E-AGRICULTURE: CONCEPTS AND APPLICATIONS

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Abstract
The widespread use of ICT and its importance for innovation and economic growth has been recognized widely. Nowadays application and use of Information and Communication Technologies (ICT) in day to day life of the people has become common. As we look on from the past, then, only television and radio were the electronic broadcasting technologies that were used to reach the rural communities. In Nigeria, many strategies have been developed and being executed with the aim of developing the agricultural sector which is one of the main sources of income in the northern and some of the western parts of Nigeria. The traditional methods used in agriculture have been in practiced by farmers for a long period. With the emergence of new technologies and its widespread use, the use of those technologies in Agriculture sector will probably create a positive effect on the growth and development. There are many ways to incorporate the emerging trends in ICT with Agriculture that will aid on the enhancement of rural development and Agriculture sector via efficient information and communication processes. In view of this, the best strategies to achieve the above listed is the application and utilization of the rapid growing technologies in Information and Communication Technology to agriculture.

Keywords: e-agriculture, information and communication technology, geographical information system.

1. Introduction

The widespread use of ICT and its importance for innovation and economic growth has been recognized wide (EIU, 2006). Nowadays application and use of Information and Communication Technologies (ICT) in day to day life of the people has become common (Zahedi & Morteza, 2012). As we look on from the past, then, only television and radio were the electronic broadcasting technologies that were used to reach the rural communities. However, in recent years, there was a rapid emergence of internet and mobile based technologies (Balaji, Meera, & Dixit, 2007). As the result, an easy and fast mode has emerged to reach the urban as well as rural communities. In Nigeria, many strategies have been developed and being executed with the aim of developing the agricultural sector which is one of the main sources of income in the northern and some of the western parts of Nigeria. The traditional methods used in agriculture have been in practiced by farmers for a long period. With the emergence of new technologies and its widespread use, the use of those technologies in Agriculture sector will probably create a positive effect on the growth and development. There are many ways to incorporate the emerging trends in ICT with Agriculture that will aid on the enhancement of rural development and Agriculture sector via efficient information and communication processes (Singh, Kumar, & Singh, 2015). E-Agriculture as an emerging field in the intersection of agricultural informatics, agricultural development and entrepreneurship, referring to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies (FAO, 2005). The e-Agriculture concept, however, moves even beyond technology to the combination of knowledge and culture which is primarily focusing on the improvement of communication and the process of learning among the different stakeholders of agricultural sector who are engaging at the different levels.

2. Application of ICT Tools in the Agricultural Sector

2.1 Geographical Information System

A Geographical Information System (GIS) makes visual comparisons between different types of data possible. It helps to establish relationships between different data sets and is important in the production of maps, and charts and additional information associated with coordinates and time. It helps in the analysis of post-harvest variation in crop yield measures, and provides a holistic view of the production system (GIS Development, 2006). GIS is a computerized data storage and retrieval system, which can be used to manage and analyse spatial data relating crop productivity and agronomic factors. It can integrate all types of information and interface with other decision support tools. GIS can display analysed information in maps that allow (a) better understanding of interactions among yield, fertility, pests, weeds and other factors and (b) decision-making based on such spatial relationships (Singh, Kumar, & Singh, 2015).

2 GIS in AGRICULTURE

1 PRECISION AGRICULTURE

3 AGRICULTURE - GIS Application

1.1 Handheld Personal Computer

Handheld Personal Computers are small, light, and robust and have been used for providing access to information, mobile mapping and other data gathering activities (GIS DEVELOPMENT, 2007) Through forum and social networking site farmers can get connect with other experts and exchange their views and other details. Farmers can get a lot of information on variety of agriculture topics by surfing. Farmers can get connect foreign customer which can help to improve their product and increase their production capacity. Farmer can get information regarding price, weather, temperature etc. Keeping financial record, Production record, online banking, Buy required resources through internet etc… The amount of water sprinkled in a balanced quantity is also computerized. The production capacity in farming and animal husbandry has increased due to use of computer in agriculture field .There are less losses due to work are monitored by computer. By using computer in traditional field like agricultural field we can increase the productivity and minimize the error happen. Computers are more helpful in receiving necessary details quickly, accurately and computers are also used in imaging and Monitoring .Due to this usefulness of computer in medical field people can be cured as much as possible.

