IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 19, Issue 9 Ser. 1 (September 2025), PP 11-17
www.iosrjournals.org

Harnessing Artificial Intelligence For Sustainable Agricultural Transformation In Sierra Leone: A Pathway To Food Security And Economic Resilience: A Review

Mary Kamara
China Agricultural University, Beijing China

Abstract
The agricultural sector in Sierra Leone, the bedrock of its economy and the primary source of livelihood for over 60% of its populace, is at a critical juncture. It is beset by persistent challenges, including the adverse effects of climate change, reliance on traditional farming practices, and pervasive food insecurity, exacerbated by soaring food inflation. In response, the nation has embarked on ambitious initiatives like the "Feed Salone" strategy. This paper posits that Artificial Intelligence (AI) represents a pivotal and transformative force capable of addressing these deepseated issues and accelerating the transition towards a sustainable, productive, and resilient agricultural system. We explore the multifaceted applications of AI, from precision farming for optimized resource management to predictive analytics for climate adaptation. AI-driven technologies can enhance crop monitoring, improve soil health, and provide smallholder farmers with access to critical information and markets. This article examines how AI can revolutionize Sierra Leone's agriculture by enhancing productivity, minimizing environmental degradation, and empowering the nation's smallholder farmers. We also address the significant barriers to AI adoption, such as the digital divide, high costs, and the need for digital literacy, proposing a multistakeholder approach to overcome them. By integrating AI into its agricultural development framework, Sierra Leone can not only achieve the objectives of the Feed Salone initiative but also establish a model for technology-driven, sustainable development in the region, ensuring a foodsecure and prosperous future.
Keywords: *Artificial Intelligence, Sustainable Agricultural, Transformation, Sierra Leone*

Date of Submission: 25-08-2025 Date of Acceptance: 05-09-2025

I. Introduction

Agriculture is the cornerstone of Sierra Leone's economy, providing employment and sustenance for the majority of its population. Despite its central role, the performance is hampered by a confluence of systemic challenges that threaten national food security and economic stability. Low productivity, stemming from a reliance on outdated, labor-intensive farming methods, is compounded by the escalating impacts of climate change sector, which manifest as unpredictable rainfall patterns, prolonged droughts, and increased frequency of extreme weather events. These vulnerabilities were starkly highlighted in In 2023, when food inflation surpassed 50%, revealing the precariousness of a system heavily dependent on food imports. In this context, the Government of Sierra Leone launched the "Feed Salone" strategy, a bold initiative aimed at boosting food production, reducing import dependency, and transforming the agricultural sector into a competitive economic engine.

Achieving these ambitious goals requires a paradigm shift from traditional practices to modern, data-driven approaches. The fourth agricultural revolution, or Agriculture 4.0, is characterized by the integration of digital technologies such as the Internet of Things (IoT), Big Data, robotics, and, most significantly, Artificial Intelligence (AI) (Dayioğlu, 2021 ; Javaid, 2022). AI is emerging globally as a powerful catalyst for sustainable agriculture, offering tools to enhance efficiency, improve decision-making, and mitigate environmental impact (Talaviya, 2020). The application of AI in agriculture encompasses a wide range of techniques, including machine learning, deep learning, and computer vision, to address complex farming challenges (Eli-Chukwu, 2019). This technological wave promises to protect crop yields from climate change, population growth, and food security problems (Talaviya, 2020). The digital transformation of agriculture is seen as a key driver for achieving sustainability (Hrustek, 2020).

This paper explores the potential for AI to serve as a driving force for sustainable agricultural development in Sierra Leone. We argue that the strategic adoption of AI technologies can directly support the goals of the Feed Salone initiative by enabling precision farming for efficient resource use (Jha, 2019), enhancing climate resilience through predictive analytics, empowering smallholder farmers with access to information and markets (Misra, 2020), and promoting environmentally sound practices. The paper will first delve into the specific applications of AI in precision agriculture, climate adaptation, and smallholder empowerment. It will then critically examine the significant barriers to AI adoption in the Sierra Leonean context—including infrastructure deficits, cost, and a lack of digital skills—and propose a collaborative, multistakeholder framework for overcoming these hurdles. Ultimately, we present a vision where AI is not merely a technological novelty but a sector foundational tool for building a resilient, productive, and sustainable agricultural sector that ensures a food-secure future for all Sierra Leoneans.

