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ENTREPRENEURSHIP, ARTIFICIAL INTELLIGENCE AND FOOD SECURITY IN NIGERIA

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Abstract
Food insecurity remains a persistent challenge in Nigeria despite the country's considerable agricultural potential. This paper examines how technological costs, digital literacy and financial constraints may shape the contribution of artificial intelligence (AI) and entrepreneurship to food security in Nigeria. It adopts a qualitative, desk-based review of relevant literature on AI-enabled agriculture, entrepreneurship, food security, digital literacy, agricultural finance and environmental conditions. The discussion is conceptually informed by entrepreneurship scholarship on uncertainty and the potential of AI to improve prediction and decision-making; the paper does not report original fieldwork or a statistical test of relationships. The literature reviewed suggests that AI may support agricultural production, crop monitoring, weather forecasting, market access and the reduction of post-harvest losses. However, these potential benefits depend on affordable technology, reliable digital infrastructure, digital skills, access to finance and appropriate storage facilities. The paper argues that reducing food losses and improving food availability require coordinated investment in storage, agricultural technology and inclusive digital services. It recommends affordable AI tools suited to low-connectivity settings, stronger rural infrastructure, practical digital-literacy programmes, accessible agricultural finance and collaboration among government, technology developers, extension workers and farmers.

Keywords: Artificial Intelligence, Digital Literacy, Entrepreneurship, Financial Constraints, Food Security, Technological Costs.

Introduction
Food security remains one of the most pressing challenges for nations globally, particularly in developing countries such as Nigeria. Food security is defined as a condition in which all

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people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). Nigeria's food insecurity arises from multiple, interconnected challenges. Food availability, or the supply of food through domestic production or imports, is constrained by low agricultural output, inefficient policies, corruption, civil insecurity, and climate change. Despite agriculture employing a large portion of the workforce and Nigeria's vast arable land and favorable agro-ecological zones, local production often falls short of demand, making the country heavily reliant on imports such as rice and wheat (Okoli & Ibebunjo, 2025). This dependence increases vulnerability to global market fluctuations and destabilizes food availability and affordability. Food accessibility, the ability of households to obtain adequate food, is further limited by rising poverty, income inequality, and high food prices, while poor infrastructure and insecurity restrict distribution to remote communities (Rahman et al., 2023). These systemic challenges contribute to widespread malnutrition, highlighting that food insecurity in Nigeria concerns not only production but also distribution and utilization. Over the last two decades, there has been growing recognition of the potential for technological innovations to address persistent agricultural challenges and strengthen food security. Traditional interventions, including mechanization, improved seed varieties, and irrigation systems, have provided incremental benefits but have not fully mitigated the structural issues contributing to food insecurity (FAO, 2021; Eme et al., 2014).

In context to this, Artificial Intelligence (AI), defined as computer-based systems capable of performing tasks that typically require human intelligence, such as prediction, pattern recognition, and decision-making, has emerged as a transformative tool for agriculture. Globally, AI is applied to provide predictive analytics, monitor crop health, and improve supply chain efficiency, often demonstrating measurable impacts on yields, costs, and resilience (Javaid et al., 2023; Rangrej et al., 2023; Liu et al., 2021). Despite these advances, AI adoption in Nigeria remains limited. Research and innovation in the Nigerian agricultural sector continue to emphasize conventional approaches, with minimal attention to AI-driven solutions (Akinola et al., 2022). Contextual differences between Nigeria and countries that have successfully deployed AI, such as India, China, and the United States, are substantial. These countries benefit from advanced infrastructure, robust financial systems, and high digital literacy, whereas over 70% of Nigerian farmers are smallholders with limited access to credit, weak connectivity, and minimal exposure to digital technologies (World Bank, 2022). These disparities highlight the need to explore how AI can be adapted to low-resource environments with infrastructural deficits, affordability constraints, and socio-cultural considerations. Limited scholarship examines AI as a transformative tool in Nigerian agriculture, and most studies on AI in agriculture focus on contexts with advanced infrastructure, digital literacy, and financial systems (Akinola et al., 2022; FAO, 2021; Eme et al., 2014; Rangrej et al., 2023; Liu et al., 2021). Consequently, the applicability of global evidence to Nigeria is uncertain. Field-level insights into how AI tools such as weather prediction, pest detection, or soil monitoring perform in local farming contexts are scarce. Moreover, equity issues, including the potential exclusion of women, smallholders, and marginalized populations from AI benefits, remain largely unexplored (Clapp et al., 2022). This gap underscores the need to explore contextual adaptation strategies and provide actionable recommendations to ensure AI enhances food security inclusively in Nigeria.

