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Development of a Multilingual Mobile-Based Platform for Efficient Information Dissemination in Crop Production

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Agriculture remains the backbone of Nigeria's economy, yet farmers, especially in Northern Nigeria, struggle with inadequate access to timely and relevant crop production information. This challenge contributes to low productivity, poor crop yields, and limited adoption of modern practices. This study presents the development of a mobile App for efficient information dissemination in crop production. The system was developed using Flutter for the mobile interface, Node.js for the backend, and MySQL for database management. Core features include weather forecasts, soil texture guidance, multilingual support (English, Hausa, Arabic), and a chat module for farmer-expert interaction. Evaluation of the platform was conducted with ten (10) smallholder farmers from selected farming communities in Northern Nigeria using questionnaires and practical system usage sessions. The findings revealed that the platform significantly improved farmers' access to timely agricultural information, enhanced decision-making related to crop production, and supported the adoption of improved farming practices. Evidence from the evaluation showed increased reliance on weather forecasting, soil guidance, and pest management features, demonstrating the system's effectiveness in promoting sustainable farming practices.

Keywords Crop Management, Digital Agriculture, Information Dissemination, Mobile Application, Node.js

1. Introduction

Agriculture contributes over 20% of Nigeria's Gross Domestic Product (GDP) and provides livelihoods for more than 70% of the population (National Bureau of Statistics, 2023). Despite its importance, smallholder farmers in Northern Nigeria face persistent challenges in accessing timely, accurate, and localized agricultural information. Traditional extension services remain limited in coverage and effectiveness, often failing to meet farmers' real-time needs (Piserchia & Edimu, 2025).

With the widespread adoption of mobile technologies, digital agriculture has emerged as a viable solution for bridging information gaps. Mobile-based platforms enable real-time dissemination of weather forecasts, soil management guidelines, pest control strategies, **This** and best farming practices. However, many existing platforms lack localization features such as regional language support and culturally relevant content, which limits adoption among rural farmers (Ayim et al., 2022). This study addresses these gaps by developing a multilingual mobile-based platform tailored to the information needs of farmers in Northern Nigeria.

Agriculture remains the backbone of Nigeria's economy, employing a significant portion of the population (National Bureau of Statistics [NBS], 2023). However, small-scale farmers, who form the majority of agricultural producers, face substantial challenges due to limited access to timely and accurate information. Traditional extension services, though valuable, are often inefficient in reaching all farmers, leaving many without the knowledge needed to adopt modern farming techniques. This research presents a mobile-based platform in three (3) major languages in Nigeria that enhances crop management through efficient information dissemination. The system provides farmers access to crop production guidelines, weather

updates, and interactive support, thereby addressing critical challenges in agricultural productivity.

II. Related Work

Several studies highlight the importance of digital tools in agriculture. Food and Agriculture Organization (FAO, 2020) reports that mobile-based platforms can improve farmers' access to extension services and reduce knowledge gaps. Similarly, Khan et al. (2020) reviewed crop management systems and emphasized the role of ICT in improving agricultural practices. In Nigeria, some platforms have been developed to support farmers, but limitations remain. For instance, most lack regional language support, which restricts adoption among rural farmers. Unlike prior work, this platform introduces a localized, multilingual system explicitly designed for farmers in Northern Nigeria. By incorporating English, Hausa, and Arabic, the system ensures inclusivity, while chat-based features enhance interactivity between farmers and agricultural experts.

Information Accuracy and Decision-Making Theory (IADT)

This theory emphasizes the role of accurate information in enhancing decision-making processes in agriculture. It posits that farmers who have access to precise, real-time data are better equipped to make informed decisions, leading to increased productivity (Smith et al., 2021). In the context of Northern Nigeria, where many smallholder farmers lack access to reliable agricultural information, the application of IADT supports the development of a crop management system that delivers localized, real-time advisories. By reducing uncertainty and enabling proactive responses, the system ensures that farmers make better agronomic and financial decisions, thereby promoting food security and sustainable farming practices (Adebayo & Yusuf, 2023).

