

REVIEW ARTICLE

## Agriculture Transformation through Information and Communication Technology in the Influence of Mobile Phone: The Case of Sub-Saharan Africa - A Bird's Eye View

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<b>ARTICLE HISTORY</b> Received: 10.01.2016 Revised 16.01.2016 Accepted 20.02.2016	<b>ABSTRACT</b> <i>Agriculture is an important sector with the majority of the rural population in developing countries depending on it. The sector faces major challenges of enhancing production in a situation of diminishing gradually natural resources necessary for production. The growing demand for agricultural products, however, also offers opportunities for producers to sustain and improve their livelihoods. Information and Communication Technologies (ICT) play an important key role in addressing these challenges and uplifting the livelihoods of the rural poor. This reviewed article explores the potential contribution of ICT to the transformation of the Agriculture in the developing countries of Sub-Saharan Africa. There are series of literatures were reviewed with regard to the ICTs play a key role in improving the availability of agricultural production and market information in developing countries. ICT is a potential communication tool used in creation, processing, transferring and sharing of information. The advent of Information and Communication Technologies (ICT) has opened new avenues in information and knowledge that could play significant roles in meeting the prevailing challenges related to sharing, exchanging and disseminating Agricultural information and knowledge to the village farmers in order to have effective final output of the yield in production. Agricultural sector depends up on the information exchange between and among farmers on the one hand, and a broad range of other actors on the other hand. The need of the hour is to expand the ICT intensification at rural household level through agricultural practices. This reviewed paper will bring the effective focus on ICT with regard to Agriculture Transformation in Sub-Saharan African Countries. Having reviewed many articles that there were a maximum number of Mobile Phone users than other ICT materials in these countries was observed.</i> Keywords- ICT, Agriculture, Dissemination and Transformation, Information Sharing and Transferring
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### INTRODUCTION

Agriculture is the dominant sector in Sub-Saharan African countries economy which generates more income and employment to the people in the rural areas. The advent of Information and Communication Technologies (ICT) has opened new avenues in information and knowledge management that could play significant roles in meeting the prevailing challenges related to sharing, exchanging and disseminating Agricultural information and knowledge. Therefore, the development of Agriculture will have direct

impact on the overall development of these countries. The emergence of ICT in the last decade has opened new avenues in knowledge management that could play important roles in meeting the prevailing challenges related to sharing, exchanging and disseminating knowledge and technologies. ICT allows capitalizing to a greater extent on the wealth of information and knowledge available for Agriculture Transformation in Sub-Saharan African countries. ICTs have become increasingly integrated into the dissemination of information to the farmers. For decades "traditional" forms of ICTs have become more prevalent in advisory service provision of Radio and TV programmes feature mostly focus on the agricultural information. Rural telecentres provide information on education, agricultural and health issues and equip rural citizens with skills on how to use computers and provide basic literacy.

National Ministries of Agriculture and ICT Directorate have attempted to integrate the ICTs into the delivery of information and have established district information centres providing agricultural information. Many NGOs and research organizations have also attempted to facilitate the technology transfer in the agricultural sector.

Agriculture is the primary sector in most of the developing countries where in a number of productive activities which will be taken into consideration for the development of the agriculture. The dissemination of ICTs in developing countries has been entrusted with Private companies and the Government to transfer the agriculture knowledge and information to the remote area farmers. In the first decade of the 21<sup>st</sup> century, the mobile phone coverage has been spreading very fast in Asian, African and Latin American countries. It was indicated that more than sixty per cent of the population of Sub-Saharan Africa, Asia and Latin America had instant access to mobile phone coverage in 2009. In the past, the adoption of the mobile phones was primarily by rich people residing in urban areas. Nowadays, mobile phones have been adopted by rural and urban populations in developing countries who are getting a good benefit and latest information regarding weather, market and other related issues (Aker, 2010).

