

# Trends and Opportunities: Transforming Agriculture in Nigeria Through Artificial Intelligence for Information Support

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## ABSTRACT

*Paper explores the opportunities that could be harnessed it well deployed to develop Agriculture in Nigeria. This opportunity lay in the deployment of artificial intelligence in the processing and consumption. The paper has the following objectives and is therefore discussed under types of agriculture, Artificial Intelligence and how to deploy A.I in agriculture and the benefit of deploying A.I. The survey research methodology was employed and a proportionate sampling was also employed, where a total population of 191 participants was used through the Census method as the sample size in some selected States in Northern Nigeria. Finally, the paper concludes by saying the Government at all levels should try as much as possible to ensure farmers are connected and facilities provided to enhance Agriculture and Agricultural activities to achieve food sustainability.*

**KEYWORDS:** Agriculture, A.I, Farmer, Food Sustainability

## INTRODUCTION AND BACKGROUND INFORMATION

It is not always easy to measure the extensive impact of deploying high-impact technology in Agriculture in order to reduce the challenges associated with the delivery of traditional agriculture services. Farmers must be provided with information on the advantages and disadvantages of using high-impact technology to simplify their farming activities. The need for using high-impact technology in our farms prompted this paper it farmers and the Government synergize and cooperate, the resulting effect would certainly be a thing of joy to both parties.

A mobile device or application will be a catalyst in reducing the challenges associated with information transmission/dissemination associated with the delivery of traditional extension services. It could be made available through Hausa, Igbo and Yoruba, which will enable greater access for farming activities.

Diversified and in-depth offline library literature and a self-help toolkit for farmers will be made available and such information could be made available to farmers through video tutorials. Reliable information and data enables government to draw and asses more efficient policies and on the other hand farmers will make a better decision and

this will extend the value chain. The use of digital technologies can mitigate the challenges of Nigerian smallholders farmers' face, and help agricultural value chains function better, especially at the last mile. Weather and climate services offer farmers vital information to adjust their practices based on anticipated conditions or respond to impending extreme weather events. These agricultural advisory services draw on a multitude of data sources to support decision-making, while agricultural digital financial services (agri DFS) enable access to inputs and assets for Climate-smart practices.(GSMA,2023).

## **LITERATURE REVIEWED**

Agricultural sector must as a matter of urgency and aggressively pursue Artificial Intelligence to enhance linkages and to address the effect of poverty in the Nation. Small and large scale farmers in Northern Nigeria are extremely enterprising irrespective of where they are, but one of the challenges they faced is access to technical/ scientific information and equipment's(Sani, Oladukun and Bwalya 2016). Farmers in Nigeria, if given the chance and provided with Scientific/ Technical knowhow would be able to produce high quality and enough foods and goods for consumption and for Market. Agriculture has the pivotal role in Nigerian Economy by providing Employment, Creating wealth and Reducing Poverty, Malnutrition and Food insecurity (Spore, 2015).Yet, today, the role is largely unrecognized by many people including Stake holders due to largely non-challant attitudes comprehensive, streamlinedandaccurate scientific information (Sani, Oladukun and Bwalya, 2015).

The neglect to give agriculture the desired attention in most African countries has been so for longtime until in the 1970s-90s when most of the states has some capacity to develop agriculture and generate data and policies that would enhance agricultural productivity and rural development policies(Spore,2015). However, this was followed by a decline because of funding and attitudes of other key stake holders (Sani,Oladukun and Bwalya, 2016). Many African Countries including Nigeria manage to conduct an Agricultural Census every Ten Years (Agricultural Development Plan) which is essential because it is the foundation of all Agricultural Statiscal system and with this census, it will certainly boost and enhance agricultural value chain and empower small and largescale farmers (Spore, 2015). Part of what is mostly needed now is to scale up the Digital project in the Nigerian food market so as achieve development in the country.

Information, particularly agricultural information is a pre-requisite for National development and many farmers have been exposed to Agricultural information either through indigenous knowledge or through Extension workers (Aina, 1995). Thus the opportunity cost of farmers not having access to information at the right time and right medium of communication will have a serious repercussion on farmers and one of such information is scientific information. In recent years, Internet connectivity and mobile phones penetration has been rising faster in Africa than anywhere in the world and there is a lot of innovationtaking place across the continent(Spore. 2015). Thus, there is a unique opportunity to use this moment and to use Artificial Intelligent frontier to fall along the agricultural sector for the Nigerian development. At aatime where the world needs to produce more with fewer resources, AI could help to transform agriculture (Cline, 2020).

