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A Development Approach for Successful Adoption of Information Technology in Agriculture

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----------*ABSTRACT*----------
Agriculture is becoming knowledge concentrated because of the need to participate in internationally viable markets. There is an increase in obstacles and restrictions in accessing agricultural inputs, due to need to use regular resources to sustainably cope with the growing threats from varied climatic instabilities, we require new knowledge as the most critical resource for agriculture development. Information and Communication Management and use of appropriate ICT tools or institutions improve agriculture research through sharing and exchange of information and managing research. It rapidly improves agriculture and benefits farmers.In this paper the researcher will employee extensive document analysis methodology to look at ICT used in agriculture, ICT adoption, and the role of ICT in agriculture, ICT as decision support system, how ICT is used to expand the marketplace, how ICT is applied, current state and future needs of ICT in agriculture and a detailed literature on various ICT used in agriculture, development route taken to adopt ICT, agriculture extension, advisory and education and the migration process involved to full using ICT.
KEY WORDS: *Adoption, information, agriculture, technology, automated systems, Smartphone mobile,* Radio frequency identification, *Global Positioning System.*

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I. BACKGROUND INFORMATION

ICT plays a pivotal role as a catalyst and change agent in agriculture. Information and Communication Management and use of appropriate ICT tools or institutions improve agriculture research through sharing and exchange of information and managing research. It rapidly improves agriculture and benefits farmers. We explore the value of ICT and approach of development that could be adopted in order to harness the benefits that these technologies can bring to farmers and organizations in agriculture.

A. Valuable ICT for Agriculture

The source of information is majorly: extension agents, radio and television, mobile phones, video programs, and internet. In addition, the costs of mobile phones and air time, electricity, phone support services, internet services, radio and television network services, and literacy of marketers significantly influence the use of ICT.[1] The use of mobile phones should be encouraged for distributing information and infrastructure should be improved.[1]

B. ICT Adoption In Agriculture

In this paper will try to discourse of the recent adoption of ICT for agriculture for effective production of agriculture products and promotion of linkages between manufacturers and customers. The adoption of agriculture practices and its application technology has expanded. [2] Up to the present time, a number of agriculture products producer cooperatives and companies are serving more than a million clients. This provides a clear view of the remunerations, encounters and limitations of ICT and the progress in farmers' development.ICT is important for agriculture development and requires a long-term effort for its development.[2] However, ICT and other technology for farming development are limited due to the instability of the Horn of Africa.[2] ICT use has increased especially in terms of use of farmer mobile phones for communication anda few other applications.

Expanding use of ICT has moved forward in the last two decades forfarmers, although there has been inadequate provision of communication materials in training andmobilization sessions in most development projects.[2]successfully efforts has been made towards effective use of ICT i.e.telephone, facsimile/fax, computers, computer networks, Internet, cellular telephony, digital audio and video devices. ICT adoption for

agriculture occurs as a product of several interacting factors such as: policy related to the use of ICT at global, national andInstitutional levels for development [3].
Strategy in ICT implementation, status of ICT infrastructure, especially in rural areas where it's located. Investment both financial and in human skills in ICT use in agriculture,accessibility and availability of technology, the ability to implement ICTsin information systems
and effectively generate, manage and use information for agricultural development and progress.

C. Role of ICT in Agriculture

ICT (Information and Communication Technologies) refers to technologies that provide access to information through telecommunications medium such as the radio, television, cell phone, computers, satellite technology; internet including email, instant messaging, video conferencing and social networking websites which have made it possible for users across the world to communicate with each other to give users quick access to ideas and experiences from a wide range of people, communities and cultures. [4]. 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 dwindling 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 play an important role in addressing these challenges and uplifting the livelihoods of the rural poor [4]. The areas of support include the following two broad areas:-

1. Decision Support Function

ICT play a great role as decision support system to the farmers. Through ICT, farmers can be modernized with the recent information about agriculture, weather, new varieties of crops and new ways to increase production and quality control. The distribution of sufficient, efficient and tailored technologies related to agro-climatic zone, size of farm and soil type etc. to the farmers is lacking in agricultural areas and it is the real challenge in front of policy makers in Kenya [5].Information and communication technologies can transmit the exact and trustworthyfacts at right time to farmers so that they can employ it and get profits. The decision backing system through ICTenables farmers for planning type of crops, practicing good agricultural practices for cultivating, harvesting, post harvesting and marketing their produce to get better outcomes [6].
Diverse information is prerequisite in agriculture based on the different agro climatic regions, size of land holdings, types of crops cultivated, technology followed, market orientation, weather condition, etc. As reported by many researchers, 'question and answer service' was perceived as the best facility by majority of the farmers to get personalized solutions to their specific agricultural problems [7].

