

# Smart Agro Intelligent System

Joyce Thadey, Gladness Masatu, Azori Lukaya

Vestina Ndomba, Witness Jastini, Yalkin Njovu, Yuda Lumwecha, Kiptanui Linus  
Department of Computer Science  
Ruaha Catholic University (RUCU)  
Iringa, Tanzania  
gladnesssabatho7@gmail.com.

**Abstract:** *Agriculture remains the backbone of Tanzania's economy, providing employment and income to the majority of the population, particularly smallholder farmers in rural areas. Despite its importance, agricultural productivity remains low due to challenges such as limited access to timely and reliable farming information, climate variability, crop diseases, poor farm management practices, and inefficient use of agricultural inputs. Although recent advances in digital technologies such as mobile applications, artificial intelligence, and data-driven decision-support systems present promising opportunities to address these challenges, most existing smart agriculture solutions operate as isolated applications that fail to provide holistic support for farmers' day-to-day decision-making processes. This review paper examines existing smart agriculture and intelligent farming systems with the aim of identifying key research trends, limitations, and gaps affecting their adoption and effectiveness in developing countries. The review focuses on issues related to system fragmentation, dependence on internet connectivity, lack of localization to specific farming contexts, and insufficient evaluation of real-world impact. Based on these observations, the study motivates the development of a Smart Agro Intelligent System that integrates crop calendars, climate alerts, AI-based disease identification, learning resources, farmer interaction tools, and cost-profit tracking into a single, accessible platform. The proposed system aims to enhance informed decision-making, improve crop productivity, reduce production costs, and promote sustainable agriculture among smallholder farmers in Tanzania.*

**Keywords—** Smart Agriculture, Intelligent Farming Systems, Artificial Intelligence, Decision Support Systems, Crop Calendar, Climate Alerts, Disease Detection, Smallholder Farmers.

## 1.0 INTRODUCTION

Agriculture remains the backbone of Tanzania's economy, employing the majority of the population and contributing significantly to national food security and income generation. Mobile applications, artificial intelligence, and data-driven decision-support systems, offer new opportunities to address these challenges[1]. This project focuses on the development of a Smart Agro Intelligent System that integrates crop calendars, climate alerts, AI-based disease identification, and farm management support into a single platform[2]. Despite its importance, smallholder farmers continue to face challenges such as low productivity, climate variability, crop diseases, and poor access to timely and accurate farming information[3]. Recent advances in digital technologies, including user-friendly platforms to improve farming decisions, enhance productivity, and promote sustainable agriculture in Tanzania[4][5].

## 1.1 BACKGROUND OF THE STUDY

The concept of a Smart Agro Intelligent System emerged in response to persistent challenges faced by farmers in Tanzania, particularly smallholder farmers who form the backbone of the country's agricultural sector. Agriculture employs approximately 65% of the Tanzanian population and remains the primary source of food, income, and livelihood for the majority of rural households. Despite its importance,

agricultural productivity in Tanzania remains relatively low due to factors such as poor timing of farming activities, inefficient irrigation practices, limited access to reliable agricultural information, high production costs, climate variability, and frequent outbreaks of crop pests and diseases[6]. Most smallholder farmers produce an average of only 1.2 tons per hectare, compared to a potential yield of about 3.5 tons per hectare when improved farming methods, accurate timing, and informed decision-making are applied. This significant productivity gap continues to undermine national food security and farmer incomes across Tanzania's diverse agro-ecological zones, ranging from the Lake Victoria basin to the Central Zone and the Southern Highlands[7]. The need to address these challenges has become more urgent as climate change intensifies weather unpredictability, directly affecting planting seasons, irrigation schedules, and crop survival rates. Traditional farming practices, which rely heavily on experience and manual observation, are increasingly insufficient in coping with modern agricultural risks[8]. Farmers often lack access to timely and location-specific information regarding weather patterns, soil conditions, pest outbreaks, and market prices. As a result, many farming decisions are made based on guesswork rather than evidence, leading to resource wastage, reduced yields, and increased vulnerability to crop failure. These limitations highlighted the necessity for intelligent, data-driven agricultural systems capable of supporting farmers with accurate, real-time, and actionable insights[9].

