.7 million).

A lack of access to information has traditionally made rural farmers in East Africa vulnerable to several risks, both during farming and transportation as well as marketing of their crop. Today, we learn from literature that the rapid spread of mobile phones has the potential of changing this situation considerably (e.g. Hellstrom, 2010:41).

In order to study this potential more closely and to answer our research question, we have chosen the Babati district in northern/central Tanzania as our research site (see map,

figure 1). The district was chosen because the district division, wards and villages represent a typical rural, smallholders farming area in Tanzania. The Babati district is one of five districts in the Manyara region.

Figure 1: The Research Site –Babati District in Tanzania



The major land based economic activities are agriculture, forestry and livestock keeping. Agriculture is the main economic activity in the district and about 20 per cent of the land is suitable for cultivation. Both smallholder peasant farmers and large-scale commercial producers practice agriculture. A variety of crops are cultivated, including, maize, sorghum, beans, pigeon peas, wheat and millet, while cash crops are made up of groundnuts, sunflowers, sugarcanes, bananas and coffee.

The Agricultural Sector Review (URT, 2008) has identified some key challenges facing the sector, among those being marketing information in the crop, livestock and marketing sub-sectors in Tanzania. Current market information systems are characterized by isolated efforts, for example from the sector specific organs like Sisal and Cotton Boards and respective ministries, departments or agencies. According to the Agricultural Sector Review, the systems are not comprehensive in the sense that they only cover small areas of Tanzania and dissemination of market information is disorganised and not co-ordinated. Players and dealers give, for example, incorrect market information to customers in order to increase their market advantages. The Ministry of Industry, Trade and Marketing has made some efforts to try to curb the problem and has established market price information on agricultural and livestock products, which are distributed weekly through media (newspapers) and directly to all interested stakeholders. The Ministry is also building up a national database for market price information, crop types, dealers and stocks, based on data from information centres in the regions (URT, 2008).

3. LITERATURE REVIEW

ICT has the potential to bridge the digital divide and to support development in developing countries by providing access to information and by building communication lines between people and communities around the world (Furuholt, 2009).

In their Mobile Development Report, Nokia recommends that, in order to enhance rural development, mobile phones could be used in the following four levels (Sood, 2006):

1. *To provide communication*
2. *To provide access to information*
3. *For passive or inter-passive consumption of media*

4. *To interact with systems, institutions, communities and other users*

Due to high prices of advanced mobile equipment and to expensive and poor infrastructure in poor areas of the world, the use of mobile technology in rural areas is still limited to the first level of this categorisation. Even in Mauritius, which has one of the most sophisticated cellular markets in Africa, advanced mobile data services (apart from SMS) have still not entered the lives of most mobile subscribers (Ramburn and van Belle, 2011).

We can, however, still see important traces of developmental effect by this use presented in research literature. Some of this literature describes cases in primary industries in developing countries, for example communicating fish price information among fishermen in Kerala, India (Jensen, 2007) and SMS access to real-time seed stock inventory in the Philippines (Mendes et al., 2007). The empirical data on use like this is still limited and only covers sporadic cases.

From Africa, two reports (Menda et al., 2005; Stienen et al., 2007) describe how ICT can make a difference in agricultural livelihoods, but both of them cover traditional computer data base solutions and not use of simple mobile technology.

Three promising examples of improving livelihood for African fishermen are presented by Myhr and Nordstrøm (2006) from Tanzania, Rashid and Elder (2009) from Senegal and Salia et al. (2011) from Ghana. In the Tanzanian study, they (Myhr and Nordstrøm) found that the fishermen used mobile phones to find buyers and thus cut the time for bringing the fish to the consumers, which led to better quality and higher prices for their products and also made them less vulnerable to loss due to a damaged catch. The project in Senegal collected fish prices and uploaded them to a central database using mobile phones. Farmers in the field were able to check prices before they set off to find out the best offer for their produce (Rashid and Elder, 2009). It was found that the farmers made about 15% higher profits for their catch after having paid net costs including the cost of the information services. In addition, as in the case of Tanzania, the fishermen were able to reduce the amount of spoiled fish while in search of a market buyer.