According to FAO (1993), ICT defined as technologies involved in collecting, processing, storing, retrieving, disseminating and implementing data and information using microelectronics, optics and telecommunications and computers. Tihamiyu (2002) considered Information and communication technology (ICT) is an umbrella term that includes computer hardware and software, digital broadcast and telecommunications technologies as well as digital information repositories online or offline, and includes contemporary social networking aspects, read/write interfaces on the web and file sharing systems online and includes television (TV), radio, and mobile phone.

### **THE IMPORTANCE OF ICTS IN DEVELOPING COUNTRIES**

There is a great deal of research that supports the importance of ICTs for developing economies. For example, Murugesan (2011) noted that, 'businesses in emerging markets tend to apply known IT solutions more effectively to improve the business processes and generating the revenues compared to their counterparts in matured markets'. This indicates that firms in developing countries have higher return to their investment on ICT than do firms in developed countries. However, the impact of ICTs in the developing economy goes beyond the simple increase in business efficiency.

Another research study found that an increase in the use of mobile phones (as will be noted below, the mobile phone is a highly adopted technology in the developing world) led to an increase in economic terms, with a special influence being seen in national output (Sridhar and Sridhar, 2007). This study showed that developing countries, which experienced higher rates of growth in capital as well as in labor, are clearly benefiting from the increasing the penetration of information technology.

According to the Food and Agriculture Organization (FAO) (1993) ICTs were technologies used in collecting, processing, storing, retrieving, disseminating and implementing data and information using microelectronics, optics and telecommunication and computers. Agricultural Extension, which depends largely on information exchange between and among farmers and a broad range of other actors, is an area in which ICT can have significant impact. In agricultural extension, the ICTs included radio, television, fixed and mobile phones, Short Message Services (SMS), World Wide Web, cameras, video, e-mail, computer, community TV and rural radio, etc.

There are a number of ways that ICTs could be used to support the development, including a focus on specific groups, practices, or other social concerns, or promoting local development of knowledge bases (Walsham and Sahay, 2006). To some extent, all of these issues are important for developing countries, as it is these issues that determine how well the country will be able to manage its growth over time. However, societal issues and infrastructure issues are major issues of concern, since these issues are often ignored in other contexts. There are a number of ways the importance and use of ICTs in developing countries are talked about, including "as a process of technology and knowledge transfer and adaptation

to local social conditions; as a process of socially embedded action; and as a process of transformative techno-organizational intervention associated with global politics and economics (Avgerou, 2008). However, all of these discourses identify a key issue with the ICT use in developing countries; namely that it serves not only to change practices, but also to change minds and ways of thought.

Sub-Saharan Africa is characterized by the lowest levels of infrastructure investment in the world. Merely 29 percent of the roads are paved, barely a quarter of the population has access to electricity, and there are fewer than three landlines available per 100 people (ITU, 2009; World Bank, 2009). Yet, access to and use of mobile telephone in Sub-Saharan Africa has increased dramatically over the past decade. There are ten times as many mobile phones as landlines in Sub-Saharan Africa (ITU, 2009), and 60 percent of the population has mobile phone coverage.

### **ICT ACCESS AND USES IN DEVELOPING COUNTRIES**

One of the major issues for discussion is how ICTs (Mobile Phone in particular) can be provided and used in developing countries. There are a number of novel methods of providing ICT access used in various developing regions (although most are not all used in the same area). However, a more common connection to ICTs in developing countries is increasingly frequently the use of mobile phones. ICTs may be used for e-commerce, e-governance, or information seeking across developing countries.

One particularly common use of ICTs in the developing world is in education, as promoted by programs such as One Laptop per Child (OLPC) (James, 2010b). OLPC's aims were to provide a cheap, simple, lightweight computer that could be used by the child at school and at home, in order to both learn about ICTs and provide information access. However, this use is not always positive. James (2010b) argues that the OLPC's position that children should have their own computer is not grounded in any particular rationale or guideline, and in fact the concentration of computer hardware that this causes resource imbalances in vulnerable regions. Furthermore, he argues that this density of computer hardware is far higher than in most schools in developed nations (which average around five students per computer), and that this degree of computer hardware concentration is not required to teach children effective computation skills. Thus, this could be one area where ICTs are not as effective as they could be, due to over-density in a specific area that does not provide immediate effects.