The growth of Smart Agro Intelligent Systems accelerated rapidly in the early 2020s due to improvements in digital infrastructure and technological accessibility across Tanzania. Increased availability of affordable smartphones, expansion of mobile network coverage, faster internet connectivity, and reduced data bundle costs enabled more farmers to access digital services than ever before. This technological shift was further strengthened by government initiatives, particularly the launch of the Digital Agriculture Strategy in 2024, which aimed to promote the use of information and communication technologies among approximately 5.2 million smallholder farmers nationwide. The strategy emphasized the integration of digital tools into agricultural extension services, data-driven decision-making, and innovation-driven farming practices to enhance productivity and sustainability[10].

Initial pilot implementations of smart agricultural technologies demonstrated promising results. In 2022, pilot projects conducted in the Morogoro region introduced simple Short Message Service (SMS) based advisory systems that provided farmers with planting calendars tailored to local weather conditions, along with automated alerts warning of potential droughts or heavy rainfall. These low-cost digital interventions enabled maize and tomato farmers to improve the timing of their farming activities, resulting in yield increases of approximately 28% and a reduction of irrigation water usage by about 30%. Such improvements translated into reduced production costs, improved water conservation, and enhanced overall farm efficiency[11].

Further advancements were recorded in 2023 in the Mbeya region, where researchers and agricultural experts tested smartphone-based applications capable of diagnosing crop diseases through image analysis. Farmers were able to take photographs of infected crops and receive instant diagnostic feedback with an accuracy rate of approximately 92%. This early detection mechanism allowed farmers to apply appropriate treatments promptly, significantly reducing crop losses caused by delayed or incorrect disease management. In 2024, similar innovations were extended to the Dodoma region, where mobile applications were developed to assist farmers in tracking production costs such as seeds, fertilizers, labor, and transportation. These applications enabled farmers to compare production expenses with actual income earned from crop sales at local markets, thereby improving financial planning and profitability assessment[12].

By 2025, smart farming technologies had gained wider recognition and adoption across various agricultural regions in Tanzania through government-led programs, university research initiatives, and partnerships with agricultural stakeholders. Regions such as Arusha, Kilimanjaro, Morogoro, Mbeya, and other major farming zones increasingly relied on mobile alerts to guide farmers on optimal irrigation schedules, timely weeding, and appropriate harvesting periods. The overarching objective of these initiatives was to enhance farming efficiency, minimize losses caused by climate variability and crop diseases, reduce

unnecessary production costs, and ultimately improve household incomes and food security[13].

Modern smart farming systems now integrate multiple functional components into cohesive platforms. These components include crop calendars that utilize localized weather data and soil characteristics, automated weather alerts for rainfall, drought, and frost events, AI-powered chat assistants capable of diagnosing crop diseases using farmer-submitted images, moderated farmer community platforms that reduce the spread of misinformation, cost and profit calculators for post-harvest financial analysis, and intelligent reminders for irrigation, weeding, and harvesting activities. In addition, digital learning resources such as video-based training hubs provide farmers with practical guidance on best farming practices for key crops including maize, beans, rice, and tomatoes cultivated across different regions of Tanzania[14].

The Smart Agro Intelligent System seeks to bridge existing gaps by providing Tanzania's first comprehensive and integrated digital agricultural platform that consolidates these functionalities into a single accessible mobile and web-based solution. By aligning with national development frameworks such as the Agricultural Sector Development Programme Phase II (ASDP II), the system supports goals related to sustainable agricultural intensification, increased farmer incomes, enhanced food security, and long-term resilience of the agricultural sector. Through intelligent integration of data, analytics, and user-centered design, the Smart Agro Intelligent System represents a critical step toward transforming traditional farming into a modern, efficient, and sustainable agricultural ecosystem[15].

## 1.2 PROBLEM STATEMENT

Despite the critical role played by smallholder farmers in Tanzania's agricultural sector, many of them continue to experience low crop yields, inefficient use of farming inputs, and poor decision-making due to the absence of a unified and intelligent digital support system. Although several agricultural applications and information services exist, most of them offer isolated functionalities such as basic weather updates, market price information, or general farming tips, forcing farmers to rely on multiple uncoordinated tools to meet their needs. This fragmentation results in farmers missing essential guidance related to optimal planting periods, irrigation scheduling, pest and disease management, and accurate tracking of production costs and expected returns. Consequently, farmers face increased production risks, greater vulnerability to climate variability, wastage of resources, and reduced profitability. The lack of an integrated, accessible, and context-aware digital platform has limited the effective adoption of smart farming practices, particularly among smallholder farmers with low digital literacy and limited connectivity. Therefore, there is a clear and pressing need for a user-friendly Smart Agro Intelligent System that consolidates crop calendars, climate alerts, AI-based disease diagnosis, educational resources, farmer interaction forums,

and cost benefit analysis tools into a single platform to support informed decision-making, enhance productivity, and improve the livelihoods of smallholder farmers.

