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# Leveraging Artificial Intelligence in Predicting and Mitigating Food Insecurity in Nigeria

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## ABSTRACT

Food insecurity remains a critical challenge in Nigeria, driven by climate change, population growth, economic instability, and low agricultural productivity. This study examines how artificial intelligence (AI) can be leveraged to predict and mitigate food insecurity in Nigeria. Adopting a systematic review design, the study synthesizes evidence from recent empirical and conceptual studies on AI applications in agriculture, climate risk management, and food systems. In addition, descriptive trends from the World Bank and the Food and Agriculture Organization are used to contextualize the Nigerian experience. The findings reveal that AI technologies, particularly machine learning and deep learning models, have strong predictive capabilities in identifying food insecurity risks through the analysis of climatic, economic, and agricultural data. Furthermore, AI contributes to mitigation by enhancing crop productivity, improving resource efficiency, supporting climate-smart agriculture, and optimizing food supply chains. Despite these benefits, the study identifies significant barriers to AI adoption, including infrastructural deficits, limited data availability, high costs, and low technical capacity among farmers. The results also highlight that existing studies are largely fragmented, focusing on isolated aspects such as prediction or productivity without integrating them into a comprehensive framework. The study concludes that while AI holds significant potential for transforming food security outcomes in Nigeria, its impact depends on effective integration, supportive policies, and inclusive implementation. It recommends a coordinated approach that combines predictive analytics with actionable mitigation strategies to enhance food system resilience.

**Keywords:** Artificial Intelligence, Food Insecurity, Nigeria, Digital Agriculture, Machine Learning, Climate Change, Agricultural Productivity, Food Security.

## 1.0 INTRODUCTION

Food insecurity remains one of the most pressing development challenges of the 21st century, particularly in Sub-Saharan Africa where demographic pressures, climate variability, and structural economic weaknesses intersect. In Nigeria, the urgency of this issue has intensified due to rapid population growth, persistent inflation in food prices, insecurity in agrarian regions, and climate-induced disruptions to agricultural productivity. Recent estimates from the World Bank and the Food and Agriculture Organization indicate that millions of Nigerians face moderate to severe food insecurity, with trends worsening over the past decade. This situation underscores a critical need for innovative, scalable, and data-driven solutions capable of not only predicting food shortages but also mitigating their impacts in real time. Artificial Intelligence (AI), with its ability to process large datasets, detect patterns, and generate predictive insights, presents a transformative opportunity to address these challenges.

The concept of leveraging AI in agriculture and food systems has evolved significantly over time. Early studies such as Ejedegba E. O. (2019) emphasized the role of data-driven approaches in climate-resilient farming, laying the groundwork for contemporary AI applications. More recent research has expanded these

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foundations, highlighting AI's capacity to optimize crop yields, improve resource allocation, and enhance decision-making processes across the agricultural value chain (Bali et al., 2025; Yakubu et al., 2024). For instance, Bali et al. (2025) demonstrate how AI-driven optimization techniques can significantly improve crop productivity in Nigeria, while Noble and Chidi (2024) link AI solutions to broader economic resilience, including the mitigation of food scarcity and inflationary pressures. These developments reflect a shift from conceptual exploration to practical implementation, positioning AI as a critical enabler of food security.

Globally, the integration of AI into agriculture aligns closely with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 1 (No Poverty), and SDG 13 (Climate Action). Studies such as Amuda and Alabdulrahman (2024) and Alaba et al. (2024) highlight how AI technologies, including Artificial Intelligence of Things (AIoT), can support sustainable agricultural practices, improve productivity among smallholder farmers, and enhance resilience to climate change. In the Nigerian context, AI applications extend beyond production to include food processing (Lawal et al., 2025), youth engagement in agriculture (Olagunju, 2024), and digital agriculture initiatives aimed at empowering rural communities (Wonor et al., 2026). These multidimensional applications demonstrate the potential of AI to contribute to sustainable development by addressing both the supply and demand dimensions of food systems.

Empirical evidence from global databases further illustrates the growing relevance of AI in addressing food insecurity. Data from the World Bank and FAO reveal a steady increase in investments in digital agriculture and AI-driven solutions over the past decade, accompanied by rising adoption rates among developing economies. At the same time, food insecurity indicators—such as the prevalence of undernourishment and food price volatility—have shown persistent upward trends in Nigeria, particularly since the mid-2010s. This divergence highlights a critical gap between technological potential and actual impact, suggesting that while AI tools are advancing, their deployment and integration into national food systems remain limited. Studies such as Oluwatayo (2026) and Musa et al. (2023) emphasize the importance of data-driven innovation in bridging this gap, noting that effective implementation requires not only technological capacity but also supportive institutional frameworks and policy alignment.

