Working Paper

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Josephine Kirui, Wesley Maritim, Evelyne Kiptot, Sylvia Wafula, Joshua Ngaina, Jane Kugonza

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Summary

This paper presents the findings of a Rapid Appraisal (RA) study that was undertaken with 28 farmer trainers (FTs) to assess the use of the Short Message Service (SMS) in accessing agricultural information. The study was conducted in Kaptumo and Olkalou in Kenya. The study used RA tools that included discussions with key informants and semi-structured interviews guided by a checklist. The data and subsequent analysis revealed that all FTs owned mobile phones and were able to read and write text messages. English was the popular language among FTs in SMS usage (90% preference over other languages). The results further showed that information contained in text messages could be made useful immediately as all FTs read SMS received before the day ended. Additionally, the study indicated that FTs received agricultural text messages from fellow FTs (100% in Olkalou and71.4% in Kaptumo), service providers (50% in Kaptumo), extension workers (71.4% in Kaptumo), and local administration (78.6% in Kaptumo). The study further revealed that FTs occasionally share the text message information that they receive with other farmers. These findings point to the fact that the use of mobile phone technology is widely used by farmers to access and share agricultural information. Policy makers and extension service providers need to embrace this service so that farmers can access agricultural information in a timely and cost-effective manner.

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Abbreviations and acronyms

CGIAR	Consultative Group on International Agricultural Research
EADD	East Africa Dairy Development
FAO	Food and Agriculture Organization of the United Nations
FTA	Forests, Trees and Agroforestry
FTs	Farmer Trainers
HIV	Human Immuno-deficiency Virus
ICTs	Information Communication Technologies
mm	Millimetres
PIM	Policies, Institutions and markets
RA	Rapid Appraisal
SMS	Short Message Service
TTS	Text To Speech
UH_1	Upper Highland 1

1 Introduction

Agriculture plays a vital role in the social and economic development of most African countries and is the main contributor to economic growth and stability. Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 70 percent of the African population. In order to maximize the agricultural productivity of their land, farmers need to be aware of the best practices and advancements in agronomy and breeding. These provide farmers with knowledge on general farming practices such as type of fodder, seeds available, use of fertilizers, pest management, harvesting and marketing. However, most smallholders are resource-poor and face many challenges which include how to access relevant information. This information may include crop management or scheduling of crop activities (Krishna and Ankaiah 2005, Tiwari 2008), improved seedlings (Irivwieri 2007), input price and availability (Rao 2004, Tiwari 2008) and soil fertility (Ekoja 2004).

Modern information and communication technologies (ICTs) have the potential to increase agricultural productivity through communicating knowledge and information to rural agricultural communities, providing capacity building, accessing markets and credit, restructuring of extension and scaling up inter-linkages of development interventions. The telephone system is not only a fundamental communication infrastructure but also a basic facility that supports the use of other technologies. For example, in some African countries, the telephone is the only ICT tool used by most farmers (Bertolini 2004). Its advantages include adaptability and the capability of transferring both voice and data at gradually decreasing cost (Mangstl 2008). Additionally, mobile communication technologies have become gradually more important in many parts of the world especially in improving the delivery of information about agriculture (Munyua et al. 2008). These communication devices present several advantages such as portability, wide range of coverage and instantaneous two-way communication. For instance, mobile phones are used to communicate among Ghanaian fishermen with the purpose of providing each other with information about where to fish, weather conditions and market prices. Real-time agricultural information and fish prices are also provided through mobile phones in Senegal (Munyua et al. 2008); the advice communicated about the best place to sell their catch is also utilized by Kerala fishermen in India (Abraham 2007, Jensen 2007).

According to Donner (2008), mobile telephony can serve as a development tool to the extent that it accelerates, complicates and interacts with the process of economic development in general. Because communication within and between institutions responsible for making livelihood decisions is substantially enhanced, those who are served by these institutions benefit by the improvement of local capacities enabled by the acquisition and exchange of information

(FAO 2003). Other research studies have reported that farmers and agricultural experts are sending information as images via mobile phones with a built-in digital camera (Parikh 2009). This approach saves time and money in addition to providing more support by a limited number of agricultural experts to a greater number of farmers over a larger area.