### **1.3 OBJECTIVES**

#### **1.3.1 Main Objective**

To develop a Smart Agro Intelligent System for Tanzania's smallholder farmers that supports informed agricultural decision-making, improves crop productivity, and promotes sustainable and technology-driven farming practices across the country.

#### **1.3.2 Specific Objectives**

1.To design and implement a crop calendar generator based on regional weather patterns, soil characteristics, and agro-ecological conditions in Tanzania to support accurate planting and harvesting decisions.

2.To develop an AI-powered chat assistant integrated with image recognition capabilities for crop disease identification, pest detection, and provision of timely farming advice.

3.To implement an automated notification system that provides alerts and reminders for critical farming activities such as irrigation, weeding, planting, and harvesting at appropriate times.

4.To create a farmer cost–profit tracking module that enables smallholder farmers to record production costs, monitor income, and evaluate profitability for each farming season.

## **2.0 RELATED WORKS**

### **2.1 AI-Driven Crop Disease Detection and Management**

This research presents an AI-powered crop disease detection system that uses machine learning techniques to identify and manage plant diseases, demonstrating how advanced algorithms can enhance early diagnosis and intervention in agriculture[16]. The study shows that accurate disease prediction can significantly reduce crop losses and improve yield quality by enabling farmers to take timely actions based on model outputs. It also discusses the challenges of model deployment in diverse field conditions and the importance of using accessible tools for farmers with limited technical skills[17]. This directly relates to the AI-powered image recognition and chat assistant feature in the Smart Agro Intelligence System, illustrating that integrating disease detection with user-friendly technology can empower farmers with diagnostic support and practical recommendations. The system emphasizes real-time support, aligning with your project's goal of improved crop health monitoring and advisory services[18].

### **2.2 Enhancing Smart Agriculture Through IoT Crop Monitoring.**

This study explores a comprehensive IoT-based crop monitoring system designed to optimize farming practices by collecting, analyzing, and acting on real-time environmental data. Sensors are deployed across the farm to continuously measure soil moisture, temperature, humidity, and leaf health, while cameras capture crop images for early disease detection[19]. The system leverages machine learning algorithms to process this data and provide actionable insights, including irrigation recommendations, fertilization schedules, and pest management alerts. Farmers receive notifications directly on their mobile devices whenever environmental parameters deviate from optimal ranges, enabling timely corrective actions and minimizing crop losses[20]. Beyond real-time monitoring, the system stores historical data to identify trends in soil and crop conditions, helping farmers plan crop rotation and long-term resource allocation. The study highlights how integrating IoT with AI can bridge the gap between data collection and practical decision-making, making farming more efficient, sustainable, and profitable[21].

This research directly supports the weather-linked alert system, irrigation reminders, and real-time monitoring features of the Smart Agro Intelligence System. By providing predictive insights, actionable alerts, and continuous tracking, it ensures that farmers are not only reacting to problems but are empowered to make proactive decisions, enhancing productivity and resource management. The study also notes challenges such as network reliability, sensor maintenance, and user interface design, emphasizing that effective smart agriculture systems must combine robust hardware, accurate analytics, and accessible interfaces to maximize adoption among farmers.

### **2.3 Real-Time Smart Agriculture Monitoring and Alerts**

This research presents an Internet of Things (IoT)-based Smart Agriculture Monitoring System that continuously collects environmental data, such as soil moisture, ambient temperature, humidity, and light intensity, through interconnected sensors deployed in the field[22]. The system processes real-time information using embedded analytics and machine learning models to determine when specific parameters fall outside optimal ranges[23]. When critical thresholds are reached, automated alerts are sent to farmers via SMS or mobile notifications, enabling them to act quickly to adjust irrigation, pest control, or other farming activities. Additionally, the system stores historical data for trend analysis, allowing farmers to evaluate long-term conditions and make evidence-based decisions. This study highlights the important role of real-time monitoring and early warning mechanisms in reducing crop losses, improving resource efficiency, and enhancing yield consistency[24].

