Influence of Information Technology Project Management To Agriculture Sector In Uganda

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ABSTRACT

Agriculture being a major activity that supports the livelihoods of the people mainly rural communities has been geared higher by evolution of information and communication technology through easy dissemination of information and knowledge in a cost effective manner. This paper assessed the ICT`s business values and contributions towards performance of agriculture businesses in Uganda. This paper also provides useful and practical guidance for agricultural enterprises that are considering promoting ICT business processes into agriculture environment. A number of benefits brought about by IT to the agriculture sector such as improved food security, production of quality goods, information sharing and improved profits among others have been elaborated. Information technology tools that easy the agriculture operations and make it more desirable activity have been identified and discussed. Important recommendations and conclusions have also been developed to further advance agriculture sector to the top most level.

This paper also provides useful and practical guidance for agricultural enterprises that are considering promoting ICT business processes into agriculture environment.

Keywords: *IT- Project Management, E-Agriculture*

BACKGROUND

The global integrations that are continuously brought about by information and communication technologies have opened up exceptional opportunities to eradicate poverty with improved agricultural methods. UNDP, 2012 emphasized that the Agricultural sector has the greatest potential for improving rural livelihood and eradicating poverty. Agriculture is increasingly becoming more knowledge-intensive as it gives access to timely, accurate information that is tailored to specific locations and conditions which is critical in helping farmers make the most of their resources in often changing circumstances (FAO, ITU, 2016).

Agriculture is strategically important in supporting the livelihoods of the majority of the rural population in Africa and therefore the growth of e-agriculture has the potentialto accelerate agriculture and rural development, promote food security and reduce rural poverty in developing markets(Ian Theunissen, 2015).

Uganda the pearl of Africa with enough land and good fertile soils realized that agriculture is most reliable business to her citizens and thus adopted the improved methods of agriculture in line with the everyday growing technology. Agriculture in the country is the leading economic business that has made good progress towards the welfare of the people and now the country is in the process of implementing the use of Information Technology Project Management as a way of improving on agricultural mechanization. It is started that at least over 80 percent of the households and 85 percent of the people, live in rural areas and most of these largely depend on Agriculture as their main source of income (Gollin& Rogerson cited by Winny Nekesa Akullo, et al, 2016).

Ministry of agriculture is the lead agency and has learnt the significant role that ICT is doing to the sector right away from Urban to Rural for their day to day running of agriculture business industry. The government of Uganda has invested some effort in procuring improved farming tools to contribute towards better agricultural performance with improved quality and quantity of end products and profits. This has resulted into many organizations launching different agricultural program to support agriculture for development (Md. Tamzid Rahman, 2016). The technological tools include but not limited to irrigation machines, cultivation tractors, Automatic weather determinants/ prediction machines, among others.

The agriculture sector is taking biggest percentage of the country`s budget to ensure that agriculture mechanization is maintained. The country has appreciated a very good improvement on agriculture mechanization which has eased communication, transportation of products, irrigation systems, produce marketing, monitoring and evaluation of agricultural activities among others. This has made positive effects on people's livelihood as well as their contribution to community lifetime.

According to (NITA-U, 2013), government of Uganda is leveling the ground through formulation and implementation of policies and regulations aimed at attracting investments in the agriculture sector. There has been tremendous growth in the number of Institutions providing Internet services, suppliers of computers and related accessories/equipment which have stimulated the introduction of IT Services such as Social Media where users can interact and share information in real time in a variety of formats such as text, video, pictures and audio among others.

This study generally shows a significant role of inspired use of IT project management arrangements and facilitation to agriculture sector.

Much as Project management resources in IT field have improved farming mechanization in different ways, it is still unfortunate that the majorities of farmers in Uganda remain without access to ICT services particularly people from rural areas where means of communication is still poor in nature, use of ICT awareness is still low, marketing techniques for their products is still a problem and these have continuously accelerated financial crisis as well as famine to the people of this country.

There is no question that significant agriculture business opportunities are available through the use of IT Project management and there are also many recognized Information Technology tools to be addressed that can enhance and improve on agriculture. This paper intends to explore the influence of IT project management towards the performance of agriculture businesses as well as providing recommendations that can assist agricultural enterprises in assessing the ICT`s business values.

BRIEF INTRODUCTION OF UGANDA AND AGRICULTURE

Uganda one of developing countries in Africa has a total population of 42 863,000 (United Nations, Department of Economic and Social Affairs, 2017). Over 80% of the population is engaged in Agriculture sector mainly for subsistence livelihood and the country heavily depends on agriculture as its major economic activity (Winny Nekesa Akullo, et al, 2016) which contributes Gross Domestic Product of about 42%.