1.1 Types and sources of agricultural information delivered to farmers

During the growing season, other types of useful information may play crucial roles in improving the amount and the quality of products. This may include weather information (Rao 2004, Tiwari 2008), fertilizer supply (Ekoja 2004), fertilizer use in terms of amount and timing (Krishna and Ankaiah 2005), pest surveillance and management (Ekoja 2004, Rao 2004, Tiwari 2008), type and dosage of pesticides (Krishna and Ankaiah 2005), weed control (Ekoja 2004), and disease management (Tiwari 2008).

Following the harvest, information about market opportunities, financial planning and market prices may be required (Irivwieri 2007, Tiwari 2008).Continuous support for relevant information from various sources such as authorities or related government department websites may improve agricultural effectiveness and the efficiency of the use of ICT tools.

1.2 Impacts of mobile phone uses in agriculture

In Africa, ICTs have become increasingly integrated into the dissemination of information to farmers. 'Traditional' forms of ICTs such as radio and television have become more prevalent in advisory service provision. More recent are rural telecentres which provide information on education, agricultural and health issues, and equip rural farmers with skills on how to use computers to access agricultural information. Currently, most farmers' information is provided either by extension workers, through libraries or via websites. Research has expanded the efficient and productive uses of the mobile phone to include: (1) obtaining information advantage for sound decision-making (e.g. dissemination and retrieval of market information especially for buying and selling); (2) coordination function (e.g. efficient coordination of transportation especially during emergencies); and (3) networking and social capital (e.g. agricultural specialists and veterinarians can readily exchange information to improve crop yields and livestock production) (Hudson 1997).

There are 30 mobile phones per 100 people in sub-Saharan Africa, and 60 percent of the population has mobile phone coverage compared to fewer than three landlines per 100 people (Aker and Mbiti 2010). In Tanzania, for example, 97 percent of the population have access to a mobile phone – profoundly impacting people's lives and livelihoods (Hancock 2005). Mobile phones can capture knowledge in the place where it is generated. Even the simplest mobile

phones provide a mechanism to make a call and report on knowledge being created in situ. Camera-enabled phones allow users to capture an image, which adds a visual dimension to knowledge. Having both audio and video capability enriches the knowledge-sharing experience. Access to an Internet-capable mobile phone enables local communities to access relevant local content. Local entrepreneurs have begun to develop platforms and content specifically targeted to these new users.

Burrell (2008), studying the impact of mobile phones in Uganda, expanded the mobile telecommunication attributes of efficiency, effectiveness, equity, and reach within resource-constrained environments. Burrell (2008) uncovered nine reasons for adoption and use to aid in supporting sustainable livelihoods. They are: (1) emergency coordination; (2) organization of domestic remittances between family members living in different parts of the country; (3) reduction in transportation and transaction costs in trade (e.g. coordinating trade by phoning other farmers and traders to discuss produce marketability and market prices); (4) monitoring transactions and security enhancement (e.g. people who sent money through intermediaries used the phone to inform recipients and confirm arrival); (5) reduction of downtime (e.g. a taxi driver could be contacted during transportation and thus would be able to receive increased requests for services and increased income); (6) ability to increase networking and building of social capital; (7) consultation, ability to keep people in touch with expert advice (e.g. an HIV+ woman was able to phone doctors to receive reassurances and instruction when she fell ill); (8) coordination function through text messaging (e.g. local counsellors were notified to attend a training session); and (9) the ability for data storage (e.g. a boat operator used his address book to keep track of debts).

In Kenya, the Text To Speech (TTS) telephone service, a project of the Local Language Speech Technology Initiative based in the United Kingdom and the National Farmers Information Service converts text to audio in English or Kiswahili. This has provided farmers in Kenya with information in either English or Kiswahili related to how to plant, grow, and harvest bananas. Anyone with a landline or mobile phone can access information. Communities that are more difficult to reach by traditional means can more easily access agricultural information. A TTS service bypasses the need for literacy as well as the problem of reaching farmers living in very remote areas, and can easily be kept up-to-date by extension workers. Farmers can call the line any time of day, every day. This project ran as a pilot for several months in 2006. It has now been expanded to provide advice on growing maize, tomatoes, mangoes, chillies and vegetables; and raising cattle, poultry, goats and bees (Marez et al. 2007).