These findings are directly applicable to the Smart Agro Intelligence System, particularly in providing weather-linked alerts, irrigation reminders, and activity scheduling notifications. By integrating real-time sensing with decision support, such platforms help farmers anticipate problems rather than react after damage has occurred. However, the

researchers also identified challenges including sensor maintenance in harsh environments and ensuring reliable connectivity, indicating that future systems should incorporate robust hardware and fallback communication methods to ensure continuous service delivery[25].

#### **2.4 Integrative IoT and AI Disease Forecasting for Climate Challenges**

This comprehensive review investigates how integrated Internet of Things (IoT) devices, machine learning, and artificial intelligence (AI) techniques are being employed to forecast plant diseases and manage climate variability in agriculture. By combining data from weather stations, soil sensors, and remote sensing networks, the integrated models can analyze environmental patterns and predict disease outbreaks before they escalate into widespread infestations[26]. The researchers emphasize that early prediction allows farmers to adopt preventive strategies such as targeted pesticide application or altered irrigation schedules, ultimately reducing crop losses and input costs. Additionally, the study underscores how climate change has made disease patterns more unpredictable, increasing the value of real-time forecasting systems that adapt dynamically to changing conditions[27]. The authors also discuss the importance of training models on diverse and locally relevant datasets, since models trained on limited or geographically narrow data may underperform when applied elsewhere[28]. The findings strongly support the Smart Agro Intelligence System's goal of providing disease alerts, climate-aware notifications, and decision support for farmers. By incorporating AI forecasting with real-time environmental data, your system can empower farmers with actionable insights tailored to their specific crop and location. This integrative approach not only enhances agricultural resilience but also bridges the gap between technology and on-ground farming needs, highlighting the value of combining multiple features into a single, cohesive platform[29].

#### **2.5 Precision Agriculture: Impact of Smart Technologies**

This literature review assesses the impact of precision farming technologies including AI, IoT, and data analytics on agricultural productivity, environmental sustainability, and economic viability. The study shows that precision technologies optimize resource use (such as water and soil nutrients), reduce greenhouse gas emissions, increase yield effectiveness, and strengthen farm sustainability[30]. It highlights the role of data-driven decision support systems in enabling farmers to make informed choices about irrigation timing, planting schedules, and crop management. However, the authors note that there is a need for more integrated approaches that consider economic, environmental, and social dimensions together, rather than isolated tech applications[31]. This supports your project's holistic approach of combining weather alerts, AI guidance, farm record tools, and training resources to enhance overall farm performance and livelihood outcomes[32].

### **3.0 OBSERVATIONS**

Synthesizing the reviewed literature on smart agriculture systems reveals several key observations regarding existing research trends, limitations, and gaps.

#### **Fragmentation of Smart Agriculture Solutions**

A common observation across reviewed studies is that most smart agriculture technologies are developed as standalone solutions targeting specific farming challenges such as weather advisory, crop disease detection, market information dissemination, or farm management[33]. Few studies demonstrate comprehensive system designs that integrate multiple intelligent components into a single platform. This fragmentation increases the complexity for smallholder farmers, who are required to rely on multiple uncoordinated tools to support farming decisions, thereby limiting the overall effectiveness and adoption of smart agriculture technologies[34].

#### **Dependence on Continuous Internet Connectivity**

The literature indicates that many intelligent farming systems are designed with a strong reliance on continuous internet connectivity. Cloud-based architectures dominate existing solutions, particularly in AI-driven advisory and disease diagnosis systems[35]. However, this design approach does not adequately consider rural farming contexts where internet access is unreliable or unavailable. Limited research has focused on offline-capable system designs, lightweight processing models, and adaptive synchronization mechanisms suitable for low-connectivity environments, creating a significant gap in practical applicability[36].

#### **Limited Adaptation to Local Farming Contexts**

Another notable observation is the limited consideration of local agricultural contexts in existing smart farming systems[37]. Many solutions rely on generalized datasets and models that do not sufficiently reflect local crop varieties, climatic conditions, soil characteristics, or traditional farming practices. This lack of contextual adaptation reduces the accuracy and usefulness of recommendations provided to smallholder farmers, affecting trust and system adoption[38].

#### **Insufficient Assessment of Practical Impact**

Finally, the reviewed literature shows that most smart agriculture systems are evaluated primarily using technical performance metrics or short-term pilot results[39]. There is limited evidence of long-term studies assessing the real impact of these systems on crop productivity, cost reduction, farmer income, and sustainability. This gap highlights the need for more comprehensive evaluation frameworks that focus on real-world agricultural outcomes[40].

