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Leveraging Digital Innovation for Agricultural Transformation in Nigeria: Pathways Toward Smart Food Systems

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ABSTRACT

The deployment of intelligent technologies in agriculture offers promising solutions to Nigeria's persistent food security challenges. With its vast agricultural potential and growing youth tech ecosystem, Nigeria is positioned to adopt smart agricultural innovations across the food value chain. This paper explores the applications, benefits, and constraints of intelligent agriculture in Nigeria. It highlights current use cases in precision farming, post-harvest technologies, and digital marketplaces, while proposing strategic interventions for scale-up and sustainability.

Keywords: Smart Agriculture, Nigeria, Food Systems, Digital Innovation, Precision Farming.

INTRODUCTION

Agriculture remains a vital sector of Nigeria's economy, employing over 35% of the workforce and contributing significantly to GDP (FAO, 2022). However, the sector faces severe productivity gaps due to climate change, inefficient practices, post-harvest losses, and limited market access. Intelligent agriculture—encompassing data-driven and digitally enabled practices—presents a transformative opportunity for addressing these systemic issues (Akinyele & Yusuf, 2020). This paper evaluates the current state of intelligent agriculture in Nigeria and charts a course toward sustainable food systems.

THE AGRICULTURAL LANDSCAPE IN NIGERIA

Nigeria's agriculture is characterized by:

Smallholder dominance: Over 80% of farmers cultivate less than 2 hectares.

Rain-fed dependency: Less than 10% of cropland is irrigated.

High post-harvest losses: Up to 40% in perishables like tomatoes and fruits.

Market fragmentation: Poor logistics and middlemen-driven trade.

These conditions make the sector ripe for smart interventions to increase efficiency and reduce waste.

INTELLIGENT AGRICULTURE TECHNOLOGIES IN USE

Precision Farming and Drones

Startups like Zenvus are deploying sensors to monitor soil moisture, nutrient levels, and crop growth, enabling farmers to make data-informed decisions (Zenvus, 2023). Additionally, drones are being used to assess

field health, guide pesticide application, and support land surveying in northern Nigeria (Tijani & Oladipo, 2021).

IoT-Based Irrigation and Climate Tools

IoT systems, combined with localized weather forecasting, help optimize water usage. Mobile apps now offer climate alerts and planting recommendations tailored to location and crop type, enhancing resilience to weather shocks.

Digital Marketplaces and Mobile Platforms

Platforms like FarmCrowdy, Thrive Agric, and AgroMall connect farmers with consumers, investors, and suppliers. These platforms offer market price transparency, e-wallets, and logistics tracking, reducing exploitation and improving access to finance.

Blockchain in Food Traceability

Pilot programs are exploring blockchain for ensuring food traceability and safety, especially for Nigeria's agricultural exports like sesame and cocoa. Although nascent, these technologies may improve compliance with international quality standards.

POLICY AND INSTITUTIONAL FRAMEWORK

Nigeria's National Digital Agriculture Strategy (NDAS) and Agricultural Promotion Policy (APP) support smart agriculture integration. The Central Bank of Nigeria's Anchor Borrowers' Programme includes funding for tech-enabled farms.

However, implementation is hampered by:

Bureaucratic inefficiencies and lack of inter-ministerial coordination,

Low digital literacy among rural farmers,

Inconsistent power supply and internet access in remote areas.

Government–private sector partnerships and decentralized innovation models are key to overcoming these bottlenecks.

EDUCATION, RESEARCH, AND INNOVATION HUBS

Universities like the University of Ibadan, UNN, and FUTMinna are engaging in research on AI and robotics for agriculture. However, more collaboration with the private sector is needed to commercialize innovations.

Agri-tech hubs such as Co-Creation Hub (CcHub) and Wennovation Hub in Lagos are incubating startups focused on smart food logistics, AI yield prediction, and remote advisory services. These ecosystems are fostering youth involvement in agri-innovation.

CHALLENGES AND EQUITY CONSIDERATIONS

Key barriers to scale include:

Cost of smart devices and subscription services for rural users.

Limited female access to digital tools due to socio-cultural norms.

Fragmented data systems, which make integration and interoperability difficult.

Policy must prioritize digital inclusion and ensure gender equity in the rollout of smart technologies.

ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS

Smart agriculture can lead to:

Reduced agrochemical overuse, preserving soil and water.

Lower greenhouse gas emissions via efficient logistics.

Job creation in agri-data analysis, tech maintenance, and drone operation.

Youth retention in agriculture, curbing rural-urban migration.

However, environmental risks related to e-waste and energy consumption must be addressed through recycling frameworks and renewable energy integration.

STRATEGIC RECOMMENDATIONS

To unlock the full potential of intelligent agriculture in Nigeria, this paper recommends:

Subsidizing smart farming tools for smallholders through voucher systems.

Expanding rural broadband and solar-powered ICT hubs.

Integrating digital agriculture modules into tertiary education curricula.

Creating a National Smart Agri-Tech Taskforce to coordinate initiatives and ensure scalability.

Engaging local communities in technology design to promote adoption and relevance.

CONCLUSION

Nigeria stands at the cusp of an agricultural revolution powered by digital innovation. Intelligent agriculture offers practical tools for transforming the agri-food system into one that is inclusive, sustainable, and efficient. By prioritizing investment in infrastructure, education, and regulatory reform, Nigeria can emerge as a leader in smart agriculture across Africa.

REFERENCES

Akinyele, T. A., & Yusuf, R. A. (2020). Digital farming in Africa: Prospects and limitations in Nigeria. *African Journal of Agricultural Innovation*, *12*(3), 112–123.

FAO. (2022). Nigeria: Country Programming Framework 2022–2026. *Food and Agriculture Organization of the United Nations*. https://www.fao.org/nigeria

Tijani, A. I., & Oladipo, F. (2021). Assessing the role of agri-tech startups in transforming food systems in Nigeria. *Journal of Smart Agriculture and Rural Development*, 6(2), 55–66.

Zenvus. (2023). *Precision agriculture in Africa: Zenvus case study*. Retrieved from https://www.zenvus.com