In May 2008, Kenya launched a farmers' information service where the country's farming community can receive and exchange timely news and information on agriculture, weather patterns and other related issues through their mobile phones. The service was expected to allow 4.5 million farmers access to agricultural extension information through the web and telephone. The system is updated through the web by field extension officers and the same information updated on the 'interactive voice response' to be accessible to any kind of phone (Pihlstrom and Brush 2008). Mobile phones are also being used to distribute agricultural insurance products to farmers, most of whom cannot afford conventional insurance. A product called 'Kilimo Salama', Swahili for 'safe agriculture', enables smallholder farmers in Kenya to insure their agricultural inputs against adverse weather conditions such as drought or too much rain. Developed by UAP Insurance, the Syngenta Foundation for Sustainable Agriculture and mobile operator Safaricom, Kilimo Salama allows smallholder farmers to insure as little as one kilogramme of maize, seed or fertilizer. To be covered under the scheme, farmers only need to pay an extra five percent for a bag of seed, fertilizer or other inputs (Jaiswal 2011).

Mobile phone technology plays a central role in the scheme as it is used both for registration of new policies as well as for pay-outs. Kilimo Salama is distributed mostly through agro dealers that have been equipped with a camera phone that scans a special bar code at the time of purchase, which immediately registers the policy with UAP Insurance over Safaricom's mobile data network. This innovative application then sends an SMS message confirming the insurance policy to the farmer's handset. Pay-outs are determined by automated weather stations that monitor the rainfall. Based on the stations' measurements and a predefined formula of crop rainfall needs, pay-outs are automatically made to farmers using Safaricom's mobile money transfer service M-PESA. Farmers don't have to fill out any claim forms. Since its official launch in 2010, the scheme has already made pay-outs to numerous farmers. Other insurance companies have since introduced similar products. It is expected that products like Kilimo Salama will increase productivity since only about half of Kenyan farmers invest in improved seeds and soil inputs. A key reason for the low demand is the fear among farmers that poor conditions such as drought will render their investment worthless, robbing them of both their crops and their savings (Jaiswal 2011).

1.3 Objective of the study

The main objective of the rapid appraisal was to understand the use of text messages by farmer trainers in accessing information on agricultural production. The specific objectives were to:

1. Determine the percentage of farmer trainers owning mobile phones and using short text messages in communicating.
2. Determine the type of short text messages that are mostly received and sent and if there are agricultural extension messages that are sent and received.
3. For those using the text message service, determine the language of communication.
4. Determine the type of agricultural extension messages that they would prefer to receive and share.

2 Materials and Methods

2.1 Description of study site

The study was conducted in Olkalou and Kaptumo divisions in Nyandarua and Nandi Counties respectively. Olkalou and Kaptumo constitute EADD project areas (Kiptot et al 2010) where farmers in these EADD cluster sites participated in other projects such as FAO's Mitigation of Climate Change in Agriculture and Novas calf replacers trial.

Olkalou is classified as upper highland 1 (UH_1) and receives mean annual rainfall of 1500mm. There are also some dry areas within the county referred to as dry lowland. Mixed farming characterizes agricultural activities practiced in the area. The main crops grown include maize, wheat, beans, peas, cabbages, potatoes, carrots, tomatoes and onions whereas livestock reared include cattle, goats, sheep and chicken. The dairy farming system in the upper highland is mainly open grazing as opposed to the zero-grazing practised in the low land areas.

Kaptumo is a mixed farming division and agriculture is the main stay of its residents. Agriculture supports over 90 percent of the population contributing 42 percent of household earnings. The key food crops are maize, Irish potatoes, sorghum and millet; while tea, coffee and pyrethrum are the major cash crops. The division receives up to 2000mm mean annual rainfall and is classified as UH_1 indicating great prospects of high productivity in agricultural enterprises key among which is dairy farming that has indicated expansion potential in the area. However, agricultural productivity in Kaptumois dependent on the ability to circumvent challenges such as lack of affordable farm inputs and agricultural loans, poor infrastructure, lack of reliable markets and delayed payments for the farm produce.

2.2 Data collection methods

Data was collected through the use of Rural Rapid Appraisal (RRA) tools (Chambers 1994, Kirsopp-Reed 1992, Kumar 1993, Okuthe et al. 2003). These tools included secondary data collection, key informant interviews and semi-structured interviews guided by a checklist. A checklist was developed to guide the facilitators during the RRA interviews comprising 14 farmer trainers from community groups. They were selected from two administrative divisions of Kaptumo in the Rift Valley and Olkalou in the central region of Kenya. The selected 14 farmer trainers represented the 142 men and 62 women farmer trainers in Kenya.

