A Local Ict Application Tools for Agricultural Development in Nigeria

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Abstract: The world is experiencing rapid agricultural development especially in developed countries. This is synonymous with the tremendous rate with which such countries have adopted information and communication technology (ICT) tools, into their agricultural process. Since ICT has reduced the globe to a village, it has enjoyed full acceptance in every nook and crannies of human activities. The essence of this paper is to establish a conceptual bridge connecting the concept of Agricultural Development and the laid down objective of ICT. Agriculture has taken its own share of computerisation as almost all the agricultural processes like farm recording, soil survey/sampling, measurement, information dissemination, diagnosis of diseases, budgeting, forecasting and so many others has adopted ICT in one way or the other. This paper takes a thorough look at areas where ICT tools have enjoyed wide adoption in agriculture. It also listed some known applications that farmers all over the world can access for use in their farms. Most importantly, it uses a local application (software) to demonstrate how effective an ICT tool can be in agricultural application.

Keywords: Information and Communication Technology (ICT), ICT Tools, Agriculture, Farm Dairy, GPS, Food Security.

I. INTRODUCTION

The three basic needs of a man are food, cloth and shelter. Out of these, food remains the foremost [1] . This is so because nutrition forms part of the characteristics of any living thing. Suffice it to say, priority should be given to food production. Since everyone around the globe wants to maximize the benefit accruing from the modern technology, this paper tries to look at how Information and Communication Technology (ICT) helps to improve food production not only in Nigeria but the world at large. According to a popular Malthusian theory on the trend of food production against the population growth warned that effort should be doubled if man wants to sustained food security. The theory stated that while food production is growing arithmetically, the population advances geometrically [2] . Though the observation was correct as at then, especially with the rate of population growth, the case of food production has taken a different pattern as many factors have influenced the production rate. One of such factors is the advancement in technology.

Technology is a broad term, we therefore narrow our discussion in this work to the role Information and Communication Technology tools play in making food and natural resources available for man. Agricultural development will not only provide food for the populace in Nigeria, but will also enhance the economic growth of the country. This will contribute enormously to achieving vision 2020 of the federal government. Development in other sectors like health, education, industry, to mention but a few, notwithstanding remains that adequate food security will produce a great turnaround, hence the need to sensitize the public on the contribution of ICT in Agricultural Development in Nigeria. Food insecurity is the cause of hunger all over the globe [3]

A. Information and Communication Technology (ICT)

According to Rouse [4], ICT is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. The impact of ICTs lies on its ability to bring information processing and communication to the un-reached populations. Technology is the use of available material around to solve a problem for the man kind [5] Modern information and communication technologies have made the world a global village in which people can exchange information with others across the world as if they were sitting inside the same room. For this reason, ICT is often studied in the context of how modern communication technologies affect societies. Vast applications of ICT cut across all fields of life including agriculture.

Information Technology is the technique employed in acquiring, processing, storage and dissemination of audio, video, pictorial, textual and other discrete information with the aids of electronics computing devices and telecommunication gadgets. It actually combines computing, with high-speed communication links carrying information of differing sorts such as sound, video, text or ordinary image from one destination to another. Devices such as cell phones, pagers fax machines, and portable computer have reduced the meaning attached to physical locations in terms of time, work, and leisure to mere formalities.

Technology in general is defined as any tool, device, program or system that when applied to the educational environment will increase productivity, creativity and achievement of students, teachers, and administrators and will prepare students

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for new roles in learning, living and working in a technological world. Generally, these are devices that aid in the acquisition, manipulation, or communication of information or performance of a work process. These technologies encompass computers, Televisions, overhead projectors, satellite broadcast systems, peripheral devices, calculators, adaptive devices, networking infrastructure, instructional, operational, and management programs, and other forms of existing technologies as well as those not yet invented. Technology is the technical means people use to improve their surroundings. It is also knowledge of using tools and machines to do tasks efficiently. We use technology to control the world in which we live. Technology is people using knowledge, tools, and systems to make their lives easier and better. People use technology to improve their ability to do work. Through technology, people communicate better. Technology allows them to make more and better products.

