
Artificial Intelligence and Inclusive Growth in Nigeria's Agro Industry

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1. INTRODUCTION

Agriculture is vital to Nigeria's economy, employing over 36% of the population and contributing 22.35% to GDP (NBS, 2023). Despite this potential, the sector faces a persistent productivity gap due to limited access to financing, climate vulnerabilities, inefficient resource use (FAO 2017), substantial post-harvest losses, and fragmented value chains, all of which undermine food security and poverty alleviation (CBN 2021). The integration of Artificial Intelligence (AI) presents a transformative opportunity to shift Nigerian agriculture from subsistence farming toward technology-driven agripreneurship, seeking to close the "yield gap" through innovative, data-driven strategies.

AI adoption enhances resource optimization for youth agripreneurs and smallholder cooperatives. Data-driven methods, including soil sensors and satellite imagery, improve crop productivity and reduce input waste by enabling precise management of

water, fertilizers, and other farm resources (Inoue 2020). AI-powered predictive forecasting offers localized planting calendars and pest alerts, bolstering farm resilience, while real-time market intelligence helps smallholders align harvests with demand, increasing profits and minimizing post-harvest losses. AI in agroforestry promotes sustainability by monitoring nutrients and ecosystem services. Additionally, it enables access to the carbon credit market, providing environmental conservation monetization that strengthens both productivity and economic resilience in agrarian communities.

Across the value chain, AI applications enhance productivity and financial inclusion. Precision agronomy leverages AI-driven satellite imagery and drones for crop monitoring and soil analysis, while digital diagnostics enable mobile apps to detect pests such as the Fall Armyworm. AI algorithms also analyze alternative data to generate credit scores for smallholders,

facilitating access to loans and reducing financial barriers. These innovations lower entry barriers for Nigerian youth, making agriculture a more appealing and profitable career grounded in data-driven practices.

To fully realize these benefits, policymakers must adopt knowledge-based governance emphasizing digital infrastructure, AI-augmented extension services, and the establishment of a National Agricultural Data Exchange. Guidance is essential to ensure AI adoption empowers smallholder farmers, enhances food security, and modernizes the sector into a sustainable and globally competitive growth engine. Without deliberate policy measures, uncritical AI adoption risks exacerbating socio-economic inequalities, as connectivity and digital literacy gaps may marginalize smallholder farmers, women, and rural youth.

This policy brief highlights the need for inclusive and deliberate actions to ensure AI benefits are equitably shared. By creating accessible, affordable, and inclusive digital environments, Nigeria can harness AI-driven transformation in agriculture and agroforestry for sustainable growth, leaving no vulnerable communities behind (World Bank, 2019). Proactive policy interventions are essential to enable inclusive

advancement and maximize the sector's potential.

2. RESEARCH METHODS

The insights and recommendations in this policy brief are derived from a mixed-methods research approach conducted in 2023, which includes:

(1) Desktop Review: A comprehensive analysis of existing literature, global case studies of AI in agriculture (AI4Ag), and a review of current Nigerian agricultural and digital economy policies.

(2) Stakeholder Mapping: Identification and analysis of key actors in the ecosystem, including agritech startups (e.g., Zenvus, Thrive Agric, Crop2Cash), government agencies (FMARD, NITDA), NGOs, and farmer cooperatives.

(3) Field Research: Qualitative fieldwork conducted in selected agrarian communities in North-Central Nigeria, featuring:

(a) Focus Group Discussions (FGDs): 12 FGDs with smallholder farmers (separately with men, women, and youth groups) to understand their challenges, tech adoption readiness, and perceptions of AI.

(b) In-Depth Interviews (IDIs): 25 interviews with agricultural extension agents, local agro-input dealers, community leaders, and representatives of agritech firms.

(c) Survey: A quantitative survey of 400 rural farmers to establish baseline data on smartphone ownership, internet access, digital literacy, and primary production challenges.

3. KEY INSIGHTS

AI creates opportunities for productivity gains.

AI applications, such as precision agriculture, predictive analytics, and automated pest and disease detection have shown a high potential for increasing crop yields and reducing post-harvest losses. AI applications can directly address key pain points in the agricultural process during pre-production, production, post-harvest; and in agroforestry:

(1) Pre-Production: AI-driven soil testing can advise on fertilizer types and quantities, reducing waste and costs.

(2) Production: Satellite imagery and drones with computer vision can monitor crop health, predict yields, and detect pests and diseases early (e.g., leaf discoloration),

enabling targeted interventions and reducing crop loss, leading to more efficient resource use and higher productivity (Akinroluyo *et al.* 2025).

(3) Post-Harvest: AI-powered marketplaces can directly connect farmers to buyers, reducing the power of intermediaries and increasing profit margins. Predictive models can optimize storage and logistics, drastically reducing the 40-50% post-harvest losses (FMARD 2020).

(4) Agroforestry: AI can model the best tree-crop combinations for specific micro-climates, enhancing sustainability and profitability.

The risk of a deepening "AI Divide" is acute.

The widespread adoption of AI is hindered by significant barriers, including a lack of reliable internet connectivity in rural areas, limited access to affordable digital devices, and low digital literacy among farmers (Omole and Fasina, 2024). The research identified three significant barriers to inclusive adoption:

(1) Infrastructure: Only 35% of surveyed farmers had reliable internet access; erratic electricity limited smartphone and tool usage.

