

How Artificial Intelligence Could Transform The Nigerian Agricultural Sector

ABSTRACT

Agriculture in Nigeria faces many challenges such as disease and pest infestation, poor soil preparation, use of unviable seeds, and poor herbicide and pesticide usage to say the least. This leads to poor crop yield and environmental pollution due to the incorrect use of chemicals. The field of Artificial Intelligence with its rigorous learning capabilities has become a key technique for solving different agriculture-related problems. This paper addresses the application of Artificial Intelligence to different Agricultural sub-domains and, the limitations the average Nigerian farmer will face when adopting some of these methods.

INTRODUCTION

Background of the Study

As of 2020, about 35% of the population in Nigeria was employed in the agriculture sector, which is a subset of the country's economy. Despite the presence of oil in Nigeria, the FAO reported that agriculture still forms the backbone of the country's economy. For most Nigerians, it is their primary means of support. (Agriculture in Nigeria, 2021)

Nigeria has 34 million hectares of arable land, of which 6.5 million are used for perennial crops and 28.6 million are used for meadows and pastures. Approximately 24 per cent of Nigeria's GDP is derived from agriculture. The nation is a global leader in producing various agricultural products, including sorghum, cocoa, pineapple, and palm oil. Just behind the United States, it is the second-largest sorghum producer in the world. In terms of palm oil and cocoa bean production, it comes in fifth. Nigeria exports a lot of goods to other countries in this industry. One of the ten best performing export categories is oil, followed by fruits, nuts, and seeds. (Sasu, 2022)

Commercialization at the small, medium, and large-scale enterprise levels are changing the industry. The Nigerian agricultural sector, on the other hand, has faced several difficulties,

including an outdated land tenure system that restricts access to land (1.8 ha/farming household), a very low level of irrigation development (less than 1% of cropped land is irrigated), limited adoption of research findings and technologies, high input costs, and limited access to credit due to the mismanagement of specialized institutions established for the development of the agricultural sector. (Olomola, 2007) Agriculture also faces challenges, including lack of collateral security from farmers, ineffective fertilizer procurement and distribution, and, more recently, changes in average temperatures, rainfall, climate extremes, and infestation of pest- and disease-causing organisms caused by climate change. (Kurukulasuriya, 2013)

Artificial Intelligence (AI) is the science of instilling intelligence in machines to be capable of doing tasks that traditionally require the human mind. (Artificial intelligence in the internet of things). In terms of application, adaptation, processing speed, and capabilities, AI-based systems are developing quickly. Less routine tasks are increasingly being handled by machines. AI merely involves "choosing" the right decision at the right time, whereas human intelligence entails "taking" a perfect decision at the right time. Simply put, AI lacks the decision-making creativity that humans possess. Although it is possible to argue that human ingenuity will always change the nature of productive work, AI-based systems have quite elegantly reduced the repetition of human efforts and can produce results in a comparatively short amount of time. The majority of current AI research can be categorized as "Narrow AI." This implies that technology only improves a select few tasks. However, that is not what we are aiming for at all. As a result, a variety of fields have combined to advance AI. (Burns, n.d)

The interdisciplinary nature of AI has been boosted by the collaboration of numerous fields, including philosophy, computer science, mathematics, statistics, biology, physics, sociology, psychology, and many more. All the information produced in each of these fields is what makes intelligence possible. It is crucial to analyse this data to reveal the underlying principles. Although it takes a lot of time, the human brain is easily capable of doing it. This is due to some undesirable characteristics of the data in the real world, which, include: huge volume, unstructured nature, a variety of data sources, a need for real-time processing, and a constant state of

change.