Agricultural Knowledge Management Systems

Knowledge management systems compile and disseminate best practices and research findings to farmers. According to Rahman et al. (2022), these systems enhance knowledge retention and application, leading to increased productivity. The authors emphasize the importance of customizing content to meet the specific needs of different farming communities. According to Nwachukwu & Olayemi (2022), AKST

emphasizes the cyclical nature of knowledge: from generation through research, to dissemination via ICT tools, and application by end-users. In Northern Nigeria, where knowledge dissemination is fragmented, this theory supports the establishment of a centralized, accessible platform to streamline agricultural knowledge delivery.

As highlighted by Garba et al. (2021), integrating these knowledge units using digital platforms ensures that farmers receive context-specific, timely, and actionable information. The proposed crop management system aligns with IAKMF by consolidating these modules in a multilingual, easy-to-use interface.

Agricultural Digital Knowledge Ecosystem

The Agricultural Digital Knowledge Ecosystem theory postulates that agricultural innovation depends on dynamic digital ecosystems involving stakeholders like researchers, extension agents, private tech providers, and farmers. Usman and Bello (2021) argue that these ecosystems thrive when knowledge flows are democratized through digital platforms. The proposed system aligns with this theory by creating an inclusive interface where farmers can access expert insights, crowd-sourced best practices, and real-time data updates.

Contextualized Information Dissemination Theory (CIDT)

This theory highlights the importance of tailoring information to local contexts, language, culture, literacy levels, and farming conditions for effective agricultural communication. Nuhu et al. (2023) found that farmers in Northern Nigeria are more responsive to information delivered in local dialects and formats (e.g., audio or infographic). CIDT supports the integration of Hausa and Arabic languages in the crop management system, ensuring accessibility and usability across literacy levels.

III. Methodology

Data for system requirements and evaluation were collected from ten (10) smallholder farmers and two (2) agricultural extension experts selected from farming communities in Kano and Kaduna States, Northern Nigeria. Participants were selected using purposive sampling, focusing on farmers actively engaged in crop production and willing to participate in the study.

Data collection methods included structured interviews and questionnaires, which were used to identify farmers' information needs, existing challenges, and expectations from a digital agricultural platform. An Agile development

model was adopted, utilizing iterative sprints to enable continuous feedback, rapid prototyping, and adaptive planning throughout requirements analysis, design, implementation, and testing phases to ensure flexible, user-centered development and validation of the platform.

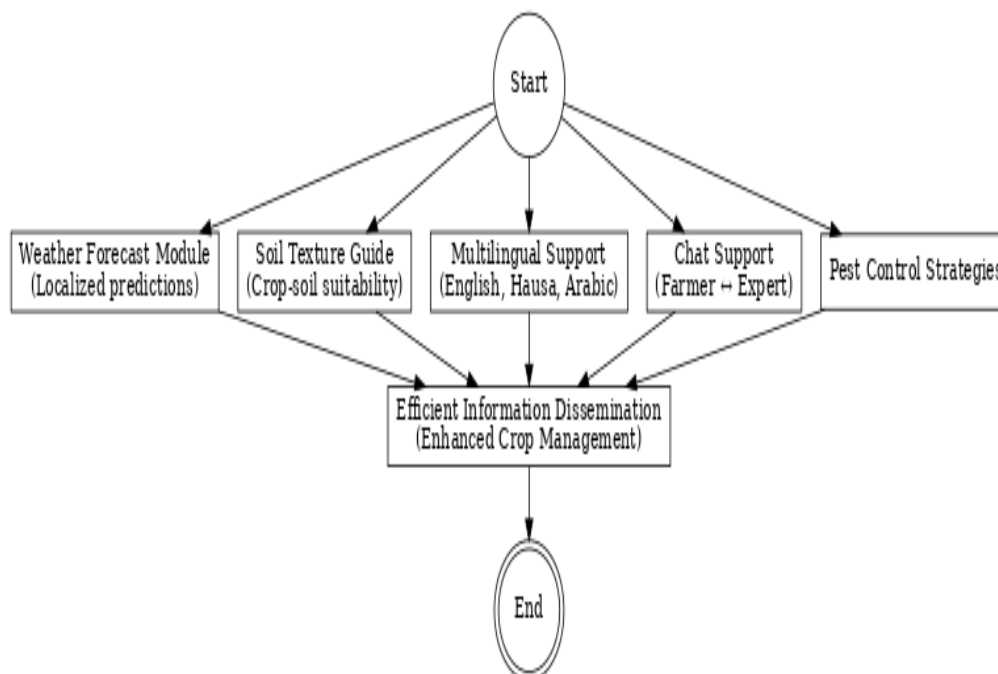


Figure 1: Architecture of the system

The system architecture of the platform consists of three layers: the frontend, a mobile application built with Flutter for cross-platform support; the backend, developed using Node.js and ExpressJS to provide APIs; and the database, implemented in MySQL to manage user data, weather records, and crop production content.