3 Results and Discussion

3.1 Demographic analysis

Demographic analysis of selected farmer trainers showed that the number of men was very high compared to women in both Olkalou and Kaptumo (Figure 1 a). Notably, majority of farmer trainers in Olkalou and Kaptumo were between the age of 39-48 and 49-59 years respectively (Figure 1 b). Moreover, the majority (more than 57%) of selected farmer trainers had secondary level of education (Figure 1 c).

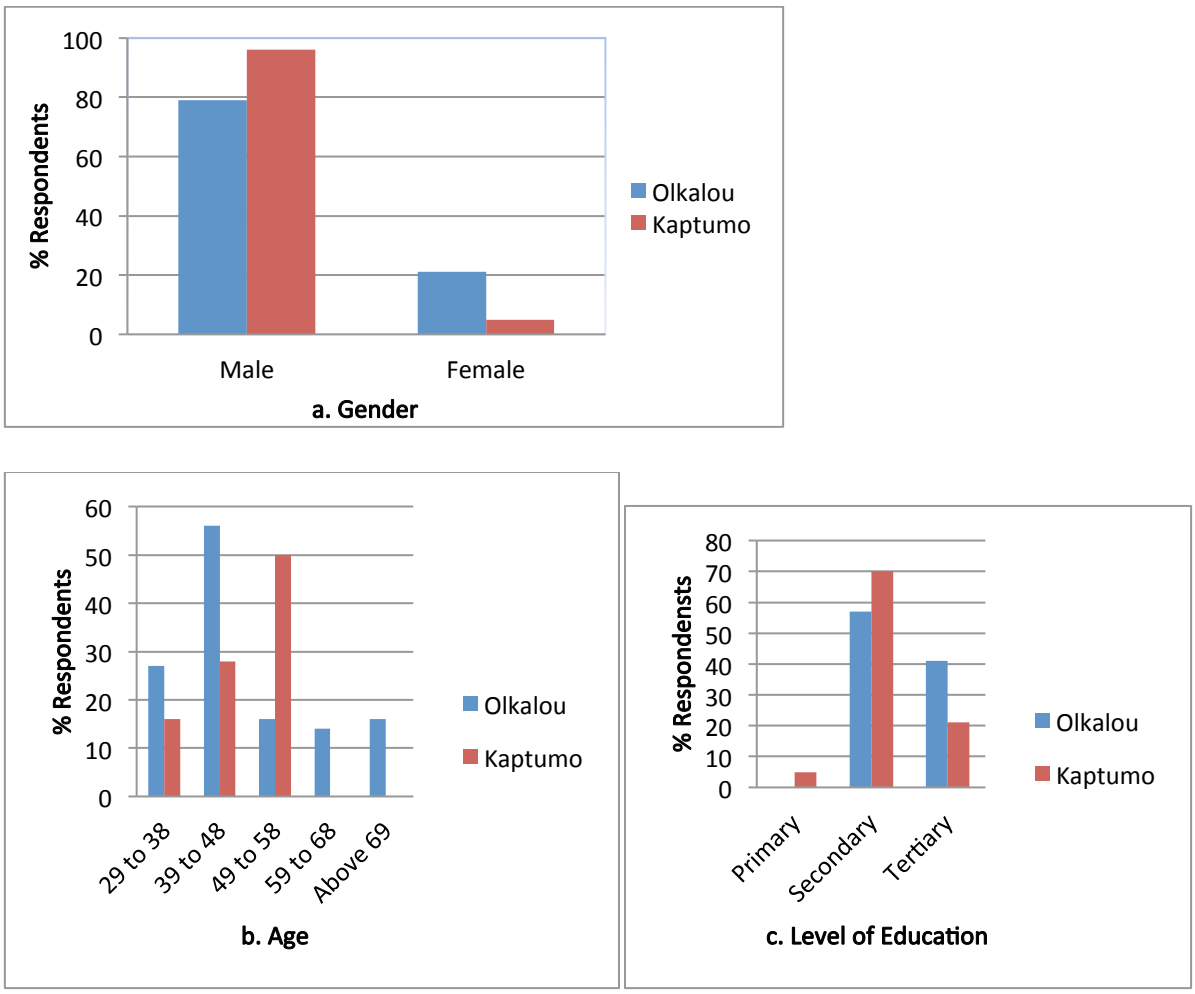
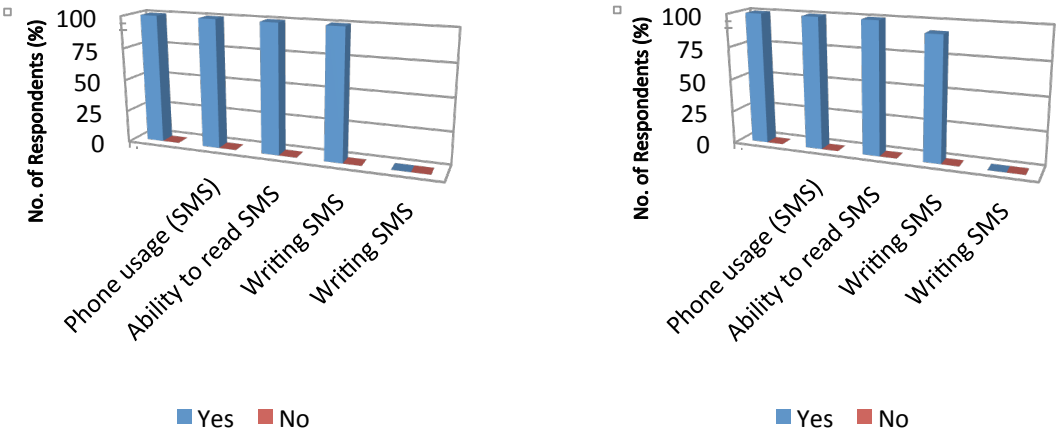