Artificial intelligence is the broader concept of machines being able to carry out task in a way that is considered smart. This smart process includes machines being able to function automatically, reason and learn by themselves

(Cline, 2020). Some of the AI tools that could be used to enhance information transfer and enhanced productivity in agriculture are: Weather forecasting, farm power machines, drones, computers, Internet, soil monitoring machines and Livestock brooding and milking machines. Therefore, accurate, low cost data and timely information to farmers allows companies and researchers to actually design products and services that fit their needs and target audience. So also with AI it has the capacity and potentials to unlock, increase yields, bring higher revenue, lower losses and reduce unemployment and poverty. The other benefits of AI include among others, increase in coordination with customers and this entails using Cell- phones to discuss issues concerning commercial information. Another benefits of AI is , it boost economic growth of farmers, serve on climate change mitigation, enhance customer excellence, Lead to scientific discovery, act on crop monitoring management, optimized weed detection, act on quality control, help in data driven decision making and optimized irrigation (Cline, 2020). Artificial intelligence has emerged as a transformative tool, offering unprecedented opportunities for precision agriculture, predictive analysis, resource optimization, and data-driven decisionmaking. However, technological innovation is only one piece of the puzzle. Effective policy implementation grounded in collaboration, inclusivity, and the practical realities of our farmers and stakeholders will serve as the necessary enabler for meaningful change. It is this dynamic intersection of innovation and governance that we seek to exp.ore and strengthen over the time in the path of agricultural development (Jacob, 2024)

## **METHODS**

Survey research methodology was employed for this study and a proportionate sampling employed. A Total of 191 respondents were target and all the respondents were chosen through(census method).The respondents were drawn from three States in Northern Nigeria. The States were Katsina,Kaduna and Kano. The States were chosen because they share same boarder, same ecological conditions,same characteristics, same climate,and people with same educational back ground. In Katsina State, Funtua local Government was chosen, in KadunaState,Zaria local Government was chosen and in Kano State Gwarzo local Government was chosen.

## **RESULTS AND DISCUSSION**

In this section, Descriptive statistics was used to described data on the Characteristics of the farmers, The AI benefits, Problems dimension were analyzed using statistical tool of simple means , standard deviation and Chi-square. The results were presented in tables and Figurative forms.

### **Socioeconomic characteristics of the respondents (Quantitative)**

Table.1 Shows information on continuous variables socioeconomic characteristics of respondents. On the age of the respondent indicated that the mean age was 44 years, this implies that farmers are still at their productive age and the expectation is that adoption of AI technologies varies among farmers, with age being a significant factor influencing this uptake. The work of Shang et al also acknowledges the influential role of age in technology adoption by farmers. With mean average of 25 household sizes among the respondents of the study indicate that family need could be a barrier for low adoption of AI technologies as incomes will be for family needs. However Aniedu, (2016) found a positive relationship between household size and adoption. Farming experience is a significant factor that help farmer to become more or less averse to risk implied by adopting a new technologies, result indicate an average 26 years farming experience among the respondents which could lead to conservatism and skepticism toward new

technologies as reported by Sibuea et al,(2023) that great deal of experience may negatively affect farmer adaptive capacity.

| Description of Variables          | Minimum | Maximum | Mean | S.D   |
|-----------------------------------|---------|---------|------|-------|
| Age (years)                       | 22      | 82      | 44   | 10.82 |
| Household size (persons)          | 2       | 40      | 25   | 7.23  |
| Farming experience (years)        | 5       | 58      | 26   | 11.61 |
| Highest educational level (years) | 6       | 18      | 7    | 6.4   |
| Farm size (numbers)               | 0.2     | 3.6     | 2.2  | 7.9   |