Other characteristics include virility, volatility, etc. AI can be thought of as a method for effectively using data so that it is meaningful, understandable to the people who provide it, and modifiable (in the event of errors). (Ashish, Chakraborty, & Law, 2015, p.1) Therefore, data science methods are heavily utilized in AI. Broadly speaking, data science is the science of creating tools and processes to examine massive amounts of data and derive information from it. Consequently, the discipline is a synthesis of numerous other fields of study. Ideas for creating tools are primarily drawn from computer science, which is primarily concerned with storage scalability and algorithmic efficiency. Ideas for analysis come from a much wider range of sources. Methodologies are drawn from both the social sciences (such as economics, sociology, and political science) and the basic sciences (such as physics, statistics, and graph theory). Data science is also very popular with specific interdisciplinary techniques, such as pattern recognition, machine learning, and data mining. (Ashish et al, 2015)

Machine learning is a key tool for achieving artificial intelligence (ML). A certain class of learning issues can be resolved by the human brain. (Ashish et al, 2015) For instance, the visual system contains many optical neurons that facilitate human object recognition. Learning is not just limited to people; it also extends to other living things like plants and animals. A child learns to speak, a plant learns to adapt to its environment, a bird learns to fly, and so on. Our capacity to pick up new skills and adapt to our surroundings is essential to our survival. Machine learning is the term used to describe the equivalent process by which machines can learn and improve themselves for better performance. Machine learning is a field of inquiry devoted to understanding and building methods that 'learn', that is, methods that leverage data to improve performance on some set of tasks. (Tom,1997)

Learning is the process of acquiring or enhancing behaviours, skills, values, or preferences, thereby increasing knowledge. It might also entail combining different kinds of information. In essence, learning is the process by which a system modifies its settings to enhance future performance. With the aid of "machine learning," machines can mimic this learning process. An emerging area of study in computer science is machine learning, which allows inanimate systems to learn without explicit programming.

A human programmer can't provide explicit, minutely detailed specifications to carry out the task in the IoT scenario, in contrast to more conventional uses of computers where the volume, variety, velocity, and complexity of the data are overwhelming. To make a computer or system eventually teach itself to adapt to the current environment and make independent decisions, the concept of machine learning is made to be concerned with implicit learning abilities. This is how machine learning compensates for the IoT or CPS smart concept. (Chakraborty et al, 2015)

The Internet of things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. The term "internet of things" has been criticized because devices only need to be individually addressable and connected to a network, not the general internet. (Gillis, 2021) Internet of Things is simply a network of interconnected physical objects (such as household items, agricultural fields, plants, animals, etc.) and people. With some smart objects that are attached to both and are capable of sending, receiving, and analysing data, humans are connected to these devices. These intelligent objects serve as a network representation for the thing (a person or physical object) to which they are attached. (Chakraborty et al, 2015) Data collection on temperature, precipitation, humidity, wind speed, pest infestation, and soil composition are just a few of the many IoT applications in agriculture. This information can be used to automate farming practices, make wise decisions to increase quality and quantity, reduce waste and risk, and manage crops with less effort. The overall objective is to increase farm productivity while lowering costs by combining sensor data with the farmer's knowledge and intuition about his or her farm. . (Ashish et al, 2015)

Research Problem Definition

It has been observed that Nigeria's Agricultural Sector is wrought with many problems like inefficient irrigation methods, improper use of pesticides and herbicides, poor selection of seedlings for cultivation, and many more. However, a search through of literature has revealed that some countries in the world can efficiently deal with or minimize these problems. How these countries succeed in dealing with these problems

becomes a puzzle, all we know is that they apply artificial intelligence to their Agricultural Industry. None, to the best of the researcher's knowledge, exist in the application of Artificial Intelligence to the Nigerian Agricultural Sector. It is a gap that this work seeks to bridge

PURPOSE OF THE STUDY

The purpose of this study is to examine areas in which Artificial Intelligence could be applied to the Nigerian Agricultural Sector. Specifically, the research was designed to:

1. Identify the applications of Artificial Intelligence to the determination of seed viability before planting in the Nigerian Agricultural Sector
2. Find out how artificial intelligence could be used in the Nigerian agricultural sector for irrigation and soil preparation.
3. Identify the applications of Artificial Intelligence to weed control in the Nigerian Agricultural Sector.
4. Examine the problems in the adoption of Artificial Intelligence in the Nigerian Agricultural Sector

