EMERGING TECHNOLOGIES IN AGRICULTURAL ENGINEERING

Dr Kehdinga George Fomunyam
Mangosuthu University of Technology, Umlazi, Durban, 4031, South Africa

ABSTRACT

The main purpose of this paper is to analyze emerging technologies in agricultural engineering and its import on agricultural production. There has been series of changes in agricultural technology. Agricultural engineering has been reputed to be a veritable tool for ensuring food security globally and it is now recognized in the global front. Efforts to make it more acceptable has resulted in the development of various technologies aimed at improving agricultural production. This study analyzed the emerging technologies in agricultural engineering and gave a thorough review of how it has brought about improvement in agricultural production generally. The study relied on relevant literature as it relates to agricultural engineering to lend support to the topic under consideration. It concludes and recommends that these technologies should be replicated across board especially in African countries where food insecurity and malnutrition is still prevalent.

Key words: Engineering, Agricultural Engineering, Technology

Cite this Article: Dr Kehdinga George Fomunyam, Emerging Technologies in Agricultural Engineering. International Journal of Mechanical Engineering and Technology 10(7), 2019, pp. 172-178.

http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=10&IType=7

1. INTRODUCTION

There has been concerted effort at the global front to combat food deficit, need for food, and changes within the environment. This has been at the forefront of international, political and research agenda in the area of agriculture and food production. Thus, the emergence of modern technologies into agricultural engineering is celebrated worldwide. Evidences from recent projections revealed that the global population will soar to reach an estimate of 9billion by year 2050 and there will be significant increase in certain regions like Asia, Latin America, and Sub-Saharan Africa (FAO Statistics, 2016). This typifies that there will be demands for more supply of food to feeding the teeming population in those regions. Hence, the need for intensification of efforts in all spheres to ensure that food is readily available.

It is noteworthy to keep in mind that one of the major challenges to be faced in this epoch is the need to have at least 60% increase in the current food production level so as to keep up with the increasing population in Nigeria (Blackmore,2012; Wilson,2013). Added to this gap in food production is the recent issue of climate change which has adverse effect in developing countries. The recurrent incidences of flood and drought, erosion, and aridification...
in the north are all dimensions through which climate change takes place and, olagbende *et al* (2016) remarked that as a result of the effect of climate change and increase in population, there will be significant effect on agriculture and the environment globally which might affect food security.

Agriculture has always been at the focal point at all levels of development globally and it has been facilitated by interventions in the field of engineering. The need to have a better way of doing things brought about the drive for agricultural engineering and this has been manifested as interplay between man, plants, animals and mechanical devices. Agricultural engineering comprises all activities that facilitates the production and processing of food, feed, fiber and fuel resources which result to; significant reduction in drudgery, effectiveness in delivery and conservation of natural resources.

Records show improvement in the conduct of agricultural engineering globally and what stemmed from crude, unsophisticated tools have transformed into complex mechanical devices that eases production thanks to mechanization. Hoes, cutlasses and drought animals have transformed into large complicated machines like the diesel tractors, harvesters, planters etc. Also, electric power have a significant impact on production in that it eases operations, reduces drudgery and makes preservation of food easy (Ogunlowo *et al*, 2005). The growth in agricultural engineering has not stopped as it keeps getting better. There are variety of emerging technologies that has facilitated the practice of agricultural engineering and replete among them are precision agriculture, smart farms, drone farming, and GPS-based applications.

This study will therefore aim to analyze the emerging technologies in agricultural engineering and give a thorough review on how it has brought about improvement in agricultural production generally.

2. NEXUS BETWEEN TECHNOLOGY AND AGRICULTURAL PRODUCTION

According to Tillman *et al* (2002), agriculture has been reputed for being a source of food for the world population. Agriculture has been in existence for over 10000 years, it started with the hunter gatherer groups in southwest Asia and China. Agriculture today can boast of feeding 7billion people in the global front and this is a testament to the fact that agriculture has evolved over the years. There are series of changes that came with its development and it rose from simple to modern coupled with the use of technology to ensure that it proceeds smoothly. The positive approach of technology in agriculture has contributed to human lives and the world today. Agriculture at the crux of civilization have so much importance and it supplies the things needed for life and sustenance such as food, clothing, shelter and income. This is in line with the findings of Insight (2009) who reported that agriculture is important in the lives of individuals all around the world.