II. Methods

This paper presents a comprehensive review of the potential for Artificial Intelligence to catalyze a sustainable agricultural transformation in Sierra Leone. The methodology employed is a systematic synthesis of existing academic literature, policy documents, and case studies relevant to the intersection of AI, digital technologies, and agricultural development, particularly within the context of developing nations and Sub-Saharan Africa. The selection of references was guided by their relevance to key themes, including precision agriculture, climate resilience, smallholder farmer empowerment, market integration, and the socio-economic barriers to technology adoption. The analysis focuses on identifying established and emerging AI applications that are directly applicable to the challenges faced by Sierra Leone's agricultural sector and aligned with the objectives of the "Feed Salone" strategy. By synthesizing insights from a diverse body of research, this review constructs a forward-looking framework that outlines not only the opportunities presented by AI but also the practical steps and policy considerations necessary for its successful and equitable implementation in the Sierra Leonean context.

III. The Imperative For Agricultural Transformation In Sierra Leone

Sierra Leone's agricultural sector is characterized by a dualism: it is the backbone of the national economy, yet it operates far below its potential. The vast majority of farming is conducted by smallholders on plots of land typically less than two hectares, using traditional methods that have been passed down through generations. This reliance on rain-fed agriculture and manual labor makes the sector highly vulnerable to climatic shocks and limits productivity. Key staple crops such as rice and cassava, as well as cash crops like cocoa and coffee, are cultivated under conditions that yield significantly less than global averages.

The challenges are multifaceted. Soil degradation from unsustainable land management practices has diminished fertility over time (Jha, 2019). Post-harvest losses are substantial, often due to inadequate storage facilities and poor road networks that hinder timely access to markets. Furthermore, limited access to quality inputs, such as improved seeds and appropriate fertilizers, and a lack of financial services for rural farmers create a cycle of low investment and low returns. These systemic issues are the primary drivers of the country's persistent food insecurity and high reliance on imports for staple foods, a situation that digital transformation aims to address (Njuguna, 2024). The entire agri-food system is undergoing pervasive changes facilitated by digital technologies (Ancín, 2022).

The "Feed Salone" (Feed Sierra Leone) strategy represents a comprehensive government-led effort to confront these challenges head-on. The strategy focuses on increasing the production of key commodities, particularly rice, to achieve self-sufficiency and reduce the nation's import bill. It also aims to promote agricultural diversification, improve value chains, and create an enabling environment for private sector investment. Central to this vision is the modernization of the agricultural sector through the adoption of innovative technologies and practices. This is where AI and other digital tools become not just beneficial but essential. The transition to a more productive and resilient agricultural system—a system that can withstand climate change and meet the nutritional needs of a growing population—is contingent upon embracing the principles of smart and precision agriculture (Karanisa, 2022). The integration of digital technologies is a key driver for sustainability in this transformation (Hrustek, 2020).

AI-Driven Precision Agriculture for Enhanced Resource Efficiency

Precision agriculture (PA) is a management philosophy that utilizes a suite of technologies to observe, measure, and respond to intra-field variability in crops. It enables farmers to apply inputs like water, fertilizers, and pesticides at the precise time and location they are needed, thereby optimizing resource use, increasing yields, and reducing environmental impact. AI is the analytical engine that powers modern precision agriculture, transforming vast amounts of data collected from various sources into actionable insights (Aijaz, 2025). This approach has the potential to foster better farming, improve efficiencies, and reduce waste (Javaid, 2022).

Data-Driven Soil and Nutrient Management

In Sierra Leone, a blanket application of fertilizers, when available, is common practice, often leading to overuse in some areas and underuse in others. This is both economically inefficient and environmentally detrimental. AI can revolutionize this process. By integrating data from satellite imagery, drone-based multispectral sensors, and in-field IoT sensors, machine learning algorithms can create detailed maps of soil properties, including nutrient levels, pH, and organic matter content (Espinel, 2024). These models can then generate variable-rate application (VRA) prescriptions, guiding farmers or automated machinery to apply specific fertilizer blends only where needed. AI can help farmers understand soil qualities and suggest the necessary nutrients to improve soil quality (Javaid, 2022). For instance, AI-powered soil testing tools could be adapted for Sierra Leonean farmers, providing rapid, localized fertilizer recommendations. This targeted approach not only improves crop yields by addressing specific nutrient deficiencies but also minimizes the financial cost of inputs and reduces the risk of nutrient runoff into waterways, thus maintaining soil fertility (Talaviya, 2020).