B. Agricultural Development

Agriculture is the act of cultivating plant and animal to provide food, drug, bio-fuel and other products for sustenance of human life. It is a profession that started at the beginning of the world. According to the holy book (bible), Genesis chapter four verse 2, Abel became a shepherd, but Cain was a farmer. This marks the beginning of agricultural practices. The study of agriculture is referred to as Agricultural Science. Agricultural practice uses natural resources to produce goods which maintain life, including food, fiber, forest products, horticultural crops, and their related services. The rate of development of agriculture is dependent on the climate of the region, culture of the people in the area, and the **technology** deployed. An outstanding shift in agricultural practices occurred over the past century due to new technologies, and the advancement of world markets. The major agricultural products include foods, fibres, fuels, and raw materials amongst others [6] . Definite foods include cereals, vegetables, fruits, oils, meat and spices. Fibres include cotton, wool, hemp, silk and flax. Raw materials include lumber and bamboo. Other useful materials are produced by plants, such as resins, dyes, drugs, perfume, bio-fuels and ornamental products such as cut flowers and nursery plants. Greater percentage of the world's population is engaged in agriculture. Some are engaged into agriculture just to feed their families, this is known as **subsistence farming**. Others farm to feed their family and generate capital for other projects or businesses, this is called **commercial farming.** Based on Food and Agricultural Organisation (FAO), [7] 2011 report, Nigeria's agricultural output for 2011 is rated at 39% of the overall National Gross Domestic Product (GDP). This amount to 2.2% of the world's GDP. If the labour force becomes more aware of the involvement of ICT tools in agricultural practices and utilises them, there will be no doubt that the agricultural contribution to both national and global GDP will tremendously rise.

C. Information and Communication Technology and Agricultural Development

Enhancement of agricultural and rural development through improved information and communication processes has come to stay with us in this 21st century. Some refer to it as E-Agriculture. This involves the development, evaluation and application of innovative use of information and communication technology to improve agriculture. Bearing in mind that there are different phases with which the concept of agriculture can be conceived, like crop cultivation, food security, food storage, food marketing, water management, fertilizer application, packaging, product transportation, animal husbandry, and so many others; human ware that are involved in each of these phases relied mostly on quality information and knowledge to manage them effectively. This is the area where the importance of ICT will be felt tremendously because some of the information required modern technology tools for their processing. The revolution which our country needed in agriculture will be ushered in by embracing information and communication technology into the agricultural sector. Currently, the ministry of agriculture in Ebonyi is touring the 13 Local Government Areas in the state, educating the old and young, especially the unemployed graduate to embrace agriculture. Ebonyi state government should think more of embedding their advocacy with modern ICT tools. This will definitely lure their target unemployed youth into the sector easily. Fig 1 shows the relationship that brings together agriculture and ICT.
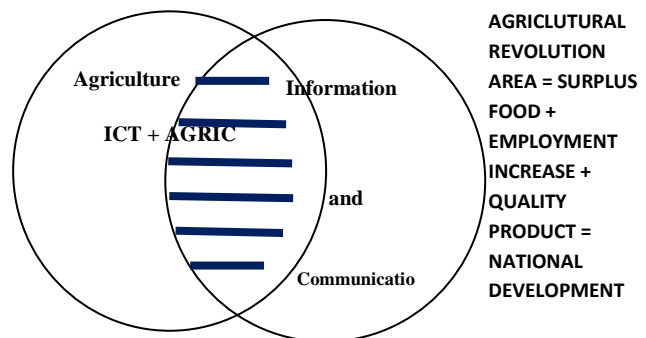

Fig 1: Relationship between Agriculture and ICT.

II. APPLICATION AREAS OF ICT TOOLS IN AGRICULTURE

It is no longer news to say that there are vast areas of ICT application in agricultural sector in the world today. What one needs is to identify some of these areas especially in cases where the area has been neglected.

Farm management tools and information technology can be used to collect and analyse data to inform on-farm decision making for many aspects of the farming

business, resulting in more informed decision making and potentially more productive and profitable farming enterprises. Currently there are a large number of farm tools available, however many farm tools are not widely used. Information-based decision tools are still largely used by farm consultants on behalf of their clients, and farmers, who do use farm tools, either directly or via their farm consultant, tend to be those with higher profitability who continue to seek ways to improve their farming systems [8]. Application areas of ICT tools range from farm recording, measurement, communication, extension services, soil surveying, budgeting, forecasting, calculations to diagnosis.

i. Farm Recording: Excellent farm management requires having accurate useful farm records. Good records do not necessarily mean that the farm will be successful; however, it is success enabler. Farm records are like the report cards for all the farming activities and transactions. With a farm report card, farmers can access how well they are managing their operation compared to other producers. They can also see the strengths and weaknesses in their operation. Having accurate facts and figures is most useful when borrowing money, seeking government support and completing tax returns. Some of events worth taken note of when farming include farm dairy (facts and figures of day to day activities or business), crop records, livestock records, unit cost of all inputs (fertilizer, water, fuel, stock), unit cost of all returns from farm output (milk, excess feed, manure), livestock inventory accounting, key financial records (interest, loan, government charges, rate, labourers' wages, office up keep), important dates for meetings and supervisions.