Figure 1: Analysis of a) Gender b) Age and c) Education level of farmer trainers

3.2 Mobile phone ownership, SMS usage and language of communication

Analysis of mobile phone ownership and usage indicated that all farmer trainers owned mobile phones (Figure 2). Moreover, all farmer trainers in both areas were able to use their phone, read and write SMS. In Olkalou, the study found that all the farmer trainers wrote SMS using English while more than 90 percent preferred English in Kaptumo (Figure 2). The high number of farmer trainers using the English language to write SMS was attributed to the fact that majority of these farmers had secondary education as shown in Figure 1 (c). According to studies by

Rowan-Campbell and Tandon (2009), use of mobile phones was identified to increase economic opportunities among farmers and traders. The mobile phones SMS enabled farmers to access buyers who were not previously accessible due to boundaries imposed by traditional social network linkages and geographic constraints. Therefore, mobile phone ownership enables rural farmers to get connected not only to a greater network of buyers and consumers but also provides them the ability to lobby for more resources by being connected to decision and policy makers (Rowan-Campbell and Tandon 2009).

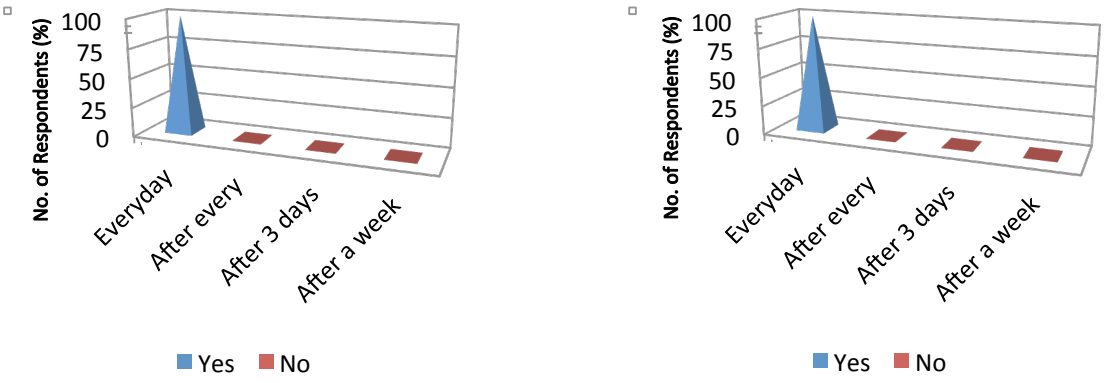


a. Olkalou b. Kaptumo

Figure 2: Mobile phone ownership, SMS usage and language of communication in a) Olkalou and b) Kaptumo