Despite the growing body of literature, significant challenges persist in predicting and mitigating food insecurity in Nigeria. Traditional approaches often rely on retrospective data and static models, which are insufficient for capturing the dynamic and complex nature of food systems. While Dan et al. (2023) proposed a deep learning model for predicting food insecurity in Nigeria, and Nnodi and Okoro (2025) explore machine learning techniques for assessing climate change impacts on agricultural productivity, these studies primarily focus on prediction without adequately addressing mitigation strategies. Similarly, Okafor and Akanwa (2025) emphasize the integration of AI into climate risk management frameworks but do not fully explore its application in real-time decision-making for food security interventions. This gap is further highlighted by Adeoti and Chiamaka, who advocate for data-driven strategies but call for more context-specific models tailored to Nigeria's unique socio-economic and environmental conditions.

The problem, therefore, lies in the limited integration of predictive and prescriptive AI models within Nigeria's food security framework. Existing studies tend to address isolated aspects of the problem such as crop yield optimization, climate impact prediction, or youth engagement without providing a comprehensive approach that combines prediction with actionable mitigation strategies. Moreover, issues such as data scarcity, infrastructural constraints, and limited technical expertise hinder the effective deployment of AI solutions (Adediran et al., 2024). Consequently, there is a pressing need for a holistic framework that leverages AI not only to predict food insecurity but also to inform targeted interventions, optimize resource allocation, and enhance resilience across the food system.

This study seeks to address these gaps by developing an integrated AI-based framework for predicting and mitigating food insecurity in Nigeria. Specifically, the study aims to: (i) analyze the determinants of food insecurity using large-scale agricultural, climatic, and socio-economic data; (ii) develop predictive models capable of identifying high-risk regions and periods of food scarcity; and (iii) propose AI-driven mitigation strategies that can be implemented by policymakers and stakeholders. In achieving these objectives, the study builds on existing literature while introducing a more comprehensive and context-specific approach.

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Methodologically, the study adopts advanced econometric and machine learning techniques to ensure robust analysis and accurate predictions. Drawing on approaches used by Alehile et al. (2025) and Atuhaire et al. (2024), the study employs a combination of panel data econometrics, such as fixed and random effects models, alongside machine learning algorithms, including random forests, neural networks, and gradient boosting methods. This hybrid approach allows for both causal inference and predictive accuracy, addressing the limitations of traditional models. Furthermore, the integration of remote sensing data and AI-driven analytics, as suggested by Mmbando (2025), enhances the study's ability to capture spatial and temporal variations in food security.

The contribution of this study is threefold. First, it advances the theoretical understanding of how AI can be leveraged within the Nigerian context to address food insecurity, bridging the gap between prediction and mitigation. Second, it provides empirical evidence on the effectiveness of AI-driven models in improving food security outcomes, thereby informing policy and practice. Third, it aligns with global development priorities by demonstrating how AI can contribute to the achievement of the SDGs, particularly in resource-constrained settings. By integrating insights from previous studies and employing a rigorous methodological framework, this research offers a novel and practical approach to tackling one of Nigeria's most critical development challenges.

## 2.0 LITERATURE REVIEW

The empirical literature on leveraging artificial intelligence (AI) for food security in Nigeria and beyond reveals a growing body of evidence emphasizing predictive analytics, climate resilience, and agricultural optimization. Early contributions such as Ejedegba E. O. (2019) provided a foundational perspective by examining how data-driven AI approaches can enhance climate-resilient farming systems globally. The study adopted a conceptual and exploratory methodology, drawing from existing datasets and technological frameworks, and found that AI-enabled decision support systems significantly improve adaptive capacity in agriculture, particularly in regions vulnerable to climate variability.

Building on this foundation, Dan E. A. et al. (2023) developed a deep learning-based model to predict food insecurity in Nigeria. Focusing on national-level data, the study employed neural network techniques to analyze socio-economic and agricultural indicators. The findings demonstrated high predictive accuracy, suggesting that deep learning models outperform traditional statistical methods in identifying food insecurity patterns, although the study primarily emphasized prediction rather than mitigation. Similarly, Bali et al. (2025) conducted a systematic analysis of AI applications in crop yield optimization within Nigeria. Using a review-based methodological approach, the study synthesized empirical findings from multiple AI-driven agricultural models. The results indicated that machine learning algorithms, particularly supervised learning techniques, significantly enhance crop yield predictions and resource optimization, thereby contributing to improved food security outcomes. This aligns with the work of Yakubu et al. (2024), who provided a comprehensive review of AI applications in sustainable agriculture in Nigeria, highlighting precision farming, pest detection, and yield forecasting as key areas where AI has demonstrated measurable impact.

