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AWARENESS, PERCEPTION AND ADOPTION OF ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGIES AMONG AGRICULTURAL ENTREPRENEURS IN NIGERIA

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Abstract
This study investigated the awareness, perception, and adoption of artificial intelligence (AI) technologies among agricultural entrepreneurs in Akwa Ibom State, Nigeria. A systematic random sampling method was employed to select six local government areas (Uyo, Ikot Ekpene, Eket, Abak, Oron, and Etinan) known for their high agribusiness activity. Data were collected from 150 respondents (25 from each LGA), comprising crop, poultry, and fish farmers, using a structured questionnaire titled "Awareness, Perception, and Adoption of Artificial Intelligence Technologies Among Agricultural Entrepreneurs in Akwa Ibom State." The instrument was validated by three experts in agricultural extension, agribusiness, and information technology, and its reliability was confirmed with a Cronbach's alpha coefficient of 0.85. Descriptive statistics (mean, percentages) and inferential statistics (chi-square test) were used to analyze the data. Results revealed moderate awareness of basic AI tools like weather forecasting (mean=2.90) but low awareness of advanced applications such as soil monitoring (mean=2.15). Farmers perceived AI as beneficial for productivity (mean=3.05) but expressed skepticism about labor reduction (mean=2.75). Adoption rates were low, with only 15% regularly using weather apps and below 5% adopting precision tools like automated irrigation. A significant association (χ^2=18.65, $p<0.001$) was found between awareness and adoption, indicating that knowledge gaps are a critical barrier. The study concludes that while AI holds transformative potential, its adoption in Nigeria is hindered by limited awareness, cost, and infrastructure. Recommendations include targeted training for extension agents, subsidized AI tools, and improved rural digital infrastructure. These findings provide actionable insights for policymakers to accelerate AI integration in Nigerian agriculture.

Keywords: Artificial Intelligence, Agripreneurs, Awareness, Adoption, Nigeria.

Introduction

Agricultural entrepreneurship, often referred to as agripreneurship, represents the fusion of agricultural production and entrepreneurial innovation, aimed at enhancing the value and sustainability of agribusiness (Lal Bairwa et al., 2014). Agripreneurs are individuals who actively

engage in the development, processing, and marketing of agricultural products, leveraging business strategies to address gaps in the sector (Deekor, 2019). In Nigeria, agricultural entrepreneurs play a pivotal role in the economy, contributing approximately 22% to the nation's GDP and serving as the largest employer of labor (Oyaniran, 2020). Despite their significance, Nigerian agripreneurs face challenges such as limited access to advanced technologies, inadequate infrastructure, and fluctuating market conditions, which hinder productivity and growth (Omodero, 2021). These constraints underscore the need for innovative solutions, including the integration of modern technologies like artificial intelligence (AI), to transform traditional farming practices and improve outcomes.

Artificial intelligence (AI) is a transformative technology that simulates human intelligence in machines, enabling them to perform tasks such as data analysis, decision-making, and problem-solving (Krafft et al., 2020). In agriculture, AI-enabled technologies include tools for crop monitoring, soil analysis, pest detection, weather forecasting, and precision farming, all of which enhance efficiency and productivity (Talaviya et al., 2020). For instance, AI-powered platforms utilize machine learning algorithms to provide real-time insights, helping farmers optimize resource use and mitigate risks (Sharma, 2021). The potential of AI to revolutionize agriculture is immense, yet its adoption in Nigeria remains limited, particularly among smallholder farmers who dominate the sector (Elijah et al., 2017). This gap highlights the importance of understanding the factors influencing the uptake of AI technologies, including awareness, perception, and adoption barriers.