2. Expanded Marketplace

One of the major shortcomings in Kenyan agriculture is complex deliverynetworks for marketing of agricultural produce. Farmers do not get conversant with the updated prices of commodities, proper place for selling their inputs and consumer trends also. I.e. in rift valley those who plant maize, in western sugarcane, in north eastern mangos etc. ICT has countless potential to expand marketing possibility of farmers directly to the customers or other appropriate users for maximum profit. Farmers may connect directly with many users and may get information about current prices for their commodities. They can get access to the market sitting at home. Additional, it will restrict the middle profit also which will be beneficial for the farmers. This can improve a farmer's source of revenue; empower farmers for making good decisions about appropriate future crops and commodities and marketing networks to sell their produce as well as to get inputs.

II. ICT APPLICATION: CURRENT STATE AND FUTURE NEED

Agriculture Industry in Kenya has not been left out of the "information revolution" that has been taking place over the past two decades. For example, a superficial exploration of the Internet produces a long list of software companies that produce refined software to assist agricultural producers in managing the farm for example, flock management, financial/accounting. Research [8] specifies that during the 1980s and early 1990s, farmers largely were not taking advantage of information technology [9]. Involvement with cattle operations disclosed that many operations are not keeping good records, which advocates the operations are not utilizing IT [10].

Conferences at the 1999 European Federation for Information Technology in Agriculture(EFITA) Consultation [11, suggest that, while many factors influence IT adoption, it is serious, both now and in the future, that IT be utilized in agricultural operations. One presenter at the conference used the word command to point out the criticality of IT adoption. While the concept of IT can represent many different functions, most agricultural operators will, arguably, maximize utility from record-keeping functionality to support strategic, tactical, and operational management of the farm.

III. ICT TECHNOLOGIES USED IN AGRICULTURE

A. Smartphone mobile in agriculture

The use of mobile technologies as apparatus of mediation in agriculture is becoming progressively morecommon. Smartphone disseminationimproves the multi-dimensional positive influence on maintainable poverty reduction and identify accessibility as the main challenge in harnessing the full potential in agricultural space [15]. The influence of smartphone even in rural areas extended the ICT services beyond simple voice or text messages. Several smartphone apps are available for agriculture, horticulture, animal husbandry and farm machinery. We have several Smartphone mobile applications which have been designed and developed most commonly used in agriculture to deliver information faster to thousands of farmers across the world.

B. Automated systems

We are having Computer-controlled devicesfor examplean automated milking systems are computer controlled standalone systems that milk the dairy cattle without human labor. The complete automation of the milking process is controlled by an agricultural mechanical device, a complex herd management software, and specialized computers. Automated milking excludes the farmer from the actual milking process, allowing for more time for administration of the farm and the flock. Farmers are able to improve flock management by using the data gathered by the computer. By analyzing the effect of various animal feeds on milk yield, farmers may fine-tune accordingly to obtain prime milk yields. Since the data is available down to individual level, each cow may be traced and observed, and the farmer may be notified when there are unusual changes that could mean sickness or injuries.[12] below is an example of computer controlled devices for milking.

Figure 1: Automated milking station

C. Radio frequency identification (RFID)

Several Veterinary Department of different countries have introduced a livestock-tracking program to track the cattle across the country. Each cattle is tagged with the use of RFID technology for easier identification, providing access to relevant data such as: transporter's location, name of breeder, origin of livestock, sex, and dates of movement. This program has been very successive in countries like Asia, with the use of RFID it increases the effectiveness of livestock industry in international markets by satisfying the regulatory requirements of importing countries like United States, Europe and Middle East. The use of RFID program also provide enhancements in controlling disease outbreaks in livestock [13][14]. Below is an example of a cow with ear tag and RFID

Figure 2: Cow ear with eartag and RFID

D. Global Positioning System (GPS)

Today, GPS receivers are included in many commercial products, such as automobiles, smartphones, exercise watches, and GIS devices. In agriculture, the use of the Global Positioning System provides paybacks in geo-fencing, map-making and surveying. GPS receivers have fallen in price over the years, making it more common for citizen to use. With the use of GPS, residents can produce simple yet highly accurate digitized map without the help of a professional cartographer.