Research Objectives

The study is guided by the following objectives:

i. Examination of the relationship between technological cost and food security in Nigeria.
ii. Examination of the role of digital literacy and food security in Nigeria.
iii. Examination of the role of financial constraints and food security in Nigeria.

What is Artificial Intelligence (AI)?

AI is not easy to define, and there is no standard definition of what AI actually involves (Samoili et al., 2021). According to the Organisation for Economic Co-operation and Development (OECD), an AI system is a "machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments" (OECD, 2019, p. 7). In 2024, the OECD published an updated definition of an AI system as "a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments" (OECD, 2024, p. 4). Different AI systems vary in their levels of autonomy and adaptiveness after deployment. The outputs of an AI system include predictions, recommendations, decisions and, more recently, content. Prediction can involve forecasting, identifying patterns or generating information. A recommendation may support a human decision maker, while a decision represents a higher level of automation. Generative AI systems can also produce text, images, audio and video. For the purpose of this study, the importance of AI lies principally in its capacity to support prediction, decision-making, monitoring and improved management of agricultural activities.

Food Security

Food security is a flexible concept as reflected by the many attempts to define it in research and policy usage. The current widely accepted definition came from the Food and Agriculture Organization (FAO): food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002). At the 2009 World Summit on Food Security, stability was added as a fourth dimension of food security and refers to the ability of food systems to withstand shocks, whether natural or man-made (FAO, 2009). More recently, sustainability has been suggested as a fifth dimension to encompass the long-term time dimension (Berry et al., 2015). The concept of food security has therefore moved from an initial emphasis on food availability and production to a wider understanding that incorporates access, utilisation and stability. This broader understanding is particularly relevant to Nigeria, where food insecurity is associated with problems of production, affordability, distribution, environmental conditions and social vulnerability.

Dimensions of Food Security

According to the Food and Agriculture Organization (FAO, 2008), food security comprises four major dimensions: availability, accessibility, utilisation and stability. Food availability refers to the supply of food produced locally or imported from other countries to meet the nutritional needs of the population. Food accessibility concerns the physical and economic ability of individuals and households to obtain adequate food. Physical accessibility depends on factors such as transportation infrastructure and effective distribution networks, while economic accessibility is determined by people's purchasing power. It also encompasses sociocultural considerations and social protection measures that support vulnerable and disadvantaged populations. Food utilisation relates to the ability of individuals to consume sufficient quantities of nutritious and safe food to maintain a healthy and active life. This

dimension emphasises not only the quantity and quality of food consumed but also the importance of safe drinking water, proper sanitation and hygienic conditions for effective nutritional outcomes. Finally, food stability refers to the ability of nations, communities, households and individuals to maintain consistent access to adequate food over time, even in the face of disruptions. Such disruptions may arise from natural disasters, climate-related events, armed conflicts, wars and economic crises. These four dimensions are interrelated, and sustained food security depends on their effective functioning to ensure that people have reliable access to sufficient, safe and nutritious food.It may therefore be seen that food security exists at a number of levels: availability at the national level; accessibility at the household level; utilization at the individual level; and stability as a time dimension that affects all the levels. All four dimensions must be intact for full food security. More recent developments emphasize the importance of sustainability, which may be considered as the long-term dimension of food security. Sustainability involves ecological, biodiversity and climate-change considerations as well as socio-cultural and economic factors (Berry et al., 2015). These factors will affect the food security of future generations.