Advances made in science and technology has been beneficial to agriculture making it profitable while assuring sustainability. Technology has also reduced the burden on farmers in that, complex machineries now perform most jobs that ordinarily would have been done by farmers. Although, the increase in world population necessitates the creation of new and appropriate ways of providing food items for the teeming population and boost productivity. This means that technology, has generated better ways to manage the soil, water, nutrients, and pesticide while increasing food production and not undermining the environment and human safety.
3. A REVIEW OF EMERGING TECHNOLOGIES IN AGRICULTURAL ENGINEERING

As stated by Jehoon (2018), series of innovative technologies will emerge and such technologies might possibly not be defined by current laws and systems. Some of these emerging technologies are discussed below:

3.1. Global Positioning Satellite

Global positioning satellite is applicable in mapping and guidance duties. With the use of GPS, generic radio communication technique can be applied to mobile telephones or other networked systems. ZigBee (2007) asserts that, GPS allows for remote monitoring of farms, the gate, livestock, equipment/machineries and automatic filling of feeding and water troughs.

3.2. 3D Printing

3D printing is also known as Additive Manufacturing (AM) or Solid Freeform Fabrication (SFF) gained prominence in the food sector following the works of researchers from Cornell University in New York. AM is done by applying a printer that works based on the principle of extrusion (Periard, Schaal, Malone & Lipson, 2007). One of the characteristics of this technology is the layer by layer deposition of material which is gotten from a pre designed template (Pinna et al, 2016: Rayna &Striukova, 2016). This implies that this technology is additive and that it works by adding various layers of materials on others.

In the same vein, Sun, Zhou, Fuh & Hong (2015c) claims there are many methods to the application of the 3D printing technology and it is applicable in the food sector in that, it is used in making custom made food designs, customized and digitalized nutrition, easing supply chain, and widening the available food input. Using this technology produces amazing designs that cannot be done manually or by using the conventional templates but, it can be done by laymen plying predetermined templates from the works of chef, culinary experts and food scientists as stated by (Sun, Zhou, Fuh & Hong, 2015c). This typifies the ease that comes with 3D printing.

3.3. Block Chain

A block chain is a digital transaction ledger controlled by a network of computing machines that do not have the influence of a trusted third party. According to Bano (2017), one distinguishing feature of the block chain is its ability to maintain a constant view and agreement among the users. This shows that block chain technology confers consensus on its participants. The block chain have various application in crypto currencies, same way it is vital in agricultural production in the area of food supply chain. There is a close relationship between agriculture and food supply chain because, the end products of agricultural production are utilized as inputs in the supply chain with the consumer as the final man in the chain (Maslova, 2017). This is why ICT4Ag (2017), reported that block chain technology made them record success. The company ‘Agridigital’ initiated the world’s first settlement of the public sale of 23.46 tons of grain on a blockchain. Since then, there has been increase in the volume of transaction recorded. Their success story became a template for potential use of blockchain technology in the agricultural supply chain.

In addition, block chain technology can be applied when solving real life problems in the agricultural supply chain. The food chain globally is multi-faceted and complex because various actors are involved. Block chain offers a remarkable benefit in agriculture in that it can provide a convenient safe and easy way to carry out transactions among different untrusted parties. This is in line with the findings of Lin (2017) who stated that transactions are key in agriculture and food supply chain even when numerous players are involved.
starting from the primary stage of production to the tertiary stage. In developing countries, block chain can be a support to small farmers. This agrees with Chinaka (2016) in his remark that block chain could involve finance and insurance of rural farmers which also eases business transactions.

3.4. Robotics
Robotics is applicable to a variety of functions on the farm in milking animals (International Federation of Robotics, 2017). Though it has been predicted by European Parliamentary Research Service (2016) that, around 50% of European herds will be milked by robots in 2025. Note that it was the theoretical implication and practical application of automated systems that led to the invention of robotics. Robots are designed to perform autonomous or semi-autonomous (with a handler) smart roles and it has different sizes and shapes depending on the context of usage. Robots are relevant in agriculture especially in smart farming and it performs autonomously when sensors are incorporated into them. They are able to analyze situations and make decision. Data on the sensors can be leveraged on to improve their decision making skills. It goes to show that Robots are important for automating the agricultural sector which starts from cultivation to harvesting, besides the fact that they can be used in the livestock sector for milking, cow dung disposal, cleaning of barns, field fencing etc.