On the whole, you notice that traditional method of paper recording will not be effective for a serious farmer. This is where an ICT tool like computer will play a major role. Different **Farm Recording Application Software** are already in existence. Deployment of one of these tools will bring in a digital touch into the recording approach. For instance, Microsoft Office packages like Microsoft **excel** can help to track expenses. Personal Digital Assistant (PDA) will be appropriate for a farmer that is computer literate to easily keep record of events and expenditures in the farm. Data entry for field records can work in conjunction with a GPS receiver to track planting dates, chemical and fertilizer usage, scale tickets, hybrid/variety location, weather, viewing the history of past hybrids, chemical applications, tillage practices, and yield.

ii. Communication: Information dissemination is an important aspect of farming. This is because information triggers decision making in any organisation. This information must be accurate, complete, concise, and delivered at the right time and to the right place. This necessitates the use of reliable ICT tools that will provide user-friendly, accessible, cost effective and secured information delivery. The form of this information may be recorded texts, drawings, photograph, video of events, audio, animations, and so on. Another aspect of this is how to transfer this information especially in digital form.

Bearing in mind that we are in digital age, some of the noticeable information and communication tools that will play a major role in agricultural information dissemination includes computer systems, digital cameras, PDAs, mobile phones, iPADs, Smartphone, projectors, MODEMs, and other internet facilities. There exist also many mobile application software that may be installed in computer or mobile devices that can wirelessly exchange information between the field and office. This will save valuable time and improve computerized field records.

Typical case to buttress the importance of the use of ICT tools in agriculture is found in Kenya where elephant bulls destroy farm crops each time they cross the geo-fence. The elephants were tagged with devices that send text messages to farmers each time the elephants reach the geo-fence. The technology adopted here is that of SMS and GPS to signal authorities for appropriate action.

iii. Survey/Measurement: This is an act of examining and recording measurements, features, etc. of an area of land in order to make a plan of it. This is used to map out field boundaries, drainage lines, pivot and ditches. Geographic Information System (GIS) is used to digitally map the land and obtain geodetic data such as topography and contours. This is combined with other statistical data for soil analysis. This will form a major decision maker for the farmer on what to plant and when to plant it based on previous historical information. With Global Positioning System (GPS) and sensors in the field, farmers can harvest along side with their crops, detailed digital maps of their field. This will reduce waste and improves yields. GPS is used for mapping field boundaries, capturing attributes such as weed and insect types, dates, notes, tile diameter, and digital images from a camera. GPS area calculator and GPS distance measuring device called Planimeter is a map ruler tool for all kinds of measurements (distance, area and angle) on Google Maps. Plainmeter uses Google Maps, GPS, and Network location services. The same Plainmeter can be used in agriculture fence measurement, underground utilities, map measurements, field pasture area measurement, garden and farm work, planning, and area records.

iv. Extension Services: According to the publication on SciDev.Net, it noted that the ratio of agricultural extension worker in Africa to farmers is 1: 4000; compared to 1: 200 in developed countries. This was a discovering made at a conference held in Nairobi in November 2011. A Dutch director of the Technical Center for Agriculture and Rural Cooperation, Michael Haliu, said that, even where there is no shortage of extension personnel and funds, smart use of ICTs can help deliver knowledge in real time to farmers, especially in poorly staffed and remote corners of Africa [9] . This emphasized the impact of ICT tools. With the rapid increase in the number of mobile phones, internet, iPods, and conventional radio and television users, the gap created by lack of extension officers will be reduced to minimum. For instance, Government should Provides extension officers with computer tablets with GPS embedded, for offering timely extension advisory services to farmers. They will use the tablets to send crop status images to experts.

v. Diagnosis: Software tools can assist farmers to individually diagnose animal and plant diseases without necessarily seeking for expert advice. The tools can be installed for usage in both standalone systems and mobile phones for instant use when needed.