In the recently published study from Ghana, Salia et al. (2011) supply with detailed empirical survey data in order to show how mobile phone use among fishermen has enhanced the efficiency of input and output markets for fishing and improved their businesses relations and livelihoods. The results indicate that use of mobile phones enabled fishermen to improve their incomes, expand their markets, feel more secure at sea and remain in closer touch with both families and other fishermen.

The smallholder crop farmers and the fishermen share considerably similar environments and challenges; they all spend time away from their families and normally with a long distance to the markets in the more urban centres. In order to improve revenues, these farmers need to receive better market prices through reliable access to information facilitated by the use of mobile phones. Mobile phones also help the farmers to control the business environment and situations, as well as reducing chances of vulnerability to several risks.

In the SIDA report on innovative use of mobile applications in East Africa (Hellstrom, 2010:41), K.S. McNamara discusses multiple dimensions of mobiles' contribution to agriculture and rural development. McNamara claims that mobile devices and services can help create a "virtuous circle" of innovation that can benefit even the poorest farmers and increasingly integrate them into local, regional and global markets.

A survey conducted by Souter et al. (2005) in Tanzania, India and Mozambique presents some empirical data, describing the use of mobile phones in these countries. The results show the importance of information to people's livelihood and general well-being, ranging from information about family members, to information related to their livelihood strategies (crops management, remittance, market prices, government and legal requirements,

etc). They confirm the importance of interactive communication in order to engage in dialogue with others, whether in social or business transactions. Particularly important are those interactions linked to social capital; conversations between members of family or within a wider social network.

The survey suggests that, of the five main categories of livelihood assets (human, social, natural, financial and physical capital) telephony is most closely associated with social capital. In respect of natural capital (soil, water, trees, growing crops, etc), weather and market information are important to enable farmers to manage their resources.

Souter et al. (2005) state that the potential of mobile phones, in order to reduce vulnerability, lies in people's ability to obtain information that allows them to deal with seasonal factors (e.g. weather information), to reduce the imbalance between themselves and those they trade with (e.g. price information) and to respond more quickly and effectively to shocks. It is in this latter area that the respondents in these countries acknowledge the beneficial impact of the mobile phone.

The analysis of the study shows that those who are engaged in business activities and those of higher economic status believe that the use of mobile phones has brought them significant economic benefits. Other categories, however, see no economic benefit, specifically; there is no correlation in any of the three countries between changes in household income and frequency of mobile phone use or perceived change in access to telecommunications.

In addition, Sife et al. (2010) have done a survey on the contribution of mobile phones to rural livelihoods and poverty reduction in Tanzania. Their findings correspond pretty much with Souter et al. (2005) and Hellstrom (2010). They conclude that the phones contribute by expanding and strengthening social networks; increase people's ability to deal with emergencies and increase the efficiency of travel and business activities.

There are many ways that mobiles can support agricultural development and help people into the virtuous circle described by McNamara in Hellstrom (2010) (see above). These improvements can occur along the entire agricultural value chain and can benefit all participants in the value chains. Using McNamara's dimensions (Hellstrom, 2010:41) as a starting point, supplied with input from other literature on mobile use in primary industries, we have grouped these contributions into five dimensions (Table 2):

These five dimensions correspond to a great degree with the four levels of phone use that Nokia recommends (Sood, 2006) (see above) for bringing about development in rural areas. All the three articles by McNamara (Hellstrom, 2010), Souter et al. (2005) and Sife et al. (2010) point to the developmental role of mobile phones across the entire agricultural value chain and the need for specific seasonal actions and information flow. In our study, we have concentrated specifically on this aspect of farmers' use of their cell phones.

4. METHODOLOGY

The Babati district in northern Tanzania (see description and map in section 2, above) was chosen as our research site because the district division, wards and villages represent a typical rural, smallholders farming area in Tanzania. The distance to larger cities like Arusha, Mwanza and Dodoma is long and the infrastructure (roads, electricity supply and telecommunications) has traditionally been poor. Thirteen surrounding villages were selected and one farmer within each village was invited for interview.

This study primarily employs the four levels of mobile phone use presented by Nokia as a starting point (Sood, 2006) and the link between mobile technology and the agricultural value chain pointed to by McNamara (Hellstrom, 2010). Both have been presented in the literature review in section 3, above and we want to trace this use across the entire value

chain. For this purpose, we used input from the farmers about their activities and organised our interviews according to these, as described in table 3, below.