In Kenya, for example, the solution to prevent an elephant bull from roving into farms and destroying valuable crops is to tag the elephant with a device that sends a text message when it crosses a geo-fence. Using the technology of SMS and GPS, the elephant can meander freely and the authorities are notified whenever it is near the farm. [16]Below are example of devices used for GPS.

Figure 3. GPS Receivers

IV. A DEVELOPMENT ROUTE FOR TECHNOLOGY ADOPTION

In this paper we proposes that a Development Route framework can be defined as an evaluation tool to assist with IT adoption in agricultural operations. This framework could be used to: Determine the current level of IT utilization for a particular farmer, determine the next step on the route, and develop a specific step migration plan that addresses operational processes along with IT components.The pathvaries from no Information Technology to a networked, multi-user IT environment. The five steps are defined as follows.

a) "Intra-Cranial" ("I-C"). This step is the absence of IT, with "record keeping" done in the farmer's memory and perceptions;
b) Paper/Pencil. Capturing farm data in a notebook, journal, or accounting-type ledger is a vast IT improvement over "I-C";
c) Single Machine/Generic Tools. This includes Personal Computers (PCs) or Personal Digital Assistants (PDAs) using "standard-load" tools such as word-processing, spreadsheet, database applications, and Internet browsers;
d) Single Machine/Specific Tools. This includes PCs or PDAs using specific tools such as herd-management, accounting/financial or Internet-based applications;
e) Networked Machines. This includes client/server implementations of either generic or specific tools. This step would likely only be taken by large operations that need concurrent support for multiple system users. This step will likely require an IT management function.

V. IMPORTANCE OF DEVELOPMENT ROUTE

There are explanations why this concept of a Development Route can be used to assist a farmer in realizing the benefits of IT.

a) Incremental Change

From the fact that human being counter attack change, especially when the level of change is weighty, this development route permits for minor steps as opposed to massive hops. For instance, it is unlikely that a Step I farmer with no PC know-how will purchase a PC with flock-management software and use it to manage the flock. It is more expected that such a farmer would begin the record-keeping journey by writing information on paper.

b) Incremental Expenditures

Each step along the route entails payments for equipment and tools. Skipping steps will pile expenditures all at once. The expenditures at the lower steps will likely focus on operational equipment and tools that will be needed to produce the data required at later steps. For instance, the Step I farmer likely does not weigh calves or yearlings because he is not keeping up with that data. Knowing that Step IV tools can maintain such information, the farmer can purchase scales at Step II, where IT expenditures are virtually

nonexistent, to allow for weighing animals and institutethat process on his farm. Expenditures at the higher steps will shift towards IT equipment and tools. For example, Step III calls for a PC to be purchased while Step IV calls for extra software.

c) Incremental Build

Most of the expenditures and operational processes adopted at a given step will not be lost with migration to the next step. In fact, most of the operational processes adopted in a particular step are actually in preparation for the next step. Similarly, records kept at a given step can be expanded upon in later steps.

VI. MIGRATION PROCESS

When using the Development Route framework to assist with IT adoption, a migration process is needed to guide the development and execution of the farmer-specific step migration plan. As intimated above, the basic migration process would be:

a. Determine current step using the Development Route definitions;
b. Maximize IT utilization at the current step;
c. Learn about available IT and necessary operational change at the next step;
d. Develop and institute appropriate operational changes; and
e. Purchase, install, and use new IT.

During the migration process, time spent in a given step should be long enough to ensure that both operational processes and IT tools are used consistently and effectively. It is suggested that a farmer stay in each step for at least 2 years. This allows a year for adoption of the current step's technology and operations, followed by a year of planning to take the next step. That means that at least a 5-year commitment is needed to move from Step I to Step IV.