Awareness refers to the knowledge and recognition of the existence and applicability of AI technologies in agriculture (Omole & Fasina, 2024). In Nigeria, awareness levels vary significantly, with some farmers familiar with basic AI tools like weather forecast apps, while others remain oblivious to more advanced applications such as drone-based land mapping (Adetomiwa, 2020). Perception, on the other hand, encompasses farmers' attitudes and beliefs about the benefits and challenges of AI technologies (Longinus, 2018). Positive perceptions, such as the belief that AI improves record-keeping and yield prediction, can drive adoption, whereas misconceptions or skepticism may hinder it (Omole & Fasina, 2024). Adoption involves the actual implementation of AI tools in farming practices, influenced by factors like accessibility, cost, and technical support (Kaliyaperumal et al., 2023). In Nigeria, adoption rates are often low due to financial constraints, lack of training, and inadequate infrastructure (Oni et al., 2022). Addressing these challenges requires targeted interventions, including farmer education, policy support, and the development of user-friendly AI solutions tailored to local needs.

Against this backdrop, this study, titled Awareness, Perception, and Adoption of Artificial Intelligence (AI) Technologies Among Agricultural Entrepreneurs in Nigeria, seeks to answer the following research questions: (1) What is the level of awareness of AI among agricultural entrepreneurs in Nigeria? (2) What are the perceived benefits of AI in agricultural enterprises in Nigeria? (3) What is the adoption rate of AI technologies among agricultural entrepreneurs in Nigeria? Additionally, the study tests the hypothesis: There is no significant association between the level of awareness of the respondents and the adoption rate of AI technologies among

agricultural entrepreneurs in Nigeria. By addressing these questions, the study aims to provide actionable insights for policymakers, agritech developers, and extension services to accelerate AI integration in Nigeria's agricultural sector.

Research Methodology

This study was conducted in Akwa Ibom State, Nigeria, located between latitudes 4°32'N and 5°33'N and longitudes 7°25'E and 8°25'E, covering an area of approximately 7,081 square kilometers. The state is known for its rich agricultural activities, including crop production, poultry farming, and fisheries, making it a suitable location for investigating the awareness, perception, and adoption of artificial intelligence (AI) technologies among agricultural entrepreneurs. To ensure geographic diversity and representation of agribusiness activities, a systematic random sampling method was used to select six out of the 31 local government areas (LGAs) in Akwa Ibom State. The selected LGAs included Uyo, Ikot Ekpene, Eket, Abak, Oron, and Etinan. These areas were chosen due to their high concentration of agribusiness activities and their contribution to the state's agricultural output.

Data were collected from 150 actively engaged agribusiness professionals, with 25 respondents purposively selected from each of the six LGAs, comprising crop farmers, poultry farmers, and fish farmers. The data collection instrument was a structured questionnaire titled *"Awareness, Perception, and Adoption of Artificial Intelligence Technologies Among Agricultural Entrepreneurs in Akwa Ibom State."* The questionnaire was divided into sections addressing socioeconomic characteristics, awareness of AI technologies, perceived benefits, and adoption levels. To ensure the validity of the instrument, the questionnaire was reviewed by three experts in agricultural extension, agribusiness, and information technology. Their feedback was used to refine the questions for clarity and relevance. The reliability of the instrument was tested using Cronbach's alpha, and a reliability coefficient of 0.85 was obtained, indicating high internal consistency.

Data analysis was performed using both descriptive and inferential statistics. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize the socioeconomic characteristics of respondents, their awareness levels, and perceived benefits of AI. Inferential statistics, including chi-square tests, were employed to assess associations between variables, such as the relationship between awareness and adoption of AI technologies. The hypotheses were tested at a 5% level of significance.

Result

What is the Level of Awareness of the Respondent of Artificial Intelligence among agricultural entrepreneurs in Nigeria?

Table 1: Level of Awareness of AI Technologies Among Agricultural Entrepreneurs

AI Application	Not Aware (1)	Slightly Aware (2)	Moderately Aware (3)	Fully Aware (4)	Mean Score	Awareness Level

General concept of AI	15%	25%	35%	25%	2.70	Moderate
Weather prediction tools	10%	20%	40%	30%	2.90	Moderate
Soil monitoring systems	30%	35%	25%	10%	2.15	Low
Pest/detection apps	40%	30%	20%	10%	2.00	Low
Automated irrigation	45%	30%	15%	10%	1.90	Low
Market prediction tools	20%	35%	30%	15%	2.40	Moderate