RESEARCH QUESTIONS

The following questions will guide this study:

1. What are the applications of artificial Intelligence to the determination of seed viability before cultivation and how can they be applied in the Nigerian Agricultural Sector?
2. How can Artificial Intelligence be applied in the Nigerian Agricultural Sector to aid Soil Preparation and Irrigation?
3. What are the applications of Artificial Intelligence to Weed Control and how could they be applied in the Nigerian Agricultural Sector?
4. What are the problems that would be faced when adopting Artificial Intelligence in the Nigerian Agricultural Sector?

THE INTENTION OF THE PAPER

The following will benefit from this paper: Farmers, University Lecturers that teach Agriculture, Electronic and Instrumentation Engineers interested in Agriculture, Agriculturists interested in electronic and instrumentation engineering, and the Nigerian State. This paper will hopefully assist the above-mentioned personnel in the development of viable strategies powered by artificial intelligence to fully optimize the Agricultural Sector of Nigeria.

The findings of this study when applied will help put an end to the poor selection of seeds before cultivation. It will help to reduce the amount of freshwater used for irrigation in Nigeria. It will help in the reduction of wastage and improper use of herbicides and pesticides, thereby saving money and preventing environmental pollution.

SCOPE OF THE PAPER

The paper will focus on the applications of artificial intelligence techniques to the determination of seed viability in the Nigerian Agricultural Sector. Additionally, it will emphasize how artificial intelligence could be used in Nigeria's agricultural sector for irrigation and soil preparation. It will also focus on the applications of artificial intelligence to weed and pest control. Finally, the study will focus on the problems the average Nigerian farmer would face if he/she were to decide to adopt Artificial Intelligence in his/her farming endeavours.

BRIEF SURVEY OF RELEVANT LITERATURE

The literature review for the study was done under four main headings – Application of AI to Seed Selection, Application of AI to Pest Control, Applications of AI to Weed Control, and Problems Nigerian Farmers would face when adopting AI.

The literature review revealed that Artificial Intelligence could be applied to vast areas in Nigerian Agricultural Sector.

The literature review revealed that with the aid of Machine Learning, Near Image Spectroscopy could be used to precisely identify seeds that are viable for farming which would greatly increase the probability of healthy crop growth in the Nigerian Agricultural Industry.

The literature review further threw light on how machine learning coupled with IoT devices and sensors could optimize irrigation, thereby reducing fresh-water usage in the Nigerian Agricultural Sector.

Also, the literature review revealed that pesticides and herbicides could be more efficiently applied to crops, thereby reducing their cost of acquisition and minimizing the negative effects on the environment.

Finally, the literature review revealed some of the most difficult challenges that Nigerian farmers would face when adopting AI techniques in their farming endeavours.

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LITERATURE REVIEW

The literature review for this study is organized under the following headings:

Artificial Intelligence in Seed Selection, Artificial Intelligence in Irrigation, Artificial Intelligence in Pest Control, Artificial Intelligence in Weed Control, and Problems that would be faced by Nigerian Farmers when adopting AI.

ARTIFICIAL INTELLIGENCE IN SEED SELECTION

Seeds are the bedrock of any planting endeavour. There is a great need for a quick and effective method to determine the germination condition and viability of the seed before planting or sale. Seed viability is of great significance in seed quality characteristics reflecting potential seed germination. The safety and quality of seeds and their products directly affect human health. (Shuxiang, Chi, Jiangbo, Yunfei, & Yu, 2019) For the evaluation of seed viability, conventional techniques such as the standard germination test, electrical conductivity test, seedling growth test, accelerated ageing test, cold test, and tetrazolium have been proposed and used. These techniques, however, are frequently manual, time-consuming, destructive, and/or call for specialized knowledge and expertise. As a result, they are not appropriate for widespread use or compatible with the conservation of endangered species. Therefore, the seed industry urgently needs non-invasive and high-throughput screening methods to provide farmers with viable seeds before sowing. By removing the instability and inconsistency caused by human intervention, machine learning-based detection systems are incredibly essential for determining seed viability along with satisfying reliability and accuracy. (Du and Sun, 2004; Elmasry et al., 2012).

