AI-POWERED MOBILE ASSISTANT FOR PRECISION CINNAMON FARMING USING REAL-TIME WEATHER AND SOIL DATA IN THE SOUTHERN PART OF SRI LANKA

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Ceylon cinnamon (*Cinnamomum verum*) is a globally renowned agricultural product and a key contributor to Sri Lanka's economy, particularly in the Southern Province. However, cinnamon farmers face persistent challenges due to climate variability, declining soil health, and limited access to real-time, localized agricultural insights, leading to suboptimal decision-making. To address these issues, this study presents the design, development, and evaluation of an Artificial Intelligence (AI)-powered mobile assistant aimed at enhancing precision cinnamon farming through the integration of real-time weather forecasts and soil condition data. The system was developed using the Flutter framework with Firebase backend services, incorporating RESTful Application Programming Interface (API)s for weather and soil data integration, while TensorFlow Lite enables on-device AI inference to ensure low-latency recommendations. Random Forest is used for predictive analytics, providing personalized, location-specific recommendations on irrigation scheduling, fertilization, plantation planning, and pest management. The assistant also supports multilingual interactions in Sinhala and Tamil, improving accessibility for rural farmers. Data were sourced from the Sri Lankan Department of Agriculture, meteorological services, public weather APIs, and scientific literature, complemented by field surveys and controlled experiments across three cinnamon cultivation sites over 6 months. The evaluation involved 20 AI-assisted farmers and a control group of 20 farmers following traditional practices. Field trials showed significant improvements: crop yields increased by 8-12%, water usage decreased by 15%, fertilizer usage reduced by 10%, and pesticide use lowered by 7% without compromising productivity. Over 80% of participants reported high satisfaction, citing usability and multilingual support as key enablers. This solution addresses gaps in existing agricultural platforms by delivering real-time, localized decision support tailored to the cinnamon sector. Future enhancements will integrate pest detection, disease prediction, and broader regional deployment, contributing to climate-resilient, sustainable, and data-driven agriculture in Sri Lanka.

Keywords: mobile assistant, precision agriculture, Cinnamon, real-time data, sustainable farming practices

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INTRODUCTION

Ceylon cinnamon (*Cinnamomum verum*) is not only a globally renowned agricultural product but also deeply rooted in the cultural and economic identity of Sri Lanka, particularly in the Southern Province. Despite its significance, farmers face numerous challenges such as climate unpredictability, declining soil health, and limited access to real-time, localized agricultural data (Pulasinghe et al., 2023; Lakshan et al., 2023). Many still rely on traditional practices, resulting in sub-optimal farming decisions.

To address these issues, this study proposes the development of an Artificial Intelligence (AI)-powered mobile assistant designed for cinnamon farmers in Southern Sri Lanka. By integrating real-time weather forecasts and soil condition data, the system provides personalized, actionable recommendations to promote precision agriculture, improve crop yields, and ensure sustainable resource use. The assistant also emphasizes accessibility by supporting Sinhala and Tamil language interactions, which are more common languages among Sri Lankan people.

The study aims to design, develop, and evaluate an intelligent mobile assistant that empowers farmers with data-driven, localized decision-making tools to enhance productivity and sustainability in cinnamon cultivation**.**

METHODOLOGY

This study employs a design science and applied experimental methodology. The mobile assistant was developed using the Flutter framework to ensure cross-platform compatibility, with Firebase functioning as the backend to manage real-time data storage, authentication, and cloud synchronization. To deliver low-latency predictive analytics, TensorFlow Lite was integrated, enabling on-device AI inference even in areas with limited connectivity. The system utilizes RESTful Application Programming Interfaces (APIs) to retrieve real-time weather data from publicly available sources, while soil condition inputs are incorporated through manual data entry. It offers personalized recommendations for critical agricultural tasks, including irrigation scheduling, fertilization planning, plantation management, and pest control, by combining historical datasets with real-time weather forecasts to enhance decision-making. To improve accessibility for rural

farmers, the assistant features a multilingual chatbot interface supporting Sinhala and Tamil.

Data for this study were collected from multiple sources to ensure the system's relevance, accuracy, and effectiveness. Agricultural and environmental data of the past 10 years (Full maturity, where the tree produces maximum quality bark, is around 7-10 years), including historical crop records, best practices, weather parameters (rainfall, temperature, humidity, wind speed and solar irradiance), and soil profiles, were obtained from Sri Lanka's Department of Agriculture, meteorological services, and combining publicly available weather API(Google) data with relevant scientific literature (Soussi et al., 2024; Sharma et al., 2023). To better understand farmers' current practices, technological literacy, and usability preferences, surveys were administered to cinnamon farmers in the Southern Province. Additionally, system logs were used to record user interactions with the assistant, providing valuable insights into usage patterns and the effectiveness of the recommendations. Furthermore, controlled field experiments were conducted over 6 months (including a harvesting cycle, which is 2-3 times per year) across three cinnamon cultivation sites in Southern Sri Lanka, involving 20 farmers using the mobile assistant and a control group of 20 farmers following traditional farming methods. The results, including crop yield, resource utilization, and decision-making behaviors, were analyzed using paired-sample t-tests and ANOVA to evaluate the statistical significance and impact of the proposed solution (Figure 1).