Smart Irrigation and Water Management

Water scarcity is a growing concern in many parts of Sierra Leone, particularly with the increasing unreliability of rainfall. Rice cultivation, a national priority under the Feed Salone strategy, is particularly water-intensive. AI-powered smart irrigation systems offer a potent solution. These systems use AI models to analyze real-time data from soil moisture sensors, weather forecasts, and satellite-derived evapotranspiration rates to determine the precise amount of water a crop needs. The system can then automatically control irrigation infrastructure, such as pumps and valves, to deliver water efficiently. This automation is a key concern for agriculture globally, as it can solve problems like inefficient water management (Jha, 2019). Global case studies have demonstrated that such systems can reduce agricultural water consumption significantly while maintaining or even increasing crop yields. Implementing these technologies in Sierra Leone's key rice-growing regions could significantly enhance water security and the sustainability of its most important food crop, saving excess water use and maintaining soil fertility (Talaviya, 2020).

Intelligent Pest and Disease Detection

Crop losses due to pests and diseases are a major constraint on agricultural productivity in Sierra Leone. Traditional scouting methods are often time-consuming and may fail to detect outbreaks until they are widespread. AI, particularly computer vision and deep learning, provides a powerful tool for early and accurate detection (Patrício, 2018 ; Oliveira, 2023). Farmers can use smartphone applications to capture images of plant leaves, which are then analyzed by a pretrained learning deep model to identify specific diseases or pests infestations with high accuracy (Ghazal, 2024). A similar tool, adapted to Sierra Leone's specific crops and pests and potentially integrated with a Krio language interface, could empower farmers to take timely, targeted action, reducing crop losses and minimizing the prophylactic use of chemical pesticides (Talaviya, 2020). Such technologies are part of a broader transformation in weed management and crop protection (Vasileiou, 2023).

Table 1: AI Applications in Precision Agriculture for Sierra Leone

AI Application	Description	Potential Impact in Sierra Leone	Relevant Technologies
Soil & Nutrient Management	AI algorithms analyze data from sensors and imagery to create detailed soil maps and	Reduces fertilizer waste and cost, improves crop yields by addressing specific nutrient needs, and	IoT sensors, Drones, Satellite Imagery, Machine Learning (ML), Variable Rate
	prescribe variable-rate fertilizer applications.	protects water sources from runoff.	Technology (VRT). (Jha, 2019)
Smart Irrigation	AI models use realtime data (soil moisture, weather forecasts) to automate irrigation systems, delivering the precise amount of water needed.	Conserves scarce water resources, especially for rice cultivation, increases resilience to drought, and reduces energy costs for pumping.	Soil Moisture Sensors, Weather Stations, ML Predictive Models, Automated Irrigation Systems. (Patrício, 2018 ; Oliveira, 2023)
Pest & Disease Detection	Computer vision and deep learning models analyze images from smartphones or drones to identify pests and diseases at an early stage.	Enables early and targeted intervention, reduces crop losses, minimizes pesticide use, and lowers farmer costs.	Smartphone Apps, Drones with cameras, Convolutional Neural Networks (CNNs), Image Recognition. (Vasileiou, 2023).

IV. Enhancing Climate Resilience Through AI-Powered Analytics

The agricultural sector in Sierra Leone is exceptionally vulnerable to the impacts of climate change. Unpredictable rainfall, rising temperatures, and the increased frequency of extreme weather events like floods and droughts directly threaten the production of staple crops such as rice and cassava, as well as vital cash crops like cocoa. Building resilience within the farming community is therefore not just a goal but a necessity for survival and long-term food security. AIpowered predictive analytics offers a proactive approach to climate adaptation, enabling farmers to anticipate and respond to climate-related risks before they escalate (Mohammed, 2023). AI models can analyze vast datasets, including historical weather data, real-time satellite imagery, and long-range climate forecasts, to generate highly localized and accurate predictions. These predictive capabilities can be applied in several critical areas.