According to Department of Relief, Disaster Preparedness and Management, 2017, Agriculture supports the livelihoods of 73 % of households, provides employment for about 33.8 % of the economically active population, and over 80 % of the poorest of the population.

In a period of two decades, Uganda has had e-agriculture initiatives in place courtesy of the work by some Non-Governmental Organizations like the Busoga Rural Open Source, Development Initiative and Women of Uganda Network, IT innovations like Drumnet, Esoko, Community Knowledge Worker, Farmers' Friend among others (Eric Nelson Haumba, 2014). Projects such as Uganda livelihoods and Enterprises for agricultural Development (lead), Community Agricultural Infrastructure Improvement Programme, Project -1 (CAIIP-1), NAADS others have been implemented to uplift the performance status of agriculture.

INFORMATION TECHNOLOGY PROJECT MANAGEMENT

IT project managementis the process of planning, organizing and delineating responsibility for the completion of an organizations' specific information technology (IT) goals (Margaret Rouse, 2015). IT projects are grouped into different types, some of which include Software development and implementation, hardware installations (e.g., servers, desktop computers, or telephony systems), network system upgrades, data management, etc.

Managing projects using Information Technology has proved to be sufficient due to provisions of easy and quick access to any necessary information to guide and support the effective running of projects at limited costs. Information technology increases the knowledge of shareholders and stakeholders of projects in as far as projects sustainability is concerned.

Information and communication technology (ICT) can play a critical role in facilitating rapid, efficient, and cost effective knowledge management which encompasses processes and practices concerned with the creation, acquisition, sharing and use of knowledge, skills and expertise (UNDP,2012).

For the case of agriculture business, the farmers whether in rural or urban areas are able to access agricultural related knowledge and skills through different tools of information technology such as televisions, internet, radios, social media among others. These tools enable easy circulation of information and knowledge through different ways as illustrated below.
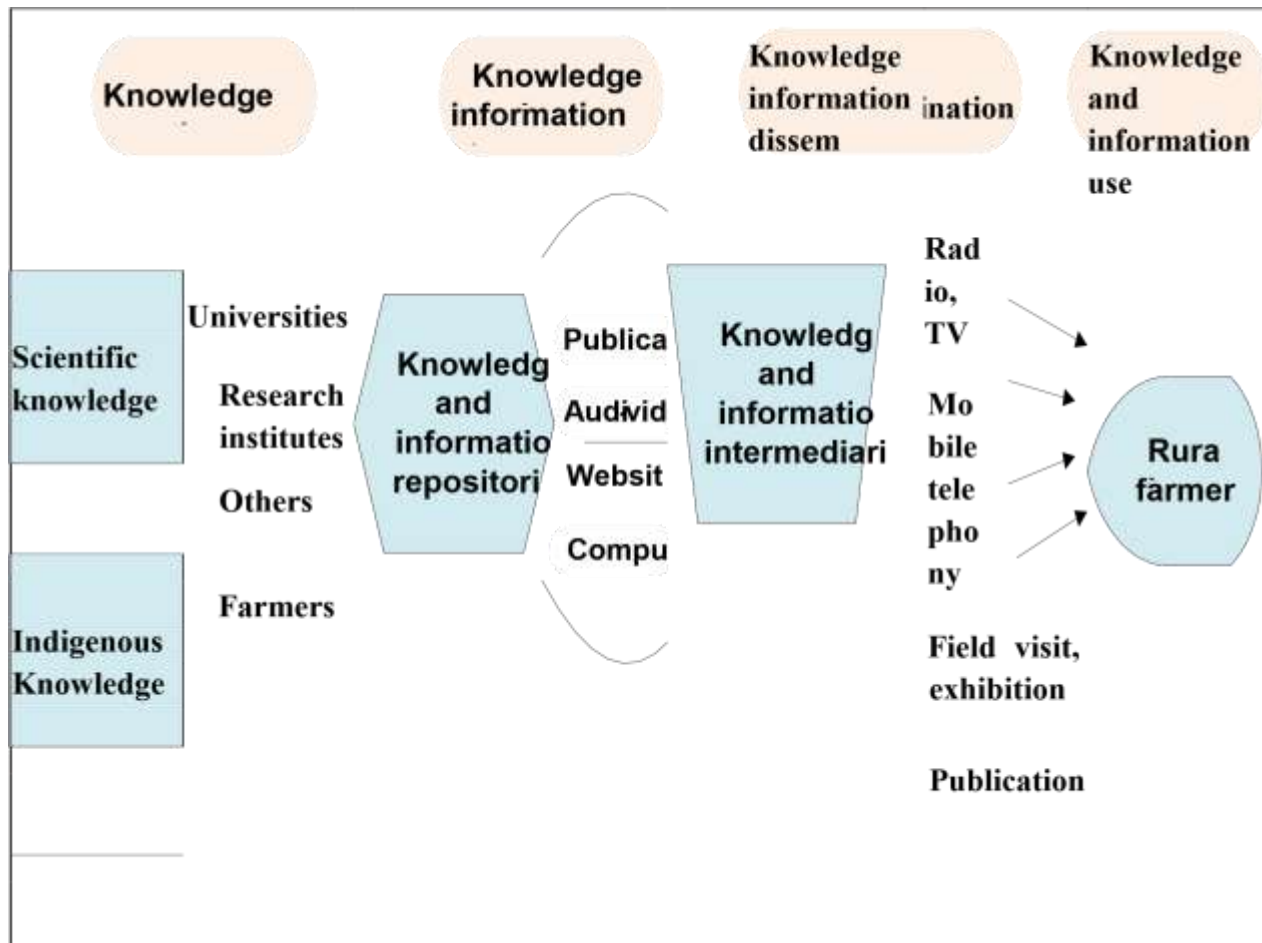
Figure 1: Tools of knowledge and information management in agriculture; *source*: UNDP, 2012