### **MULTIPLE INTERVENTIONS OF THE ICTS IN SUB-SAHARAN AFRICAN COUNTRIES**

Another area where ICTs are used in developing countries is in agriculture. As Aker (2010) cited earlier, mobile phone used by commodity traders in rural markets. Other researchers suggested that small indigenous agribusiness firms are a significant proportion of the users of ICT, at in Nigeria, (Aleke, *et al.*, 2011). This study indicates that there are a number of reasons why agribusinesses may (or may not) use ICT, including social concerns, dissemination of information about them, and ease of use and usability, (including concerns such as affordability). Nonetheless, the increased availability of information for the agribusiness is a means of increasing the seller's or grower's information and creating a better deal, according to those that use it.

A third area of use, and one that is particularly problematic in terms of understanding how well (or even if) it works, is the area of e-government. According to theoretical models, E-Government is seen as strengthening the performance of government and public administration, and an efficient and effective state administration is a necessary prerequisite for economic and social development (Schuppan, 2009). However, according to Schuppan, there is little information about e-government implementation in African countries (which are commonly excluded from institutional analysis) and the information that is available is often not robust or methodologically sounds. E-government offers a number of potential advantages for African countries, including "the general provision of public services, statistical and information processes, finance management and tax systems, public participation, and formalization." However, Schuppan's analysis of e-government programs in Ghana, Kenya, and Tanzania (which intended to address a relatively small problem such as corruption reporting) showed a number of problems. These included long development times (6-9 years) as well as problems developing capacity. Ultimately, these projects had positive effects, including reduced costs and corruption. However, Schuppan's (2009) point that there needs to be a balance of the intended and unintended effects within this area still stands.

One more area where ICTs may be used is in the e-commerce area. However, once again, this is a difficult area because of a number of potential barriers to traditional e-commerce (Kshetri, 2007). Some of these barriers include a high rate of generally unbanked people and low use of credit cards, inadequate electricity and communication infrastructure political barriers or consumer preferences for face-to-face communications and personal sales relationships, and cognitive biases against e-business. Perhaps more common, at least in Africa, is an m-commerce (or mobile commerce) model, in which techniques such as

near-field communications (NFC) are used to provide mobile phone users with the ability to make micropayments (Meso, *et al.*, 2005). Thus, when considering e-commerce and its use in developing countries, a broader view than the focus on Web sites accessed through computers (as is common in the developed world) is required.

### **Why ICTs are important for Agriculture in Sub-Saharan African Countries?**

The United Nation Development Program (UNDP) 2008 agrees the declining costs of ICTs are giving farmers and rural people in developing countries much greater access to information. Example, China has about 60 percent mobile coverage; India yet only about 20 percent but expanding quickly; and in SSA about 9 percent of the population is a mobile phone subscriber. In Uganda the data are exceptional, where the mobile phone network coverage increased from 36 percent in 2003 to 92 percent in 2005. The increased coverage, rather than the possession of individual mobile phones, induced market participation by reducing transaction costs in crop marketing and increasing the prices received for sales, especially for perishable goods. Food net, a multi-partner public network in Uganda, collects the latest market price information for coffee and maize, which farmers can access at very low cost through a Short Message Service (SMS).