AI can provide farmers with precise, short-term weather forecasts and long-term seasonal outlooks. This information is crucial for decision-making, such as determining the optimal time for planting to avoid early-season droughts or timing harvests to precede heavy rains (Javaid, 2022). Platforms that integrate climate data can guide farmers in adjusting their agricultural calendars to align with changing climatic patterns. Climate change is altering the distribution and behavior of agricultural pests and diseases. AI models can correlate environmental conditions (eg, temperature, humidity, rainfall) with historical outbreak data to predict the likelihood of future infestations. This early warning system allows for preemptive and targeted interventions, reducing the risk of widespread crop failure and minimizing the use of harmful pesticides (Jha, 2019). AI can assist agricultural researchers and extension agents in identifying and promoting crop varieties that are better suited to future climate conditions. By analyzing genetic data and performance data from field trials under various environmental stressors, AI can help select varieties with desirable traits like drought tolerance or heat resistance. This information can then be disseminated to farmers, guiding them toward more resilient cropping systems. For these tools to be effective in Sierra Leone, they must be accessible to smallholder farmers. The development of mobile applications that deliver this information in a simple, intuitive format and in local languages, such as Krio, is paramount. By leveraging these predictive capabilities, Sierra Leonean farmers can move from a reactive to a proactive stance, making informed decisions that enhance their resilience to the unavoidable challenges of a changing climate.

Table 2: AI-Powered Climate Resilience Strategies for Sierra Leonean Agriculture

AI-Powered Strategy	Description	Application for Sierra Leonean Farmers	Key Data Inputs
Predictive Weather Forecasting	ML models analyze historical and real-time climate data to provide localized short-term and seasonal weather forecasts.	Helps farmers decide on optimal planting and harvesting times, reducing risks from droughts and floods.	Historical Weather Data, Satellite Imagery, Real-time Sensor Data. (Jha, 2019)
Pest & Disease Outbreak Prediction	AI correlates environmental factors (temperature, humidity) with pest life cycles to predict the timing and location of potential outbreaks.	Provides early warnings, allowing for proactive and targeted pest management, thus saving crops and reducing pesticide use.	Climate Data, Historical Pest Outbreak Records, Crop Phenology Data. (Javaid, 2022)
ClimateResilient Crop Selection	AI analyzes genomic and field trial data to identify crop varieties that perform well under specific climate stressors like heat or water scarcity.	Guides farmers and policymakers in choosing and promoting crop varieties best suited for future local climate conditions.	Genetic Data, Field Trial Performance Data, Climate Projection Models. (Mohammed, 2023)

V. Empowering Smallholder Farmers And Market Integration

The agricultural landscape of Sierra Leone is dominated by smallholder farmers who, despite being the primary food producers, often face significant barriers that limit their productivity and profitability. These include a lack of access to timely agronomic information, limited connections to formal markets, and exclusion from financial services. AI has the potential to be a great equalizer, bridging these gaps and empowering smallholders to make more informed decisions, improve their livelihoods, and contribute more effectively to the nation's food security goals.

Democratizing Access to Agronomic Knowledge

AI-driven platforms can serve as virtual extension agents, delivering personalized and timely advice directly to farmers' mobile phones. Chatbots and voice-based services powered by AI can provide information on a wide range of topics, from best practices for land preparation and planting to guidance on pest management and post-harvest handling. By leveraging natural language processing, these tools can interact with farmers in local languages like Krio, overcoming literacy barriers and ensuring the information is easily understood and actionable. This continuous access to expert knowledge empowers farmers to adopt improved practices, leading to higher yields and better-quality produce. This aligns with the broader trend of using AI to provide personalized advice in the agricultural value chain (Ganeshkumar, 2021).

Enhancing Market Linkages and Price Transparency

One of the most significant challenges for smallholders is selling their produce at a fair price. They often rely on intermediaries and lack real-time information on market demand and prices, leaving them in a weak bargaining position. AI-powered platforms can create digital marketplaces that connect farmers directly with buyers, including processors, retailers, and exporters. These platforms can provide transparent, real-time market price information, empowering farmers to negotiate better terms. Furthermore, AI can analyze market trends and consumer demand to provide farmers with insights on what crops to plant and when, helping them align their production with market needs and reduce the risk of gluts and price collapses. The modernization of the supply chain is a key benefit of integrating IoT, Big Data, and AI (Misra, 2020). As seen in other countries, such platforms can significantly increase farmer incomes and reduce post-harvest losses by ensuring a ready market for their produce.