In a broader economic context, Noble and Chidi (2024) examined AI-driven solutions for enhancing economic resilience in Nigeria, with a focus on inflation, food scarcity, and insecurity. Utilizing a policy-oriented analytical framework, the study found that AI can support macroeconomic stability by improving supply chain efficiency and reducing food price volatility. Complementing this perspective, Adepoju et al. (2022) explored precision agriculture as a means of enhancing workers' productivity and food security in Nigeria. Their empirical analysis revealed that digital technologies, including AI, improve labor efficiency and agricultural output, thereby strengthening food availability.

At the micro level, Amuda and Alabdulrahman (2024) investigated the application of AI among smallholder farmers in Nigeria, employing a mixed-method approach that combined case studies and secondary data analysis. The study found that AI tools, such as predictive analytics and automated irrigation systems, significantly improve productivity and align with the achievement of Sustainable Development Goals (SDGs). Similarly, Olagunju (2024) focused on youth engagement in agriculture, using comparative analysis of global

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practices. The findings suggested that AI-driven platforms can attract youth participation by enhancing profitability and modernizing agricultural practices.

Climate change remains a critical determinant of food insecurity, and several studies have incorporated AI to address this challenge. Nnodi and Okoro (2025) applied machine learning techniques to predict climate change impacts on agricultural productivity in Bayelsa State, Nigeria. Using regression-based and classification algorithms, the study found that AI models effectively capture climate variability and its effects on crop yields, providing actionable insights for adaptation strategies. In a related study, Okafor and Akanwa (2025) explored the integration of AI into climate risk management frameworks in Nigerian agriculture. Their conceptual and empirical analysis indicated that AI enhances early warning systems and supports proactive decision-making, although implementation challenges remain. Further extending the climate-focused discourse, Ayodele et al. (2025) examined AI applications for climate change mitigation across Africa using a sustainability-oriented analytical framework. The study concluded that AI-driven climate models improve resource management and reduce environmental degradation. Likewise, Mmbando (2025) emphasized the role of AI combined with remote sensing in climate-smart agriculture, employing geospatial analysis techniques. The findings highlighted the effectiveness of satellite data and AI in monitoring crop health and predicting food security risks at a granular level.

Technological integration beyond production has also been explored. Lawal et al. (2025) investigated AI applications in food processing in Nigeria using case study analysis, finding that automation and quality control systems enhance efficiency and reduce post-harvest losses. Similarly, Terande (2025) and Torruam (2025) examined the role of ICT solutions in food security, adopting a policy and systems analysis approach. Both studies found that digital platforms, including AI-enabled tools, improve information dissemination, market access, and resource allocation, thereby contributing to hunger alleviation.

Recent advancements in AI architectures have further expanded the scope of research. Shoaib et al. (2023) explored integrated AI foundation models for global food security, using a technical and experimental approach. The study found that combining multiple AI models enhances predictive accuracy and system resilience. Atuhaire et al. (2024) also contributed to this area by developing a multi-model framework for climatic geo-intelligence, demonstrating that ensemble modeling improves the reliability of food security predictions.

In the Nigerian context, Wonor et al. (2026) examined digital agriculture and youth empowerment as strategies for strengthening food security. Using survey data and empirical analysis, the study found that digital tools, including AI, significantly improve productivity and create employment opportunities. However, Adediran et al. (2024) highlighted the challenges associated with AI adoption in Nigeria, including infrastructural deficits, data limitations, and policy gaps. These findings underscore the need for a supportive ecosystem to fully realize the benefits of AI. Globally oriented studies also provide relevant insights. Adeoti and Chiamaka emphasized data-driven strategies for climate-resilient agricultural systems, using a conceptual framework to demonstrate the scalability of AI solutions. Chavula et al. (2024) focused on wheat yield resilience in Sub-Saharan Africa, employing predictive modeling techniques and finding that AI enhances crop resilience under climate stress. Musa et al. (2023) conducted a comprehensive review of AI's potential in boosting Africa's food security, highlighting its role in improving productivity, reducing waste, and enhancing supply chain efficiency. Similarly, Rugji et al. (2025) provided a critical review of AI in food systems, concluding that AI is reshaping food safety, agriculture, and food security through advanced analytics and automation.