E-AGRICULTURE

E-Agriculture is advanced practice of farming which involves unlimited communication and knowledge sharing with the help of information and communication technologies (ICT) which is capable to work towards economic and agricultural sustainable development. The knowledge about agricultural development is shared between researchers in different related organizations, government and non-government organizations, private sectors, and others interested agencies all over the world.

Ian Theunissen, 2015 explained e-agriculture as an emerging field that sees agricultural services, technology dissemination, information and communication delivered or enhanced through the internet of things (IoT).

E-agriculture, or ICTs in agriculture, is about designing, developing and applying innovative ways to use ICTs in the rural domain, with a primary focus on agriculture which offers a wide range of solutions to some agricultural challenges (FAO, ITU, 2016). This type of agriculture applies technologies such as radios, televisions, cellular phones, computer and network hardware and software, satellite systems and etc, as well as the various services and applications associated with them, such as videoconferencing and distance learning (Hudson Wereh, 2012).

Many researchers have gotten interest in discovering more about managing agricultural projects using Information technology and a lot of new ideas have been developed every other day to agriculture raised to a better standard, and these ideas have enabled decision makers to appreciate that agriculture once given first priority, can be the best option to develop communities both rural and urban without excluding the minorities.

Some models have been developed to demonstrate the functionalities involved between information technology and agriculture as a business and main source of food, and one of them is illustrated in the figure below;

Figure 2: The ICT Based e-Agri Support Module; source: MD Tamzid Rahman, 2016.

Hudson Wereh, 2012 explained the relevant entry points for ICT in agriculture as given below;

Enhancing agricultural production: Increasing efficiency, productivity and sustainability of small scale farms, information about pest and disease control, early warning systems, new varieties, new ways to optimize production and regulations for quality control

Improving markets: better of markets resulting from informed decisions about future crops and commodities and best time and place to sell and buy goods, up-to-date market information on; prices for commodities, inputs and consumer trends**.**

Building farmer capacities: Strengthen capacities and better representation of their constituencies when negotiating input and output prices, land claims, resource rights and infrastructure projects, reduce social isolation, widen the perspective of local communities in terms of national or global developments, open up new business opportunities and allow easier contact with friends and relatives.

INFLUENCE OF IT IN MANAGING AGRICULTURE PROJECTS
The promotion of the use of Information technologies in Agricultural Information Services is tailored around many advantages and opportunities that accompany them, including; ease of use, provider sustainability, timely delivery of updated information, and a wider reach out (Winny Nekesa Akullo, et al, 2016).