Entrepreneurship and Artificial Intelligence

AI has the potential to affect the core of entrepreneurship. Entrepreneurship theories are built around the fundamental question of how entrepreneurs deal with uncertainty. Entrepreneurs operate in environments where future possible states of the world and consequences of actions and their probabilities are unknown (Knight, 1921). There is uncertainty about market demand for novel products and services, social resistance to innovation, and responses of competitors; at the same time, entrepreneurs are constrained by limited resources. The key capability of AI is prediction, which has the potential to reduce uncertainty (Lupp, 2023; Agrawal et al., 2024). AI can be used to search through a very large set of options to identify opportunities, for example for product design or the choice of market segments. Entrepreneurship theories also emphasize that entrepreneurs employ imagination and creative approaches to decision-making to identify opportunities under uncertainty (Kier & McMullen, 2018). Generative AI is starting to show signs of creativity and may augment the creative abilities of entrepreneurs (van Gelderen et al., 2021). However, even if AI can help resolve what is possible, the human entrepreneur still needs to solve the fundamental problem of what is desirable according to the entrepreneur's goals, preferences and objectives (McMullen & Shepherd, 2006). Entrepreneurial decision environments are characterized by uncertainty and are therefore a fundamental boundary even for enhanced AI (Townsend et al., 2023). A process perspective on entrepreneurship is useful in considering AI impacts on different stages of entrepreneurship (Shepherd et al., 2019; Chalmers et al., 2021; Obschonka & Fisch, 2022; Schiavone et al., 2022). Giuggioli and Pellegrini (2023) identify three clusters in the literature that align with sequential phases in an AI-enabled entrepreneurial process: opportunity, decision-making and performance. AI can assist in discovering or co-creating opportunities (Lupp, 2023). It may influence the decision to start a company and how entrepreneurs develop, design and scale (Chalmers et al., 2021). Large datasets and learning algorithms that identify patterns or make precise predictions can also be applied to entrepreneurial opportunity and exploitation (Cockburn et al., 2019). The relevance of these developments to food security lies in the possibility that agricultural entrepreneurs can use AI to identify opportunities, improve production decisions, strengthen market access and reduce losses across the food system.

Entrepreneurial Opportunities and Applications of Artificial Intelligence in Food Security

Artificial Intelligence (AI) transforms, destroys and creates human occupations and brings new opportunities and challenges to existing and potential entrepreneurs. AI may create new business opportunities for entrepreneurs (Shepherd & Majchrzak, 2022), but may also push individuals into self-employment whose prior wage jobs are automated through the implementation of AI. The key capability of AI is prediction, which has the potential to reduce uncertainty (Lupp, 2023; Agrawal et al., 2024). AI can be used to search through a very large set of options to identify opportunities, for example for product design or the choice of market segments. In agriculture, this capacity can support decision-making concerning production, crop monitoring, disease detection, weather forecasting, storage, marketing and distribution. A process perspective on entrepreneurship is useful to consider AI impacts on different stages of entrepreneurship (Shepherd et al., 2019; Chalmers et al., 2021; Obschonka & Fisch, 2022; Schiavone et al., 2022). Giuggioli and Pellegrini (2023) identify three clusters in the literature that align as sequential phases in an "AI-enabled entrepreneurial process": opportunity, decision-making, and performance. AI as a technological breakthrough changes the business environment and has been described as an external enabler of entrepreneurial activities and success (Davidsson et al., 2020; Davidsson & Sufyan, 2023). In the opportunity phase, the entrepreneur looks for ways to reshape and enhance traditional business model approaches with AI. AI can assist in discovering or co-creating opportunities (Lupp, 2023).