Table 2: Five Dimensions of Mobile Use for Supporting Agricultural Development

	Description	Explanations	References
1	<i>Access to timely information</i>	Mobile devices can improve smallholders' access to timely information about prices, market and farming practices.	(Mendes et al., 2007) (Rashid and Elder, 2009) (Hellstrom, 2010:41)
2	<i>More efficient and transparent markets</i>	By helping to make markets more efficient and transparent mobiles can reduce waste and empower smallholders in negotiation with wholesalers, traders and transport providers and link smallholders to distant markets and higher-end agricultural value chains.	(Myhr and Nordström, 2006) (Jensen, 2007) (Salia et al., 2011:14)
3	<i>Advance warning</i>	Mobile applications can improve advance warning of weather risks, pests and other environmental risks and provide timely, locally-relevant information on how to respond to these.	(Souter et al., 2005) (Sife et al., 2010:10) (Salia et al., 2011:15)
4	<i>Access to complimentary services</i>	They can also facilitate access to vital complementary services, particularly financial services.	(Ngugi et al., 2010), (Daily News, 2011a)
5	<i>General communication and co-ordination</i>	Mobile phones can help the rural poor in general; to connect with one another for more effective collective action as producers, traders and as citizens	(Souter et al., 2005) (Salia et al., 2011:15) (Hellstrom, 2010:41).

Along the time-line, preparation for farming takes place between October and December, the farming period is between December and March and the two last phases, the harvesting period and marketing occur between June and September. From this cyclic timeline, we examined how the farmers' use of mobile phones influenced their livelihood constructs opportunity, empowerment and vulnerability to risk.

We conducted semi-structured face to face interviews with the farmers in two phases in 2009 and 2011. The sample was selected by taking into consideration the different characteristics of respondents from different villages and we interviewed respondents from 13 farm-villages of the Babati district: Nakwa, Mamire, Nekamsi, Bagara, Galapo, Dareda, Riroda, Duru, Komoto, Endagwe, Miomboni, Singe and Magugu villages. All villages within the reach of the Babati municipality were included in the sample. Only those farmers who sell their crops during and after harvesting seasons were interviewed.

In addition, document analysis was performed during visits to different sources like Tanzania Communication Regulatory Authority (TCRA), Research on Poverty Alleviation (REPOA), Economic and Social Research Foundation (ESRF), Ministry of Agriculture, Food Security and Cooperatives, Ministry of Livestock and Fisheries and Ministry of Industry, Trade and Marketing, to solicit related information.

The first session took place during May and June in 2009, while the second round of interviews was conducted in January and February 2011. In both sessions, our interviews followed closely the list of activities in table 3, below. In the second session, we aimed at discovering changes and development in the mobile phone use over time, in addition to augmenting with supplementary information, in particular on economic conditions. While we covered all 13 villages in the first session, only four of the villages, Nakwa, Dareda, Komoto and Magugu were visited the second time.

Table 3: Farmers' Activities and Use of Mobile Phones

Period	Activity
Preparations for farming	<i>Coordinating labour pool (voluntary-based, family members and neighbours)</i> <i>Collecting weather information</i> <i>Investigating seeds prices</i> <i>Preparation kraal manure for planting (mainly used by the farmers in the area during planting)</i>
Farming period	<i>Pooling of labour for cultivation and weeding</i> <i>Organizing manure for use during planting</i> <i>Collecting and exchanging rain information</i> <i>Hiring/borrowing farming implements (e.g. hand hoes, ox plough, harrows etc.)</i> <i>Investigating prices of tractors for cultivation</i> <i>Ordering and hiring of oxen for cultivation</i> <i>Collecting information about new types of seeds</i> <i>Ordering seeds</i> <i>Investigating labour cost per for cultivation and weeding in the neighbouring villages</i> <i>Organizing fertilizer</i> <i>Collecting information about availability of extension officers and subsidized farm implements from the local authorities</i> <i>Coordinating information and deliveries of pesticides</i>
Harvesting period	<i>Organizing and pooling of labour for harvesting</i> <i>Arranging for storage equipment and warehouses/stores</i> <i>Arranging for and ordering of preservative chemicals against mice and "scania"</i>
Post-harvesting (Marketing and transport)	<i>Organizing transport from the farms to warehouses (tractors or ox trailers)</i> <i>Calling market centres, traders, dealers and check prices and stocks of crops before settings deals with middlemen/agents or deciding to travel to obtain better opportunities.</i> <i>Calling for and ordering transportation to markets</i> <i>Selling crops via mobile phone</i> <i>Contacting distant families/relatives (for decisions and money transfers)</i> <i>Money transfers and payments</i>