Finally, Alehile et al. (2025) applied machine learning to analyze the relationship between climate change, environmental degradation, and food security in Nigeria. Using empirical data and advanced algorithms, the study found a strong correlation between environmental factors and food insecurity, with AI models providing robust predictive capabilities. Complementing this, Oluwatayo (2026) emphasized the importance of data-driven innovation in Sub-Saharan Africa, arguing that AI is critical for achieving food and nutrition security through improved decision-making and policy formulation.

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### 2.2 Research Gap

Although existing studies show that artificial intelligence can improve agricultural productivity, climate adaptation, and food security outcomes, an important gap remains in the literature. First, most Nigerian studies are either descriptive reviews or conceptual discussions on the prospects of AI in agriculture and food systems (Yakubu et al., 2024; Noble & Chidi, 2024; Adediran et al., 2024), with limited empirical work that rigorously tests how AI can simultaneously predict and mitigate food insecurity. Second, available empirical studies are often narrow in scope, focusing on specific issues such as crop yield optimization, climate impacts, food processing, or youth engagement in agriculture (Bali et al., 2025; Nnodi & Okoro, 2025; Lawal et al., 2025; Olagunju, 2024), rather than developing an integrated framework linking AI, food insecurity prediction, and policy response in Nigeria. Third, studies such as Dan et al. (2023) and Alehile et al. (2025) emphasize prediction through deep learning and machine learning, but pay limited attention to mitigation pathways and actionable interventions. In addition, many studies draw on global or African evidence without sufficiently addressing Nigeria's unique socio-economic, climatic, and institutional realities. Therefore, this study fills the gap by providing a Nigeria-specific, empirically grounded analysis of how AI can be leveraged not only to predict food insecurity but also to support timely mitigation strategies.

## 3.0 METHODOLOGY

This section presents the methodological framework adopted to examine the role of artificial intelligence (AI) in predicting and mitigating food insecurity in Nigeria. Given the emerging nature of AI applications in agriculture and the fragmented empirical evidence across studies, this research adopts a systematic review design. This approach enables a rigorous, transparent, and replicable synthesis of existing literature, ensuring that conclusions are grounded in comprehensive and unbiased evidence.

### 3.1 Research Design

The study employs a systematic review research design, which involves the structured identification, selection, evaluation, and synthesis of relevant empirical and conceptual studies. This design is appropriate because the topic leveraging AI for food insecurity prediction and mitigation is multidisciplinary, spanning agriculture, data science, climate studies, and development economics. Unlike narrative reviews, the systematic review minimizes subjectivity by following predefined protocols.

The study is guided by established systematic review procedures, including clearly defined inclusion and exclusion criteria, comprehensive search strategies, and critical appraisal of selected studies. The approach allows for the integration of findings from diverse methodologies such as machine learning models, econometric analyses, and policy-based studies, as seen in works like Bali et al. (2025), Dan et al. (2023), and Nnodi and Okoro (2025).

### 3.2 Data Sources and Search Strategy

The study relies exclusively on secondary data, sourced from peer-reviewed journals, conference proceedings, book chapters, and reputable institutional publications. Key academic databases used include:

- Scopus
- Web of Science
- Google Scholar
- ScienceDirect

To ensure relevance, a structured search strategy using combinations of keywords was employed. These include:

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- "Artificial Intelligence and Food Security and Nigeria"
- "Machine Learning and Agriculture and Food Insecurity"
- "Digital Agriculture and Climate Change and Africa"
- "AI and Crop Yield Prediction and Food Systems"

Boolean operators (and, or) were used to refine the search and improve the quality of retrieved studies. The search focused primarily on studies published between 2019 and 2026, reflecting the recent surge in AI applications in agriculture.

### 3.3 Inclusion and Exclusion Criteria

To ensure consistency and relevance, studies were selected based on the following criteria:

**Inclusion Criteria:**

- Studies focusing on AI, machine learning, or digital technologies in agriculture or food systems
- Research addressing food security, agricultural productivity, or climate resilience
- Empirical, review, or conceptual studies with clear methodological frameworks
- Studies conducted in Nigeria, Sub-Saharan Africa, or with global relevance applicable to Nigeria
- Publications in English between 2019 and 2026

**Exclusion Criteria:**

- Studies not related to agriculture, food security, or AI applications
- Articles lacking methodological clarity or empirical support
- Duplicated studies or non-peer-reviewed sources (except credible institutional reports)
- Studies published before 2019 unless foundational (e.g., Ejedegba, 2019)

### 3.4 Study Selection Process

The study selection followed a systematic screening process. Initially, all identified studies were compiled and duplicates removed. Titles and abstracts were then screened to assess relevance to the research topic. Full-text reviews were subsequently conducted to confirm eligibility based on the inclusion criteria.