Tanaymitra, 2014**,** highlighted that the potential of Information Technology (IT) in the context of agriculture can be assessed broadly as a tool for direct contribution to agricultural productivity forexample remote sensing using satellite technologies, geographical information systems, and agronomy and soil sciences which increase agricultural output, and as an indirect tool for empowering farmers to take informed and quality decisions which will have positive impact on the way agriculture and allied activities are conducted.
Information technology infrastructure play a number of roles in ensuring effective management of agricultural activities, some of which described as follows;

Global position systems(GPS): these are applied in monitoring the performance and progress of agricultural fields through geo-reference data collection, and mapping of interested activities. GPS-based applications in precision farming are being used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping and also allows farmers to work during low visibility field conditions such as rain, dust, fog, and darkness (GPS.GOV, 2016). The GPS are mostly preferred because they are easy to use, portable to

carry in fields and are very accurate in positioning the sites. Therefore, within a shorter period of training, the farmers are able to produce digital accurate maps for easy interpretation of their activities hence beneficial information for decision making. The GPS is also used to geo-fence the farms so as to monitor any entrance and inform the farmers through text messages, which helps to control intruders from accessing the sites.

Geographic information systems (GIS): these are always applied in precision farmingfor georeferenced data analysis and digital mapping of farms for easy understanding of soil, crops and animal progress status. GIS is the most accurate and reliable tool used by agricultural projects in decision making. Elizabeth Bornema, 2014, highlighted that GIS map and project current and future fluctuations in precipitation, temperature, crop output, and more and hence capable to analyze soil data combined with historical farming practices to determine what are the best crops to plant, where they should go, and how to maintain soil nutrition levels to best benefit the plants.

Automatic weather stations (AWS); the stations perform a variety of duties ranging from reading current, predicting future and historicalweather data. The stations work with wireless receivers which link them to central computer for periodic retrieval of data that is collected on daily basis and then used to serve the intended purposes. The weather data recorded include that of rainfall, temperatures, humidity, wind speed and sunshine which plays a vital role in monitoring and forecasting the future conditions. AWS help farmers and food producers cope with increasingly unpredictable weather (WFP, 2012) by providing reliable information for determining appropriate seasons for planting their crops. WFP, 2012 further revealed that AWS enable Uganda to play a sustained role in contributing to the exchange of weather data globally. The figure below illustrates the operations of automating weather stations in providing necessary services to the farmers and decision makers.
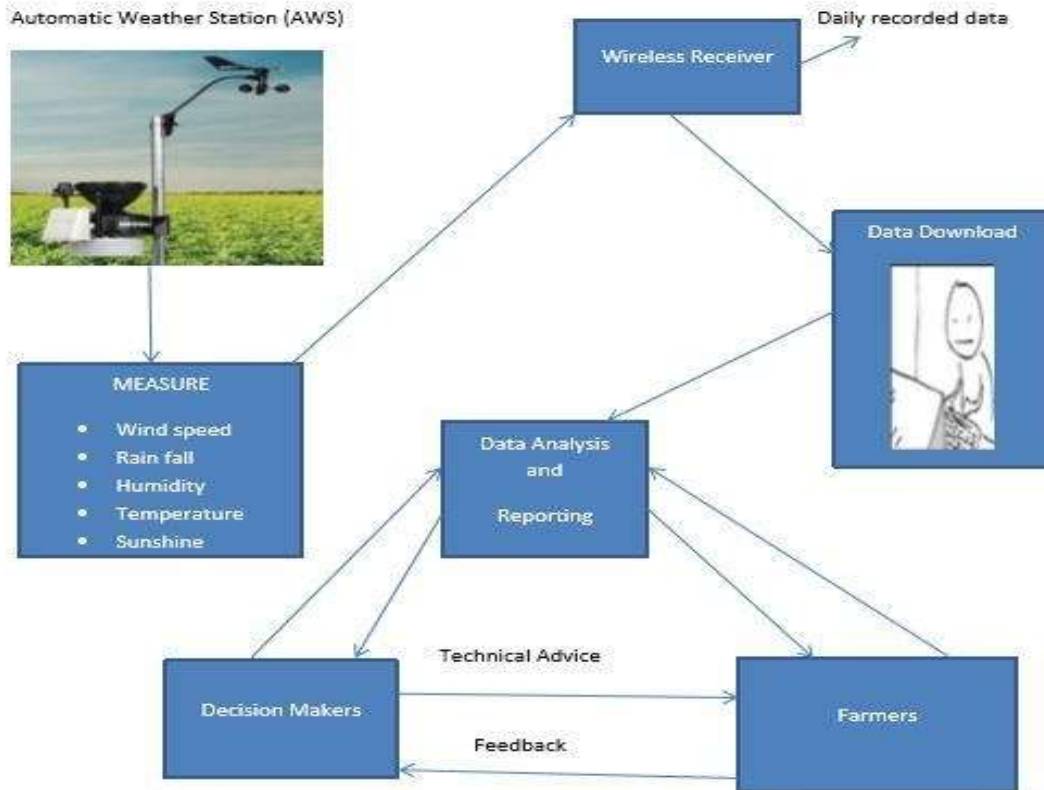

Figure 3: Proposed Automatic Weather Station operations and service provision

Computer-controlled devices: these devices are made with advanced methods of performing their duties faster, accurate and with minimum or no human labour applied. For example, use ofautomatic milkingsystems to milk the dairy cattle improves the quality and quantity of milk that is milked in a given period of time. The farmers are also given ample time to handle a variety of activities in their farms at the same time ranging from supervision to feedback acquisition. The computer-controlled devices also provide alerting information to farmers on how much to milk, when to milk and guides on suitable feeds to improve on milk yields.