Source: Field Survey, 2024

### **Socioeconomic characteristics of the respondents (Categorical)**

Table....present the categorical variable demographic profile of the respondent. The result showed that the majority of the respondents were male constituting 88% of the total sample. This finding provides support for past studies that often reveal gender-based disparities in adoption of agricultural technologies artificial intelligence inclusive which may be due to factors such as access to resources, information, and decision-making autonomy (Molly, 2023). However Akinbode et al,(2023) reported that there is no significant effect of gender on digital agricultural technologies adoption. The result also show that more than half of the respondents were married (66.5%) followed by single (18.3%). This highlighted the greater involvement of married people in agricultural activities in the study area. This result apparently supports the findings of Barau et al, 2019 that married is an important constitution typically in the study area. And was supported by Deji,et al,(2023) who indicate that married farmers are more open to AI technologies because of their perceived stability and professional orientation. On the respondents educational attainment, the result shows that more than half of the sample (53.4%) had attained primary education followed by secondary with 22,5% of the respondents which indicate the educational attainment association with a greater propensity to adopt AI technologies in the study area. This finding is similar to that of Pivoto, *et al* (2019) who suggests that adoption of AI-based technologies require education and knowledge about AI-based technology. About 60.7% of the respondents didn't belong to any agricultural organization. This is contrary to empirical evidence indicate a significant relationship between farmers' cooperative membership and adoption of advanced technologies including artificial intelligence. A study by Tsoumas et al,(2022) revealed the role of cooperative membership among cotton using AI generated sowing techniques that significantly increased yield from 12% to 17% in Authen,Greece.

**Table 2:** Socioeconomics Characteristics of respondents (Categorical Variables)

| Variable       | Frequency | Percentage |
|----------------|-----------|------------|
| Gender         |           |            |
| Male           | 168       | 88         |
| Female         | 23        | 12         |
| Marital Status |           |            |
| Single         | 35        | 18.3       |
| Married        | 127       | 66.5       |

|                        |     |      |
|------------------------|-----|------|
| Widow                  | 2   | 1.05 |
| Divorced               | 27  | 14.1 |
| Educational attainment |     |      |
| Non-formal education   | 35  | 18.3 |
| Primary education      | 102 | 53.4 |
| Secondary              | 43  | 22.5 |
| Tertiar                | 11  | 5.8  |
| Cooperative Membership |     |      |
| Member                 | 75  | 39.3 |
| Non-Member             | 116 | 60.7 |
| Access to credit       |     |      |
| Access                 | 36  | 18.9 |
| No Access              | 155 | 81.1 |
| Extension Contact      |     |      |
| Contact                | 45  | 23.6 |
| No-contact             | 146 | 76.4 |

Source: Field Survey, 2024

### **Trend in Artificial intelligence for agriculture in the study area**

Use of mobile application powered by artificial intelligence is increasingly being used to support Nigerian farmers by providing tailored agricultural advice, financial services, crop diseases detection and soil detections. Some of the notable AI-powered mobile application used by the farmers include; Crop2crop, Plantix, Darli. Accordant to GSMA, (2024) report indicate that integrating AI into digital service has significantly enhance the effectiveness of many Agritech companies into Nigeria's agricultural sector.

On the use of predictive analysis by the farmers to make data- drive decision only 20% of the respondents indicate the usage of this artificial intelligence and machine learning application to enhance productivity and sustainability. Despite its importance in helping farmers to predict and mitigate risk such as adverse weather condition, pest infestations, and diseases outbreaks. The tools remain limited which accordant to RMRDC (2024), as a result of inadequate infrastructures, high costs, lack of technical knowledge and limited access to finance.

Use of artificial intelligence to enhance financial inclusiveness among the Nigerian farmers provides innovative solutions that address traditional barriers to financial services in developing agricultural sector in the country. Charbots which is voice-based AI-driven application offer personalized financial support services to the user and make financial information more accessible to the farmers. Result of the survey indicates that 30% respondent use the method to boost their productivity. However this accordant to World Bank (2021), could be due to general limited financial literacy and capability with the report indicate that low educational attainment among rural farmers could be the reason. Efforts on policies by Central Bank though promoting digital financial services that focused on incubation and financial infrastructure through application programming interface (API) technology, directdebit, mobile money account and data exchange among banks will improve the situation.