5. FINDINGS AND ANALYSIS

The recently acquired possibility to own or access a mobile phone has brought radical changes to the way Tanzanian farmers communicate, receive information and support decision making and this study reveals some of the unusual new usage and the impact

brought about by mobile phone usage. As categorized in the methodology section, this study reveals how farming life is affected by the use of mobile phones in the cyclic pattern of the life of the farmers.

5.1 In General

We realise that rural farmers in Tanzania mainly use their cell phones for communication, i.e. they currently stay at level one of the above Nokia classification. In the first round of interviews, however, we found some traces of indirect higher level use, via some kind of intermediaries, for example national information about pesticides and new seeds, communicated from the local agricultural extension officers.

The farmers state that there are two principle reasons why they only use their phones for simple communication: Price and knowledge. One farmer in Magugu explained: “Use of mobile web for accessing media info is minimal because very few farmers can do this ... because of price charged per MB when downloading info/docs or browsing websites e.g. Google”. Another farmer is not using his mobile phone to browse because: “...I don’t even know how to open a website”.

And, for communication, voice call is more frequently used than SMS again due to pricing. Quoting one farmer (in 2011):

“Farmers make voice calls more than sending SMS. The reason behind is that the price of one SMS is higher compared to price of airtime per minute;...calling from Zain to Zain (Airtel) currently cost one Tanzanian shilling (TZS) per second, that means TZS 60 per minute, while sending a single SMS is TZS 59. Most of the time a farmer doesn’t need a whole minute to talk, which means, in a single call, a farmer uses an average of TZS 20-23 per a call. For TZS 59 a farmer makes a lot of calls. SMS is only being used when farmers exchange with other people things like account numbers, mobile phones number of other colleagues etc.”*

During the two years between our interview rounds, there has been a considerable increase in use frequency, due to reduced prices and improved infrastructure. Daily News (2011b) reports that the call time spent by the subscribers by the end of 2010 has increased to 218 per month compared to 188 in the previous quarter as a result of a reduction of call rates by the providers. One reason for the price reductions is increased competition between the service providers. Moreover one farmer told us that:

“...Though calling across (to the other service providers say Voda or Tigo) has been relatively cheap since last time we talked, calling within the same service provider is far cheaper; this has affected our use of mobile phones”.

Even if people in rural Tanzania, in general, are very poor, they are willing to spend a remarkably amount of money on mobile use, which shows that they feel they gain many benefits from it. Our respondents spent about 10% of their total monthly expenditure on this technology, which, to a large extent, agrees with users of other information technology. In their study of Internet café users in Tanzania, Furuholt and Kristiansen (2007) found that they used around 10% of their expenditure on Internet café fees and that the share was even higher for users in rural areas than in cities like Dar es Salaam.

* USD 1 = TZS 1,500

Improved infrastructure has been another reason for increased use. Today, all the 13 villages are covered by at least two service providers. In 2009, people in some villages (e.g. Galapo and Mamire) had to go to higher places or nearby villages to make a call. One happy farmer told us that today his working days are much more efficient, because he can call directly to pesticides shops or markets when he is at the shamba (farm) or working in the field.

We can also trace some indications that the users are gradually moving to higher usage levels. Some are, for example, collecting weather information from specially dedicated services and some have even started to use electronic money transfer services through systems like Vodacom M-PESA.