The AI-powered assistant offers a range of features designed to support precision cinnamon farming through accessible, real-time guidance. It provides location-specific recommendations by integrating weather API data and soil condition inputs, ensuring that farmers receive timely, relevant advice based on their unique environmental conditions. The system delivers personalized guidance for essential agricultural tasks such as irrigation, fertilization, and plantation scheduling, helping farmers make informed decisions. It also supports soil monitoring, allowing users to manually input soil data or connect integrated sensors for real-time analysis (Ranade et al., 2023). Additionally, the assistant maintains a record of the farmer’s agricultural history and presents this information through easy-to-understand visual reports, enhancing long-term decision-making. To ensure accessibility, especially in rural areas, the chatbot offers multilingual interaction in both Sinhala and Tamil. The entire system has been designed with a strong emphasis on data privacy, security, and user-friendly functionality, making it suitable for use by smallholder farmers with varying levels of digital literacy.

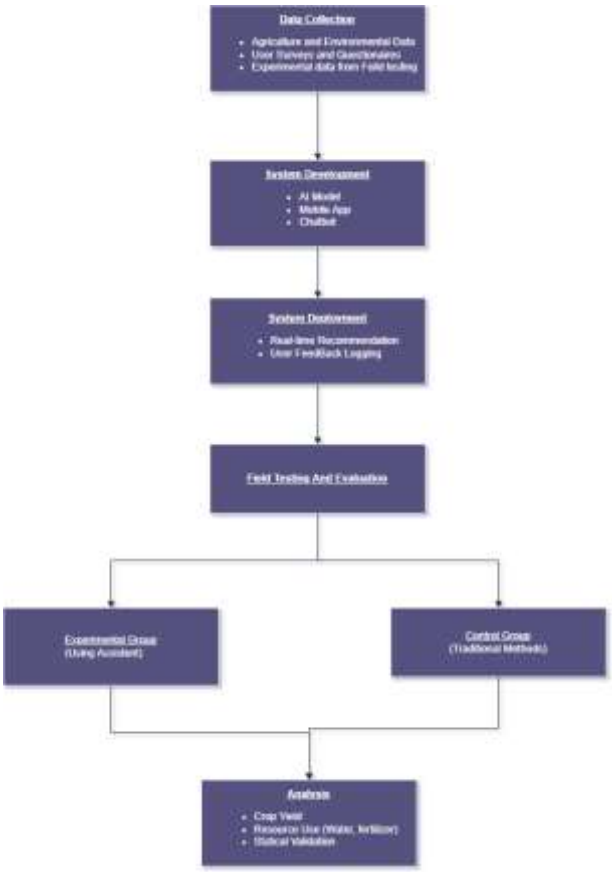

Figure 1. Methodology Workflow of AI-powered Assistant for Cinnamon Farming

RESULTS AND DISCUSSION

Preliminary field trials demonstrated that farmers using the AI-powered agricultural assistant experienced notable improvements in their farming practices across multiple parameters. The most significant impact was observed in decision-making, particularly regarding irrigation scheduling and fertilizer application, as the system provided real-time, location-specific environmental data to guide their actions. Consequently, these farmers achieved an average crop yield increase of 8–12% compared to the control group, a difference confirmed to be statistically significant according to paired-sample t-tests ($p < 0.05$).

In addition to yield improvement, the assistant enhanced resource efficiency by enabling optimized irrigation and fertilizer usage, resulting in an average water consumption reduction of 15% and a fertilizer input reduction of 10% without negatively impacting productivity. Furthermore, pest management decisions were improved through alerts, helping reduce pesticide use by approximately 7%.

User satisfaction levels were also remarkably high, with over 80% of participants rating the system as easy to use. The integration of local language support (Sinhala) proved important for enhancing accessibility among rural farmers, particularly in regions with limited exposure to English-based digital tools (Table 1).

Table 1: Parameter analysis of the field test of the AI assistant

Parameter	Control Group	AI-Assisted Farmers	Improvement (%)
Average Crop Yield	100%	108 - 112%	+8 - 12%
Water Usage	100%	85%	−15%
Fertilizer Usage	100%	90%	−10%
Pesticide Usage	100%	93%	−7%
User Satisfaction (Ease of Use)	-	80% positive responses	-

These findings align with prior studies emphasizing the value of AI-driven, localized agricultural solutions (Linaza et al., 2021; Jain, 2025). Additionally, the developed system addresses gaps in existing platforms such as AgroX, which focuses primarily on cinnamon grading but lacks real-time decision support (Pulasinghe et al., 2023), and global platforms like Farmonaut, which lack local language integration and context-specific features (Farmonaut, 2025).

CONCLUSIONS/RECOMMENDATIONS

The AI-powered mobile assistant significantly enhances cinnamon farming by integrating real-time environmental data into personalized, accessible decision support. The system improves yields, resource efficiency, and overall farming resilience.

Future work will focus on enhancing the capabilities of the AI-powered assistant to further support cinnamon farmers in Sri Lanka. Planned developments include the integration of pest detection and disease prediction functionalities, building on existing approaches such as those demonstrated by the SenzAgro platform (SenzAgro, 2023). In addition, broader deployment of the system across multiple regions is proposed to assess its scalability, adaptability, and overall impact in diverse agricultural contexts. Continuous system refinement will also be prioritized, using user feedback and ongoing AI model optimization to improve accuracy, usability, and relevance. Collectively, these advancements have the potential to revolutionize Sri Lanka's cinnamon industry by promoting climate-resilient, data-driven, and sustainable agricultural practices

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