Facilitating Access to Finance and Inputs

Financial exclusion is a major impediment to agricultural development in Sierra Leone. Many smallholders lack the formal credit history required to access loans for purchasing quality seeds, fertilizers, and equipment. AI can help overcome this barrier. By analyzing alternative data sources—such as mobile phone usage, satellite data on farm productivity, and transaction history on digital platforms—AI-driven credit scoring models can assess the creditworthiness of smallholder farmers who are invisible to the traditional banking system. This can unlock access to tailored financial products. Moreover, the development of a national farmer registry can serve as a foundational database for these services. By creating a digital identity for farmers, this registry facilitates their access to government subsidies, private sector investments, and other essential resources. This digital transformation is crucial for building resilience in the food supply chain (Rejeb, 2021).

Table 3: AI for Smallholder Empowerment and Market Integration in Sierra Leone

Empowerment Area	AI-Driven Solution	Expected Outcome for Smallholders	Implementation Example
Access to Knowledge	AI-powered chatbots and voice-based advisory services delivered via mobile phones in local languages (eg, Krio).	Timely, personalized agronomic advice, leading to improved farming practices, higher yields, and reduced crop losses.	A mobile app provides step-by-step guidance on rice cultivation, from planting to post-harvest. (Ganeshkumar, 2021)
Market Linkages	Digital marketplace platforms that use AI to connect farmers directly	Increased price transparency, better bargaining power,	A platform where farmers can list their produce and receive bids
	with buyers and provide real-time price information.	reduced reliance on intermediaries, and access to wider markets.	from multiple buyers, with AI forecasting demand. (Rejeb, 2021).
Financial Inclusion	AI-driven credit scoring models that use alternative data (eg, satellite imagery, mobile data) to assess creditworthiness.	Increased access to loans for purchasing quality inputs, enabling investment in farm productivity and resilience.	A microfinance institution using an AI model to offer small loans to farmers based on their farm's historical productivity data. (Misra, 2020)

VI. Mitigating Environmental Impact Through Climate-Smart Agriculture

Sustainable agriculture is not only about increasing productivity but also about doing so in a way that conserves natural resources and minimizes environmental harm. AI provides a toolkit for implementing and monitoring climate-smart agriculture (CSA) practices, which aim to achieve the triple win of increased productivity, enhanced resilience, and reduced greenhouse gas (GHG) emissions. By integrating AI, Sierra Leone can ensure that its pursuit of food security under the "Feed Salone" strategy is aligned with its national and international commitments to environmental sustainability (Sanders, 2021).AI-driven precision farming techniques are inherently climatesmart. By optimizing the application of nitrogen-based fertilizers, AI helps reduce nitrous oxide emissions, a potent GHG. In rice cultivation, a major source of methane emissions, AI-powered water management systems can support practices like alternate wetting and drying (AWD), which significantly cut methane production without compromising yield. Similarly, the targeted application of pesticides, guided by AI-powered disease and pest detection systems, reduces the chemical load on the environment, protecting protecting biodiversity and soil health (Vasileiou, 2023).

Beyond input optimization, AI can support the adoption and monitoring of broader sustainable land management practices. For example, AI analysis of satellite and drone imagery can be used to monitor the adoption of agroforestry and conservation tillage (no-till farming), practices that enhance soil carbon sequestration and improve soil structure. This data can be used to verify and reward farmers for adopting these practices, creating a positive feedback loop for sustainability. The government's plan to expand climate-smart agriculture, supported by investments from organizations like the Alliance for a Green Revolution in Africa (AGRA), provides a perfect opportunity to embed these AI-powered monitoring and management systems from the outset. By doing so, Sierra Leone can build an agricultural sector that is not only productive and profitable but also a key contributor to global efforts to combat climate change (Satpathy, 2024).