### **4.0 CONCLUSION.**

This study has examined the design and impact of the Smart Agro Intelligence System, an integrated platform that

leverages artificial intelligence, IoT, and data-driven decision support to address the challenges faced by farmers. While existing technologies provide targeted benefits such as disease detection, weather monitoring, or farm record-keeping farmers often struggle with fragmented solutions that fail to meet all their needs. The Smart Agro Intelligence System responds to these gaps by combining weather-linked alerts, AI-powered crop disease diagnosis, crop calendar generation, financial record management, activity notifications, and a learning hub for continuous education. By unifying these features, the system enables farmers to make informed, proactive decisions, optimize resource use, prevent crop losses, and enhance overall productivity, while also fostering community engagement through moderated knowledge-sharing forums.

Ultimately, the Smart Agro Intelligence System demonstrates the transformative potential of integrating AI, real-time monitoring, and localized educational resources into a single cohesive platform. It empowers farmers to act based on predictive insights rather than reactive measures, improving yield quality, economic outcomes, and sustainable agricultural practices. For maximum impact, future development should focus on robust implementation, user-friendly interfaces, and adaptation to region- and crop-specific contexts, ensuring that the platform remains accessible, effective, and transformative for farmers across diverse settings.

## 5.0 RECOMMENDATION AND FUTURE WORKS.

### 1. Future Research Directions

**Modular and Scalable System Design:** Future research should focus on creating detailed blueprints for modular smart agriculture platforms, including AI, IoT, and data flow integration. Investigating middleware that dynamically connects disease detection, weather analytics, and farm management modules can enhance system scalability and flexibility.

**Lightweight AI Models for Resource-Limited Settings:** Researchers should develop and benchmark AI models for crop disease detection, pest identification, and soil health monitoring that can run efficiently on low-cost smartphones or offline devices. Techniques such as model compression, edge computing, and knowledge distillation can make AI accessible to smallholder farmers.

**Development of Localized Agricultural Datasets:** Open-access datasets specific to regional crops, soil types, and weather patterns are critical for improving the accuracy and relevance of AI advisory systems. This will support predictive analytics and localized recommendations tailored to farmer needs.

**Long-Term Impact Assessment Studies:** Scholars should carry out studies that measure the socio-economic and environmental outcomes of smart agriculture systems over

time. Understanding effects on yield, income, and sustainable practices will help evaluate the true benefits of integrated digital farming tools.

### 1. System Implementation Recommendations

**User-Friendly and Accessible Interfaces:** The platform should be designed with intuitive dashboards and guidance, ensuring that farmers with varying levels of digital literacy can navigate features such as crop calendars, financial record management, and AI chat assistants.

**Reliable Connectivity and Offline Support:** Systems should incorporate offline functionality and lightweight data requirements to remain operational in regions with unstable internet, ensuring continuous access to critical features such as irrigation and harvesting reminders.

**Real-Time Data Updates:** Integration of up-to-date weather, soil, and crop disease data is essential for maintaining the accuracy and reliability of alerts and predictive recommendations.

### 3. Farmer and Community Support Recommendations

**Localized Learning Resources:** Expand the learning hub with region-specific educational content, including videos, tutorials, and crop-specific guides to strengthen farmer knowledge and skills.

**Community Engagement and Knowledge Sharing:** Encourage moderated forums and peer-to-peer learning where farmers can exchange experiences, receive advice, and discuss local challenges, promoting collective problem-solving and adoption of best practices.

**Enhanced Financial and Resource Management Tools:** Improve the farm record-keeping feature to include automated summaries, profit-loss analysis, and visual dashboards to help farmers assess costs, revenues, and profitability effectively.

**Sustainability and Continuous Improvement:** Establish feedback and maintenance mechanisms to ensure the system evolves according to farmer needs, technology updates, and environmental changes.

### Figures

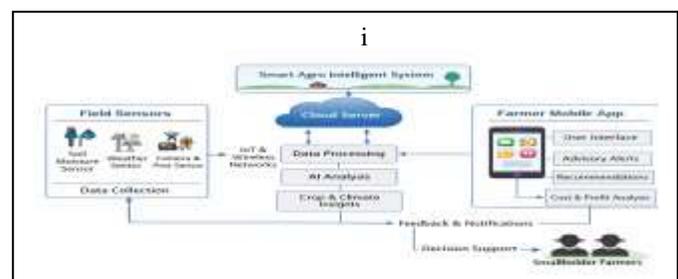


Fig. 1. Presents the architecture of Smart Agro Intelligent System.