5.2 Preparations for Farming and the Farming Period

During preparation for farming and cultivation, farmers use mobile phones, mostly when calling agricultural extension officers for agricultural related advice, about prices and types of seeds and organizing manure and fertilizers. Farmers spend most of the time in the farm areas in the villages. The phones also helped them in communicating with agrovets shops, seeking information about types of seeds and fertilizers to be used given the nature of the season. For example, due to delays of the rains, farmers are sometimes advised to use short-term seeds. They are also able to communicate with extension officers to enquire about subsidized fertilizers and seeds. According to one farmer mobile phones are helping in cross-checking with companies that have produced seeds and fertilizers and with people in neighbouring villages to find out if prices and advice given by the agricultural extension officers in villages are true and reliable. One of the respondents said:

“...through the use of mobile phones, in seeking advises on types of seeds and fertilizers to use and also through accessing markets information, my life has improved a lot. I can surely say my life have moved from one step to the other”.

Farmers save money and time that had to be used for travelling to look for the best seeds and to obtain advice from the extension officers. These uses of mobile phones have given the farmers the possibility of coordinating activities, gaining knowledge to control situations and increasing their bargaining power and hence lowering all associated costs.

One popular type of mobile phone usage during preparation, cultivation and planting is for mobilizing of labour from distant farms and villages. They call people they know and when they arrive, the workers are already prepared for their tasks. The farming activities are labour intensive and mobile phones make the mobilising easier. It was also mentioned that mobile phones help in collecting price information for labour and hence help farmers to reduce the cost of cultivation and weeding. Hence, the phones save farmers' time, empower them by enabling them to control their situation, allowing them to become more efficient and thus increasing their revenues.

Some farmers also collect rain information via the phones, in particular when their farms are located far from their village residences. This is due to the mountainous nature of the district, whereby weather conditions vary from one village to another. In Galapo village (located at the windward side of Mount Kwaraha), for example, where they grow maize and wheat, the conditions are different from villages like Singe, Magugu, Riroda and Nakwa, which are located on the other side of the mountain. So those owning farms in Galapo and living in other villages have to rely on mobile phones communication to acquire the required rain information in order to start planting and maintain their fields.

For some farmers, mobile phones are useful when they need to hire and negotiate prices for tractors for cultivation purposes: “... *in two minutes you make three calls and choose the cheapest one and decide when to get the tractor*”, said one of the respondents, while another farmer stated that:

“We call owners of tractors in Babati, I am in a rural area and while continuing with my activities...I can talk and agree on the price of tractors for cultivation per acres...at the end I have saved time and used less money, say TZS 2000 to make a call. Honestly, mobile phones have improved our life to a great level”.

As an extra effect, respondents have also described situations where groups of farmers mobilise and negotiate tractor prices together and then achieve even better prices. This would never have been possible without the mobile phones.

The phones also play a role in facilitating communication for hiring and borrowing farm implements. Respondents told us that they borrow from each other because it is not possible to own all the equipment. During the planting season, farmers communicate across villages to hire or borrow ox ploughs, the oxen themselves, harrows, etc. Making appointments with relatives or neighbours on when to come and collect implements provides farmers with greater command of their situation.

It was also mentioned that mobile phones are useful when they face problems with the tractor out in the fields. One of the farmers explained that:

“Sometimes you might have a tractor breakdown or running out of fuel in the middle of the farms, what you do is to call the mechanic, who are mostly located in the urban (district headquarters) areas...he comes to the farm and repair the tractor, instead of pulling the tractor to the garage which is both time-consuming and costly.”

This reduces the vulnerability to risks of spending nights in the bushes, being robbed, or suffering from severe weather.

Our data from the two first seasons of the farming year thus cover all five dimensions of the mobile’s contributions to agricultural and rural development, pointed to by McNamara in Hellstrom (2010) and specified in section 3, above. *Access to timely information* (prices, market and farming practices) is emphasised by all our contacts and so is *More efficient and transparent markets*, through contact with intermediaries and wholesalers and organising of storage and transport. The mixed and mountainous terrain means that many farmers are dependant on timely weather (in particular rain) forecasts (*Advance warning*) and some of them have recently started to *Access complimentary services*, like M-PESA for cash management. And, at last, the collective bargaining of tractor rental (above) is a good example of the *General communication* dimension.

5.3 Harvesting and Marketing Period

The harvesting season is the peak season for the farmers and at that time mobile phone usage increases. During this season, the interviews revealed that the farmers mostly use their mobile phones in the following ways (arranged in order of importance):

1. *Calling markets centres, agents, players and dealers for prices*
2. *Selling crops via mobile phones*
3. *Organising for storage and booking warehouses*
4. *Collecting information and ordering of preservative chemicals*

5. *Contacting distant family members*

Activities like mobilisation of labour and transport from farms to warehouses and markets are not unimportant, but the respondents reported that they used less airtime for these tasks.