The platform also incorporates several key features, including a weather forecast module that provides localized weather predictions, a soil texture guide that recommends suitable crop soil combinations, multilingual support in English, Hausa, and Arabic, and a chat support system that enables farmers to interact with experts in real time.

IV. Results and Discussion

Figures 2–9 below present the mobile and web application interface developed for efficient agricultural information dissemination. The screenshots illustrate key modules such as weather forecasting, soil texture guide, multilingual content delivery, and real-time chat support, which demonstrate the system's functionality and usability.



Figure 2: Login/Dashboard – Shows the login interface and the main dashboard after successful authentication.



Figure 3: Crops Page/Crop Detailed Information (English) – Displays a list of available crops and detailed information for each crop.



Figure 4: Crops Page/Crop Detailed Information (Hausa) – Displays a list of available crops and detailed information for each crop.



Figure 4: Crops Page/Crop Detailed Information (Arabic) – Displays a list of available crops and detailed information for each crop.

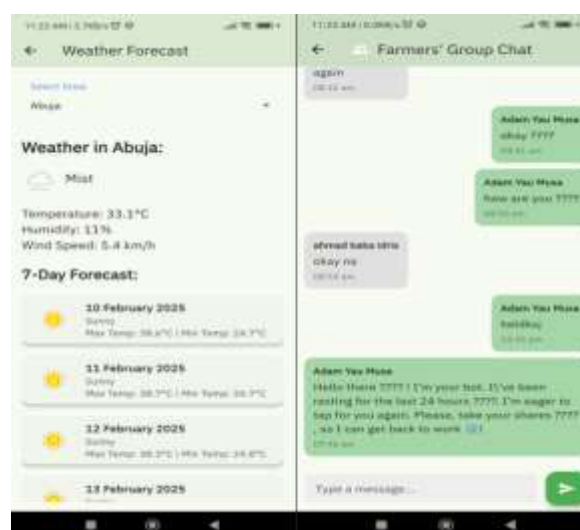


Figure 5: Weather Forecast/Farmer's Group Chat – Shows real-time weather updates and a chat platform for farmers to discuss and share insights.



Figure 6: Admin - Landing page - The user-friendly entry point with quick access to agricultural services.



Figure 7: System login page – Secure access point for users to enter credentials and access the platform.



Figure 8: Admin Dashboard – Centralized interface for administrators to manage users, data, and system operations.



Figure 9: Add Crop Details – Interface for entering and managing crop information in the system.



Figure 10: Manage Crops – Interface for viewing, updating, and deleting crop records.

System Evaluation Results

The system evaluation focused on assessing the usability, relevance, and effectiveness of the developed platform after hands-on usage by farmers. Farmers interacted with the application over a guided session and subsequently responded to evaluation questionnaires.

Results indicated that 90% of participants found the weather forecasting feature useful for planning farm activities, while 90% reported improved understanding of pest and disease control measures. Additionally, 70% of farmers expressed increased confidence in making farming decisions due to access to localized and multilingual content. The chat module was particularly valued for enabling real-time interaction with agricultural experts, reinforcing the system's role in improving information accessibility and decision-making.

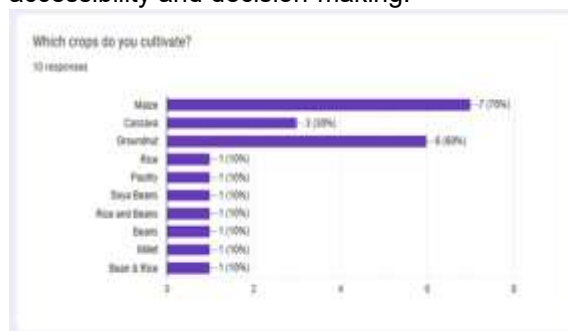


Figure 11: Trend showing types of crops farmers cultivate. The types of crops cultivated included maize (70%), rice (10%), groundnut (60%), cassava (30%), and other crops such as beans, millet, and soya beans (30%), with maize emerging as the most widely grown crop.

