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Internet of Things (IOT) For Smart Agriculture: Economic Recovery and Sustainable Development

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Abstract

The Internet of Things (IoT) has emerged as one of the most powerful and widely discussed technologies in recent times. IoT is a network of connected objects or 'things' that are embedded with sensors or electronic components that enable them to collect and exchange data with each other and the environment. IoT has been identified as a key enabler for economic recovery and sustainable development, particularly in the context of smart agriculture. Smart agriculture is an approach to agricultural production and management that utilizes advanced technologies such as sensors, robots, and big data analytics to improve yields and reduce waste. This study reviews the potential of IoT in smart agriculture to achieve economic recovery and sustainable development. Specifically, it examines how IoT can be used to increase productivity, enhance sustainability, and reduce cost, security, privacy, data management, energy, lack of access to knowledgeable farming techniques, and oversight of land use. It then discusses the economic and social benefits that can be achieved from applying IoT in smart agriculture and suggests strategies to overcome these challenges.

Keywords: Smart, Agriculture, Recovery, Economic

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Introduction

The Internet of Things (IoT) is one of such devices discovered by man in communication and information technology, Hence in 1999, IoT was launched in the computing subspace as one of such technologies found in the area of information dissemination. A member of the radio identification frequency development community (RIFDC) designed it to fast-track communication in the area of cloud computing and data analytics because of its fast rate of coverage especially in radio coverage.

The world has identified smart agriculture as a key component in its economic recovery plan. Smart agriculture practices can increase crop yield and quality, increase farm inputs, decrease operational costs, and provide greater environmental protection. To capitalize on the potential of smart agriculture, the world must first develop a clear understanding of the technologies available and their potential benefits. Additionally, the country needs to explore existing regulations and policies to ensure they are not impeding the adoption of the technology. There is a need to build capacity in the agricultural sector to ensure proper implementation and integration of smart agriculture.

IoT as a computing resource, has assisted its users in information sharing, communication management, intelligence, planning, and management as a whole including policy-making analysis. Shiva, (2019) evaluated IoT as a network of physical objects. It could be applied in a series of networking activities including computers, devices, smartphones, home appliances, toys, cameras, and so on. It also could be applied in medical and industrial systems, animals, and buildings. IoT is all-encompassing. It could apply in all spheres of human life primarily to promote good living in the area of information sharing and communication.

According to Keyur (2018), IoT could be categorized into three major categories

i. IoT engaging people to people

ii. IoT engages people with things or machines and

iii. IoT involves things and machines to things or machines.

All of these are various interacting devices involving IoT through the Internet mechanism.

Agriculture has over the years been practiced primitively by farmers, especially in sub-Saharan Africa. This is due to the absence of intelligent technological know-how where its practice could be leveraged. In the West and developed economies, agricultural practice is technologically driven. This is not so in Africa. This non-practice of IoT-based agriculture has resulted in food storage defects in Africa.

How do we apply certain technology devices such as sensors for IoT to boost food supply in Sub-Sahara Africa? If applied appropriately by relevant government agencies and private sectors IoT could launch Africa into a community of nations that have mechanized agriculture and consequently exporting agricultural produce. This will launch Africa from a food-importing nation to a food-exporting nation like Taiwan, the USA, and China. With the right strategies in place, Africa can leverage smart agriculture to achieve its economic recovery goals.

The Technology Acceptance Model

The model for technology acceptance is an information system and communication model propounded by Davis in 1989. It hinges on accepting new technology and using it. The technology acceptance model explains that when one who uses technology has been offered a new technology, there will be a factor that will influence their decision on how, when, and where to use the new technology. Such factors are useful in perceiving what the degree is when users agree that using a

particular technology will improve their performance or achievement. The user intentions and perceived usefulness in the world of social effect (image, voluntariness, and subjective norms) and cognition such as thinking and reasoning in processes are instrumental to the (relevance, job and output quality, demonstrability, and result) of new technology. The main reason for this model is to suggest an acceptable tool for identification and modifications that must be brought to the new technology to make it easier and acceptable to the users. The model of technology acceptance emphasizes that the use of interconnected devices of communication is determined by behavioral intention. Therefore, for a workplace, even when an employee does not want the communication system to be used, the probability that the user will use the new model is very high because it will increase performance at work. Figure 1 aptly illustrates the attributes of the model. The model was adopted in this paper because it explained the expected behavior of IoT users in accepting and utilizing Internet services for research and users' perception of IoT.