A. Mobile Application (apps) Tools for Agriculture

Mobile applications have gained massive advantage over desktop packages. The reason is obvious. It is available any time you need it. Distance is not a barrier here. It is most essential in the case of

agriculture where over 95% of what the farmer does is in the field. Hopkins [10] listed Ten Best Mobile Agriculture Apps as follows:

1. Aphid Speed Scout: This app determines if soybean aphids have reached the 250 aphids per plant brink. Plants are considered "infested" if there are up to 40 or more aphids on that sample. The app also recommends further scouting or treatment options based on the number of infested plants in a given area. This can be installed in *iPhone, iPad, iPod Touch.*

2. Optimizer 2.0: This app aids farmers to predict corn yields. It provides farmers with data through a daily text message and a Web login portal. Messages include the projected corn yield and the most limiting factor for their farm. Projections are made based on variety of seed, soil type, weather data and other limiting factors.

3. YieldCheck: This provides growers with a way to calculate and store corn yield estimates. Users can organize estimates based on client, farm and field. They can also see the location of all of their estimates on a map with satellite imagery. Farmers can enter kernel counts for three ears of corn and disclose the amount of bushels they can expect this fall. It is available for *iPhone, iPad, and iPod Touch.*

4. iCropTrak: This is a multi-user software solution that runs in the field with or without Internet connectivity. It utilizes GPS technology in the iPad, the larger screen size and touch interaction, gives users an opportunity to deploy data collection templates for functions as complex as food safety inspections, field spray management, employee timesheets and so on. This is only available for *iPad.*

5. Farm Manager: This allows farmers to record cropping, livestock, and machinery procedures, and accesses this information with simplicity. Users can capture full history of crops from when they are planted to when they harvested; record quantity of chemical and fertilizer utilize, and also keep track of type, rate, and date applied including machinery maintenance. This software can be installed and run on *iPhone, iPad, iPod Touch.*

6. PrecisionEarth: This is dedicated to soil sampling making it easier to accumulate grower, field and soil sampling data. It uses open standards so the data you load and the data you export will work with your current GIS, Web and desktop applications without a glitch. Users can load and display directed sampling layers and boundary vectors, export soil sampling location and display background maps. *iPhone and iPad* support this application software.

7. Corn Planning Calculator: This software provides real-time valuable calculations for the planting of corn from definite inputs resulting in the accurate spacing of the corn being planted. Data such as population desired, cost per acre, seed counts and spacing in inches or metric format are achieved. You found it usage with tools like *iPhone, iPad, iPod Touch.*

8. Grain Shrinkage Calculator. This returns the amount of bushels remaining after the grain moisture is removed. The software takes the moisture content in the field and after storage and calculates the difference. Seven common grains that enjoyed its applications are: corn, wheat, soybeans, oats, barley, buckwheat, and rye. *Android phones are the only tool now that supports this application software.*

9. JD Link. This is equipment management software from John Deere, hence, the name JD. It is a telematics system designed to remotely connect owners and managers to their equipment. It provides alerts and machine information including location, utilization, performance and maintenance data to owner. It states also where and how equipment is being used. Found in *iPhone, iPad.*

10. CropNAtion: It provides a virtual social network for farmers to share information, images of their crops and track agriculture trends in their region to their counterparts in

another region. It is compatible with *Android phones and iPhone*

III.   DEMONSTRATION OF A TYPICAL ANIMAL DISEASE DIAGNOSTIC SYSTEM

The name of this **DEMO** application is "Expert System on Diagnosis of Animal Diseases (ESDAD)". This software was developed to enhance interactivity normally required in modern software applications. Splash screen was used to usher in the package with meaningful introductory information displayed on it that helps to explain the application. The splash screen precedes the login form. The design of the splash screen is shown in figure 2 below.
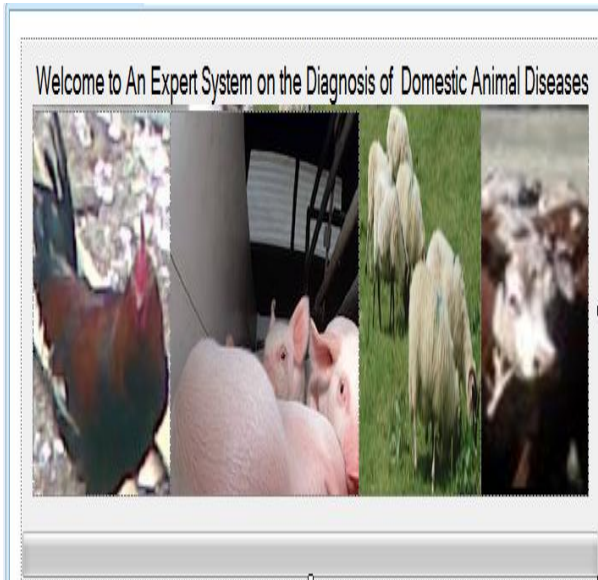
Fig2: A Splash Screen of an Expert System for the Diagnosis of Animal Diseases