3.5. Smart Farming (Precision Agriculture)
Blackmore (2009), explained that precision agriculture was initiated in development and was applied to industrial manufacturing which dates back to the 1970s and 1980s. It is a practice that involves the application of monitoring and intervention techniques to ensure that efficiency are guaranteed, this involves the use of sensing technologies and automation. What led to the development of precision agriculture was the need to have better means of handling spatial and temporal variation like in soil, water and crop varieties (S Blackmore, 2009). Although, other methods of agriculture existed but they did not factor in the need to consider space and temporal variability. This is done by ensuring the use of other smart and intelligent machines which applies inputs in ways that are effective. This led to the development of compact, small and smart machines that ensures that wastes are reduced, environmental impact is controlled and food sustainability is guaranteed.

3.6. Big Data
Data is a vital part of human life and data is produced on a daily basis which makes its application wide (Carbonell, 2016). The use of data is important in agricultural production especially in agribusiness. In the light of this statement, (Hilbert, M and Lopez, P, 2011) expresses that the penchant to access, analyze and manage huge volumes of data can result in successful agribusiness hence the drive to incorporate big data into our production. As described by Mayer-Schongerger, V and Cukier, K (2013), big data can be useful in forecasting and this will improve the efficiency of production and prompt decision making. With organizations having a wide plethora of data, big data will aid their analyzation. Also, big data is useful in weather data, in improved forecasting of output and production, and in optimum use of seed and other inputs. It can also influence real time decision and alerts as a result of data generated on the fields and equipment.

3.7. Artificial Intelligence
Artificial intelligence is one of the important areas of research in computer science and it is widely acceptable. What lends support to the wide reception it has garnered is the rate at
which it can solve problems that might not be handled nicely by humans using traditional computing systems (Rich and Knight, 1991). Artificial intelligence can be applied in general crop management and it was first proposed by McKinion and Lemmon in 1985 in their research paper titled “Expert Systems for Agriculture” (McKinion, and Lemmon, 1985). Its operation is paramount in pest management, disease management, agricultural product monitoring and storage control, and soil and irrigation management, weed management, yield prediction etc.

3.8. Internet of Things

Internet of things is the assembly in a network, physical objects, vehicles, buildings and other items which are infused with; electronics, software, sensors and network connectivity that allows for collection and exchange of data (GSI, 2015). This portrays internet of things as a fusion of various systems which works together to transmit, collect and exchange data. Internet of things allows for sensing of objects and this can be done remotely across a network since it projects interaction between the physical world and the world of computer. When this is done, it results in efficiency and precision thereby conferring economic benefits. In the definitions of (Santuci, 2011: LOPEZ Research Series, 2014: Reddy, 2014), it was revealed that any medium which allows identifying, connecting and communicating with other object is a viable example of internet of things. The combination of technologies which include low cost sensors, low power processors, cloud computing, wireless connectivity etc., has made internet of things possible. Because of internet of things, all environmental conditions can be monitored such as; temperature, humidity, light intensity and soil moisture. The aforementioned can be linked up with other systems to send an alert whenever there is a dip or increase in such conditions (Huang, 2014). Internet of things can also ensure proper tracking of agricultural products from the farm to the final consumers.

Subsequently, it is evident that the fourth industrial revolution has already begun as revealed in the words of Schwab (2015) hence, a shift from the previous paradigm will be observed. The fourth industrial revolution will come with disruptive changes that will be different from that of the first to the third revolutions. On that account, there is need to place focus on the opportunities it might introduce to agricultural production. Technologies in agricultural engineering have evolved over time and there are series of innovative technologies that aims at easing the conduct of agricultural production globally. Most of these technologies are still resident in highly industrialized nations. In Africa, the system of agricultural production is crude, conservative and relies on rainfall for production. This seems inappropriate at this time as there must be concerted effort which must seek to artificially alter and make natural elements available all year round so as to ensure food security. With the scourge of climate change, there has been a shift, to cope with this shift, people must leverage on this emerging technologies.

4. CONCLUSION

This study has considered emerging technologies in agricultural engineering and it expresses that the emerging technologies are key to ensuring optimum food production for the teeming populace of the world. Farmers in Africa will need to meet up with the standardized technologies to aid provision for all her citizens and also give room for surplus in case of exportation to other countries and to reserve for future demands. Recall that the increasing population of the world alongside, the serious food insecurity issues and the scourge of climate change has been discussed during the course of this research. There is need therefore, to maintain optimum food production, reduce cost, conserve resources and mitigate...
environmental hazards, which makes it fundamental to incorporate emerging technologies into agricultural production.

REFERENCES


[29] Background_on_Agricultural_Practices_and_Food_Technologies