The largest market centre for smallholder crop farmers in Babati is Arusha. Before selling their crops, farmers have to call brokers or agents in Arusha to get to know current market prices. The brokers usually work for businessmen from Namanga (on the border between Tanzania and Kenya) or from Nairobi, Kenya. When they are satisfied with the prices, they decide to travel to Arusha to sell their crops or sell to middlemen in Babati. The supply chain of crop business is dependant on the involvement of the middlemen. If they avoid them at the village or district level, they will meet them at the major markets in Arusha. We were told, for instance, that currently there was a high demand for beans due to low production last year. Then the middlemen were flocking to Babati, wanting to buy beans at cheap prices. But by using mobile phones, farmers called businessmen in Arusha, or other farmers and checked the actual market prices before deciding to sell. This communication gave them the possibility to better negotiate with agents and middlemen, which balanced their information asymmetric relationship, empowered the farmers and made them able to increase their income.

After agreeing on price and quantity, the broker either might decide to come to the village to pick up the crops, or to advise farmers, via mobile phone, how to load and transport the crops to e.g. Arusha. One respondent told us that:

“... we talk directly with Indian businessmen from Arusha about prices of maize or mbaazi (pigeon peas)...they usually offer good prices...and if you have more than one ton of mbaazi, they come directly to your household and purchase them”.

This shows that, today, because of the mobile phone, farmers are rarely selling their farm products at home at throw-away prices. Selling farm products via mobile phones increases their efficiency and income and they do not need to carry the crops themselves over long distances with poor road conditions.

Access to mobile phones also helps farmers to communicate with the owners of warehouses in surrounding villages and to negotiate prices and book storage place for their crops. *“Without a phone, I would have been forced to walk or bike and look for the owners and make a deal. That would have taken a lot of time”*, explained one respondent.

During harvesting, farmers are calling agricultural extension officers seeking advice on better crop storage modes and on types of pesticides used to preserve the crops from pests. Ordering and purchasing of the pesticides is carried out either from agrovets in Babati, or seeds and pesticides agents in the villages. Farmers often contact the agent's headquarters, in order to verify prices, which give the farmers a sense of control of the market.

One main use of mobiles for the Babati farmers is to keep contact with their relatives far away. This opportunity is also important for their farming work. Before they had mobile phones, they were either prevented from contacting their relatives or they had to postpone the farming during family emergencies. Today, they are able to participate in family decision-making whilst farming. This was substantiated by one farmer:

“...where I am working and make my farming activities is far away from where my family lives. Through the use of my mobile phone, I can easily communicate with my family, knowing their problems, advice and finding solutions before the matter has gone bad. Sometimes when a child is sick, I'm

calling them and tell them to go to hospital and I am sending money for covering the expenses through another person.”

This study has also found, however, that farmers are still prone to various risks during the harvesting and marketing season. The interviews show that most of them are related to travelling, but mobile phone use gives the farmers great support in reducing or avoiding these risks, in several ways, one example being bad road conditions. When travelling to markets, information about this helps them save time and avoid spending nights along the road and thus being in danger of robbery. One farmer explained:

“Robbers are sometimes hijacking transporters between Babati and Arusha, mobile phone communication helps a lot; our roads are bad, sometimes we are forced to spend nights in the roads and all this jeopardize our security especially if you are carrying with you things like money. So we usually call and make sure that the road is accessible. Relatives or friends, who knows that you are on the same road, will call you and notify that the” road is dirty”...this helps us a lot, we can now control roads security situation”.

Our second data collection round has clearly demonstrated how use of mobile phones has reduced the vulnerability for the rural farmers, along the whole value chain. One example is the information transparency. When prices, both linked to production and to marketing are open and predictable, this has *“empowered us all, from the farmer and the small scale middlemen in the villages, to the middlemen in the central rural areas. We are all aware of the prices; no one gets big loss, but also no one gets massive profit”*, was stated from one of our interviewees. Another related example is the growing use of mobiles for money transfers and banking. A third example is the opportunity of doing additional business. One farmer with entrepreneurial drive told us that due to his mobile phone, he has saved time doing farm work, so that he could build up an additional business, based on phone usage, which makes him and his family less vulnerable:

“I’m now half farmer and half businessman, using the phone as a middleman in the crop business, selling sand and cement for construction purposes and organising tractors for other groups of farmers.”