3.3 Frequency of reading, sources and recipient of SMS

The study indicated that all the farmer trainers in both divisions read their SMS every day (Figure 3). This showed that information received could be made useful immediately. Worth noting is that sources of received SMS were mainly friends and household members while more than 85 percent acknowledged receiving SMS from their workplace. However, few farmer trainers in Olkalou (21.4%) and 28.6 percent in Kaptumo acknowledged receiving SMS from fellow farmer trainers (Figure 4 and 5). Farmer trainers in Olkalou indicated that the recipients of the SMS they sent were friends, fellow farmer trainers and household members (Figure 4). However, farmer trainers in Kaptumo noted that fellow farmer trainers were not part of their SMS recipients (Figure 5)



a) Olkalou b) Kaptumo

Figure 3: Frequency of reading SMS received in a) Olkalou and b) Kaptumo

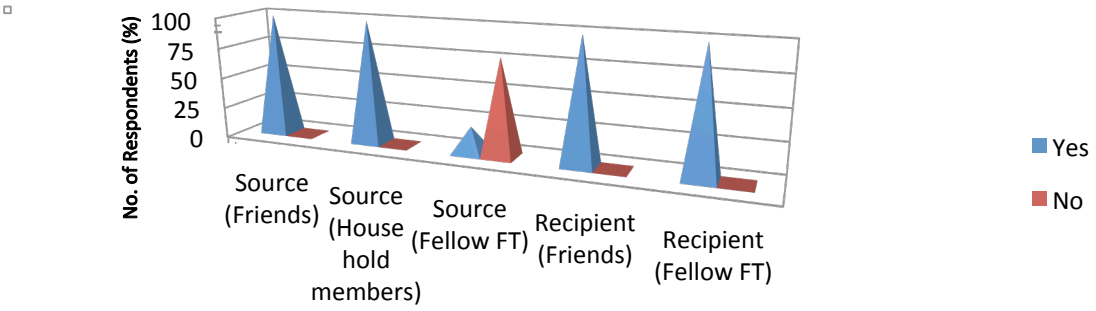


Figure 4: Sources of and recipient of SMS in Olkalou

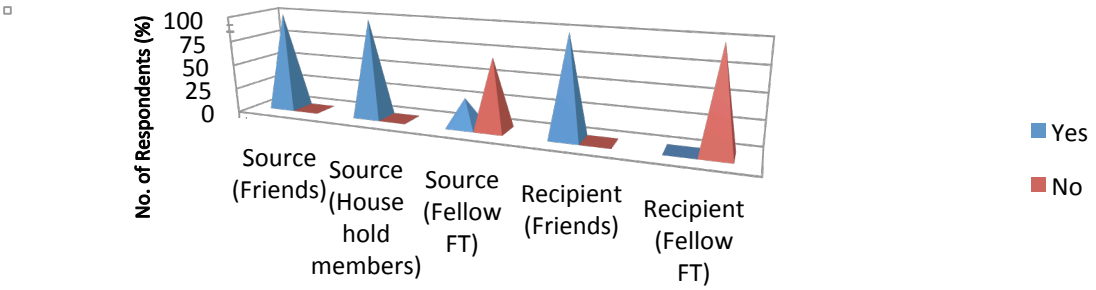


Figure 5: Sources and Recipient of SMS in Kaptumo

3.4 Sources and type of agricultural information in SMS

The study showed that all farmer trainers in the study sites received agricultural information in SMS (Table 1). Although more than 70 percent of farmer trainers in Kaptumo received SMS from extension workers, local administration and fellow farmer trainers, in Olkalou, farmer trainers mainly received agricultural SMS from fellow farmer trainers and service providers such as agrovet attendants, artificial insemination specialists and banks. The information type on these agricultural SMS were mainly regarding group meetings, livestock vaccination and inquiries on groups progress and paydays (Table 2).

Table 1: Source of agricultural SMS

Source of Agricultural SMS	Olkalou (n=14)	Kaptumo (n=14)
	(%)	(%)
Farmer trainers who receive agricultural SMS	100	100
Extension Workers	0.0	71.4
Service providers	100	50
Local Administration	0.0	78.6
Farmer trainers	100	71.4

Table 2: Information type contained in the received agricultural SMS

Information Type	Olkalou (n=14)	Kaptumo (n=14)
	(%)	(%)
Meeting	100	100
Inquiries	100	100
Payday	100	100
Livestock vaccination	100	100