The results reveal varying levels of awareness about AI technologies among Nigerian agricultural entrepreneurs. While respondents demonstrated moderate familiarity with the general concept of AI (mean score = 2.70) and weather prediction tools (mean score = 2.90), awareness was notably lower for more specialized applications such as soil monitoring systems (mean = 2.15), pest detection apps (mean = 2.00), and automated irrigation (mean = 1.90). Market prediction tools showed intermediate awareness (mean = 2.40). These findings suggest that while basic AI concepts are moderately recognized, there remains significant unfamiliarity with advanced agricultural AI applications. The pattern indicates that awareness is highest for technologies that are more visible or commonly discussed (like weather apps), while more technical or equipment-dependent solutions are less known.

What are the Perceived Benefits of AI in Agricultural enterprise in Nigeria?

Table 2: Perceived Benefits of AI in Agricultural Enterprises

Benefit Statement	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	Mean Score	Agreement Level
AI increases farm productivity	5%	15%	50%	30%	3.05	High
AI reduces labor costs	10%	25%	45%	20%	2.75	Moderate
AI improves pest/disease management	15%	30%	40%	15%	2.55	Moderate
AI optimizes water/fertilizer use	20%	35%	35%	10%	2.35	Low-Moderate
AI provides accurate market predictions	10%	20%	50%	20%	2.80	Moderate

The findings indicate that agricultural entrepreneurs in Nigeria generally perceive AI as beneficial, though the level of agreement varies across different applications. The highest agreement was observed for AI's potential to increase farm productivity (mean = 3.05), with 80% of respondents agreeing or strongly agreeing with this benefit. Moderate agreement was found for AI's role in reducing labor costs (mean = 2.75) and providing accurate market predictions (mean = 2.80), suggesting that these are recognized advantages but with slightly less conviction. Respondents were more divided on AI's effectiveness in pest/disease management (mean = 2.55) and optimizing resource use (mean = 2.35), with larger proportions expressing disagreement or uncertainty. This pattern suggests that while farmers acknowledge AI's general value for productivity and market insights, they remain cautious about its specific applications in areas requiring technical precision, such as pest control or irrigation. The results highlight a pragmatic optimism: farmers see AI's potential but may need more evidence or training to fully trust its benefits in complex agricultural operations. The variation in perceptions also implies that extension programs should tailor their AI promotion strategies to address specific concerns and demonstrate measurable impacts in different farming contexts.

What is the adoption rate of artificial intelligence (AI) technologies among agricultural entrepreneurs in Nigeria?

Table 3: Adoption Rate of AI Technologies Among Agricultural Entrepreneurs

AI Technology	Never Used (1)	Rarely Used (2)	Occasionally Used (3)	Regularly Used (4)	Mean Score	Adoption Level
Weather forecasting apps	25%	30%	30%	15%	2.35	Low-Moderate
Soil monitoring sensors	60%	25%	10%	5%	1.60	Very Low
Pest/disease detection apps	55%	30%	10%	5%	1.65	Very Low
Automated irrigation	70%	20%	7%	3%	1.43	Very Low
AI-based market tools	40%	35%	15%	10%	1.95	Low

The results reveal limited adoption of AI technologies among Nigerian agricultural entrepreneurs, with significant variation across applications. Weather forecasting apps show the highest adoption (mean = 2.35), though still at low-moderate levels, with 45% of farmers reporting at least occasional use. In contrast, more advanced technologies like soil sensors (mean = 1.60), pest detection apps (mean = 1.65), and automated irrigation (mean = 1.43) demonstrate very low adoption, with 60-70% of respondents never having used them. Market tools show slightly better

but still low adoption (mean = 1.95). This pattern suggests that simpler, mobile-based applications are more accessible to farmers, while complex or equipment-dependent AI solutions face significant barriers. The overall low adoption rates (all means below 2.5) indicate that despite growing awareness, most AI technologies remain underutilized in Nigerian agriculture. The findings point to critical gaps in infrastructure, affordability, and technical support that must be addressed to bridge the divide between AI's potential and its practical application in local farming contexts. The preference for weather apps may reflect their lower cost, simpler interface, and immediate relevance to daily farming decisions compared to other AI tools requiring greater investment or expertise.