Smartphone mobile apps in agriculture: the technology of mobile smartphones is also applied in agriculture intervention and has positively contributed towards the sector. The technology ensures delivery of information in simplest manner. With smartphones, data related to ongoing or planned activities in rural farms is collected and shared with technical personnel in which farmers are advised on way forward without necessary incurring movements. The farmers can also carry out monitoring of their farms using mobile phones through texts messages. Mobile phone technology is a cheapest tool used in managing agriculture due to their low purchase prices, easy to maintain and portability. Provisions of Social Media via smartphones are also essential in developing agriculture under the intervention of information communication technology (ICT) where sharing/ exchange of Knowledge, ideas and mitigation measures is easily handled between farmers and their specialists.

Radio Frequency Identification (RFID): This technology involves giving animals the identification feature for easy allocation and obtaining information about the animation. Animals such as cattle, goats and poultry are given tags on their body parts so that every information about the animal such as is easily accessed via micro waves to the owner's smartphone or computer. This enables the farmer to easily trace the animal's whereabouts, control the breeding capacities, understand the feeding requirements, animal's weight and disease management, without necessary being in the farm but even at distant locations.

(ShashikantPatil, 2017) identified benefits of Radio Frequency identification tags as very accurate, precise, faster and very secure and can be easily implanted also inside or outside for the entire life of the animal without any harm. ShashikantPatil further explained that RFID technology helps farmers to easily record and maintain milking and egg laying database and monitoring for quick classification, individual preventive measures or maintaining group health improvement as well as improving agro-management through increased efficiencies, controlled and monitored feed, reduced feed and labor costs, enhanced outcomes and exponentially improved group health of animals.
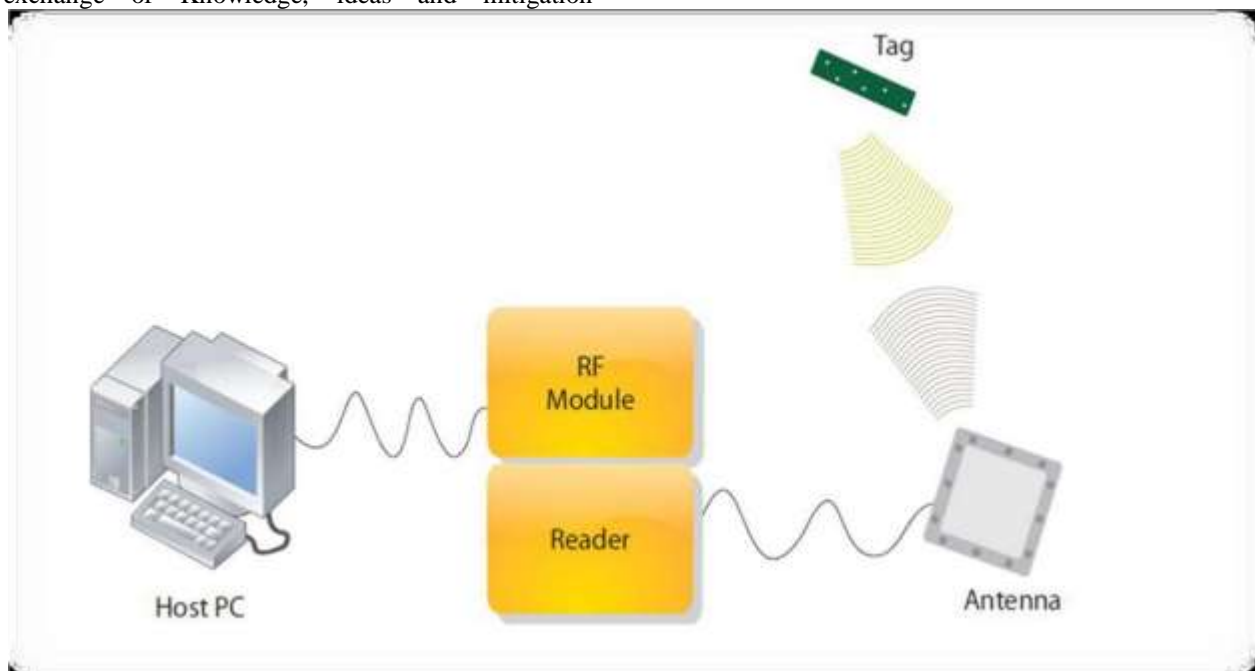