Near-infrared (NIR) spectroscopy is based on the absorption of electromagnetic radiation at wavelengths in the range of 780-2500 nm. The basis for near-infrared (NIR) spectroscopy is the electromagnetic radiation at wavelengths between 780 and 2500 nm. The C-H, O-H, and N-H bonds of the primary compounds of seeds, such as water, sugars, chlorophylls, and carotenoids, are what primarily causes absorption. NIR can obtain the superficial spectral information and internal spectral information of seeds. This data acquired can now be fed to

a machine learning model which would yield predictive insight on the seed's viability. (Shuxiang et al, 2019)

Fruits, vegetables, crops, trees, and their seeds have all been successfully evaluated for quality using NIR spectroscopy (Pasquini, 2018).

Table 1 offers a summary of the use of NIR in the prediction of viable seeds.

No.	Seed(s)	Method(s)	Classifier(s)	Result(s)	Reference
1	Corn	NIR	PLS-DA	100%	Ambrose et al. (2016b)
2	Soybean	NIR	PLS-DA	100%	Kusumaningrum et al. (2017)
3	Pepper	NIR	PLS-DA	90.5%	Seo et al. (2016)
4	Cabbage	NIR	PLS-DA	94%	Shetty et al. (2011)
5	Radish	NIR	PLS-DA	98%	Shetty et al. (2011)
6	Juniperus Polycarpus	NIR	PLS-DA	98%	Daneshvar et al. (2015)
7	Tomato	NIR	PLS-DA	93.71%	Shrestha et al. (2017)
8	Barley/Wheat/Sorghum	NIR	PLS-DA	-	McGoverin et al. (2011)
9	Corn	NIR	PLS-DA	100%	Wakholi et al. (2018)
10	Muskmelon	NIR	PLS-DA	94.6%	Kandpal et al. (2016)
11	Pepper	NIR	PLS-DA	100%	Mo et al. (2014)
12	Wheat	NIR	PLS-DA	88.1%	Zhang et al. (2018b)
13	Castor	NIR	PLS-DA	89.5%	Olesen et al. (2015)
14	Spinach	NIR	PLS-DA	96%	Shetty et al. (2012)
15	Norway Spruce	NIR	PLS-DA	60-76%	Dumont et al. (2015)
16	Corn	NIR	PLS-DA	83%	Ambrose et al. (2016b)
17	Soybean	NIR	PLS-DA	74%	Baek et al. (2019)

18	Tomato	NIR	PLS-DA	95%	Peng et al. (2018)
19	Pepper	NIR	PLS-DA	90.8%	Seo et al. (2016)
20	Corn	NIR	PLS-DA	95%	Ambrose et al. (2016b)
21	Pea	NIR	SVM	-	Men et al. (2017)
22	Garden pea/Wheat/Rape	NIR	Net Logo	-	Kranner et al. (2010)
23	Lettuce	NIR	Pixel-based regression analysis	-	Kim et al. (2014)
24	Pepper	NIR	PLS-DA	98.9	Kim et al. (2014)

Fruits, vegetables, crops, trees, and their seeds have all been successfully evaluated for quality using NIR spectroscopy (Pasquini, 2018). The ability to determine seed viability has been extensively researched in recent years (Table 1), with diffuse reflection being the mode that is most frequently employed. (Shuxiang et al, 2019)

In terms of seed quality traits that indicate potential seed germination, seed viability is extremely important. This paragraph highlights NIR powered by artificial intelligence as an indispensable application in seed viability detection. NIR is rapid, accurate, and reliable for inspecting seed viability. If this method is applied to the Nigerian Agricultural sector, it could significantly reduce the risks associated with germination and potentially increase crop yield.