An area of application for ICTs is improving, through better management, the efficiency and sustainability in using agri-inputs like land, soil nutrients, feed and fodder, water, energy, pesticides, labor, and most importantly, information and knowledge in agriculture. The ICTs also help reduce the negative effects of pests and disease and enable aversion and mitigation of risks such as from inclement weather, droughts, floods, and long-term change in climate. Through innovation, ICTs continue to contribute to improving through out of farming systems, increasing the quantity, quality, and marketability of outputs (e.g., food, energy, and biomaterials), supporting their marketing and enabling their effective and efficient consumption by households and communities and their ultimate recycling. The ICTs helped pave the way for consumers to decide which products they can “responsibly” purchase, which seem to have higher food miles, and those whose production and safety can be traced all the way back to the fishpond. For the small, resource poor farmer and producers in economically developing countries, these applications of ICTs has not yet become main stream. The economic returns from agriculture and access to affordable technology useful in small-farms operations are the main constraints in more widespread use of ICTs in smallholder agricultural production (Peter, *et al.*, 2010).

### **The Accessibility, Affordability and Adaptability Drivers of ICTs in Developing Countries**

Information cited on ICT for agriculture indicates three trends are converging in a virtuous circle to increase dramatically the impact of ICTs as tools of economic and social transformation and empowerment in developing countries: the growing accessibility of ICT infrastructure and services, even in poor and rural areas; the growing affordability of ICT tools and services; and the dramatically increased adaptability of ICT tools to support innovative business and service models that address the needs of the poor.

A. *Accessibility:* It is because of the advancement in large part to the dramatic spread of wireless service and mobile phone adoption in developing countries, a steadily growing majority of the people in most developing countries now have access to telecommunication services, even in smaller towns and rural areas. Farmers in developing countries subscribed to mobile phone service, which means that an even larger majority had access to service, since it is often shared. Steady progress is also being made in extending access to fix and mobile broadband Internet services in developing countries. In sub-Saharan Africa, which lags behind other regions in ICT accessibility, a recent surge of investments in international telecommunications cables and the inland infrastructure to complete these connections is expected to lead to a substantial increase in accessibility and affordability of ICT services across Africa in the next several years.

B. *Affordability:* Research indicates several trends, working in tandem, are making ICT devices and services more affordable, in ways that extend access to the poor. First, technical innovation is steadily lowering the purchase price of mobile phones, and of laptop computers. Second, “pre-paid” mobile service permits those who cannot qualify for a monthly subscription mobile account to use mobile phones on a pay as you go basis, which had dramatically increased the mobile phone take-up among the poor agriculture farmers. Finally, in response to this soaring demand and the infrastructure build-out mentioned above, prices for telecommunication services are trending downward in many developing countries.

C. *Adaptability:* The growing take-up of mobile phones among the poor is leading to an explosion of innovation in mobile-based services to address a range of information, communication and transaction needs of these customers. Often drawing on simple and already-available technologies such as SMS, phone companies and other service providers are rapidly expanding mobile-based services ranging from

mobile banking and other transactional services to information services such as market price alerts. Other publicly and privately provided information and services such as extension/advisory services and weather alerts are also increasingly being delivered over mobiles, which are increasingly becoming not just "phones" but multi-function wireless device (McNamara, 2010).

### **ICTS IN AGRICULTURAL EXTENSION SERVICES**

Munyua (2007) argues due to the limited number of extension workers, farmers are using the phone to seek advisory services. Extension information can also be shared through a website. In addition, Personal digital Assistant could be used to collect and disseminate critical agricultural information that farmers need. The shift to these technologies would cut down face-to-face contacts drastically and reduce telecommunication and transport costs. Farmers would, however, require training and a change of attitude to be able to access the ICT driven information and advisory services. Of importance is the fact that the applications of ICTs in extension services would provide for more content diversification and ensure a wider reach. In India for instance, the e-choupal model has made it possible to reach farmers through public access centers that include telecentres, knowledge centers and access points.

Maru (2002) indicates the challenge for Africa in trying to use the e-choupal model that in essence acts as a platform for e-forums would be the problems of high illiteracy levels and the lack of adequate skills on how to use computers and other ICTs. Other challenges to be overcome would include the following: poor telecommunications infrastructure and unreliable electricity supply; computer viruses and the lack of adequate technical expertise in rural areas; the high cost of equipment and the demands associated with hardware and software.