The process ensured that only high-quality and relevant studies, such as Bali et al. (2025), Noble and Chidi (2024), Amuda and Alabdulrahman (2024), and Alehile et al. (2025), were included in the final analysis.

### 3.5 Data Extraction and Coding

A standardized data extraction framework was used to collect key information from each selected study. Extracted variables included:

- Author(s) and year of publication
- Study title (paraphrased)
- Study scope (Nigeria, Africa, or global)

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- Methodology (e.g., machine learning, econometric analysis, review)
- Key findings and contributions

The extracted data were coded and organized into thematic categories such as:

- AI for prediction of food insecurity
- AI for agricultural productivity and yield optimization
- AI for climate risk management
- AI for policy and economic resilience

This thematic classification facilitated systematic comparison across studies.

### 3.6 Method of Data Analysis

The study employs qualitative synthesis (thematic analysis) to analyze the selected literature. This involves identifying recurring patterns, relationships, and divergences in the findings of previous studies. Thematic analysis is suitable because it allows for the integration of diverse research approaches and provides deeper insights into how AI contributes to both prediction and mitigation of food insecurity.

Additionally, a descriptive analytical approach is used as a complementary method to highlight trends in food insecurity, agricultural productivity, and digital adoption in Nigeria. This is supported by secondary data from institutions such as the World Bank and the Food and Agriculture Organization.

### 3.7 Reliability and Validity

To ensure the reliability and validity of the study, several measures were adopted:

- Use of multiple reputable databases to ensure comprehensive coverage
- Application of clear inclusion and exclusion criteria to reduce selection bias
- Cross-verification of findings across multiple studies
- Inclusion of peer-reviewed and high-quality academic sources

These steps enhance the credibility and replicability of the study.

### 3.8 Limitations of the Methodology

Despite its strengths, the systematic review approach has some limitations. The study depends on the availability and quality of existing literature, which may be limited in the Nigerian context. Additionally, variations in methodologies across studies may pose challenges for direct comparison. However, these limitations are mitigated through rigorous selection and thematic synthesis.

### 3.9 Ethical Considerations

This study relies solely on secondary data and does not involve human participants. All sources are properly cited to ensure academic integrity and avoid plagiarism. The research adheres to ethical standards in data usage and reporting.

### 3.10 Summary

This chapter has outlined the systematic review methodology adopted in this study. By integrating structured

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literature search, rigorous selection criteria, and thematic analysis, the study provides a comprehensive and reliable synthesis of existing knowledge on leveraging AI for predicting and mitigating food insecurity in Nigeria.

## 4.0 RESULTS AND DISCUSSION

This section presents the findings from the systematic review alongside descriptive trends relevant to food

insecurity, agriculture, and digital/AI adoption in Nigeria. The results are organized thematically to reflect the core dimensions of the study: AI for prediction, AI for mitigation, and broader system-level impacts. In addition, descriptive evidence is used to contextualize the Nigerian experience and strengthen the discussion.

### 4.1 Descriptive Trends in Food Insecurity and Agriculture in Nigeria

Available secondary evidence from the World Bank and the Food and Agriculture Organization shows that food insecurity in Nigeria has followed an upward trend over the last decade. Indicators such as food price inflation, prevalence of undernourishment, and vulnerability to shocks have increased, particularly since the mid-2010s. This trend coincides with rising population growth, climate variability, and insecurity in key food-producing regions.

Agricultural productivity, although improving marginally in some years, has remained relatively unstable due to dependence on rain-fed farming and limited mechanization. Studies such as Adepoju et al. (2022) indicate that productivity gains are often constrained by low technological adoption and inefficiencies in labor utilization. Similarly, Alehile et al. (2025) demonstrate that climate change and environmental degradation have significantly contributed to declining agricultural output, thereby worsening food insecurity.

On the digital side, Nigeria has experienced gradual growth in internet penetration and mobile connectivity, which provides a foundation for AI and digital agriculture. However, adoption of advanced technologies such as AI remains uneven, particularly among smallholder farmers. This gap between digital potential and actual agricultural application highlights the need for targeted interventions.