Large datasets and learning algorithms that can see otherwise imperceptible patterns or make precise predictions can be turned towards entrepreneurial opportunity and exploitation (Cockburn et al., 2019). AI may therefore provide opportunities for agricultural entrepreneurs to develop products and services that respond to problems of food production, storage, transportation, marketing and distribution. The application of AI in agriculture can include the use of sensors and data analytics, crop monitoring, disease identification and predictive systems. The digitisation of agriculture has created opportunities for smart farming and the application of digital technologies to agricultural production (Bacco et al., 2019). Machine learning has also become increasingly relevant to agriculture, particularly in relation to prediction, monitoring and decision-making (Benos et al., 2021). Akbar et al. (2023) observe that AI has applications in smart agriculture and can support agricultural processes through intelligent technologies. Similarly, Akinola et al. (2022) identify prospects for AI applications in Nigerian agriculture while also drawing attention to the challenges that may constrain adoption.

Role of Digital Literacy and Food Security in Nigeria

Digital literacy can help farmers use technology to improve market access, obtain agricultural information and reduce post-harvest losses. Its benefits are likely to be greater when farmers also have reliable electricity, connectivity, affordable devices and appropriate digital services. The paper therefore concludes that AI has potential to contribute to food security in Nigeria, but its effectiveness depends on infrastructure, finance, digital literacy, storage facilities and technologies adapted to local conditions. The benefits of AI cannot be fully realised where farmers lack the knowledge and skills required to use digital technologies. Digital literacy therefore represents an important condition for the effective application of AI in agriculture. Farmers need to be able to access information, interpret digital outputs and use available technologies in making production and marketing decisions. Digital literacy is also relevant to market access. Where farmers can obtain timely information about prices, demand, weather and market opportunities, they may be better

positioned to make decisions about what to produce, when to sell and where to sell. Digital technologies can also contribute to financial inclusion by connecting farmers and entrepreneurs with financial services. The relationship between digital literacy and food security must be considered alongside digital infrastructure. Where connectivity, electricity and access to digital devices are inadequate, digital literacy alone may not be sufficient. Digital capacity must therefore be developed alongside the infrastructure required to make that capacity useful.

Financial Constraints and Food Security in Nigeria

Agricultural financing is the acquisition and use of capital for agricultural activities. This can be obtained from various sources including personal savings, bank loans, loans from friends and family, cooperative societies and money lenders, government sources, charitable organizations and private companies. According to Muftau (2003), agricultural credit or finance refers to credit granted to farm and ranch operators to assist in planting and harvesting crops and to support the feeding and care of livestock. Credit to the agricultural sector could take the form of an overdraft, short-term, medium-term or long-term credit depending on the purpose and gestation period of the project. Financial constraints are particularly important in considering AI adoption because AI technologies may require expenditure on hardware, software, connectivity, data, maintenance and training. Small farmers and agricultural entrepreneurs who already experience difficulty accessing conventional agricultural credit may consequently face additional barriers to technological adoption. Waqar (2008) examined agricultural credit constraints and borrowing behaviour among rural farmers in Punjab and found that collateral requirements, complicated procedures, delays in disbursement and other obstacles affected access to credit. This study illustrates the importance of considering the conditions under which agricultural producers obtain finance. In Nigeria, Emmanuel (2008) examined the impact of the macroeconomic environment on agricultural-sector growth and included agricultural credit, nominal interest rates, exchange rates, world prices of agricultural produce, foreign private investment, government expenditure and inflation in the analysis. The study found relationships between agricultural production and these macroeconomic conditions. Similarly, Nwanyanwu (2009) examined the role of bank credit in economic growth in Nigeria and observed that bank credit had not significantly affected economic growth, attributing this partly to the reluctance of banks to lend to productive sectors such as agriculture. These findings remain relevant to the question of AI adoption. Where farmers and agricultural entrepreneurs cannot obtain adequate finance for ordinary agricultural inputs and activities, the additional costs associated with AI adoption may constitute a further barrier.