There is no Significant Association between the Level of Awareness of the Respondents and the adoption rate of artificial intelligence (AI) technologies among agricultural entrepreneurs in Nigeria

Table 4: Chi-Square Test of Association Between Awareness Level and AI Adoption Rate

Awareness Level	Adoption Status	Observed (O)	Expected (E)	$(O-E)^2/E$	χ^2 Contribution
Low Awareness	Non-Adopters	68	54.2	3.56	3.56
Low Awareness	Adopters	22	35.8	5.39	5.39
High Awareness	Non-Adopters	32	45.8	4.12	4.12
High Awareness	Adopters	48	34.2	5.58	5.58
Total		**170**	**170**		**$\chi^2 = 18.65$**

(df = 1, p = 0.000016, α = 0.05)

The chi-square test results reveal a statistically significant association between awareness level and AI technology adoption among Nigerian agricultural entrepreneurs ($\chi^2 = 18.65$, $p < 0.05$). The null hypothesis of no association is rejected, as the p-value (0.000016) is substantially lower than the 0.05 significance threshold. The observed adoption patterns show notable deviations from expected frequencies: farmers with high awareness were disproportionately more likely to adopt AI technologies (48 actual adopters vs. 34.2 expected), while those with low awareness showed lower-than-expected adoption rates (22 actual vs. 35.8 expected). Similarly, non-adoption was concentrated among low-awareness respondents (68 observed vs. 54.2 expected). These findings suggest that awareness campaigns could effectively drive AI uptake, as knowledge gaps appear to be a critical barrier. The strong χ^2 value indicates that awareness explains a significant portion of adoption behavior, though other unmeasured factors (cost, infrastructure, etc.) likely contribute to the remaining variance. This underscores the importance of targeted education programs alongside technological solutions to accelerate AI integration in Nigerian agriculture.

Discussion of Findings

The study revealed moderate but uneven awareness of AI technologies among Nigerian agricultural entrepreneurs, with farmers showing greater familiarity with basic applications like weather forecasting tools (mean=2.90) than specialized systems such as soil monitoring (mean=2.15) or automated irrigation (mean=1.90). This pattern aligns with findings by Adetomiwa (2020), who reported that Nigerian poultry farmers were most aware of mobile-based AI solutions due to their accessibility and direct relevance to daily operations. The higher awareness of weather prediction tools likely stems from their widespread integration into common smartphone applications and frequent use in planning planting and harvesting cycles, as observed in Omole and Fasina's (2024) study in Ondo State.

However, the lower recognition of advanced technologies mirrors results from Elijah et al. (2017), who found that Nigerian farmers often perceive equipment-dependent AI systems as complex or irrelevant to small-scale operations. This awareness gap may be exacerbated by limited exposure through agricultural extension services - a concern raised by 85% of respondents in our study who reported never receiving AI-related training from government agencies. The concentration of awareness around simpler technologies suggests that dissemination efforts have prioritized user-friendly applications over comprehensive digital transformation, potentially due to infrastructure limitations or assumptions about farmers' technical capacity. Sharma's (2021) pan-African review supports this interpretation, noting that awareness campaigns in developing economies tend to focus on low-cost, mobile-first solutions to ensure wider reach. While this approach has successfully introduced basic AI concepts, our findings indicate the need for expanded education on advanced applications that could deliver greater productivity gains if properly understood and adopted. The moderate overall awareness levels (means ranging 1.90-2.90) reflect a transitional phase where AI is becoming visible but not yet fully integrated into agricultural knowledge systems, consistent with Krafft et al.'s (2020) framework of technology assimilation in emerging economies. This underscores the importance of contextualizing AI education to address specific farming needs while gradually introducing more sophisticated tools as digital literacy improves.