## 6.0 ACKNOWLEDGMENT

We would like to express our sincere gratitude to our project supervisor for valuable guidance, academic support, and constructive feedback throughout the development of the Smart Agro Intelligent System. We also acknowledge the support and cooperation provided by lecturers, farmers, and all individuals who contributed directly or indirectly to the successful completion of this project.

## REFERENCES

- [1] M. O. F. Agriculture, "No Title".
- [2] "No Title", doi: 10.4160/9789290606352.
- [3] "No Title".
- [4] "A LITERATURE REVIEW ON IOT IN SMART AGRICULTURE Agape Uchenna Kilaso AbdulWahaab Ude Chinecherem Egbon Victoria".
- [5] "THE UNITED REPUBLIC OF TANZANIA TANZANIA DIGITAL ECONOMY STRATEGIC FRAMEWORK".
- [6] A. R. Abdulai, P. T. Quarshie, E. Duncan, and E. Fraser, "Is agricultural digitization a reality among smallholder farmers in Africa? Unpacking farmers' lived realities of engagement with digital tools and services in rural Northern Ghana," *Agric. Food Secur.*, pp. 1–14, 2023, doi: 10.1186/s40066-023-00416-6.
- [7] H. O. Abdullahi, M. Mahmud, A. A. Hassan, and A. F. Ali, "Ingénierie des Systèmes d'Information A Bibliometric Analysis of the Evolution of IoT Applications in Smart Agriculture," vol. 28, no. 6, pp. 1495–1504, 2025.
- [8] S. G. Adjognon, L. S. O. Liverpool-tasie, and T. A. Reardon, "Agricultural input credit in Sub-Saharan Africa: Telling myth from facts," *Food Policy*, vol. 67, pp. 93–105, 2017, doi: 10.1016/j.foodpol.2016.09.014.
- [9] M. Afonso et al., "Smart Agricultural Technology Automatic trait estimation in floriculture using computer vision and deep learning," *Smart Agric. Technol.*, vol. 7, no. October 2023, p. 100383, 2024, doi: 10.1016/j.atech.2023.100383.
- [10] E. Africa et al., "Mobile phone use is associated with higher smallholder agricultural productivity in," pp. 1–16, 2020, doi: 10.1371/journal.pone.0237337.
- [11] I. N. Agriculture and R. Areas, *Digital technologies*.
- [12] M. Foster, H. Rönnqvist, and R. Q. V. T. Ab, "The performance of embankment dams with filters coarser than 'no-erosion' design criteria," 2018.
- [13] M. Bai, "Advancing agriculture in technologies Tanzania through climate-smart," vol. 20, no. 2, pp. 129–159, 2025.
- [14] V. Choudhary, P. Guha, G. Pau, and S. Mishra, "An Overview of Smart Agriculture Using Internet of Things (IoT) and Web Services," *Environ. Sustain. Indic.*, vol. 26, p. 100607, Jun. 2025, doi: 10.1016/j.indic.2025.100607.
- [15] S. Coggins et al., "How have smallholder farmers used digital extension tools? Developer and user voices from Sub-Saharan Africa, South Asia and Southeast Asia," *Glob. Food Sec.*, vol. 32, no. August 2021, p. 100577, 2022, doi: 10.1016/j.gfs.2021.100577.
- [16] D. Garg and M. Alam, "Smart agriculture: a literature review," *J. Manag. Anal.*, vol. 10, pp. 1–57, May 2023, doi: 10.1080/23270012.2023.2207184.
- [17] N. Gumbi, L. Gumbi, and H. Twinomurizi, "Towards Sustainable Digital Agriculture for Smallholder Farmers: A Systematic Literature Review," 2023.
- [18] A. Innovation and S. Review, "East African Journal of Agriculture and Biotechnology Technological, Agricultural Innovation, and Food Security in Africa: Systematic Review," vol. 9, no. 1, pp. 1–15, 2026, doi: 10.37284/eajab.9.1.4292.
- [19] I. Journal and O. F. Science, "Potential of Mobile-Based Apps Online Platforms in Fast-Tracking Access of Agriculture Information," pp. 2953–2960, 2021.
- [20] M. Kamal, "Mobile Applications Empowering Smallholder Farmers: A Review of the Impact on Agricultural Development," pp. 36–50.
- [21] T. D. Kawanguzi, B. Mugonola, and K. Mwanika, "East African Journal of Agriculture and Biotechnology Determinants of Youth Participation in Market-Oriented Vegetable Production Trainings in Northern Uganda," vol. 9, no. 1, pp. 16–30, 2026, doi: 10.37284/eajab.9.1.4312.
- [22] F. A. Kitole, E. Mkuna, and J. K. Sesabo, "Smart Agricultural Technology Digitalization and agricultural transformation in developing countries: Empirical evidence from Tanzania agriculture sector," *Smart Agric. Technol.*, vol. 7, no. December 2023, p. 100379, 2024, doi: 10.1016/j.atech.2023.100379.