Environmental Conditions, Climate and Food Security

Food security cannot be separated from the environmental conditions in which agricultural production occurs. Agriculture depends on land, water, rainfall, vegetation and other natural resources. Environmental degradation and climate-related pressures can therefore affect agricultural productivity and the stability of food systems. Over a decade ago, Ibebunjo and Okokhere (2016) articulated the importance of environmental conditions in relations to the security of the environment and overall development of society. Osawe and Ibebunjo (2010) examined environmental security threats in the Niger Delta and identified climate change, environmental degradation, poverty, socio-political and health threats as interconnected environmental-security concerns. Their analysis demonstrates the close relationship between environmental conditions, human well-being and sustainable development. In a

related study, Ibebunjo and Osawe (2010) also found that conditions leading to environmental degradation can result in crises of national and international proportions.

Climate-related pressures may also contribute to competition over natural resources and affect agricultural livelihoods. Umenze et al. (2024) examined climate change and communal conflicts in Gurara Local Government Area of Niger State and highlighted the relationship between climate-related pressures, resource conditions and conflict. These conditions are relevant to food security because agricultural production and food availability may be disrupted when farmers lose access to land or water or when environmental changes reduce productive capacity. AI-enabled weather forecasting, crop monitoring and early warning systems may assist agricultural actors in anticipating some of these risks. However, AI cannot substitute for environmental protection or appropriate agricultural policy. Its contribution should be viewed as part of a wider strategy for strengthening agricultural resilience and food-system stability.

Technological Cost and Food Security

The cost of technology is one of the major considerations in the adoption of AI. Although AI applications can reduce some production and information costs, the initial cost of acquiring technology may be beyond the reach of many farmers and small agricultural businesses. AI adoption may require access to digital devices, sensors, data services, reliable electricity, connectivity, software and technical support. These costs can become particularly significant in rural areas where infrastructure is weak. Research on entrepreneurial AI adoption indicates that high fixed costs and specialised skills can disadvantage small businesses (McElheran et al., 2024). This concern is relevant to agricultural entrepreneurs who may lack the financial resources and technical capacity needed to implement sophisticated AI systems.

Consequently, the application of AI to Nigerian agriculture should not be based solely on the availability of sophisticated technology. Technologies must be adapted to farmers' and agricultural entrepreneurs' circumstances. Low-cost applications, low-bandwidth systems and technologies that can operate with limited infrastructure may offer more practical opportunities for rural communities. The problem is therefore not simply whether AI is available, but whether it is affordable and appropriate for the users who need it. Low-cost, locally adaptable and low-bandwidth technologies may be more appropriate for many Nigerian agricultural communities than expensive systems designed for highly developed agricultural environments.

AI, Food Security and the Nigerian Context

The foregoing discussion indicates that the contribution of AI to food security in Nigeria depends on the interaction between technological opportunity and the conditions within which agricultural actors operate. AI can support prediction, monitoring, decision-making, market access and agricultural innovation, but these benefits may be limited by technological costs, inadequate digital literacy, financial constraints and weak infrastructure.

Food security is also affected by wider social and environmental conditions. Migration can alter agricultural labour availability and rural livelihoods, while environmental degradation and climate-related pressures can affect agricultural production and resource access. If unchecked, these factors can exacerbate ethno-religious conflict, resulting in greater crises for society (Ukpe et al., 2025). Consequently, technological interventions should be situated within the broader social, economic and environmental context of Nigerian agriculture. AI therefore offers opportunities rather than an automatic solution. Its contribution to food security will depend on whether agricultural entrepreneurs and farmers are able to access

and use appropriate technologies and whether institutions provide the infrastructure, finance, skills and regulatory environment necessary for effective adoption.