The main menu comes up after the user must have keyed his/her user identification and password. The main menu has four major menu items to show the major operations of the system. The four menu items are File, Diagnose, View and Help. Each of these menu items has other submenu items to specifically carryout any desired operations. Also included in the main menu design is a standard toolbar to provide for shortcut or handle access to the operations of the software. It was designed using a menustrip control and toolstrip control.

The input forms provide avenue for the user to feed in data into the application. Two input forms were used in the cause of developing this application. They are: the login form and the diagnosis form. Both of them were designed using controls like textboxes, labels, command buttons, checkboxes and panel. Figure 3 below demonstrates how diagnosis form was designed in this application.
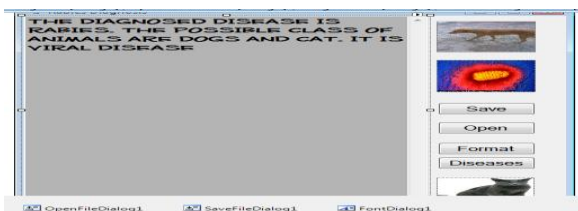

Fig 3: The Diagnostic Form Design

The output forms of the system were also designed using the labels, textboxes, picture boxes, and command buttons with many other controls to enable full description of the information from the system. The outputs of the system include result of the diagnosis displayed after the diagnosis of a particular animal to be suffering from a particular disease, disease description form that provides explanation to particular disease or animal diagnosed using web pages, and gallery form that displays all diseases within the confide circle of the particular animal. The sample output forms are presented as shown below in figure 4 and figure 5.

Fig 4: Result of Diagnosis Form The implementation of the ESDAD is based on two programming languages and

Relational Database Management system. The first programming language is

Microsoft Visual Basic 2008 Express Edition, which is world class object oriented language. Its flexibility in creating dynamic user interface application remains its strong point. Moreover, it presents prompt navigation of web pages. Another good reason for using Visual Basic 2008 is its debugging facility that allows for easy programming. The second programming language is Hypertext Mark Language (HTML). This is the official language for developing and generating the web pages. In this work, web pages are used to display a kind of explanation facility that one may need on the diagnosed disease after diagnosis. HTML runs comfortably in most of the web browsers. Microsoft Access in 2007 Office Suite was used to design the database aspect of this work.

In line with the objective of this paper, the output is the result of the diagnosis. The result from the knowledge base is usually displayed when correct set of symptoms have been selected and diagnose button clicked. Features used in the implementation include the images of the sort of animal that may suffer such diagnosed disease. The disease signs/symptoms were illustrated using pictures. Added features to derive the utility home are some formatting features that look like the one we used to see in the standard window packages. This formatting can enable the user increase or change the font size or style, change fore color, save in any part of the computer used, copy the result, or print the result out.

Fig 5: Disease Description Form

IV. CONCLUSION

There is evidence everywhere to show that, information and communication technology can be applied in virtually all human endeavours. Especially in this era of modern ICT(Internet and Web technology), human beings have enjoyed wide applications both at home, offices, farm, fields, market, schools, industries, governance just to mention but a few. This paper has adequately highlighted areas where information and communication technologies are enjoying major patronage in agriculture all over the globe. If developed countries like USA and others are so committed in digitizing every regiment of agriculture, what will stop Nigeria from joining the bandwagon, which is going to ensure adequate food security, job creation, economic development and suitability to national polity in overall? Accessing the Internet will bring a wealth of information to all

agriculture stakeholders in rural and urban areas in Nigeria and will help in overcoming the digital divide. Though most farmers in Nigeria have no hands-on experience or access to digital networks, leaders of national agricultural research and extension systems should be encouraged to consider the ICT opportunity. Training farmers and extension workers, including women, in ICT will help them access a lot of useful information. If this country wants to achieve its agricultural component of vision 20:2020, the use of ICT in agriculture should be highly encouraged both in the rural communities and in urban centres.

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