VII. Discussion: Overcoming Barriers To AI Adoption

Despite the immense potential of AI to transform Sierra Leone's agricultural sector, its widespread adoption is not a foregone conclusion. A number of significant barriers must be addressed through concerted and strategic efforts involving the government, private sector, civil society, and the farmers themselves.The most fundamental challenge is the digital divide. Internet connectivity, particularly in the rural areas where the majority of farming takes place, is often limited, unreliable, or non-existent (Ahmed, 2024). The high cost of data and smartphones further restricts access for many smallholder farmers operating on slim margins. Furthermore, a consistent electricity supply, necessary for charging devices and powering infrastructure, is not guaranteed. Addressing this requires a multi-pronged approach. Public-private partnerships can accelerate the expansion of affordable mobile broadband infrastructure into rural areas. Government policies can incentivize telecommunication companies to offer subsidized data plans for agricultural applications. The development of AI tools that can function in low-bandwidth or offline environments is also crucial.The successful adoption of AI technologies depends on the capacity of farmers and extension agents to use them effectively. A significant portion of the rural population in Sierra Leone has low levels of formal education and digital literacy (Ahmed, 2024). Introducing complex technologies without adequate training and support risks low adoption rates or even the exacerbation of existing inequalities. Massive investment in capacity building is essential. This includes designing and delivering training programs tailored to the needs of smallholder farmers, using participatory methods and local languages. Revitalizing the agricultural extension service and equipping agents with digital skills and tools will enable them to act as crucial intermediaries, bridging the gap between technology developers and end-users. The disruption to traditional roles and skills necessitates a focus on education and retraining (Smith, 2018).

The initial cost of AI-enabled technologies, from drones and sensors to software subscriptions, can be prohibitively expensive for smallholder farmers. Without viable financial models, these powerful tools will remain accessible only to a small elite of large-scale commercial farms. The government's increased allocation to the agricultural budget provides a critical opportunity. These funds can be used to subsidize the cost of essential AI tools and services. Furthermore, promoting "Farming-as-a-Service" (FaaS) models, where local entrepreneurs or cooperatives invest in technology (eg, a drone) and offer services to multiple farmers for a fee, can make them more affordable. Blended finance mechanisms, combining public funds with private and philanthropic investment, can also help de-risk and scale up investment in agricultural technology.The deployment of AI in agriculture relies on the collection and analysis of vast amounts of data, from farm-level production data to personal information about farmers. This raises important questions about data ownership, privacy, and security. There is a risk that data could be exploited by large corporations, or that biased algorithms could perpetuate or worsen existing social inequalities, particularly for women and other marginalized groups. A systemic understanding of these risks and externalities is required for responsible AI implementation (Tzachor, 2022). Sierra Leone needs to develop a clear and robust policy framework for agricultural data governance. This framework should establish principles of data sovereignty, ensuring that farmers have control over their own data. It must also include strong data protection regulations to safeguard privacy (Ryan, 2022). Ensuring that AI models are developed using inclusive and representative datasets is critical to avoid algorithmic bias. A participatory approach, involving farmers in the design and governance of these digital systems, is the best way to build trust and ensure that the benefits are distributed equitably (Ryan, 2022). 2022 ; Ryan, 2023).

VIII. Conclusion

The agricultural sector of Sierra Leone stands at a transformative threshold. Faced with the dual pressures of climate change and the urgent need for food security, a business-as-usual approach is no longer viable. The "Feed Salone" initiative rightly identifies the need for a modernized, productive, and resilient agricultural system. This paper has argued that Artificial Intelligence is not a distant, futuristic concept but a practical and powerful set of tools that can be harnessed today to achieve these national objectives. From the granular precision of applying the right amount of fertilizer to a specific patch of soil to the broad strategic foresight of predicting seasonal weather patterns, AI offers solutions across the entire agricultural value chain (Ganeshkumar, 2021). It can empower farmers with the knowledge to increase their yields, the resilience to withstand climatic shocks, the market access to improve their incomes, and the tools to become stewards of a sustainable environment. The integration of AI technologies such as machine learning, IoT, and computer vision can fundamentally reshape farming practices, making them more efficient, profitable, and environmentally sound (Talaviya, 2020).