From Technological Potential to Food-Security Outcomes

The evidence reviewed suggests that AI can contribute to food security through several pathways. At the production level, it can support crop monitoring, disease detection, weather forecasting and improved decision-making. At the market level, it can improve access to information, support market coordination and connect producers with consumers. At the storage and distribution levels, digital technologies can contribute to better management of agricultural products and reduce avoidable losses. The potential benefits are particularly important in a food system where losses can occur before, during and after production. Improving storage facilities and reducing post-harvest losses can increase the quantity of food available for consumption and reduce pressure on prices. Digital literacy is therefore central to the effective application of these technologies. Farmers must not only have access to technology but also possess the capacity to use it. The relationship between AI and food security can consequently be understood as a process in which technological capabilities are translated into agricultural applications through entrepreneurship, digital literacy, finance and infrastructure. Where these enabling conditions are weak, the potential contribution of AI may remain unrealised. The objective should therefore not be the indiscriminate adoption of AI but the development and application of appropriate technologies that respond to actual agricultural problems in Nigeria. AI applications should be affordable, accessible and capable of functioning within the infrastructural conditions of rural communities. This approach provides a basis for considering how AI can contribute to reducing food losses, improving agricultural productivity, strengthening market access and enhancing the stability of food systems in Nigeria.

Artificial Intelligence, Food Security and the Conditions for Effective Adoption

The preceding discussion indicates that Artificial Intelligence (AI) offers opportunities for addressing some of the persistent challenges affecting food security in Nigeria. However, the potential benefits of AI cannot be separated from the conditions under which farmers and agricultural entrepreneurs operate. The technology can improve prediction, information access, monitoring and decision-making, but its effectiveness depends on affordability, infrastructure, digital literacy, finance and the suitability of the technology to local conditions. AI may create new business opportunities for entrepreneurs while also transforming existing occupations and business activities (Shepherd & Majchrzak, 2022). In agriculture, this transformation can provide opportunities for new products and services based on data, prediction, digital platforms and intelligent systems. The challenge is to ensure that these opportunities contribute to improved food production, accessibility, utilisation and stability rather than widening existing inequalities. The evidence suggests that AI adoption is not evenly distributed across businesses. McElheran et al. (2024) found that firms using AI tend to be larger and that high fixed costs and specialised skill requirements may disadvantage small and entrepreneurial businesses. This has particular significance for Nigeria, where a substantial proportion of agricultural production is undertaken by smallholder farmers.

Towards a More Inclusive AI-Enabled Food System

The application of AI to food security should be inclusive. Food insecurity does not affect all groups equally, and the ability to benefit from new technologies is similarly uneven. Smallholder farmers, rural communities and other groups with limited access to finance and

digital infrastructure may be excluded from technological advances if adoption is left entirely to market forces. Digital literacy is therefore an essential component of an AI-enabled food system. Farmers require the knowledge and skills necessary to access agricultural information, interpret digital outputs and use technology in production and marketing decisions. Digital literacy can also support better market access and financial inclusion. However, digital literacy without digital infrastructure will have limited effect. Farmers require access to electricity, connectivity, affordable devices and appropriate digital services. The development of digital infrastructure must therefore accompany programmes designed to improve digital literacy. This is particularly important in rural communities where technological access may be constrained by physical and economic conditions. Agricultural innovation should consequently be designed around the realities of the intended users rather than around the technological capabilities of the developers.

Finance, Entrepreneurship and Technological Adoption

Financial constraints remain an important barrier to agricultural development and the adoption of new technologies. Farmers require finance not only for seeds, fertiliser, machinery and other conventional inputs but also increasingly for digital devices, connectivity, training and technological services. The literature reviewed indicates that access to agricultural credit has historically been constrained by collateral requirements, complicated procedures, delays and the reluctance of financial institutions to lend to productive sectors. These constraints can make the adoption of AI particularly difficult for small-scale agricultural producers. Entrepreneurial businesses may also face high initial costs associated with AI adoption. McElheran et al. (2024) identify high fixed costs and specialised skills as possible reasons for the lower adoption of AI among smaller firms. This suggests that agricultural finance and digital innovation should not be treated as separate policy areas. Access to finance can determine whether farmers and entrepreneurs are able to acquire and maintain technologies capable of improving agricultural production and food distribution.