Figure 4: RFID System; source: Muhammed Taimoor et al, 2012

A combination of all roles of Information and communication technology in effective management of agriculture projects towards development is illustrated in the figure below;
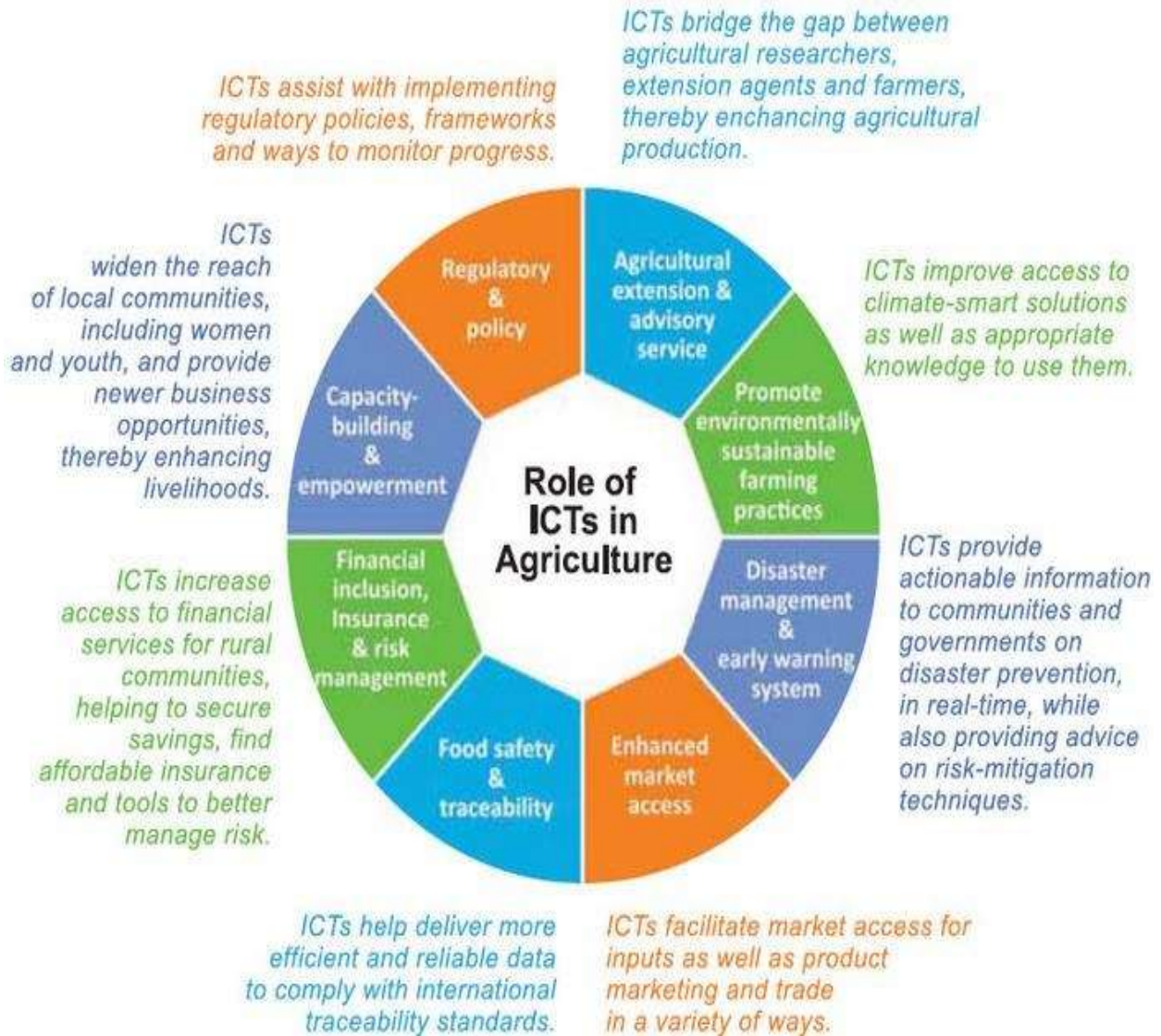

Figure 5: Roles of ICTs in agriculture; Source; FAO, ITU, 2016

Agriculture based on information technology obtains beneficial outcomes majorly the opportunity of steady progress in line with increased access to information, knowledge, skills, high produce, solutions and profits. The table below explored the outcomes obtained by its stakeholders from E-agriculture.

