Internet of Things (Iot): It's Application For Sustainable Agricultural Productivity In Nigeria

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ABSTRACT

The paper considered Internet of things as it applies to agriculture. It's relevance in the area of weather forecast, irrigation/fertilizer application, tracking of farm produce, internet banking, pests and disease control and monitoring were looked into. However, Nigerian agriculture has not witnessed such reformation and transformation due to some challenges. Therefore, some recommendations were made to combat these hindrances and move Nigerian agriculture to an enviable status of world-class standard.

Keywords: Internet Of Things (Iot), Applicatio, Sustainability, Agricultural Productivity and Nigeria

1. BACKGROUND TO THE STUDY

Internet of Things (IoT) is a recent technology that is gaining wide awareness and acceptance in several fields due to its practical relevance in everyday life improvement. IoT has found its utility in transportation, environmental monitoring and forecasting, home and office appliances, agriculture, health, security and energy conservation. However, in Nigeria, the impact of IoT in agriculture is not conspicuously evident. This might be probably traced to low level of awareness, illiteracy, poverty, insufficiency or lack of electricity most especially in the rural area where Nigerian agriculture is more pronounced.

The Internet of Things (IoT) is the network of physical objects, devices, vehicles, buildings and other items which are embedded with electronics, software, sensors and network connectivity which enables these objects to collect and exchange data (GSI, 2015). The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more-direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. IoT example, any object which is capable of identifying, connecting and communicating with other objects is an example of Internet of Things (Santucci, 2011: LOPEZ Research Series, 2013; Reddy, 2014).

Also known as precision farming, this method of farming uses data analysis to customize operations so as to maximize agricultural output based on variable inputs. These practices may enable significant opportunities for savings, given that as much as 60 percent of water diverted or pumped for irrigation is wasted. In addition, to ensure food safety, data-driven solutions enabled by the Internet of Things will allow consumers to track and monitor produce from farm to fork (Castro, 2013). There is growing interest in the potential of internet of things technologies (IoT) to support poverty alleviation and the up-liftment of the living standards of people (Kopetz, 2011) especially in the developed world. The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to contend with the enormous challenges they face.

The industry must overcome increasing water shortages, limited availability of lands, difficult to manage costs, while meeting the increasing consumption needs of a global population that is expected to grow by 70% by 2050 (FAO, 2009). New innovative IoT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. Monitor sensors that can detect soil moisture, crop growth and livestock feed levels, manage and control their smart connected harvesters, irrigation equipment, and utilize artificial intelligence based

analytics to quickly analyze operational data combined with 3rd party information, such as weather services, to provide new insights and improve decision making (Castro, 2013).

The "Internet of Things" refers to the concept that the Internet is no longer just a global network for people to communicate with one another using computers, but it is also a platform for devices to communicate electronically with the world around them. The result is a world that is alive with information as data flows from one device to another and is shared and reused for a multitude of purposes. Harnessing the potential of all of this data for economic and social good will be one of the primary challenges and opportunities of the coming decades (Castro, 2013).

A combination of technologies, including low-cost sensors, low-power processors, scalable cloud computing, and ubiquitous wireless connectivity, has enabled this revolution. Increasingly companies are using these technologies to embed intelligence and sensing capabilities in their products, thereby allowing everyday objects to sense, learn from, and interact with, their environment. Some of these devices engage in machine-to-machine communication. For example, sensors on the roadway electronically alert cars to potential hazards, and the smart grid sends dynamic electricity pricing data to home appliances in order to optimize power consumption. Other devices communicate information to their users, either directly through the product itself or indirectly through a web browser on a PC or mobile device. For example, decision support systems on farms may combine data on soil conditions from environmental sensors with historic and future pricing and weather data to produce recommendations to farmers on how to plant and fertilize particular plots of land.

IoT on the other hand is the connecting of physical things to the internet which makes it possible to access remote sensor data and control the physical world from a distance (Kopetz, 2011). The IoT has the purpose of providing an ICT-infrastructure facilitating the exchange of 'things' in a secure and reliable manner, i.e., its function is to overcome the gap between objects in the physical world and their representation in information systems (Weber and Weber, 2010).

2. STATEMENT OF PROBLEM

Sustainable agricultural practices help meet immediate societal needs while protecting land and other natural resources for future generations. The Internet of Things is helping to create smart farms where every process can be monitored to reduce waste and improve agricultural productivity. In the recent times, climate change is inflicting unfavourable condition on agriculture causing set-backs in productivity. However, IoT can help to combat a host of these challenges. Interestingly, Nigerian agriculture is mostly carried out in the rural areas of the country by rural dwellers that are illiterate. Hence, provision should be made to accommodate these set of people to boost the nation's food security, economic status and development.

3. RELEVANCE OF IoT IN AGRICULTURE

Weather is a paramount factor to be considered in crop and animal agriculture. Hence, weather forecasting and monitoring must be accurately predicted so as to carry out production activities to time for eventual improved productivity. Animal agriculture is also affected negatively by harsh weather; in terms of reproduction, performance and production. Thus, forecasting and monitoring of weather situations empower the farmer with information that can guide them in planting, harvesting and other production activities to be carried out. Also, policy makers can be fortified with information that will guide their decisions aright.