ARTIFICIAL INTELLIGENCE IN IRRIGATION

In Nigeria, 85% of the freshwater resources are used by the agricultural sector. Due to rising food demand and population growth, this percentage is rising quickly. Nigeria's manual irrigation method, which relies on measuring soil water, needs to be replaced with automatic irrigation methods that are powered by artificial intelligence (Adeoti, Oyedele, 2021)

With the use of cheap sensors and simple IoT devices, atmospheric parameters such as humidity, wind speed solar intensity, and crop parameters such as the stage of growth, plant density, and soil properties can be recorded in real-time and fed into machine learning

models to yield predictive insights on when and how to irrigate. Savitha and UmaMaheswari (2018) developed an idea of an efficient and automated irrigation system by developing remote sensors using the technology of Arduino powered by a standard machine learning model. His crop yield increased by 40%. Kandasamy and R(2018) provided another automated irrigation system. In this method, various sensors were created for various functions, such as the soil moisture sensor to measure soil moisture, the temperature sensor to measure temperature, the pressure regulator sensor to regulate pressure, and the molecular sensor to enhance crop growth. installing cameras with a digital sensor. All of these devices' output is converted to a digital signal before being transmitted to a multiplexer over a wireless network like Zigbee or a hotspot.

The first method was subsurface drip irrigation, which reduced water loss from evaporation and runoff because the water was buried beneath the crop. Later researchers developed various sensors, such as soil moisture sensors and raindrop sensors, which were controlled by wireless broadband networks and powered by solar panels and used to determine when fields needed to be irrigated. The soil moisture sensor and raindrop sensor use GSM technology to send the farmer an SMS letting them know how much moisture is in the soil. As a result, well-trained Machine learning models can send ON/OFF signals through SMS to start or stop the water supply. Thus, we can assume that this system will identify any fields that need more water and could prevent the farmer from watering during a downpour. One of the many technologies used to measure soil moisture content is used by soil moisture sensors. It is buried close to the plant roots (Dukes et. al, 2015). The sensors assist in precisely measuring the moisture level and transmit this reading to the irrigation controller. According to Qualls et al. (2007), soil moisture sensors also significantly aid in water conservation. Water on-demand irrigation is one method of using moisture sensors, in which the threshold is set based on the soil's field capacity and these sensors allow your controller to only water when necessary.

When the appointed time comes, the sensor reads the zone's moisture content or level, and watering will only be permitted there if the moisture content is below a threshold. The

other was suspended cycle irrigation, which, in contrast to water on-demand irrigation, requires irrigation time. It needs the beginning and end times for each zone. (Shah, Yagnik, Patel, Talaviya, Shah, 2019)

Table 2 is a summary of some of the applications of ai-powered irrigation systems in agriculture.

No .	Algorithms	Method of evaporation/ desired calculation	Other Technologies	Advantages/Results	References
1	PLSR and other regression Algorithms	Evapotranspiration model	Sensors for data collection, IOT Hardware Implementation	Increased efficiency and economic feasibility	Choudhary et. al, 2019
2	Artificial Neural Network based control system	Evapotranspiration Model	Sensors for measurement of soil, temperature, wind speed, etc	Automation	Umair and Usman, 2010
3	Fuzzy Logic	FAO Penman-Monteith method	-	Optimization	Kia et. al,2009
4	ANN (multilayer neural model), Levenberg Marquardt, Backpropagation	Penman-Monteith method	-	Evaporation decreased due to schedule and savings observed in water and electrical energy	Karasekret er et.al, 2014
5	Fuzzy Logic	-	WSN, Zigbee	Experimental results verification. Can be applied to home gardens and grass	Al-Ali et.al,2015
6	ANN Feed Forward,	-	-	Optimization of water resources	Cruz et. al,2017

	Backpropagation			in a smart farm	
7	Fuzzy Logic Controller	Penman-Monteith method	Wireless sensors	Drip irrigation prevents wastage of water and evaporation	Anand et. al,2015
8	Machine Learning Algorithm		Sensors, Zigbee, Arduino micro-controller	Prediction and tackles drought situations	Arind G. et. al,2017

The agricultural sector in Nigeria suffers from a severe lack of efficient irrigation systems. But with the help of Artificial Intelligence powered irrigation systems, performance can be improved, and these issues can be resolved.