(2) Literacy and Skills: Low digital literacy, coupled with language barriers (most tools are in English), prevents adoption. A significant trust deficit exists towards digital recommendations without local context.

(3) Financial Constraints: Smallholders cannot afford subscription fees for advanced AI services or the hardware (drones, sensors) required.

Improving value chain boosts productivity and market performance.

By digitizing the agricultural value chain, AI-driven logistics and predictive analytics dismantle exploitative intermediary structures, ensuring smallholders capture a fair share of market value while reducing post-harvest waste. Currently, Nigerian agriculture is hampered by information asymmetry, where "middlemen" exploit the farmers' lack of real-time price awareness. AI-integrated platforms counteract this by facilitating direct peer-to-peer market access, optimizing transport logistics, and providing granular demand-side visibility. Furthermore, utilizing Machine Learning to process historical price volatility and seasonal trends allows for "Just-in-Time" harvesting. According to NITDA (2024), these predictive models transform the smallholder from a passive price-taker into a strategic market actor, significantly

minimizing the economic losses associated with perishability and market gluts.

Socio-economic constraints hinder resource access, productivity, and livelihoods.

Genuine inclusive progress in Nigeria's agro-industry demands a deliberate approach to breaking down socio-cultural barriers, economic marginalization, and gender-related digital gaps, ensuring AI acts as a catalyst for equity rather than a driver of inequality. Though infrastructural shortcomings are commonly held responsible for sluggish advancement, the more profound issue exists within the socio-economic structure of rural agriculture. Farmers often show reluctance toward new technologies, perceiving AI as an irrelevant abstraction that lacks the localized nuance of traditional practices. This trust deficit is intensified by a market failure. Also, many AI tools are expensive imports tailored for large-scale farms, making them financially unattainable for Nigerian smallholders. Most significantly, without targeted intervention, AI risks entrenching a digital patriarchy; female farmers, who provide over 70% of agricultural labor, are disproportionately marginalized by limited access to smartphones and data, effectively barring them from the predictive insights

and market linkages that define modern agripreneurship (Ekperi *et al.* 2025).

Job creation and skills development enhance employment and productivity.

Rather than driving mass displacement, AI serves as a catalyst for high-value job creation, necessitating a specialized workforce in data analytics, drone piloting, and technical support to sustain Nigeria's digital agricultural transition. By shifting the focus from manual labor to cognitive and technical expertise, AI integration demands a structural overhaul of rural education. Investing in targeted digital literacy and specialized vocational training empowers rural youth to transition from passive bystanders to the primary architects of the agritech revolution. This systemic upskilling not only opens sophisticated pathways for economic self-sufficiency but also effectively mitigates rural-urban migration by rebranding the agro-industry as a modern, technology-centric, and highly profitable career sector.

4. POLICY RECOMMENDATIONS

To ensure that AI's transformative power is leveraged for inclusive and sustainable growth in Nigerian agriculture and agroforestry, the following actions are recommended:

Develop a national AI strategy and rural digital infrastructure for inclusive agriculture.

The government should develop a national AI-in-agriculture strategy that emphasizes inclusive design for smallholder farmers, women, and youth, while promoting public-private partnerships to enhance rural digital infrastructure. To bridge the digital divide, the Nigerian Federal Ministry of Communications should accelerate the provision of reliable, affordable internet and power in rural agricultural communities, including initiatives such as solar micro-grids, subsidized internet and digital devices for cooperatives, low-cost technologies like community Wi-Fi networks, and mobile-first AI applications. The strategy should also establish robust data governance policies to ensure data ownership, privacy, and security, fostering trust and enabling the growth of a digital agricultural economy.

Launch an inclusive AI4Ag initiative and data policies.

The government should launch a national inclusive AI4Ag initiative with a multi-stakeholder taskforce (FMARD, NITDA, NOTAP, Agritech Nigeria) to fund low-cost, accessible AI solutions. Priority areas include voice/SMS platforms for future

phones, offline-first AI tools, and multilingual interfaces in major local languages, drawing lessons from India's *Digital Green* program (Gandhi *et al.* 2009). Simultaneously, supportive data policies should ensure open agricultural data for AI start-ups while protecting data privacy, farmer ownership, and sovereignty, with clear guidelines for testing solutions to foster innovation and manage risks (Bronson & Knezevic, 2019).

Strengthen human capital and digital literacy.

Invest in human capital and digital literacy by integrating AI and data science into university curricula and strengthening agricultural extension systems such as NAERLS. Extension agents should be trained to interpret AI-driven advisory services, collect data for model improvement, and educate farmers on the use of digital tools, while youth engagement initiatives can promote rural digital literacy and support the emergence of agri-tech entrepreneurs and community digital champions (Akinroluyo *et al.* 2025).

Establish rural AI hubs and financial support to accelerate adoption.

The government, NGOs, and universities should establish accessible and affordable Rural AI Innovation Hubs across Nigeria to

provide farmers with AI tools, hands-on training in crop monitoring, and market linkage support, staffed by knowledgeable agricultural extension agents. To complement these hubs, targeted financial support and incentives should be introduced, including subsidies for AI devices and agri-fintech solutions leveraging alternative data to improve smallholder farmers' access to credit and insurance, thereby promoting widespread adoption of AI technologies.

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6. ACKNOWLEDGEMENTS

I extend my sincere gratitude to Dr. Sunday S. Mailumo for his invaluable guidance, insightful discussions, and generous support throughout the development of this policy brief.

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