Weather forecasting can be done through analysis of weather data over long periods to reduce agricultural risk. This is referred to as big data analysis. In weather forecasts for pest management, humidity, precipitation, crop type, soil fertility, leaf wetness, temperature, winds and soil moisture are collected at local level through sensors. The life cycle of pests is monitored along with the climate data, allowing researchers to predict pest outbreaks more accurately because pest maturation depends on environmental conditions (Dlodlo and Kalezhi, 2015).

Temperature, humidity, light intensity, and soil moisture can be monitored through various sensors. These can then be linked to systems to trigger alerts or automate processes such as water and air control. They can also be set up to look for early signs of pests or disease (Huang, 2014).

The use of drip irrigation system for wetting plants eliminates waste of water and fertilizers. Sensors are used to detect the moisture and nutrient deficiencies of plant and soil while the right quantity is allowed to drop where it is needed. As such, under or over watering is eliminated. This can be said to be precision agriculture and it can lead to great harvest even in dry/drought periods of the year. Crops that are naturally unavailable in dry season can be readily made abundant through this means.

IoT technologies facilitate the tracking of farm products from farm to fork, hence, all individuals involved in production, processing and transportation are fortified with necessary information to discharge their duties. In Nigeria, most of the farm produces are not always available in industrial quantity in a place at a given time. Hence, buyers or middlemen go around seeing farmers that are ready to sell their produces at a given time and they buy from them in bits. Transporting these goods is also a big challenge in Nigeria, due to the fact that they are purchased in bits, the produce sometimes may not fill up a lorry. However, with the advent of IoT, the transporter can be guided to others in the vicinity in need of this service.
Also, smart phones can be equipped with software that can enable internet/mobile banking for both farmers and buyers to encourage cashless transactions.

This can be a great intervention for farmers that are mostly rural dwellers where no bank is situated within a reasonable distance. E-banking will also reduce the incidence theft and aid e-purchase of farm inputs.

To prevent stock theft, animals are fitted with radio frequency identifiers (RFIDs) that enable tracking of the animal. The position of the animal can be visualised on a map in a control centre through data remitted wirelessly. In rural areas where there is communal grazing, animals tend to get lost. Livestock can be fitted with radio-frequency identifiers (RFID) chips and RFID readers are placed at various monitoring spots to transmit information to (Dlodlo and Kalezhi, 2015) the farmer.

With soil monitoring systems in the fields, farmers can better predict yield. The accessibility of this information, combined with the farmer's first-hand experience, can lead to better decision-making and a more efficient use of resources—with the overall benefit of better productivity. The overall goal is the same: to use the right amount of resources at the optimal time and reduce waste. Furthermore, farm workers receive real-time notifications from farm machinery equipped with wireless sensors as issues arise. The ability to perform preventative maintenance and repair issues immediately could lead to tremendous cost savings in decreasing down time and protecting valuable assets (Farrell, 2015).

The health of farm animals such as cattle or chicken can be monitored to detect potential signs of disease. This can be linked to a central system which can trigger relevant advice to be sent to farmers, and contribute towards analytics that can be used to identify any outbreaks or trends (Farrell, 2015).

Record keeping and farm monitoring on the farm are made easy through the aid of internet of things. Illegal felling of trees in the forest can be detected through IoT without the use of security personnel. Farmers can also be alerted prior to fire outbreak or incidence.

4. MAKING IoT SUSTAINABLE IN NIGERIA

In view of the importance of IoT in agriculture as well as its obscurity to practicing farmers in Nigeria, the following recommendations are made:

- Internet facilities should be made available for the rural farmers
- Adult literacy should be intensified
- Computers, i-phones and other network-connecting media given to farmers should be loaded with software written in mother tongue of the farmers of that locality
- Simple but explanatory flow chart for mode of operating the connecting media should be made available to the farmers as well as continuous training and sensitization
- Solar energy as source of power for charging phones, laptops etc should be made available to avoid eventual effects of incessant power failure
- The farmers' children should be integrated into the training and application of IoT in their area to further enhance continuity
- Extension agents should be well articulated in the field and accessible to the farmers for trainings and clarifications

5. CONCLUDING REMARKS

The global food challenge necessitates that farmers find better means of feeding the population which is growing with a geometric progression. With internet of things, agricultural practices is made modern and easy, it improves operational efficiency, drives productivity, creates new revenue sources and, ultimately, makes sustainability synonymous with profit. However, Nigerian agriculture must be worked on through provision of modern internet-based equipment/facilities and trainings to obtain improved productivity as attained in developed countries.

6. CONTRIBUTION TO KNOWLEDGE

Based on the importance and application of Internet of Things to agriculture, it is recommended that Nigerian farmers:

- Should have access to facilities and trainings on internet of things that relate to agriculture that is made available in their local language
- Should be taught to read and write their local language

Also, Government policies should support and aid the extension agents through trainings, incentives for successful execution of projects and transportation means to interior villages.

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