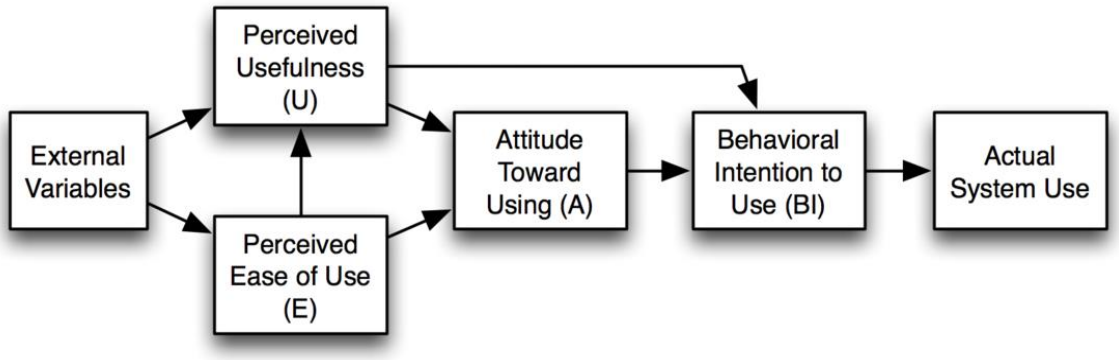

Figure. 1: Technology Acceptance Model. Source: Davis (1989).

Smart Agriculture for economic recovery and sustainable development

In the 21st century, there is a current move from the traditional way of agriculture to smart agriculture which involves devices such as sensors with IoT; Context-aware Computing, and the concept of Ubiquitous Computing. The term smart appears as a sharp word with many ramifications such as a smart farm, smart office, education, smart hospital, and so on. These instances prompt researchers to initiate research toward systems that could make some degree of the decision by their different degrees of complexity. Sensor devices have a very important role in measuring smart agriculture and support import in decision-making. Junaid (2009) shows that smart agriculture is a systematic involvedness subject to the following steps;

i. collecting and transferring information from the field of agriculture to station control for making decisions,
ii. Sensing local agricultural parameters,
iii. decision-making based on local data,
iv. gathering and identification of data from sensing location,
v. history, knowledge, domain, and determine the base on decision

It is observed that the optimization of sensors' operations will be achieved better through the development of plants and crops. Utilization of advanced technologies such as IoT devices and interconnected networks would take the next level of smart agriculture. The smart agriculture concept will change from traditional agriculture to smart agriculture and also provide solutions for agricultural problems. This will aid pathways to robust economic recovery and sustainable development in Africa.

Enabling technologies of IoT for Smart Agriculture and Economic recovery and sustainable development

IoT is a worldwide network resource for enabling advanced services and data society. It is further used for smart agriculture.

To achieve effective smart agriculture and sharing of data on the cloud, the following IoT-enabling technologies are necessary;

i. Improve the creation of new technologies
ii. Privacy and security of data and
iii. Provision of technologies that would enable related devices to improve information sharing.

Functions of smart agriculture shown in Bullet points 1 and 2 are inter-related because of their functional role in building intelligence which is invaluable in their differentiation of IoT and Internet. The IoT for instance is the combination of different technologies (hardware and software) and both provide solutions. Furthermore, both the hardware and the software technology are involved in communication.

On the other hand, IoT can be in global use by different interconnected networks of devices such as heart monitoring in plants, Electric equipment, and so on. It is also used for animals in coastal waters, and automobiles with inbuilt sensors and actuators for analysis devices such as environment, food, pathogen, and other field operation uses which could assist fire-fighters for rescue operations.

These interconnected devices could be used for useful information; using the existing technologies to the information flow. Supporting this argument, Neate, (2013) noted that things in IoT such as the interconnectivity of the network of the physical world are both integrated into the communication network.

The problem of IoT for Smart Agriculture for economic recovery and sustainable inclusion

There are some main problems facing IoT. Therefore, before accepting IoT for smart agriculture there is a need to address such problems. The following are some problems militating against the quick adoption of IoT for smart agriculture.

Energy: Energy is very vital in the IoT. Due to energy constraints in some countries, it has become increasingly difficult to access energy for the proper use of the Internet.

Security: Security is a very important issue that needs to be addressed before generally adopting IoT globally.

Privacy: As a result of the popularity of IoT and its usage in information and communication, it therefore becomes more problematic in the area of privacy for technology management; especially in developing nations of the world.

Cost: The IoT uses devices for interconnection of networks to share information or data on the Internet. For the IoT adoption to grow, the cost of equipment needed to procure such things as sensors, wifi, and control mechanisms need to be relatively accessible in the future.

Data management: This is an important area of IoT. When considering global interconnectivity and the exchange of all kinds of data, information, or generated information, the process involved in the handling of these data becomes a critical issue.

Conclusion

It is concluded that IoT offers a powerful and effective way to improve economic recovery and sustainable development through smart agriculture. IoT can help to reduce costs, increase yields, and ensure sustainable land management. While there are some challenges in deploying IoT in smart agriculture, these can be overcome by creating an enabling environment that encourages

investment, innovation, and collaboration. This study serves as a useful starting point for policymakers, businesses, and other stakeholders to better understand the potential of IoT in smart agriculture

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