Financial institutions, government agencies and private-sector actors therefore have important roles to play in creating financing mechanisms appropriate for agricultural technology adoption. Such mechanisms should recognise the distinctive characteristics of agricultural production, including seasonality, uncertainty and the relatively long gestation periods associated with some agricultural activities.

Environmental and Climate Dimensions of Food Security

The sustainability of food systems also depends on environmental conditions. Climate variability, environmental degradation and competition over natural resources can affect agricultural productivity and the livelihoods of rural communities. Environmental security concerns are therefore closely connected with food security. Osawe and Ibebunjo (2010) highlighted the relationship between environmental degradation, climate change, poverty and wider human-security concerns. These conditions demonstrate that environmental problems cannot be separated from questions of livelihood and sustainable development.

For agriculture, these issues have direct implications. Where farmers face environmental degradation, water scarcity, displacement or conflict, agricultural production and food availability may be disrupted. AI may contribute to the management of some of these risks through weather forecasting, crop monitoring, early warning systems and predictive analytics. Nevertheless, AI should be regarded as a supporting mechanism rather than a substitute for environmental management, conflict prevention, infrastructure development and appropriate agricultural policies.

The Nigerian Policy Challenge

The central policy challenge is not whether Nigeria should adopt AI, but how it can strengthen food security while remaining accessible to the agricultural population. In Northern Nigeria, terrorism has disrupted agricultural activities, displaced farming communities and undermined rural livelihoods, thereby aggravating food insecurity (Lamorde & Ibebunjo, 2022). Low-cost AI-powered tools that operate offline or with limited bandwidth are therefore important, particularly in rural communities affected by insecurity and inadequate infrastructure. Data governance is equally important. Agricultural AI systems depend on data, and their collection, storage and use require appropriate safeguards to protect farmers' information and build public confidence. There is also a need for collaboration among AI developers, agronomists, security agencies and local farmers. Such partnerships can help adapt technologies to local agricultural needs while accounting for insecurity and displacement. Government therefore has a critical role in strengthening food security through investment in digital infrastructure, agricultural research, training, financing and appropriate regulation. The private sector and entrepreneurial businesses can complement these efforts by developing affordable technologies that support agricultural recovery, improve food distribution and enhance resilience in terrorism-affected communities.

Conclusion

This paper concludes that reducing food losses and improving food security in Nigeria require attention to both pre-harvest and post-harvest conditions. Appropriate storage facilities can help preserve agricultural produce, reduce avoidable losses and improve the availability of food for consumers. Better storage and distribution may also reduce the pressure to incorporate storage losses into product prices. However, storage investment should form part of a wider strategy that includes improved production, transport, market access and agricultural support. Digital literacy can help farmers use technology to improve market access, obtain agricultural information and reduce post-harvest losses. Its benefits are likely to be greater when farmers also have reliable electricity, connectivity, affordable devices and appropriate digital services. The paper therefore concludes that AI has potential to contribute to food security in Nigeria, but its effectiveness depends on infrastructure, finance, digital literacy, storage facilities and technologies adapted to local conditions.

Recommendations

Based on the foregoing discussion, the following recommendations are made:

i. Government, private-sector organisations and technology developers should prioritise affordable AI-powered agricultural tools that can operate in low-connectivity environments and respond to the specific needs of Nigerian farmers and agricultural entrepreneurs.
ii. Greater investment should be made in rural connectivity, electricity and other digital infrastructure, alongside practical digital-literacy programmes integrated into agricultural extension services.
iii. Greater attention should be given to appropriate and affordable storage facilities to reduce pre- and post-harvest losses. At the same time, accessible financing mechanisms should be developed to enable farmers and agricultural entrepreneurs to acquire appropriate technologies and other agricultural inputs.
iv. AI should not be treated as a stand-alone solution to food insecurity. Its adoption should be integrated with agricultural extension, storage, financing, infrastructure,

environmental management and market-development policies, with collaboration among AI developers, agronomists, extension workers and farmers to ensure that technological interventions are practical, accessible and sustainable.

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