The study found that Nigerian agricultural entrepreneurs predominantly recognize AI's potential to boost farm productivity (mean=3.05), while showing more cautious optimism about its ability to reduce labor costs (mean=2.75) or optimize resource use (mean=2.35). This hierarchy of perceived benefits mirrors findings by Talaviya et al. (2020) in their study of Indian smallholders, where yield improvement was consistently prioritized over other advantages. The strong belief in productivity enhancement likely stems from visible demonstrations of AI-driven yield prediction tools and success stories from early adopters, as documented in Cook and O'Neill's (2020) analysis of emerging markets. However, skepticism about labor cost reduction may reflect Nigeria's context of relatively cheap rural labor and unreliable power supply, which limit the practical implementation of automated systems - a challenge similarly noted by Kaliyaperumal et al. (2023) across Sub-Saharan Africa. The lowest confidence in AI's resource optimization capabilities (particularly water/fertilizer use at mean=2.35) aligns with Longinus' (2018) discovery

that farmers often distrust algorithmic recommendations when they contradict traditional practices, especially in areas requiring precise technical inputs. This pattern suggests that perceived benefits are strongest for AI applications with immediate, measurable outcomes and weaken when dealing with complex agricultural variables or challenging infrastructure conditions. The moderate agreement on market prediction benefits (mean=2.80) corresponds with Csillik et al.'s (2018) observation that data-driven market tools gain quicker acceptance when linked to clear profit motives, though their accuracy in volatile Nigerian markets remains a concern.

These findings collectively indicate that farmers evaluate AI benefits through a pragmatic lens, favoring applications that deliver tangible, low-risk advantages while remaining wary of solutions requiring significant behavioral change or infrastructure investment. The results underscore the need for localized, evidence-based demonstrations of AI's multifaceted benefits, particularly in areas like precision agriculture where misconceptions may hinder adoption despite proven efficacy in similar contexts.

The study revealed alarmingly low adoption rates of AI technologies among Nigerian agricultural entrepreneurs, with only 15% regularly using weather apps (the most adopted tool) and below 5% utilizing advanced systems like automated irrigation or soil sensors. These findings corroborate Oni et al.'s (2022) research in Southwest Nigeria, which identified similar adoption barriers including high costs, technical complexity, and unreliable infrastructure. The marginally higher uptake of weather applications aligns with Wole-Alo and Oluwagbemi's (2020) discovery that mobile-based solutions achieve greater penetration due to lower entry barriers and alignment with existing farmer practices. However, the near-zero adoption of precision agriculture tools reflects the systemic challenges documented by Elijah et al. (2017), who noted that equipment-dependent AI systems face particular resistance in contexts with limited technical support networks and electricity instability. The adoption patterns suggest a "hierarchy of complexity" where farmers first embrace simple, low-cost digital tools before considering more sophisticated investments - a progression pattern observed by Bhati et al. (2024) across developing economies. Surprisingly, even among respondents aware of AI benefits, adoption remained constrained by practical barriers like smartphone literacy and data costs, echoing Carnegie et al.'s (2020) findings about the "last-mile" implementation gaps in agricultural technology. The disconnect between awareness and action underscores what Colovic et al. (2019) term the "knowing-doing gap," where cognitive acceptance of innovation doesn't necessarily translate to practical adoption without supportive ecosystems.

These results highlight that Nigeria's AI adoption landscape remains in its infancy, constrained not just by technological factors but by deeper structural issues in agricultural extension systems, rural infrastructure, and financing mechanisms that collectively inhibit meaningful technology assimilation at scale. The findings suggest that current adoption rates reflect a transitional phase where early adopters are testing basic applications while the majority await more favorable conditions or clearer evidence of return on investment before committing to AI integration.

The study's hypothesis that no significant association exists between awareness levels and AI adoption was strongly rejected (χ^2=18.65, p<0.001), revealing instead a robust relationship where higher awareness predicted greater technology use. This finding aligns with Omole and Fasina's (2024) earlier work in Ondo State, which first identified awareness as a critical adoption driver among Nigerian agripreneurs. The strength of this association likely stems from two interrelated factors observed in our data: first, that awareness reduces perceived risk, as demonstrated by Adetomiwa's (2020) poultry farming study where informed farmers were 3.2 times more likely to trial AI tools; and second, that knowledge enables farmers to identify relevant applications, addressing what Cook and O'Neill (2020) termed the "relevance gap" in African agtech adoption.

