

The Application of Information and Communications Technology (ICT) in Agriculture

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Abstract: Apart from natural mineral resources, another important sector to the economy of Nigeria as a country is Agriculture. Nigerian Agricultural sector is one of the major backbones of the national income. Also, majority of her citizens earns their living from Agriculture. These include agronomy, horticulture, forestry, aquaculture, animal husbandry, livestock science, veterinary medicine, and food processing etc. Electronic Agriculture is an area focusing on the development of agricultural and rural improvement through enhanced information and communication methods. It plays a central role in facilitating the exposure of farmers to a variety of information. In view of the importance of agriculture to the society, it became paramount to develop different computer software packages to enhance the knowledge of the farmers and empower the rural community by fostering participatory communications.

Keywords: Agriculture, ICT, Electronic, Computer software, Nigeria

1.0 INTRODUCTION

Apart from natural mineral resources, another important sector to the economy of Nigeria as a country is Agriculture. Nigerian Agricultural sector is one of the major backbones of the national income. Also, majority of her citizens earns their livelihood from Agriculture. Electronic Agriculture is an area focusing on the development of agricultural and rural improvement through enhanced information and communication methods. It involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies in the rural domain, with a primary focus on agriculture

The concept of e-Agriculture has been described as the integration and utilization of information technology (IT) in farming related operations. Farming is a traditional trade and operations involved in production have largely remained habitual in nature. Traditional methods of farming incorporated little to no use of IT, despite its potential for dramatically increasing operations efficiency. The incorporation of IT into farming involves the integration of diverse technologies, with each capable of positively impacting the efficiency of farming activities, thereby promoting sustainable agricultural practice [1].

ICT in Agriculture is another physical infrastructure which has a tremendous role to play in agriculture in respect of bridging the communications divide created by geographical barriers. Nigeria is a typical case. How to reach out to the individual farmer in each and every village, so that he/she is included in the developmental process? ICT can bring education, capacity building and training to rural people all over the world. In effect it would be a knowledge transfer mechanism from the have's to the have not's, enabling this socially relevant development process to happen [2].

Nigeria should build a high capacity ICT infrastructure and use it to develop traffic of information flow from cities, academic and R&D institutional knowledge centers to the illiterate and economically disadvantaged. Same case with other developing countries as well. It could also encompass the information flow from the 'North' to the 'South' hemispheres of Earth, if political support is there.

2.0. REASONS FOR ADOPTION OF ICT IN AGRICULTURE

The reasons for the successful adoption process seem to be as follows:

i. Prevalence and simplicity The prevalence of computers is consistently increasing which in turn reduces reluctance to adopt them. Eventually

reduced inhibition and lower costs lead farmers to seek and adopt software to suit their needs. The less sophisticated farmers tend in time to join the process by seeking suitable simple, non-challenging solutions.

ii. An increased need for information Agricultural production is in the process of constant structural adaptation dictated by deteriorating terms of trade and characterized by larger, commercialized production units (Ministry of Agriculture and Rural Development, 1999). The larger the production unit and crop diversity the larger the need for more sophisticated data management and support for decision making.

iii. Maintaining existing competencies An adopter's level of education and training correlates positively with the ability to manage information, production processes and attain benefit from adopting a new technology [3]. It stands to reason as well that an adopter's level of education correlates positively with the level of benefit accrued to adoption of the managerial information systems. ICT enables even the most conservative farm managers to utilize the system for supporting decisions without a threat of unfamiliar changes in management procedures. Older and traditionally trained managers can easily adopt ICT without a need to study new background data sets and / or management methodology. As such prior knowledge for using ICT is not a prerequisite for adoption. Despite the approach that agriculture is a comprehensive business as any other, most farmers limit their management efforts to production aspects. In comparison to other businesses, farmers are usually isolated professionally in their decisions. This is a self-perpetuating situation that encourages resistance to changes in production methods and changes in business management methodology. It is in line with the contention that individuals tend to justify their actions according to their beliefs, past experience and reluctance to relinquish their time proven traditions and experience [4]. This may result in disassociation from a new technology and diversion of time and efforts to alternatives. ICT enables the user to maintain his habits thereby minimizing the resistance.