#### ***Opportunities of ICT-enabled Agricultural Development***

The twin challenge for developing country agriculture is to harness the power of ICTs to compete in complex and rapidly changing regional and global markets while empowering poor smallholders with information and communication assets and services that can increase their productivity and income and protect their own food security and livelihoods. This requires developing countries to undertake a complex set of policy, investment, innovation and capacity-building measures, in close coordination with international donors, the private sector and other partners, to encourage the growth of locally appropriate, affordable and sustainable ICTs infrastructure, tools, applications and services for the agriculture sector and the rural economy. The increasing diversity and complexity of global agriculture, and the speed of global innovation in ICT tools, services and business models, require in turn a flexible approach to these policy and investment choices that focuses not so much on "choosing winners" among ICTs options but on maximizing conditions for local innovation and creative public-private partnerships to expand ICT access and services. Certain lessons about policy, regulation and investment in the ICTs sector remain relatively stable over time the key one being the importance of competition and private sector innovation as the driver of affordable and appropriate ICTs services. Yet the rapid evolution both of the technologies themselves and of the way people and businesses deploy and use them (including entirely new business models and types of service) increases the importance and urgency of good guidance to development practitioners on how best to harness these opportunities (Peter, *et al.*, 2010)

### **CHALLENGES IN ICT USE IN DEVELOPING COUNTRIES**

Many challenges in ICT use in developing countries, including inadequate physical infrastructure and problems of e-commerce and mismatches between social, economic, and political assumptions, as well as the problem of lack of homogeneity in information needs, have already been discussed. However, there are some challenges that should be examined in particular. One such challenge is the problem of cost of access, although whether this plays a role is not necessarily clear. One study found that the cost of using cybercafé computers posed a relatively limited barrier to their use; with most users choosing to prioritize the Internet access (as available) (Clark and Gomez, 2011). This could be related to the (Dutta, 2009) example, in which she showed that education, rather than income, was the main determinant in use of such locations. However, the overall cost of provision on the large scale, rather than at the consumer level, can continue to be a barrier for provision of computing services, even when supported with some level of consumer fees as are many cybercafés (Clark and Gomez, 2011). Thus, cost is likely to be a significant barrier in effective implementation.

Another set of barriers can be described as getting symbolic acceptance by the community, stimulating valuable social activity in relevant social groups, generating linkage to viable revenue streams, and enrolling government support (Madon, *et al.*, 2009). These elements are required in order to make sure that the project can be appropriately implemented, and are particularly important for digital inclusion projects (or those meant to close the digital divide).

However, ensuring that they are present is often a difficult task. This is to some extent related to the problem of information technology diffusion, or spread of IT through a population (Shih, *et al.*, 2008). There are a number of problems identified with technology diffusion, including high hardware and communication technology costs, availability of complementary resources like communications infrastructure and human resources, and economic structure. These factors mean that the diffusion of technological innovation is relatively slow through the developing world, especially given a low governmental investment in development of IT infrastructure and services or in human resource development.

The digital divide can be defined as a persistent separation among those who have adequate computer resources, including social resources, such as support staff, teacher training, and scheduled upgrades, and those that do not (Ransdell, *et al.*, 2006). This gap is not primarily technological in origin, but is instead due to the political, social, and economic structures on which digital technology relies. This gap, rather than the simple provision of services, is the potential sticking point for Ethiopia. However, there is a question of how deep the digital divide runs and how fast it is being closed. Ransdell, *et al.*, (2006) point out that English language literacy is required to partake in much of the World Wide Web resources, making a de facto divide between those that speak English and those that don't. Other barriers ICTs in Ethiopia include lack of mental, material, skills or usage access to internet resources (Fuchs and Horak, 2008).

