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Adoption of digital tools by african farmers for sustainable intensification of cropping systems: A case study of Nigeria

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Abstract

This study examines the adoption of digital tools by African farmers for the sustainable intensification of cropping systems, using Nigeria as a case study. Agriculture remains central to rural livelihoods and food security in Nigeria, yet productivity is constrained by climate change, poor infrastructure, limited access to finance, weak extension services, pest and disease pressures, and low adoption of modern technologies. Digital tools, including mobile applications, artificial intelligence (AI), sensors, weather forecasting systems, and precision agriculture technologies, offer important opportunities to improve farm decision-making, input efficiency, productivity, climate resilience, and market access. However, their use among smallholder farmers remains limited.

The study adopted a mixed-method and participatory research approach involving a five-day stakeholder workshop in Port Harcourt, Rivers State, Nigeria. Data were collected from various stakeholders, including farmers and agricultural stakeholders from farmers' organisations, government agencies, research institutions, private companies, and agricultural development bodies. Questionnaires and focus group discussions were used to assess farmers' awareness, perceptions, preferences, and barriers related to digital agriculture. Quantitative data were analysed using descriptive statistics and a maximum difference model in JMP Pro Version 16.0, while qualitative responses were analysed thematically.

Findings show that although farmers recognise the potential of digital tools to improve crop yields, reduce input use, support pest and disease detection, improve weather forecasting, and enhance farm management, adoption remains constrained by limited network connectivity, high costs of mobile devices and AI tools, insufficient training, lack of funding, and weak communication between researchers and farmers. The maximum difference model revealed that proper network connectivity and reducing the unit cost of mobile devices and AI tools were the most important factors for enhancing sustainable intensification through digital tool adoption. Collaborative research, funding opportunities, and communication of research outcomes in simple language were also identified as important enabling conditions.

The study concludes that digital agriculture can support sustainable intensification in Nigeria, but its adoption requires affordable technologies, stronger infrastructure, farmer-centered training, participatory innovation processes, and inclusive policy support. These findings provide practical insights for researchers, policymakers, and development actors

seeking to scale digital solutions for climate-resilient and sustainable farming systems in Africa.

Keywords: Agricultural intensification, artificial intelligence, digitalisation, farmers, Nigeria