Stakeholders	E-agriculture Outcomes
Policy makers	☐ Improve dissemination of policies and guidelines within agriculture sector stakeholders; ☐ Support more informed policy, investment and research decisions through access to timely, accurate and comprehensive information from the agriculture sector; ☐ Improved monitoring of e-agriculture services
Farmers and fishers	☐ Improve the ability of farmers and fishers to access relevant agricultural information and services; ☐ Improve access to financial services, such as payment mechanisms, insurance, loans and saving products; ☐ Improve access to trade via new markets and connections; ☐ Improve livelihood of farmers and fishers; ☐ Improve access to quality inputs and reduce prevalence of counterfeit inputs through verification mechanisms.
Agribusinesses	☐ Improve management of agriculture inputs and outputs throughout the production cycle; ☐ Enable payments to farmers via mobile or electronic channels rather than cash; ☐ Improve access to international markets through certifications and interconnected commodity exchanges; ☐ Improve management of and the delivery of relevant services to growers.

Agricultural service providers	☐ Improve the ability of providers to access agricultural information in the field; ☐ Enable providers to remotely interact with farmers; ☐ Enable providers to monitor and track services provided to farmers and adoption rates; ☐ Enhance the efficiency and credibility of extension services; ☐ Enable providers to access knowledge, evidence and expertise to support skills' development and the delivery of agricultural extension services
	within local communities.
Agricultural service providers	☐ Provide researchers with greater access to evidence-based information to support decisionmaking, design and assessment; and ☐ Improve access to agricultural literature, knowledge networks and resources

Table 1: E-agriculture outcomes; *source:* FAO, ITU, 2016

BARRIERS TO UTILIZATION OF INFORMATION TECHNOLOGY IN MANAGING AGRICULTURAL PROJECTS

Adoption of E-agriculture is still low especially among rural Ugandans irrespective of variety benefits that the technology contributes to the sector. The adoption and effective application of information technology tools to perform agricultural activities mainly depends on the level of farmers' education and wealthy. Therefore, the majority rural Ugandans who are poor with limited or completely no education, are still reluctant in adopting the technology.

Inadequate agricultural extension services also have a strong hand in hindering the appreciation and adoption of information technology in agriculture by Ugandans most especially in rural areas. Ninsiima, 2015 explained that agricultural extension services in Uganda and in many parts of the developing world are constrained by an array of challenges which include: (1) too few extension workers compared to the number of farmers; (2) a huge disconnect between research, extension and farmers; (3) and the language used in agricultural research and technical bulletins is often in the country's official language, which can be a foreign language such as English which farmers cannot read.