Mobile Workstation

2.2 Mobile (Cellular) Phone Applications

The cellular phone has provided market links for farmers and entrepreneurs. Growth in mobile phones has been explosive and now reaches more than a third of the population. This has reduced transaction costs, broadened trade networks and facilitated searches for employment (Guislain, Qiang, Lanvin, Minges, & Swanson, 2006). Bertolini (Bertolini, 2004).

Agriculture, whenever we read this term images of tractors, bullock-carts, and people working hard on the fields come across our minds. However, the time has changed and now technology has seeped into the agricultural sector. Starting from high-tech ways to find out the best quality seeds to best agriculture processes, there is a lot that can be done using the power of technology. At the same time, even the revenue of the farmers is expected to increase with the use of technology.

3. Role of ICT in Agronomic Practices

Deloitte, *et al*., (Deloitte, Alexander, De Graaf, Mukherjee, & Kumar, 2012) reported that, in identifying the ways in which ICT can help Agriculture, it is useful to view the farming life cycle as a three stage process such as;

* Pre-cultivation: Including crop selection, land selection, calendar definition, access to credit, etc.
* Crop cultivation and harvesting: Including land preparation and sowing, input management, water management and fertilization, pest management, etc.
* Post-harvest: Including marketing, transportation, packaging, food processing, etc. Crop Variety Selection

This sub-system advises the users about the most suitable variety for his/her plantation based on the specific circumstances of the farm and the user requirements. The domain knowledge of this subsystem contains two models, namely: suggestion, and selection. The inference knowledge contains three inference steps namely: specify, select, and count. The suggestion model contains a relation between the environmental conditions and the suitable varieties that is used by 'specify' inference step to suggest the paddy varieties suitable for the surrounding environments. The selection model contains a relation between user requirements and the corresponding varieties that is used by 'select' inference step to select, the most suitable varieties reflecting the user requirements. The 'count' inference step just counts the specified varieties (El-Azhary., 1998).

3.1 Land Use Planning and Management

Among the various ICT tools, Geographic Information Systems (GIS) and Remote Sensing (RS) techniques represent two key tools for land planning and management. GIS offers the opportunity to gather multiple layers of

information, drawn from different sources, into one spatial representation. This can be particularly useful in reaching consensus over land planning when users have different values and preferences linked to a given territory. Similarly, RS techniques are a valuable tool for monitoring land resources (e.g. Vegetation, water bodies, etc.), especially when a single institution is in charge of monitoring a wide area (E-Agriculture.org, 2017).

3.2 Land Preparation and Planting

Land preparation gives specific advises to the user about how to prepare specific land for paddy cultivation, while planting gives the suitable planting methods according to user specific inputs data. The domain model of this subsystem contains two models namely: establishment plan and assignment. The inference knowledge contains three inference steps namely: establish, assign, and select. The establishment plan model contains a relation between farm 5 LAND USE: GIS s that is used by e 4 AGRICULTURE: GIS : a recommended plan and an alternative plans (Edrees, 2017). Application

3.3 Soil Quality Assessment

Assessment of soil quality can be done in farm level and also in regional level. In regional level it can be done based on soil, climate and land uses. Some useful technologies aid to understand nature of soil and its problems due to management practices. ICTs have developed several folds in the recent past. Soil quality assessment is being done with some useful technologies, like remote sensing.

3.4 *Application of Image processing in Grading Agricultural Products*

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Water Management Technology

3.5 Role of ICT in Livestock Production

Farmer participation and buy-in Due to the livestock management activities that farmers are able to enter, they willingly participate on a daily basis to update the system with: New birth records and animal registrations; Regular weight recordings; Regular procedure or treatment records; Mating and breeding records; Pregnancy determination records; Movement records within their own herds (mobs / flocks etc.); Deaths or losses of animals; Early warning mechanism whereby the stock theft department could be notified, more quickly; Contribute to livestock statistics; Contribute to the national statistics of reproduction and production; Use more functions of the system to improve their livestock operations (multi-species); Grow with the additional functionalities (become more self-reliant rather than spoon-fed as with certain systems); Allows more public–private interactions vs purely a dominant public sector service (Deloitte, Alexander, De Graaf, Mukherjee, & Kumar, 2012).