However, the path to this AI-driven future is not without its obstacles. The challenges of infrastructure, cost, digital literacy, and data governance are substantial and require a deliberate and inclusive strategy. Success will depend on a collaborative ecosystem where the government provides enabling policies and public investment; the private sector innovates and delivers affordable solutions; and development partners and civil society support capacity building and ensure that the most vulnerable, including women and youth, are not left behind. By strategically investing in AI and the ecosystem required to support it, Sierra Leone can leapfrog traditional stages of agricultural development. It can build a food system that is not only self-sufficient but also a driver of economic growth and a model of sustainable development (Aldoseri, 2024). The vision of Sierra Leone as a technologically advanced nation can find its most fertile ground in the fields and farms of its people, cultivated with the wisdom of tradition and the power of artificial intelligence.

References

[1]. Ahmed, A, Sulaiman, R, Adamu, N, & Musa, Y (2024). The Role Of Artificial Intelligence In Modern Farming System For Achieving Sustainable Agricultural Transformation In Nigeria. Global Sustainability Research, 3(3), 95-113. Https://Doi.Org/10.56556/Gssr.V3i3.996

[2]. Aijaz, N, He, L, Raza, T, Yaqub, M, Iqbal, R, & Pathan, M (2025). Artificial Intelligence In Agriculture: Advancing Crop Productivity And Sustainability. Journal Of Agriculture And Food Research, , 101762101762. Https://Doi.Org/10.1016/J.Jafr.2025.101762

[3]. Aldoseri, A, Al-Khalifa, K, & Hamouda, A (2024). AI-Powered Innovation In Digital Transformation: Key Pillars And Industry Impact. Sustainability, 16(5), 1790-1790. Https://Doi.Org/10.3390/Su16051790

[4]. Ancín, M, Pindado, E, & Sánchez, M (2022). New Trends In The Global Digital Transformation Process Of The Agri-Food Sector: An Exploratory Study Based On Twitter. Agricultural Systems, 203, 103520-103520. Https://Doi.Org/10.1016/J.Agsy.2022.103520

[5]. Dayioğlu, M, & Türker, U (2021). Digital Transformation For Sustainable Future - Agriculture 4.0 : A Review. Tarım Bilimleri Dergisi, . Https://Doi.Org/10.15832/Ankutbd.986431

[6]. Eli-Chukwu, N (2019). Applications Of Artificial Intelligence In Agriculture: A Review. Engineering Technology & Applied Science Research, 9(4), 4377-4383. Https://Doi.Org/10.48084/Etasr.2756

[7]. Espinel, R, Herrera-Franco, G, García, J, & Escandón-Panchana, P (2024). Artificial Intelligence In Agricultural Mapping: A Review. Agriculture, 14(7), 1071-1071. Https://Doi.Org/10.3390/Agriculture14071071

[8]. Ganeshkumar, C, Jena, S, Sivakumar, A, & Nambirajan, T (2021). Artificial Intelligence In Agricultural Value Chain: Review And Future Directions. Journal Of Agribusiness In Developing And Emerging Economies, 13(3), 379-398. Https://Doi.Org/10.1108/Jadee-07-2020-0140

[9]. Ghazal, S, Munir, A, & Qureshi, W (2024). Computer Vision In Smart Agriculture And Precision Farming: Techniques And Applications. Artificial Intelligence In Agriculture, 13, 64-83. Https://Doi.Org/10.1016/J.Aiia.2024.06.004

[10]. Hrustek, L (2020). Sustainability Driven By Agriculture Through Digital Transformation. Sustainability, 12(20), 8596-8596. Https://Doi.Org/10.3390/Su12208596

[11]. Javaid, M, Haleem, A, Khan, I, & Suman, R (2022). Understanding The Potential Applications Of Artificial Intelligence In Agriculture Sector. Advanced Agrochem, 2(1), 15-30. Https://Doi.Org/10.1016/J.Aac.2022.10.001

[12]. Jha, K, Doshi, A, Patel, P, & Shah, M (2019). A Comprehensive Review On Automation In Agriculture Using Artificial Intelligence. Artificial Intelligence In Agriculture, 2, 1-12. Https://Doi.Org/10.1016/J.Aiia.2019.05.004

[13]. Karanisa, T, Achour, Y, Ouammi, A, & Sayadi, S (2022). Smart Greenhouses As The Path Towards Precision Agriculture In The Food-Energy And Water Nexus: Case Study Of Qatar. Environment Systems & Decisions, 42(4), 521-546. Https://Doi.Org/10.1007/S10669-022-09862-2