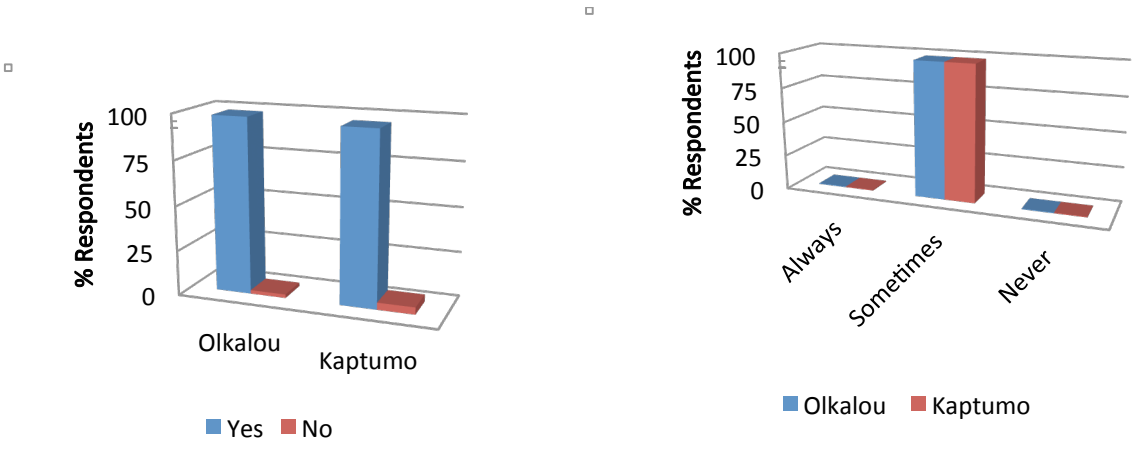
3.5 Agricultural inquiries, feedback and sharing of information

The study noted that farmer trainers in both Olkalou and Kaptumo not only made agricultural inquiries through SMS but also received feedback though SMS (Table 3). Notably, English was the preferred language in Olkalou while farmers in Kaptumo received feedback mostly in Kiswahili and English. Farmer trainers also indicated that they receive information through SMS (Figure 6 a). It was noted that all farmer trainers in Olkalou and Kaptumo only shared the information received through SMS with others occasionally (Figure 6 b).

Photo1: Farmers being trained on fodder management

Table 3: Inquiries and feedback relating to agricultural issues

Inquiries and feedback	Olkalou (n=14) (%)	Kaptumo (n=14) (%)
Inquiries	100	100
Feedback	100	100



a) Receive information via SMS b) Share information

Figure 6: a) Farmer trainers who receive information through SMS and b) sharing of information contained in the SMS received by farmer

4 Conclusion

Mobile phones are increasingly becoming an important form of communication among farmers. This study revealed that SMS provided by mobile phone service providers is no doubt an important vehicle of advancing agricultural technologies particularly among smallholder farmers in Kenya. Through the use of mobile phone SMS, farmer trainers among other agricultural resource persons receive, share, inquire and get feedback information on relevant agricultural technologies.

Exchange of agricultural information among farmers by use of mobile phones presents itself as one of the practical means to overcome the technology transfer barrier. The findings indicate that all farmer trainers own mobile phones and use SMS to exchange agricultural information. SMS usage further presents an exciting opportunity to farmers to achieve timely exchange of information among themselves within their network. The study also indicated that farmer trainer's mobile communication network includes agriculture resources persons, fellow farmers, and public administration personnel whose messages are read once received. More information is required on how to effectively enhance use of short text messages among farmer trainers and the language of communication; and investment required by private/public sector partnership in sharing agricultural information.

5 References

Abraham R. 2007. Mobile Phones and Economic Development: evidence from the fishing community in India. *Information Technologies and International Development,* MIT press 4(1): 5-7http://www.mitpressjournals.org/do i/pdf/10.1162/itid.2007.4.1.5

Aker JC, Mbiti IM. 2010. Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24(3): 207–232.

Bertolini R. 2004. Making ICTs work for food security. 2020 Africa Conference Brief 11. International Food Policy Research Institute [Online] Available: http://www.eldis.org/vfile/upload/1/document/0708/DOC23237.pdf (Accessed 12/8/2009).

Burrell J. 2008. *Livelihoods and the mobile phone in rural Uganda*. Grameen Foundation USA. http://www.grameenfoundation.applab.org/section/ethnographic-research (Accessed 6 April 2009).

Chambers R. 1994. Participatory Rural Appraisal (PRA): Challenge, Potential and Paradigm, *World Development*, 22(10): 1437-1454.

Donner J. 2008. Research approaches to mobile use in the developing world: A review of the literature. *The Information Society* 24(3): 140-159.

Ekoja II. 2004. Sensitising users for increased information use: the case of Nigerian farmers. *African Journal of Library, Archives and Information Science*14 (2): 193–204.