- [23] M. T. Kisena and E. M. Kwesigabo, "Assessing the Contribution of Mobile Phone Agricultural Information on Maize Productivity: A Case Study of Kilolo District Tanzania," vol. 1, no. 6, 2023, doi: 10.59324/ejtas.2023.1(6).106.
- [24] Z. Yang, W. Su, Q. Lai, Y. Que, D. Song, and C. Yan, "Industrial Crops & Products A grasp detection method for a carnation cutting robot based on seven-dimensional pose prediction representation," vol. 223, no. July 2024, 2025.
- [25] M. Magesa, J. Jonathan, and J. Urassa, "Digital Literacy of Smallholder Farmers in Tanzania," pp. 1–22, 2023.
- [26] C. K. Migisha, "Digital ecosystems for smallholder farmers in low- and middle-income countries.," no. December, 2022.
- [27] P. MURROMBA, M. Keeni, and K. FUYUKI, A Systematic Review of Mobile Agricultural Service Applications for Smallholder Farmers in Sub-Saharan Africa: Perspectives from the Technology Acceptance Model. 2025. doi: 10.21203/rs.3.rs-5911289/v1.
- [28] P. Upadhyaya, M. Karkee, S. Kshetri, and A. Paudel, "Smart Agricultural Technology Automated lag-phase detection in wine grapes using a mobile vision system," Smart Agric. Technol., vol. 7, no. October 2023, p. 100381, 2024, doi: 10.1016/j.atech.2023.100381.
- [29] G. E. Mushi, G. Di, and M. Serugendo, "Digital Technology and Services for Sustainable Agriculture in Tanzania : A Literature Review," pp. 1–17, 2022.
- [30] G. E. Mushi and P. Burgi, "State of Agricultural E-Government Services to Farmers in Tanzania : Toward the Participatory Design of a Farmers Digital Information System ( FDIS )," 2024.
- [31] G. K. Ndimbo, "ICTs , smallholder agriculture and farmers ' livelihood improvement in developing countries : Evidence from Tanzania," 2023, doi: 10.1177/02666669231165272.
- [32] K. Ostaszewski et al., "Steepening of magnetosonic waves in the inner coma of comet 67P / Churyumov – Gerasimenko," pp. 721–742, 2021.
- [33] A. Report, "UNITED REPUBLIC OF TANZANIA," 2024.
- [34] K. C. Radio, T. Web-, and F. Advisory, "UshuariKilimo information system Web and mobile phones for extension services in Tanzania Promising Practice Key facts," no. January, 2015.
- [35] N. Raghav, S. Rai, and U. K. Singh, "Smart Farming System with Cloud Analytics," vol. 9, no. 12, pp. 3156–3165, 2025.
- [36] S. A. Report, A. Systems, and S. Region, "digital agriculture country study Annex : tanzania DIGITAL AGRICULTURE COUNTRY STUDY ANNEX :".
- [37] A. Siddiqua and L. A. Weston, "E VALUATING P LANT D ISEASE D ETECTION M OBILE A PPLICATIONS : Q UALITY AND L IMITATIONS".
- [38] M. E. Sospeter and R. Studies, "Innovative 'Swahili based Agricultural Apps' Underutilized new Way of Reaching Farmers and Disseminating Information in Tanzania," no. 2020, pp. 215–221, 2021.
- [39] P. Unit, "TRAINING FOR BETTER LIFE " Guidelines for the Preparation and Presentation of Non-Degree and," 2025.
- [40] T. H. E. United and R. Of, "June 2022," no. June, 2022.