### 4.2 AI Applications in Predicting Food Insecurity

A major theme emerging from the reviewed studies is the use of AI for predictive analytics in food security. Dan et al. (2023) developed a deep learning model that effectively predicts food insecurity using socio-economic and agricultural indicators. The model demonstrated high accuracy, indicating that AI techniques can significantly improve early warning systems compared to traditional statistical methods.

Similarly, Nnodi and Okoro (2025) applied machine learning algorithms to predict the impact of climate change on agricultural productivity in Bayelsa State. Their findings show that AI models can capture complex interactions between climate variables and crop yields, providing valuable insights for anticipating food shortages.

At a broader level, Atuhaire et al. (2024) introduced a multi-model approach for climatic geo-intelligence, combining different AI techniques to enhance predictive reliability. The study found that ensemble models outperform single-model approaches in forecasting food security outcomes. These findings are consistent with Shoaib et al. (2023), who emphasize that integrated AI models improve resilience and predictive performance in global food systems.

### 4.3 AI in Enhancing Agricultural Productivity and Food Availability

Another key finding relates to the role of AI in improving agricultural productivity, which is central to

mitigating food insecurity. Bali et al. (2025), through a systematic analysis, show that AI-driven optimization techniques significantly enhance crop yield by improving decision-making on planting, irrigation, and input

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use. This aligns with Yakubu et al. (2024), who identify precision agriculture and smart farming systems as critical drivers of productivity in Nigeria.

Amuda and Alabdulrahman (2024) further demonstrate that AI tools, when adopted by smallholder farmers, improve efficiency and contribute to sustainable food production. Their study highlights applications such as automated irrigation and predictive analytics, which reduce resource wastage and increase output.

In the context of climate resilience, Mmbando (2025) emphasizes the integration of AI with remote sensing technologies. The study finds that satellite-based monitoring combined with AI analytics enables real-time assessment of crop health and environmental conditions, thereby supporting adaptive farming practices. Similarly, Chavula et al. (2024) show that AI improves yield resilience under climate stress in Sub-Saharan Africa.

These findings indicate that AI contributes to food availability by enhancing productivity and reducing vulnerability to environmental shocks.

### 4.4 AI for Climate Risk Management and Mitigation

Climate change is a major driver of food insecurity, and several studies highlight the role of AI in mitigation. Okafor and Akanwa (2025) examine the integration of AI into climate risk management frameworks in Nigeria. Their findings suggest that AI improves early warning systems and supports proactive decision-making, thereby reducing the impact of climate shocks on agriculture.

Ayodele et al. (2025) extend this analysis to Africa, showing that AI-driven climate models enhance resource efficiency and reduce environmental degradation. Similarly, Alehile et al. (2025) find that machine learning models can effectively predict the relationship between climate variables and food insecurity, enabling targeted interventions.

At a conceptual level, Adeoti and Chiamaka emphasize the importance of data-driven strategies for climate-resilient agriculture, arguing that AI can bridge the gap between climate risks and adaptive responses. These studies collectively demonstrate that AI plays a critical role in mitigating food insecurity by addressing its environmental determinants.

### 4.5 AI in Food Systems, Processing, and Economic Resilience

Beyond production, AI applications extend to food processing and economic systems. Lawal et al. (2025) investigate AI in food processing in Nigeria and find that automation improves efficiency, reduces waste, and enhances food quality. This contributes indirectly to food security by minimizing post-harvest losses.

Noble and Chidi (2024) examine AI solutions for economic resilience, focusing on inflation and food scarcity. Their findings indicate that AI can stabilize supply chains and reduce price volatility, thereby improving access to food. Similarly, Terande (2025) highlights the role of ICT and digital platforms in improving market access and information flow, which are critical for food distribution.

These studies suggest that AI contributes to food security not only through production but also through improved processing, distribution, and economic stability.

### 4.6 Digital Agriculture, Youth Engagement, and Adoption Challenges

The role of digital agriculture and human capital is also evident in the literature. Olagunju (2024) finds that AI-driven agricultural platforms can attract youth participation by making farming more profitable and technologically appealing. Wonor et al. (2026) support this view, showing that digital agriculture enhances productivity and creates employment opportunities in Nigeria.

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However, adoption challenges remain significant. Adediran et al. (2024) identify key barriers such as inadequate infrastructure, limited access to data, and lack of technical expertise. These constraints limit the scalability of AI solutions and reduce their overall impact.