ARTIFICIAL INTELLIGENCE IN PEST CONTROL

Pesticides are defined by the FAO as any substance or combination of substances with chemical (natural or synthetic) or biological ingredients that are used to ward off, eliminate, or control pests or to control plant growth.

When pesticides are used improperly for plant protection, there is frequently a risk to the operators' and consumers' health, as well as potential harm to the environment and the crops.

In developing nations like Nigeria, where only 25% of the world's pesticide production is used, 99% of pesticide-related deaths take place. (Ojo, 2016)

Artificial intelligence techniques may be used to reduce the amount of spray produced, thereby lessening these effects. With the use of a 3d camera, images of crops suffering from pest infestation could be taken and fed to Machine learning models trained to spot and classify pest variants. This leads to the precise and efficient use of pesticides in dealing with these pests. (Facchinetti et al, 2021)

There are numerous advantages to using artificial intelligence for pest control, from environmental sustainability to economic sustainability. Since less pesticide is needed

overall, fewer compounds will be wasted, reducing the risk of soil and groundwater pollution.

ARTIFICIAL INTELLIGENCE IN WEED CONTROL

Managing weeds can require a lot of labour. Could the solution be intelligent weeding machines? The answer is yes, according to experts, based on technological advancements made so far. Vegetable crops and other types of specialized farming already use machines powered by artificial intelligence. (Partel et al, 2018) For instance, automated lettuce thinners are now commonly used and can quickly thin an acre of lettuce. These machines reduce the crop to the desired spacing for optimal growth using carefully targeted spot-spraying. (Partel et al, 2018) However, separating crops from weeds is much trickier, according to experts. Weeds come in a wide range of hues, forms, and dimensions. Crop foliage can also grow in an overlapping pattern or be masked by weeds in the vicinity. On a small scale, some businesses and government research teams have distinguished crops from weeds using computer vision, artificial intelligence, and extremely powerful computers. One illustration is the current availability of first-generation, vision-based "intelligent cultivators" for speciality crop growers.

These hoeing machines use pattern recognition to calculate the width and spacing of planting rows, then use that knowledge to direct knives into and out of crop rows to pull weeds. New intelligent sprayers that can precisely apply herbicides to weeds only without needing to spray the entire field are powered by similar technology.

According to experts, such automated tools have significant advantages over both broadcast herbicides and hand weeding. Herbicides are more expensive to develop than intelligent devices, which can be tailored to dozens of crops, whether they are conventionally or organically grown. They do away with the need for arduous manual labour and make it possible to use herbicides more sparingly. (Partel et al, 2018)

To distinguish between weed leaves and tomato plants, Lee et al. (1999) created and tested a smart sprayer. Although processing speeds were very slow at the time, the detection results were encouraging.

To help machines quickly and accurately distinguish between allies and foes, a group at the University of California, Davis is actively working on a solution. They advocate the use of clever marking methods to make crops "machine-readable" and simple to distinguish from

weeds. Robots have been taught to recognize 99.7% of crop plants in field experiments, even in fields with dense weed growth.

A weed spot-sprayer with machine vision was created by Kargar and Shirzadifar (2013) for corn crops. To distinguish grass leaves from corn plants with over 90% accuracy, the system used image segmentation and feature extraction. It should be noted that the corn leaves in this instance are significantly wider than the grass, which improves the detection efficiency. Aitkenhead et al. (2003) investigated two methods for weed detection in carrot crops. Image segmentation operations based on the colour and shape of the leaves were part of the first process. The second method distinguished weeds using a self-organized neural network. Even though the outcomes at the time weren't as good as what was needed for commercial applications, they nonetheless demonstrated how artificial intelligence can be used to examine a variety of other properties besides segmentation procedures. When compared to traditional broadcast sprayers, which typically treat the entire field to control pest populations, precision spraying technology can significantly reduce the amount of herbicide needed, potentially avoiding the needless application of herbicide to areas that do not need to be treated. Applying herbicide only where weeds are present could reduce expenses, the danger of crop damage, the amount of pesticide residue left behind, and perhaps even the environmental impact. (Partel et al, 2018)