As part of interventions in promoting e-agriculture, the World Bank developed a model that demonstrates how agricultural development goals and challenges are linked to information flows to achieve specific impacts. The illustration is as below;
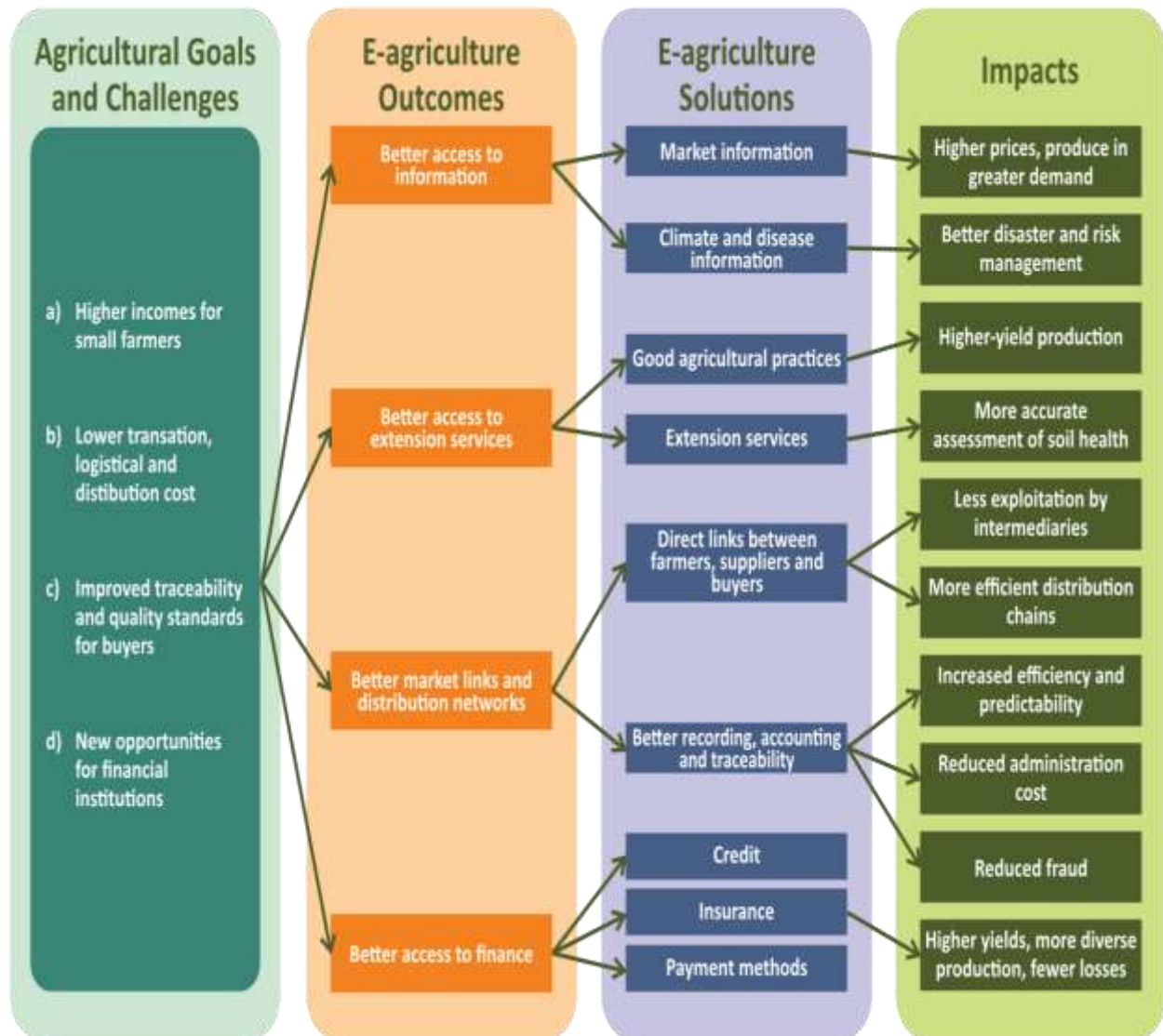
Figure 6: link up of agricultural development goals and challenges to information flows;

source: World Bank cited by FAO, ITU, 2016

RECOMMENDATIONS

The government of Uganda in support with other non-government organizations should holistically motivate information technology application in agriculture sector by reducing costs imposed on ICT tools that support agriculture. Agricultural extension services should also be improved by employing a bigger number of service providers to ensure that e-agriculture applications and benefits are fully appreciated and adopted.

Mobile phones as information and communication tool is proved to be the most reliable since it is cheap, portable and requires limited techniques to use. However, the application of these mobile phones should advance to effective cater to the capacity of rural farmers who majorly depend on them so as to sufficiently perform their purpose of disseminating information.

Capacity building among farmers across the country should be fully provided through regular trainings and monitoring to ensure that the sufficient knowledge and information are delivered to the beneficiaries in agriculture sector management in the agricultural sector at the right time in a user-friendly and accessible manner. This will assist in eliminating the reported challenges of limited technical knowhow, fraud involved in operational processes as well as ensuring clear connections between farmers and agriculture

professional consultants. Ugandan farmers most especially those using it for economic purposes should take an extra mile to fully engage in e-agriculture related operations to remain competitive in the world market.

CONCLUSIONS

Agriculture is an activity that is undertaken worldwide and basically depended on as the main source of food and to some extent as an economic activity and therefore has the potential to completely eradicate poverty once given a first priority and sufficient support. The government of Uganda applied double efforts in increasing the financial budget allocation to the agriculture sector and a number of projects in support of the sector advancement.

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Introduction of E-agriculture in Uganda, in line with information technology enhancement has played a big role in effective management of agricultural projects and the benefits are very high ranging from information and knowledge access, high quality and quantity produce, weather forecast, less time consuming among others, with limited expenses. This has enabled the bigger population in the country to enjoy a sustainable life due to improved and sustainable production.

Much as the positive side of E-agriculture in Uganda overweighs the negative one, shortages in adoption still exist most especially among rural communities due to limitations related to education and finances