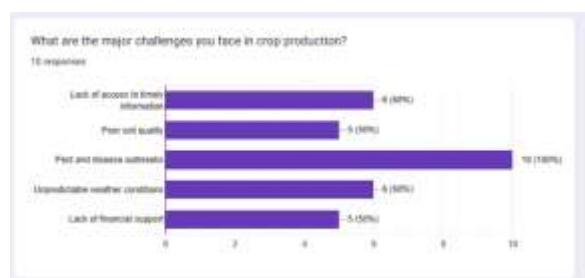


Figure 12: Trend showing major challenges faced by farmers in crop production. The major challenges faced by farmers were pest and disease attacks (100%), poor soil fertility (50%), climate change effects such as drought and floods (60%), limited access to inputs (60%), and lack of financial support (50%), with pests identified as the most pressing constraint.

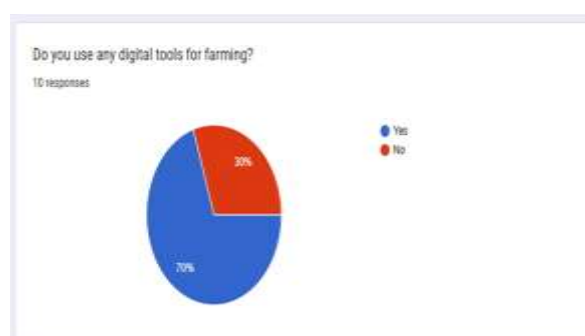


Figure 13: Distribution of farmers using digital tools. When asked about the use of digital tools, 7 farmers (70%) reported using them while 3 (30%) did not, showing a balanced adoption level with potential for wider uptake

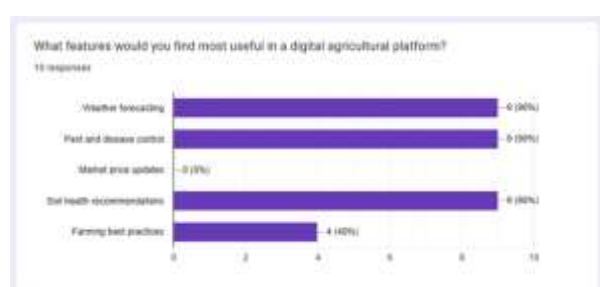


Figure 14: Trend showing digital agricultural platforms used by farmers. Among those who used digital platforms, 90% relied on the weather forecasting feature, 90% used pest and disease control features, 90% adopted soil health recommendations features, and 40% depended on farming best practices.

V. Conclusion and Future Work

This study successfully developed and evaluated a multilingual mobile-based platform for efficient information dissemination in crop production, targeted at smallholder farmers in Kano and Kaduna States, Northern Nigeria. The platform addresses critical gaps in agricultural information access by providing localized, timely, and accurate content in English, Hausa, and Arabic.

Evaluation results demonstrated that the system improved farmers' decision-making capabilities, particularly in weather planning, soil management, and pest control. The integration of multilingual support and interactive chat features enhanced usability and inclusivity, enabling farmers with varying literacy and digital skills to benefit from the platform.

The study confirms that digital agricultural platforms, when properly localized, can significantly enhance agricultural productivity and sustainability among smallholder farmers. However, challenges such as limited digital literacy and internet connectivity must be addressed to ensure wider adoption.

Contributions:

1. Improved farmer access to agricultural knowledge.
2. Localized multilingual support for inclusivity.
3. Integration of weather and soil information for better decision-making.

Future Work:

- Integration of IoT sensors for real-time soil data collection.
- Use of AI-driven recommendations for personalized crop management.
- Expansion to all 36 Nigerian states for broader impact.

Authors' Contributions

We strongly encourage authors to include author contributions. E.g. AB conceived the idea. CD conducted the experiment. Abdullateef Ebenmosi Salihu prepared the manuscript,

Conflict of Interest

There is no conflict of interest.

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