Food and Agriculture Organization of the United Nations. 2003.*Revisiting the "magic box": Case studies in local appropriation of information and communication technologies. http://www.fao.org/3/a-y5106e.pdf.* Accessed 9 February 2009.

Hancock S. 2005. *Mobile phones boom in Tanzania.* BBC Online. http://news.bbc.co.uk/1/hi/programmes/click_online/4706437.stm (Accessed 2August 2014).

Hudson H. 1997. *Global connections: International telecommunications infrastructure and policy*. New York, NY: Van Norstrand Reinhold.

Irivwieri JW. 2007. Information needs of illiterate female farmers in Ethiopian East local government area of Delta State. *Library Hi Tech News* 9(10): 38–42.

Jaiswal PK. 2011. SMS Based Information Systems. University of Eastern Finland MSc thesis.

Jensen R. 2007. The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics*122 (3):879–924.

Kiptot E, Lukuyu B, Franzel S, Place F. 2010. Informal survey on the effectiveness of the farmer trainers approach in technology dissemination: the case of the East Africa Dairy Development Project in Kenya. World Agroforestry Centre, Nairobi Kenya.

Kirsopp-Reed K. 1994. A Review of PRA Methods for Livestock Research and Development. *RRA Notes*: 2o 11-36.

Krishna RP, Ankaiah R. 2005. A framework of information technology-based agriculture information dissemination system to improve crop productivity. *Current Science* 88(12): 1905–1913.

Kumar, K. 1993. Rapid Appraisal Methods: World Bank Regional and Sartorial Studies.

Mangstl A. 2008. Emerging issues, priorities and commitments in e-Agriculture. *Agriculture Information Worldwide* 1(1): 5–6.

Marez LD, Vyncke P, BerteK, Schuurman D, K. D. MoorKD.2007. Adopter segments, adoption determinants and mobile marketing. *Journal of Targeting, Measurement and Analysis for Marketing*16: 78–96.

Munyua H, Adera E, Jensen M. 2008.Emerging ICTs and their potential in revitalizing small scale agriculture in Africa. *Proceedings of the 12th World Congress of the International Association of Agricultural Information Specialists* (IAALD). Tokyo University of Agriculture, Atsugi, Japan. (pp. 707-718).

Okuthe OS, McLeod A, Otte MJ, Buyu GE. 2003. Use of Rapid Appraisal and Cross-sectional Studies in Assessment of Constraints in Smallholder Cattle Production Systems in Western Kenya Highlands. Onderstepoort Journal of Veterinary Research, 70: 237-242.

Parikh TS. 2009. Engineering Rural Development. *Communication of the ACM,* 52(1), 54-53.

Pihlström P, Brush GJ. 2008. Comparing the perceived value of information and entertainment mobile services. *Psychology and Marketing*25: 732–755.

Rao SS. 2004. Role of ICTs in India's rural community information systems. *Info* 6(4):261–269.

Rowan-Campbell D, Tandon N. 2009. More than market info: Up-to-date information is important to farmers, but farmers want more than market information. *ICT Update*47. http://ictupdate.cta.int/en/Regulars/Q-A/More-than-market-info (Accessed 31 January 2010).

Tiwari SP. 2008. Information and communication technology initiatives for knowledge sharing in agriculture. *Indian Journal of Agricultural Sciences* 78(9): 737–747.

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201. Looking back to look ahead: insight into the effectiveness and efficiency of selected advisory approaches in the dissemination of agricultural technologies indicative of Conservation Agriculture with Trees in Machakos County, Kenya. http://dx.doi.org/10.5716/WP15050.PDF

202. Pro-poor Biocarbon Projects in Eastern Africa: Economic and Institutional Lessons. Ihttp://dx.doi.org/10.5716/WP15246.PDF

203. Projected climate change im[pacts on climatic suitability and geographical distribution of banana and coffee plantations in Nepal

The World Agroforestry Centre is an autonomous, non-profit research organization whose vision is a rural transformation in the developing world as smallholder households increase their use of trees in agricultural landscapes to improve food security, nutrition, income, health, shelter, social cohesion, energy resources and environmental sustainability. The Centre generates science-based knowledge about the diverse roles that trees play in agricultural landscapes, and uses its research to advance policies and practices, and their implementation that benefit the poor and the environment. It aims to ensure that all this is achieved by enhancing the quality of its science work, increasing operational efficiency, building and maintaining strong partnerships, accelerating the use and impact of its research, and promoting greater cohesion, interdependence and alignment within the organization.

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