iv. Flexibility ICT is not confined to a specific crop or crop-pattern which in turn allows the farmer

maximum adaptation flexibility. Consequently, different farmers growing the same crop may utilize the program differently. Experience indicates that in many cases dedicated programs, attempting to be all-inclusive become inflexible, and eventually irrelevant.

v. On time Information When information is unavailable when needed on time at a decision point, the decision is taken based on a currently different situation. This can distort the managerial processes. ICT enables accessing data and information when needed. This is due to the simplicity of entering data as well as extracting reports.

vi. Returns on investment Farmers that found ICT to be beneficial and compatible with their needs pointed out the following advantages: easy collection of data, favourable comparisons of cost and income, follow-up of data input, establishment of cumulative data sets, their use and information accessing all translating into management efficiency. Measuring the benefit from the use of information systems is difficult [5]. One reason is the unavailability of quantifiable variables, although attempts to measure information have been made. This makes measuring the expected benefit of information systems very difficult. One of the intuitively obvious variables is the return on investment but the level of investment is not necessarily correlated to profitability. Contrary to expectations it was found that quantifiable changes were modest at best [6]. Since performance goals are usually presented as justification for investment in information technology the measure should be an improvement in the production process and not necessarily a direct return on investment. In this case if ICT indeed improved the production processes, these improvements should eventually be evident. Examples would include better decisions in a specific production process, shorter supply lead-time, etc. No effort was made to quantify the benefit from ICT although the negligible cost of such package contributes to the farmer's favourable cost benefit ratio.

vii. Training and support Operational proficiency training is a necessary condition for successful

information technology adoption, the more so with complicated software [7]. Some ICT packages needs limited training being technically simple enabling adaptation to various production patterns. Regardless, on-line and phone support are available on request without charge. Occasional refresher courses are held on demand.

3.0. ICT AND E-AGRICULTURE

The application of information and communications technology (ICT) in agriculture is increasingly important.

Electronic Agriculture (E-Agriculture) is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. E-Agriculture is a relatively new term and we fully expect its scope to change and evolve as our understanding of the area grows. E-Agriculture is one of the action lines identified in the declaration and plan of action of the World Summit on the Information Society (WSIS). The "Tunis Agenda for the Information Society," published on 18 November 2005 and emphasizes the leading facilitating roles that UN agencies need to play in the implementation of the Geneva Plan of Action. The Food and Agriculture Organization of the United Nations (FAO) has been assigned the responsibility of organizing activities related to the action line.

The main phases of the agriculture industry include crop cultivation, water management, fertilizer application, fertigation, pest management, harvesting, post-harvest handling, transport of food products, packaging, food preservation, food processing/value addition, quality management, food safety, food storage, and food marketing. All stakeholders of agriculture industry need information and knowledge about these phases to manage them effectively and efficiently. Any system applied for getting information and knowledge for making decisions in any industry

should deliver accurate, complete, concise and reliable information in time.

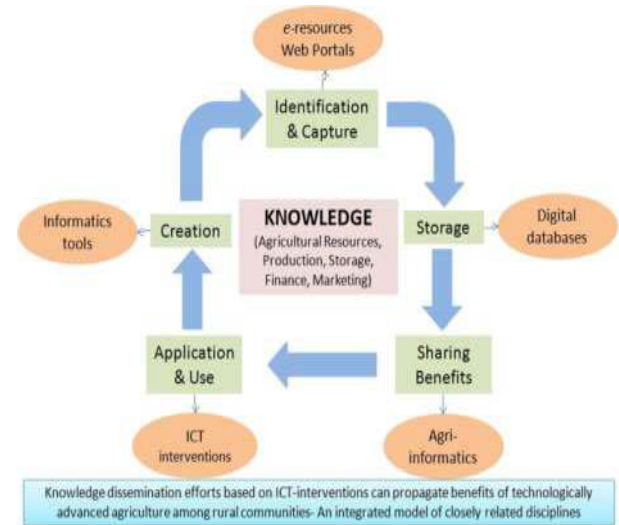


Fig.1. Agricultural Information and Knowledge Management system: E-Agriculture

The information provided by the system must be in user-friendly form, easy to access, cost-effective and well protected from unauthorized accesses. The information communication through ICT has to undergo the following steps:

- Record text, drawings, photographs, audio, video, process descriptions, and other information in digital formats,
- Produce exact duplicates of such information at significantly lower cost,
- Transfer information and knowledge rapidly over large distances through communications networks.
- Develop standardized algorithms to large quantities of information relatively rapidly.
- Achieve greater interactivity in communicating, evaluating, producing and sharing useful information and knowledge.

4.0. FRAMEWORK for E-FARMING IMPLEMENTATION IN NIGERIA

From the review of the practice of agricultural extension service in the country, it is apparent that the whole system needs a system re-engineering to make it effective. It has been said that the computerization of an inefficient system only magnifies its inefficiency. The automation of the processes that constitute the major activities will not succeed unless this system re-engineering is carried

out first. The proposed e-farming framework will compliment but not replace the role of the extension services in the country.

Agricultural extension focuses on the dissemination of information. This information is supposed to be from current research activities, agricultural product specialist and from the experience of the extension workers on the field. If the information is not available, or if available and not in a form that is amenable to being brought to the end user then the process stalls at this point. Therefore a key component of the automation process is the creation of a data store which will be a repository for this information. The agricultural sector will benefit immensely from the implementation of agricultural data marts and/or data warehouse(s) which will serve as the knowledge base for the automation process[8].

Current statistics according to Nigerian Communications Commission (NCC), posted by Channels TV (May, 2013) shows that the number of people accessing the internet over GSM mobile networks in Nigeria has now reached 32.3 million. Between the end of 2012 and February 2013, the number of people logging on to the worldwide web via their mobile device has increased from 30.9 million to 32.3. Of this number MTN Nigeria had 21.31 million users (65.9 per cent market share), Airtel Nigeria had 5.87 million users (18.16 per cent market share), Etisalat had 4.35 million users (13.47 per cent market share) and Glo had 801,218 users (2.48 per cent market share). This implies that Decision Support Software (DSS) applications running on both Internet/mobile telephony platforms using Web 2.0 tools (which will enable two-way interactions) and other GSM services such as the sms (short message service) can be used for the dissemination of information to both farmers and extension workers[9]. There is also the need for close cooperation between agricultural professional and IT professionals in the development of the software applications required.

The proposed e-farming framework will have the following participants shown in Figure 2:

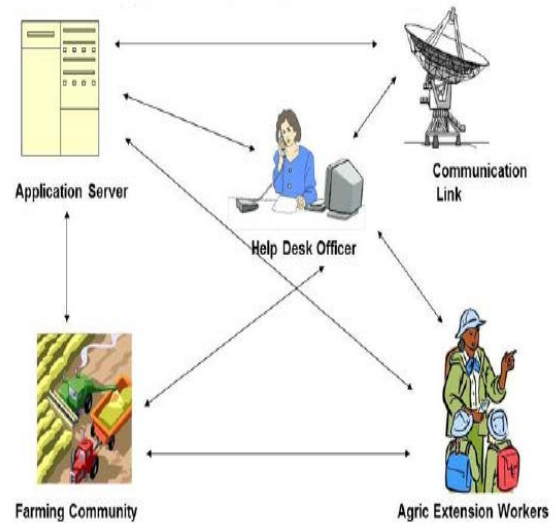


Figure 2: E-Agriculture Framework

- (1) The Farmer
- (2) The Agricultural Extension Worker (AEW)
- (3) Thee Help Desk officer(s), who are trained extension services officers with enough experience to respond to farmers and AEWs queries
- (3) The Application Server(s), which host the agricultural decision support systems (DSS), web portals, SMS (short message service) and WAP (wireless application protocol) applications that can be consulted by users of the system. It is noted that nearly all entry level (cheap) phones being sold nowadays have wap browsers and all GSM networks have SMS as a standard service on their networks.