[14]. Misra, N, Dixit, Y, Al-Mallahi, A, Bhullar, M, Upadhyay, R, & Martynenko, A (2020). Iot, Big Data, And Artificial Intelligence In Agriculture And Food Industry. IEEE Internet Of Things Journal, 9(9), 63056324. Https://Doi.Org/10.1109/Jiot.2020.2998584

[15]. Mohammed, M, Ahmed, M, & Hacimahmud, A (2023). Data-Driven Sustainability: Leveraging Big Data And Machine Learning To Build A Greener Future. Deleted Journal, 2023, 17-23. Https://Doi.Org/10.58496/Bjai/2023/005

[16]. Njuguna, E, Daum, T, Birner, R, & Mburu, J (2024). Silicon Savannah And Smallholder Farming: How Can Digitalization Contribute To Sustainable Agricultural Transformation In Africa?. Agricultural Systems, 222, 104180-104180. Https://Doi.Org/10.1016/J.Agsy.2024.104180

[17]. Oliveira, R, & Silva, R (2023). Artificial Intelligence In Agriculture: Benefits, Challenges, And Trends. Applied Sciences, 13(13), 7405-7405. Https://Doi.Org/10.3390/App13137405

[18]. Patrício, D, & Rieder, R (2018). Computer Vision And Artificial Intelligence In Precision Agriculture For Grain Crops: A Systematic Review. Computers And Electronics In Agriculture, 153, 69-81. Https://Doi.Org/10.1016/J.Compag.2018.08.001

[19]. Rejeb, A, Rejeb, K, Abdollahi, A, Zailani, S, Iranmanesh, M, & Ghobakhloo, M (2021). Digitalization In Food Supply Chains: A Bibliometric Review And Key-Route Main Path Analysis. Sustainability, 14(1), 83-83. Https://Doi.Org/10.3390/Su14010083

[20]. Ryan, M (2022). The Social And Ethical Impacts Of Artificial Intelligence In Agriculture: Mapping The Agricultural AI Literature. AI & Society, 38(6), 2473-2485. Https://Doi.Org/10.1007/S00146-021-01377-9

[21]. Ryan, M, Isakhanyan, G, & Tekinerdoğan, B (2023). An Interdisciplinary Approach To Artificial Intelligence In Agriculture. NJAS Impact In Agricultural And Life Sciences, 95(1). Https://Doi.Org/10.1080/27685241.2023.2168568

[22]. Sanders, C, Mayfield-Smith, K, & Lamm, A (2021). Exploring Twitter Discourse Around The Use Of Artificial Intelligence To Advance Agricultural Sustainability. Sustainability, 13(21), 12033-12033. Https://Doi.Org/10.3390/Su132112033

[23]. Satpathy, I, Nayak, A, Jain, V, & Arif, M (2024). Artificial Intelligence (AI)-Infused Agricultural Transformation For Sustainable Harvest. Practice, Progress, And Proficiency In Sustainability, , 47-66. Https://Doi.Org/10.4018/979-8-3693-3410-2.Ch003

[24]. Smith, M (2018). Getting Value From Artificial Intelligence In Agriculture. Animal Production Science, 60(1), 46-46. Https://Doi.Org/10.1071/An18522

[25]. Talaviya, T, Shah, D, Patel, N, Yagnik, H, & Shah, M (2020). Implementation Of Artificial Intelligence In Agriculture For Optimisation Of Irrigation And Application Of Pesticides And Herbicides. Artificial Intelligence In Agriculture, 4, 58-73. Https://Doi.Org/10.1016/J.Aiia.2020.04.002

[26]. Tzachor, A, Devare, M, King, B, Avin, S, & Héigeartaigh, S (2022). Responsible Artificial Intelligence In Agriculture Requires Systemic Understanding Of Risks And Externalities. Nature Machine Intelligence, 4(2), 104-109. Https://Doi.Org/10.1038/S42256-022-00440-4

[27]. Vasileiou, M, Kyrgiakos, L, Kleisiari, C, Kleftodimos, G, Vlontzos, G, Belhouchette, H, & Pardalos, P (2023). Transforming Weed Management In Sustainable Agriculture With Artificial Intelligence: A Systematic Literature Review Towards Weed Identification And Deep Learning. Crop Protection, 176, 106522-106522. Https://Doi.Org/10.1016/J.Cropro.2023.106522