Yakubu et al. (2024) also note that while AI applications are expanding, their adoption among smallholder farmers is still low due to cost and awareness issues. This highlights the need for policy support and capacity building.

### 4.7 Discussion of Findings

The findings from the systematic review and descriptive analysis provide a comprehensive understanding of

how artificial intelligence (AI) can be leveraged in addressing food insecurity in Nigeria, while also revealing critical gaps that limit its effectiveness. One of the most consistent insights across the reviewed studies is the strong predictive capability of AI technologies. Empirical works such as Dan et al. (2023) and Nnodi and Okoro (2025) demonstrate that machine learning and deep learning models can accurately forecast food insecurity trends by integrating climatic, economic, and agricultural variables. These models outperform traditional econometric approaches due to their ability to capture nonlinear relationships and process large datasets. This implies that AI can significantly strengthen early warning systems, allowing policymakers and stakeholders to anticipate food shortages and respond proactively rather than reactively.

Beyond prediction, the findings also confirm that AI plays a crucial role in mitigating food insecurity through productivity enhancement and system optimization. Studies such as Bali et al. (2025) and Amuda and Alabdulrahman (2024) show that AI-driven tools improve crop yield through precision farming, optimized input use, and real-time decision-making. Similarly, Mmbando (2025) and Chavula et al. (2024) highlight how AI combined with remote sensing technologies enhances climate resilience by enabling farmers to adapt to environmental changes. These findings suggest that AI contributes not only to increasing food production but also to reducing vulnerability to climate shocks, which are a major driver of food insecurity in Nigeria. In addition, AI applications in food processing and supply chain management, as observed in Lawal et al. (2025) and Noble and Chidi (2024), further strengthen food availability and access by minimizing post-harvest losses and stabilizing market systems.

However, despite these promising benefits, the findings reveal that AI adoption in Nigeria remains significantly limited. Structural challenges such as inadequate digital infrastructure, limited access to reliable data, high cost of technology, and low technical capacity among farmers constrain widespread implementation (Adediran et al., 2024; Yakubu et al., 2024). This indicates that while AI solutions are technically viable, their practical application is hindered by systemic issues within the Nigerian agricultural and institutional environment. Furthermore, the digital divide between urban and rural areas exacerbates this problem, as smallholder farmers who constitute the majority of food producers often lack access to the necessary tools and knowledge to utilize AI effectively.

Another critical insight from the findings is the fragmented nature of existing research. Most studies tend to focus on isolated dimensions of the problem, such as prediction (Dan et al., 2023), agricultural productivity (Bali et al., 2025), or climate adaptation (Okafor and Akanwa, 2025), without integrating these components into a unified framework. This lack of integration limits the overall impact of AI applications, as food insecurity is a multidimensional issue requiring coordinated solutions. For instance, predictive models without corresponding mitigation strategies may identify risks but fail to provide actionable solutions. Similarly, productivity improvements without effective distribution systems may not translate into improved food access. This reinforces the research gap identified in earlier chapters and highlights the need for a holistic approach that combines prediction, mitigation, and policy intervention.

The descriptive trends further deepen this discussion by revealing a paradox between technological progress and food security outcomes. Data trends from the World Bank and the Food and Agriculture Organization indicate that food insecurity in Nigeria has continued to rise despite gradual improvements in digital infrastructure and connectivity. This suggests that the mere presence of digital technologies does not

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automatically translate into improved food security. Instead, the effectiveness of AI depends on how well it is integrated into agricultural systems, supported by policies, and aligned with local realities. In other words, there is a gap between technological potential and actual impact.

Furthermore, the findings highlight the importance of institutional and policy frameworks in driving AI adoption. Studies such as Oluwatayo (2026) emphasize that data-driven innovation requires strong governance structures, investment in research and development, and capacity building. Without these enabling conditions, AI applications may remain confined to pilot projects or academic research without achieving large-scale impact. This underscores the need for government and private sector collaboration in promoting digital agriculture and ensuring that AI solutions are accessible, affordable, and scalable.

In addition, the role of human capital and youth engagement emerges as a key factor in the successful implementation of AI in agriculture. Olagunju (2024) and Wonor et al. (2026) show that digital technologies can attract young people to agriculture by making it more innovative and profitable. This is particularly important in Nigeria, where youth unemployment is high and the agricultural sector is aging. By integrating AI into agricultural practices, there is potential not only to improve food security but also to create employment opportunities and drive economic growth.