VII.IMPLICATIONS FOR EXTENSION

Extension professionals can use this Development Route in at least two ways, as an evaluation tool and in program development.Different agents can use an understanding of this framework when working with a farmer to quickly assess the step on the path that best represents his/her IT utilization and associated operational processes. The agent can then advice the producer on preparing to move to the next step in the route. The agent can also target producers for the appropriate level of step-based training or educational sessions.

The above-mentioned training or informative programs can be developed based on the framework. These programs would seek to increase both IT adoption and preservation. On the other hand, the framework could be used as additional information in existing programs that deal with operational processes and technologies.

It should be noted that, while this paper concentrated precisely on flock operations, the stepping-stones of the Route represent a framework that could easily be applied to other agricultural operations, including crop production operations. Apparently, the details could vary greatly between particular operations' migration routes in terms of software tools and supporting operational process but the framework would still apply. The researcher decided to use flock operation because most farmers in Kenya are more concerned with selecting traits for breeding based on size and genetic diversity of the flock and it can apply to sheep's, cattle, cows, goats etc. so the breeders will look for those traits for example in sheep they will require information about wool quality, for female conception rate or multiple birth and all this requires use of information technology to keep records.

REFERENCES

[1]. Josephine B.A and Gbolagade B.A (2015)An Assessment of Factors Influencing the Use of Information and Communication Technologies in Maize Marketing in North Central Nigeria.Institute of Food Security, University of Agriculture, Makurdi, Benue State, Nigeria. Submitted by Alice Van der E... on Wed, 11/11/2015 - 09:10

[2]. Alice V.D. (2015) Extent of ICT adoption by ACP Farmers: the case of Somaliland. Submitted by Alice Van der E... on Thu, 03/12/2015 - 09:29

[3]. FARMSOFT – A 1997 Agricultural Software Review Perspective by Mourao A. M , Wahl V , Nicol J , Nunez Butragueno J. A ,Raschas

[4]. PLEASE GIVE SOME TITLE https://shivkumardas.wordpress.com/2013/08/08/ict-in-agriculture-3/

[5]. Bahl, M. S&T for Rural India and Inclusive Growth: ICT in Agricultural Marketing 2008 (http://www.nistads.res.in).

[6]. USAID, *ICT to Enhance Farm Extension Service in Africa*, Briefing Paper, November, 2010

[7]. Meera, Shaik N., Anita Jhamtani and Rao D.U.M., *Information and Communication Technology in Agricultural Development: A Comparative Analysis of Three Projects from India*, Agricultural Research and Extension Network, 2004.Network Paper No. 135.

[8]. Findlay, H. J., Zabawa, R., Morris, C. E., &Oben, M. (1993). Computer awareness among limited-resource farmers. *Journal of Extension* [On-line]. 31(1). Available at: http://www.joe.org/joe/1993spring/a8.html

[9]. Schmidt, D., Rockwell, S. K., Bitney, L., &Sarno, E. A. (1994). Farmers adopt microcomputers in the 1980s: Educational needs surface for the 1990s. *Journal of Extension* [On-line]. 32(1). Available at: http://www.joe.org/joe/1994june/a9.html

[10]. Blezinger, S. (2001). Many tools are available to help build a quality herd. *Cattle Today Online* [On-line]. May 2001. Available at: http://cattletoday.com/archive/2001/May/CT147.shtml

[11]. Gelb, E., Schiefer, G., Parker, C., &Rosskopf, K. (2000). Why is the IT adoption rate by farmers so slow? 1999 EFITA Conference. Retrieved at: http://www.efita.dk/papers/ep4/EfitaPaper-4.asp
[12]. *"EU-Project Automatic milking". Wageningen UR. 20 February 2008. Archived from the original on 20 February 2006. Retrieved 15 March 2013*
[13]. *"Malaysia begins RFID-enabled livestock tracking program". RFIDNews. 6 April 2009. Retrieved 15 March 2013.*
[14]. *Sebastian, Richard (7 June 2010). "RFID in Malaysia – Tracing the ROI". Frost & Sullivan. Retrieved 15 March 2013.*
[15]. AsheetaBhavnaniRowena Won-Wai Chiu SubramaniamJanakiramPeter Silarszky(June 15, 2008) *T*he role of mobile phones in Sustainable rural poverty reduction.

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