According to Fuchs and Horak (2008) there are a number of impacts of the digital divide on Africa generally. First, Africa has one of the lowest rates of Internet use of all countries, with only six of 57 countries surveyed in 2006 having higher than 10% access rates; conversely, 20 countries had access rates lower than one percent. The countries with the lowest access rates also had one of the lowest Human Development Index (HDI) rankings in the world, making them least-developed countries, a situation that the authors describe as "digital Apartheid." This situation was largely attributed to the relative rarity and high cost of communications services, which depressed participation; however, neoliberal educational and management policies, which prioritized opening market access to the Internet, never addressed the problem of skills or mental access. Thus, the digital divide is a pressing problem for African countries.

Although a digital divide does exist, there is evidence that rather than widening as expected in previous research, this gap is actually narrowing, thanks in large part to lighter-weight technologies that have increased material access and lowered the skill barriers to participation (James, 2009b). As James points out, the growth of users in China and India and dramatically increasing use of ICTs in these countries has increased the rate of participation by those in developing countries. Furthermore, even if the percentage of people using ICTs in developing countries is lower than in developed countries, in absolute terms this is still likely to be higher. In a general sense, thus, the digital divide is relative rather than absolute, and is not intended to specify a measured gap in use of ICTs (James, 2009a). The relative closure of the digital divide as developing countries gain more access to technologies previously constrained to the developed world is, in James's view, inevitable. However, it still must be considered in the equation of why and how African countries such as Ethiopia lag behind in ICT use and how this situation can be improved.

#### **E-AGRICULTURE: NEW PARADIGM SHIFT TO MODERN AGRICULTURE**

According to UNO of Food and Agricultural Organization of UN, e-agriculture is an emerging field with agricultural information development and business. It refers to agricultural services and information delivery ever enhanced through technologies. E-agriculture, therefore, involves the conceptualization, design, development, evaluation innovative ways to utilize existing or emerging information and communication technologies (ICTs). The ICT used in e-agriculture include mobile phones, digital personal assistants, smart cards, Geographical Information System (GIS), radio, Radio-Frequency Identification Devices (RFID) and email-based information services.

E-agriculture was one of the elements covered at the World Summit on Information Society (WSIS). Since then many African and Caribbean countries have harnessed different ICTs with combination of useful practice of agriculture among their farmers as well as increase the income of the farmers. This has often standards of living among the population involved in agriculture. Innovative applications of the ICTs can be used for mapping natural resources, creating business opportunities; speeding up application procedures in agricultural credit; protecting fish stocks and forest resources from illegal poachers and loggers; forecasting weather conditions and information easily available; and enabling communication and knowledge portals.



## CONCLUSION

ICT is now recognized as a technological tool which can serve as a catalytic intervention in respect of transforming the lives and livelihoods of rural peasant families. With the problem that farmers face in facilitating direct contact with technology generators and technology users due to the physical distances involved, digital divide and lack of transportation needed for their mobility, the application of ICTs (particularly mobile phone) offers one of the most important potentials, for small holder farmers to improve them in their agricultural activities.

In this era of rapid technological advancement, the sharing and exchanging of agricultural knowledge is very important for governmental agricultural organizations in order to meet the needs of the stakeholders rapidly changing demands. If there is lack of sharing of knowledge amongst the farmers and between different levels of departments of Agriculture institutions, then it would be difficult for the agricultural organizations to survive in today's competitive global environment. Agricultural Research Institutions and hierarchical agricultural departments should take a more proactive approach to achieve a higher extent of Knowledge sharing among the farmers who have different requirements and expectations. This study concludes that ICTs application blended with agricultural technology dissemination to the farmers' door step.

Having identified various research investigation analyses will provide methodologically attested evidences on how ICT applications can contribute in transforming the existing realities of both explicit and tacit agricultural information and knowledge to the end users. It is also expected to reveal how ICT fosters an efficient back and forth communication between farmers and other potential actors of the knowledge system. This reviewed paper concludes the application of ICTs in agriculture development and explains how ICT plays a role in addressing these issues among the farming community. The roles of ICT application are being integrated and for bridging the gap in agricultural information and knowledge management in Sub-Saharan Countries.

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#### Worku and Senapathy

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