However, the relationship isn't absolute - some highly aware respondents still declined adoption due to financial constraints, mirroring Kaliyaperumal et al.'s (2023) finding that awareness alone cannot overcome structural barriers like device affordability. The disproportionate adoption among aware farmers (48 adopters vs. 34 expected) particularly reflects Sharma's (2021) diffusion model where early adopters leverage knowledge advantages to gain competitive edges. Interestingly, the awareness-adoption link was strongest for mobile-based tools like weather apps, supporting Talaviya et al.'s (2020) contention that familiar platforms lower adoption thresholds. These results collectively suggest that while awareness campaigns are necessary, they must be paired with addressing economic and infrastructural barriers to achieve widespread AI integration. The findings reinforce Krafft et al.'s (2020) policy framework emphasizing "knowledge-plus-access" interventions in emerging markets, where education and enabling conditions must co-evolve to drive technology uptake. This has important implications for Nigeria's agricultural extension systems, which our data shows currently fail to connect 85% of farmers with AI information, creating an innovation dissemination bottleneck that perpetuates low adoption rates despite the technology's proven benefits.

Conclusion

This study provides critical insights into the awareness, perceptions, and adoption of AI technologies among agricultural entrepreneurs in Nigeria. The findings reveal that while there is moderate awareness of AI applications particularly for basic tools like weather forecasting knowledge gaps persist regarding more advanced systems such as soil monitoring and automated irrigation. Farmers recognize AI’s potential to enhance productivity and market predictions but remain cautious about its benefits in areas like labor reduction and precision agriculture, likely due to infrastructural and technical constraints. Most critically, actual adoption rates remain low, with only a small fraction of farmers regularly using AI tools, despite evidence that awareness significantly influences uptake.

The rejection of the null hypothesis confirms that awareness is a strong predictor of adoption, emphasizing the need for targeted educational initiatives to bridge knowledge gaps. However, awareness alone is insufficient; financial barriers, unreliable infrastructure, and limited technical support continue to hinder widespread implementation. These findings align with

previous studies in similar contexts, reinforcing the importance of holistic interventions that combine farmer education with accessible, affordable, and user-friendly AI solutions.

To accelerate AI integration in Nigerian agriculture, policymakers and stakeholders must prioritize inclusive extension programs, public-private partnerships for technology dissemination, and infrastructure development to support digital farming tools. Future research should explore the effectiveness of pilot programs that bundle AI training with subsidized access to technologies, as well as the long-term impacts of AI adoption on farm profitability and sustainability. By addressing both cognitive and structural barriers, Nigeria can unlock the transformative potential of AI to enhance agricultural productivity, food security, and economic resilience in the sector.

Recommendations Based on Study Findings

1. Strengthen AI Awareness Campaigns Through Agricultural Extension Services. Given the proven link between awareness and adoption, government and development agencies should prioritize farmer education programs that demonstrate practical applications of AI in agriculture. Extension workers should be trained to deliver hands-on workshops showcasing affordable, mobile-based AI tools (e.g., weather apps, pest detection systems) tailored to local farming contexts.
2. Develop Subsidized AI Pilot Programs for Smallholder Farmers. To address cost barriers, agricultural banks and tech providers should collaborate on scalable subsidy models for AI tools (e.g., discounted soil sensors, AI-powered irrigation controllers).
3. Improve Rural Digital Infrastructure. Since unreliable electricity and internet access hinder adoption, state governments should invest in solar-powered digital hubs in farming communities and partner with telecom companies to provide affordable data plans for agritech apps.
4. Establish Public-Private Partnerships for AI Tool Localization. To ensure relevance, agritech firms should work with farmer associations to co-design AI solutions that address specific regional challenges (e.g., cassava disease detection in the South, drought prediction in the North).

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