The information disseminated to the farmers are compiled from the input providers, agro-processing enterprises, marketers, markets and consumers, policy makers, legislators, agencies, research organizations, training institutions, financial providers and business institutions herein referred to as Information Providers (IP), in both structured and un-structured format, reformatted and uploaded to the data marts or data warehouse(s) at the Local or State level. This information can be accessed directly by the farmers (depending on their level of education) or through the agricultural extension worker, through application servers/internet at the Local or State level; and agricultural help desk centers set up at each LGA or State level by telephone or SMS based applications. The Help desk officers can also have access to the

Application Servers and the Internet applications when information is required from them to be passed as response to queries by either the farmers or the AEWs. A bottom-up modeling system is proposed. Using this model the farmer and his farm forms the core of the system. The farm/farmer resides in a particular locality which is part of a LGA in the State. The AEW who has been posted to that area will have direct contact with both the farmer in his locality and the LGA or State office either physically or through the computing/mobile (Internet or WAP based) platforms. The farmer also using his computing/mobile platform can have access to the AEW or the LGA or State office application server or Help Desk officer.

5.0. MAJOR ICT ADOPTION CONSTRAINT

Following are some of the major ICT adoption constraints and observations emphasized during the presentations and discussions of this paper:

- a. If ICT cost and infrastructure as constraints are neutralized developed and developing countries face identical problems in developing and adopting ICT for Agriculture and Rural Development. This regardless of “digital divide” definitions, generation divides, digital immigrants/natives and/or “divide” definition components;
- b. Significant “wrong” (non-optimal) ICT development and implementation decisions are prevalent. They are extremely costly in economic and scarce human capital terms. Not least - they are continuously resulting in considerable loss of benefit and opportunity;
- c. “End Users” are the key factor in defining the needs and critical success factors for ICT development and implementation. “End User” lack of ICT awareness does not seem to be a significant impediment while lack of their involvement is. “End User” complaints of “ICT related waste of time” seem to be diminishing in importance as an adoption constraint;
- d. The constant oversupply of ICT innovations and cost reductions blended with the ever changing information and Internet characteristics emphasize the critical need for an “ICT Intermediary” and training. This can be provided by an Extension officer, scientist, consultant, etc. In this situation proficient End Users are becoming an influential

source of innovation and information. Their role as “agents of change” is becoming indispensable. A lack of “between End User” information exchange and “training” were indicated in this context as effective adoption impediments. Introducing a new technology to farmers poses obstacles. Other adoption and dissemination difficulties usually encountered are listed below:

- i. Not all farmers are interested in a computerized managerial information system. Some are satisfied with cost accounting at seasons’ end, sometimes not even that.
- ii. Some of the farmers use other software packages, including Excel spreadsheets or dedicated software which may or may not be adequate.
- iii. Personal impediments of various kinds.
- iv. Personal preferences. There are farmers who tried ICT and decided to quit because they did not find it user-friendly enough, special needs were not met, etc.
- v. Dissatisfied farmers will discourage others from using ICT, even after installation.
- vi. Marketing of ICT to farmers is non-existent.
- vii. Awareness of managerial information systems benefits is limited, resulting in situations where they have yet to be internalized.
- viii. Experience shows that farmers unassociated with the extension service are left behind professionally, which includes the use of ICT.

6. CONCLUSION AND RECOMMENDATIONS

For carrying out various activities by farmers and rural areas, among other things, information support is vital. To betterment of information systems in agriculture it is highly recommend to establish communication between farmers, coordinators, agricultural experts, research centers, and community by information technology. Application of ICT-based agriculture information support systems is very much important for the dissemination of agricultural information and technological knowhow by rural farming community. The information must be based on farmers’ needs, internet used as a mode to transfer the advanced agricultural information to the farming community. Application of computer software and ICT in agriculture can achieve new heights for

sustainability and precision agriculture that can change the livelihood of rural dwellers.

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