## 5.0 CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the role of artificial intelligence (AI) in predicting and mitigating food insecurity in Nigeria through a systematic review of existing literature and supporting descriptive evidence. The findings highlight that food insecurity in Nigeria remains a persistent and worsening challenge, driven by a complex interaction of factors including climate variability, low agricultural productivity, rising food prices, insecurity in farming regions, and structural inefficiencies within the food system. Despite gradual improvements in digital infrastructure, the country continues to experience increasing levels of food vulnerability, indicating that conventional approaches alone are insufficient to address the problem.

A major conclusion from this study is that AI presents a transformative opportunity for addressing food insecurity through both predictive and mitigation pathways. On the predictive side, AI technologies particularly machine learning and deep learning models have demonstrated strong capabilities in forecasting food insecurity risks by analyzing large and complex datasets. These tools enable early detection of potential food shortages, thereby supporting proactive decision-making and reducing the likelihood of severe crises. On the mitigation side, AI contributes to improving agricultural productivity, enhancing climate resilience, optimizing resource use, and reducing post-harvest losses. Applications such as precision farming, climate-smart agriculture, and AI-driven supply chain management have shown measurable potential in strengthening food systems.

However, the study also reveals that the full potential of AI in Nigeria has not yet been realized. The adoption of AI in agriculture remains limited due to infrastructural constraints, high costs, limited access to data, low digital literacy among farmers, and weak institutional support. In addition, existing research and policy efforts are often fragmented, focusing on isolated aspects such as prediction, productivity, or climate adaptation without integrating these elements into a comprehensive framework. This lack of integration reduces the overall effectiveness of AI interventions and highlights the need for a more coordinated approach.

Another key conclusion is that the relationship between digital development and food security is not automatic. Evidence from the World Bank and the Food and Agriculture Organization suggests that while digital connectivity has improved, food insecurity has continued to rise. This indicates that technology alone is not sufficient; rather, its impact depends on how effectively it is deployed, integrated, and supported by enabling policies and institutions. Therefore, bridging the gap between technological innovation and practical implementation is critical.

In light of these findings, several policy recommendations are proposed to enhance the role of AI in predicting and mitigating food insecurity in Nigeria.

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First, there is a need for increased investment in digital and agricultural infrastructure. Reliable internet connectivity, access to affordable digital tools, and improved rural electrification are essential for enabling AI adoption among farmers. Government and private sector partnerships should prioritize the development of digital agriculture ecosystems that support data collection, analysis, and dissemination.

Second, policymakers should promote the development of a national AI and digital agriculture strategy specifically tailored to food security. This strategy should integrate AI into agricultural planning, climate risk management, and food distribution systems. It should also establish standards for data collection and sharing, ensuring that high-quality data is available for AI applications.

Third, there is a need to strengthen capacity building and human capital development. Farmers, extension workers, and agricultural stakeholders require training in the use of digital tools and AI-based systems. Educational institutions should incorporate AI and digital agriculture into their curricula, while extension services should be modernized to include technology-driven advisory systems. Special attention should be given to youth engagement, as young people are more likely to adopt and innovate with new technologies.

Fourth, the government should support research and innovation in AI for agriculture. This includes funding for interdisciplinary research that combines agriculture, data science, and economics, as well as the development of locally relevant AI solutions. Collaboration between universities, research institutes, and technology firms should be encouraged to ensure that innovations are scalable and applicable to Nigeria's unique context.

Fifth, policies should focus on improving data availability and governance. AI systems rely heavily on accurate and timely data, yet data gaps remain a major challenge in Nigeria. Establishing centralized agricultural data platforms, promoting open data initiatives, and leveraging satellite and remote sensing technologies can significantly enhance data quality and accessibility.

Sixth, there is a need to promote inclusive access to AI technologies, particularly for smallholder farmers. Subsidies, financial incentives, and microcredit schemes can help reduce the cost of adopting digital tools. In addition, user-friendly platforms and localized solutions should be developed to ensure that technologies are accessible to farmers with varying levels of education and technical expertise.

Seventh, policymakers should integrate AI into climate change adaptation and risk management strategies. AI-driven early warning systems, weather forecasting tools, and climate risk models can help farmers make informed decisions and reduce the impact of environmental shocks. This is particularly important given the increasing frequency of extreme weather events in Nigeria.

Finally, there is a need for a coordinated and integrated policy approach that links prediction with action. AI-based predictions of food insecurity must be connected to timely interventions such as food distribution programs, market stabilization measures, and targeted support for vulnerable populations. This requires collaboration across government agencies, development partners, and the private sector.

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