3.6 Role of ICT in Agro-Meteorological Knowledge and Weather Forecasting

A common problem in developing countries is the lack of integrated means of processing and delivering agro meteorological information to small scale farmers. Even with improved agricultural technology and improved level of farm inputs the agricultural sectors of these countries operate below their potential level owing to the challenges imposed by the marked weather and climate variability (Mugenda, 2003). The above model shows the flow of information from various sources such as the farmers, the agricultural research institutes, meteorological stations and agricultural extension officers. The knowledge from these sources is brought together in the Knowledge Base (KB). This is then processed by the inference engine with some the algorithms as shown in the diagram. The system can perform various actions as shown. Small scale farmers can then interact with the system through short message services (SMS). The farmers can also obtain information through mass media (Lwande & Lawrence, 2008.).

3.6.1 Weather forecasting

The International Center for Agricultural Research in the Dry Areas (ICARDA) uses weather forecasting ICT tools, including meteorological stations and global information systems (GIS), so that scientists can collect and elaborate data to address the challenges that rural communities in dry areas face from the climatic stresses of aridity, drought, heat and cold. Weather stations are used to collect daily climatic data (for example precipitation, air temperature, and land temperature) that are analyzed by researchers to determine timely planting, crop development, climatic risk assessment and water-use efficiency practices (Zahedi & Morteza, 2012).

4. Conclusion

The primary challenge confronted in Agriculture sector is the need for increased production with the increasing population and decreasing natural resources needed for production. The key factors that impact on this are the scarcity of water, declining of the soil fertility level, effects of climate changes and the decreasing fertile lands that were utilized in cultivation in the past, due to rapid urbanization. However, this rapidly growing demand and the need for high quality products provide opportunities for the improvement of the livelihood of the rural communities. Therefore the Agriculture sector has to be enhanced with the aim of increased productivity that will lead to combat both rural and urban poverty and foster sustainable development through this. Based on this opportunity, the people engaged in Agriculture are in need of producing quality products with quality standards and regulations which will yield high. One of the best strategies to achieve this is the application and utilization of the rapid growing technologies in Information and Communication Technology. Although this is a new phenomenon, there are enough evidences to prove that the contribution of ICT to Agriculture has led to poverty alleviation and development in the livelihood of the stakeholders involved in Agriculture.

And probably the appropriate use of ICT at different levels of agricultural processes will lead to betterment in the efficiency and increased productivity. If the needs and importance of ICT to Agriculture is realized and deployed at proper places, they will be the most powerful tools that will lead to both economic and social empowerment.

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SPATIO-TEMPORAL ANALYSIS OF DROUGHT IN NORTH-WESTERN PART OF NIGERIA

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Abstract

Drought is a complex phenomenon which varies spatially and temporally in its extent, duration, frequency and severity. It becomes important to study the drought distribution characteristics on the time and space of a region and cause of the drought for the design and management of water resource systems (Rhee et al., 2007; Bao et al., 2011). Spatial and temporal analysis can also help to assess the exposure of water resources, vegetation patterns and the entire environment to drought. Researches on drought all over the World have shown that drought analysis gives important information on water deficit and its impact on agriculture and the hydrology of an area, which is a pre-requisite for mitigating drought and the planning of new water project. This study examined the occurrence of drought in north-western region of Nigeria. Problems related to drought includes: unpredictable commencement and end time of rainfall season, seasonal rainfall fluctuations, and long period of no rainfall. Monthly rainfall data was obtained from the Nigeria Metrological Agency (NIMET) for all stations considered. This covers up to 15years for seven different metrological stations namely: Gusau, Kaduna, Kano, Katsina, Sokoto, Yelwa and Zaria. Z-values (0.00) for the stations in the Mann-Kendall test indicate no trend in the rainfall data obtained for all the stations. Standardized Precipitation Index (SPI) was adopted for this study. SPI approach requires a transformation to the initial distribution of rainfall to achieve a normalized distribution. Drought analysis indicates that from 2007 till date, severe droughts have been recorded in all the stations for all the timescales (3, 6 and 12-month). With the observation of normal to severe drought in states within the region, an