The five ways of mobile phone usage during harvesting and marketing, prioritised by the farmers (listed above), supplemented by additional information and examples in this section cover all the five dimensions from McNamara (Hellstrom, 2010), specified in section 3 and discussed in section 5.2, above. In this section (5.3) we have, also placed emphasis on how the use of mobile technology can help in reducing risk for the farmers and thus results in empowering people and strengthening human development in rural areas. Our findings confirm both Souter et al.’s (2005) and Sife et al.’s (2010) assertions on the potential of mobile phones, in order to reduce vulnerability.

Another interesting issue is how mobile use for social purposes (e.g. discussing family affairs) has a positive effect on farming work. This also agrees with both Souter et al.’s (2005) and Sife et al.’s (2010) who emphasise the importance of maintaining the social network and claim that conversation between family members or within a wider social network is particularly important to enable farmers to manage their resources and increase their ability to deal with emergencies.

6. CONCLUSIONS AND RECOMMENDATIONS

This study was initiated to examine the role of mobile phones as an empowering tool; a factor enhancing opportunities for increased income and a tool for reducing vulnerability to risks for smallholder crop farmers in rural areas of the least developed countries. Our empirical data show that the improved access to cell phone based communication and information has resulted in great changes across the entire cyclic farming life and value chain and hence helped the farmers in controlling their situation. We have seen how farmers have become able to reduce several risks associated with their businesses. Mobile phones have in many ways made them proactive in taking care of their businesses. Better access to market information via mobile phones has increased the amount of opportunities available. These positive changes have led to higher monetary income for the farmers and in turn improved the livelihood indicators.

Even if this study has some exploratory features, it is also informed by the three articles by McNamara (Hellstrom, 2010), Souter et al., (2005) and Sife et al., 2010, which discusses multiple dimensions of mobiles' contribution to agriculture and rural development. Based on their work, we have augmented with empirical data from a rural region (Babati) in Tanzania and systemised our findings across the farming seasons, in order to enlighten on the benefits from mobile phone use across the entire agricultural value chain. This new and systemised information might enable all the stakeholders to further exploit the potential that the mobile information technology represents.

The experience we gained during data collection laid the groundwork for giving some recommendations on how mobile phone use can best continue to improve farmers' life. Some information providers (e.g. The Ministry of Industry, Trade and Marketing, mobile phone service providers and the tobacco industry) have tried to send updated market information via mobile phones to the farmers (URT, 2008; Daily News, 2011a), but this effort is not effective and our observations show that most farmers in Babati are not aware of these services. Therefore, we recommend mobile phones companies to establish a wider, affordable and effective service or product offering instant market prices and additional, relevant market information. Prices printed in the newspapers are not useful for all farmers, because few farmers can, or have an interest of, buying newspapers. Efforts to control market prices through warehouse systems established by the government should be extended to crop farmers all over Tanzania, rather than concentrating on cash crops like cashew nuts and coffee. This will certainly increase their revenues and reduce much risk associated with travelling to market centres far away.

We also suggest spreading information about and building up knowledge on, existing systems for money transfers by mobile phones, in order to make it more reliable and affordable in rural areas like Babati, where banking services are very limited. Farmers have emphasized that money transfers by mobile phones will considerably reduce the risk of being robbed. Currently money transfers services have been a great success in neighbouring Kenya, where the M-PESA system was quickly adopted and has revolutionized the way financial services are accessed in the country (Ngugi et al., 2010). So far, efforts by Vodacom to duplicate this success in Tanzania have been much less successful.

We have thoroughly studied the use of mobiles in Babati over a long period of time. This is, however, only a limited region in one of the least developed countries in Africa. Even if our research is supported by other articles, we have to be careful not to make sweeping statements on fairly insufficient grounds. Our next step, in order to draw more general conclusions, will therefore be to make comparative studies across countries and continents and look into different trades, for example in other African or Asian countries and study livestock farmers, fish industries or small scale handcraft businesses.

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