## ***Trends and Opportunities: Transforming Agriculture in Nigeria Through Artificial Intelligence for Information Support***

The use of remote sensing and machine learning are being utilized to implement precision agriculture in Nigeria. Empirical finding indicate that only 21% of the respondents utilize Artificial intelligence technology to implement precision agriculture in the study area despite the finding of Ojoet *al.*, (2021) that precision agriculture techniques increased yields of up to 30% compare to traditional farming methods, demonstrating the effectiveness of AI in enhancing agricultural productivity and also reported that precision agriculture can help smallholder farmers increase their yields while minimizing resource waste, ultimately contributing to sustainable agricultural practices. On the use of smart irrigation system use AI algorithms to determine the precise amount of water needed, thereby conserving water resources and reducing waste (Zhang et al., 2020). This finding indicates the adoption of these advanced irrigation methods is still in its early stages, with several factors influencing their limitation. This could also be attributed to low level of irrigation adaptation in the region that underscore the potential for introducing more efficient system like smart irrigation( Onomu and Aliber 2024).

**Table: 3** Trend in Artificial intelligence for agriculture

| Variable                           | Frequency | Percentage |
|------------------------------------|-----------|------------|
| Agritech platform                  | 88        | 46.1       |
| Predictive analytics               | 19        | 9.9        |
| A.I for financial inclusive        | 29        | 15.2       |
| Precision Farming                  | 21        | 10.9       |
| Smart irrigation system            | 25        | 13.1       |
| Use of Automated machine and robot | 9         | 4.7        |
|                                    | 191       |            |

Field Survey,2024

### **Opportunities for AI in Nigerian Agriculture**

AI technologies hold the potential to revolutionize agriculture in Nigeria and beyond through provision of sustainable food production that will help farmers to generate more income and reduces rural poverty. **Table ....**Shows the respondents view on the numerous contribution to sustainable agricultural transformation artificial intelligence (AI) in agriculture offers to the farmers in the study area. Majority of the respondents (26.1%) indicated integrating AI into agricultural production will enhance productivity. This is inconsistency to the finding of Adebayo et al. (2023) shows that AI-driven precision agriculture can significantly enhance crop yields while reducing resource wastage. The use of AI in agriculture not only enhances productivity but also promotes sustainable practices by minimizing the environmental impact of farming.

The Data also shows that use of AI will help in ensuring the use of climate-smart agriculture in the area with 18.9% of the respondents. Conservation Agriculture in the Northwestern Nigeria as a one of the major Climate-smart agriculture was well known and it benefit was clearly known. Therefore this finding was supported by the previous finding of Ojoko et al. (2017) assessed the effect of climate change and adaptation on agriculture by rural farmers in North-Western Nigeria., they examined factors influencing the level of use of climate-smart agricultural practices (CSAPs) in Sokoto state, Nigeria and found that conservation agriculture was the most predominantly climate smart agricultural practice in the area.

However, 13% of the respondents indicated that Artificial intelligence application in agricultural sector will ensure youth engagement in to farming in the country. Youth qualities such as great physical strength. Innovative proneness, faster rate of learning and ability to cope with adverse farming situation make their involvement in agriculture a fundamental for economic development and poverty reduction (Sichone and Kwenye, 2018). Accordant to FAO, 2019 youth agripreneurs have a key role to play in the digitalization of agriculture with young and vibrant mine observing their parent missing opportunities, start-ups from smallholders farming communities often draw inspiration aimed at helping their entire community through attracting investment and create opportunities.

Table: 4 Opportunities for AI in Nigerian Agriculture

| Variable                    | Frequency | Percentage |
|-----------------------------|-----------|------------|
| Enhance productivity        | 50        | 26.1       |
| Climate-smart Agriculture   | 36        | 18.9       |
| Youth Engagement            | 30        | 15.7       |
| Post-harvest loss reduction | 16        | 8.3        |
| Access to market            | 25        | 13.1       |
| Employment                  | 12        | 6.3        |
| Research support            | 22        | 11.6       |
|                             | 191       |            |