Although there are now automated weed control options, they are not yet widely used. Simply put, current systems can't distinguish between weeds and crops quickly enough to support widespread adoption. (Partel et al, 2018)

Before weed management powered by artificial intelligence is ready for widespread adoption, more research is required. And to do that, more weed scientists must be trained in the specialized engineering and technology skills necessary to advance artificial intelligence innovation. (Partel et al, 2018)

Especially in a scenario of a lack of trained agriculturists in the Nigerian agricultural sector, this technology has the potential to deliver more productive and sustainable agriculture based on a more precise and cost-effective approach when dealing with pests.

PROBLEMS THAT WOULD BE FACED BY NIGERIAN FARMERS WHEN ADOPTING AI

Although AI has made some notable advancements in the agricultural sector, when compared to its potential and impacts in other sectors, it still has a below-average impact on agricultural activities. Since AI implementation has many drawbacks, more work needs to be done to improve agricultural activities.

1. Response time and accuracy

The ability of an intelligent or expert system to complete tasks accurately in a short amount of time is one of its key characteristics. Most systems are either inaccurate or slow to respond, or even both. The task strategy that a user chooses is impacted by a system delay. The cost function that combines the effort needed to synchronize input system availability and the accuracy level offered is hypothesized to be the basis for strategy selection. (Eli-Chukwu, 2019)

2. Big Data Required

The amount of input data is another factor in determining an intelligent agent's strength. A real-time AI system must keep an eye on a huge amount of data. Most of the incoming data must be filtered out by the system. It must, however, continue to respond to significant or unexpected events. A field expert must have in-depth knowledge of the system's task, and only highly relevant data should be used to increase the system's speed and accuracy. Experts from a variety of agricultural disciplines must work together to create an agricultural expert system, and the growers who will use it must support its creation. (Eli-Chukwu, 2019)

3. High Data Cost

The majority of AI systems rely on the internet, which limits or discourages their use, especially in remote or rural areas. The government can help farmers by creating a web service enabling devices with a lower tariff that specifically integrates with their AI systems. (Eli-Chukwu, 2019)

4. Flexibility

Any effective AI system must possess flexibility. The use of AI techniques for specific isolated tasks is thought to have advanced significantly, but the interface between the subsystems and an integrated environment appears to be the key innovation in AI-based robotics technology. Most Nigerian Agriculturists simply won't accept methods that aren't flexible enough. For this, the subsystems themselves must be flexible. To accommodate more user data from the subject matter expert, it should also have broad capabilities. (Eli-Chukwu, 2019)

5. Lack of Training

Nigerian farmers are not yet accustomed to the application of Artificial Intelligence to their farming endeavours. In my honest opinion, the biggest challenge that will be faced when adopting AI in Nigeria's Agricultural sector is the lack of expertise in the area of Artificial intelligence. Additionally, training and retraining in the "how to use" of AI will aid farmers in adjusting to its use on their farms. (Eli-Chukwu, 2019)

CONCLUSION

By 2050, the population is predicted to surpass nine billion, necessitating a 70 per cent increase in agricultural output to meet the demand. Using the most recent technological innovations to increase farming efficiency is still a crucial requirement in this context. The market demands high-quality food, and current strategies for intensifying agricultural production require high energy inputs. Artificial Intelligence can be applied to vast areas in the Nigerian Agricultural Sector. Robotics and autonomous artificial intelligence-based systems will revolutionize numerous industries in Nigeria if we can overcome the problems faced when adopting these techniques. Large economic sectors with low productivity, such as agro-food (the production of food from the farm to the retail shelf), will be greatly impacted by these technologies.

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