Source Field Survey, 2024

### **Challenges associated with the use of Artificial Intelligence in Nigeria's Agriculture.**

The growing global population is increasing the demand for food , especially in low income sub Saharan African countries is putting pressure of Agricultural production land scape. Land degradation, soil nutrient deflation and Climate change further strain the sector, highlighting the need for advanced technologies that will increase productivity and profitability. Innovations such as the use of Artificial Intelligence, Robotics, and Drones offer solutions for improving sustainability, productivity, and efficiency. However, slow adoption due to high costs, lack of Digital literacy, low digital infrastructure, policy barriers, data quality issues, and ethical concerns remains a challenge. Table 5Shows the challenges associated with use of Artificial intelligence in Nigeria's Agricultural sector. Low digital literacy ranked highest (41.9%) challenges. This implied that majority of farmers lack digital literacy and this lead to decision-makers hesitant to invest in the technology they do not fully understand (Mustapha et al., 2021). To acknowledge this challenges GSMA, (2024) reported that Most AI-enabled services are accessed via digital channels and mobile devices, yet digital literacy rates in Nigeria remain low, posing a significant barrier to AI adoption. It is crucial to raise awareness about AI among potential users and to expand funding for digital skills and literacy training programs. High cost of AI technology among the farming households was ranked second major challenge. This may not be unconnected to the fact that only 7 percent of Nigeria's farmers have access to credit. Improved agricultural financing could increase a smallholders' capacity to invest in farm input and technologies that will mitigate risk for sustainable livelihoods (FAO, 2018).Additionally low digital infrastructure (17.8%) was reported as a major challenge that militates against AI uses among farmers in the study area. Mobile

## ***Trends and Opportunities: Transforming Agriculture in Nigeria Through Artificial Intelligence for Information Support***

devices are the primary channel through which farmers' access to AI-enabled services. Digital infrastructure gaps, limited access to mobile internet and low smartphone penetration is significant barriers to adoption of AI services among rural farmers in Nigeria

**Table: 5** Challenges associated with the use of Artificial Intelligence in Nigeria's Agriculture.

| Variable                                        | Frequency | Percentage |
|-------------------------------------------------|-----------|------------|
| Low Digital literacy                            | 80        | 41.9       |
| Cost of Technology                              | 53        | 27.7       |
| Low Digital infrastructure                      | 34        | 17.8       |
| Limited Data availability                       | 7         | 3.7        |
| Lack of Government Policies and subsidies on AI | 17        | 8.9        |
| Total                                           | 191       | 100        |

Source: Field survey data.2024

## **CONCLUSION AND RECOMMENDATIONS**

Artificial intelligence for agricultural development has emerged as a transformative tool, offering unprecedented opportunities for precision agriculture, predictive analysis, resource optimization, and data-driven decisionmaking. The use of digital technologies through artificial intelligence can mitigate the challenges Nigerian smallholder farmers face, and help agricultural value chains function better, especially in the face of climate change scenario that affect farmer's productivity and profitability and ensuring food security to the world growing population. Farmers in the study area accordant to the finding indicate high use of mobile application powered by artificial intelligence and to support farmer by providing tailored agricultural advice, financial services, crop diseases detection and soil detections. These transformations accordant to majority of the respondent believe that integrating AI into agricultural production will enhance productivity. However on the challenges that hinder Artificial intelligent integration in to agricultural production, Low digital literacy ranked highest challenges.

The following recommendations are made based on the findings:

1. Finding of the study indicate the involvement of young and educative respondent,Nigeria benefits from a huge potential pool of AI talent. This can be achieve through mainstreaming Artificial intelligent into educational policy to attract students in all the educational institution to have more interest on AI that will provide solution to numerous andmitigate the challenges Nigerian smallholder farmers face, and help agricultural value chains function betterfor all actors in the sector.
2. Agritech platform is the major trend of AI in the study area, therefore Integrating AI into agricultural digital services has the potential to significantly enhance their effectiveness that will help in increasing agricultural productivity, leveraged to address food insecurity and reduce wide spread rural poverty.
3. One of the major opportunities provided by AI according to the finding is enhancing productivity.Improving digital literacy rates, to accelerate the adoption and usage of digital technologies among farming population by addressing structural inequalities such as access to quality education and schools will increase agricultural output in the country.

4. Low digital literacy is the major challenge of AI in Nigeria, study recommend the need to raise awareness about AI among potential users and to expand funding for digital skills and literacy training programs especially to agricultural extension workers in the study area.

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