IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

AgriSaarthi – The Intelligent Agriculture Helper

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Abstract: *Agriculture remains the backbone of the economy, yet farmers often face significant challenges due to the digital divide, lack of direct market access and inefficient waste management. This project introduces AgriSaarthi – The Intelligent Agriculture Helper, an integrated mobile application designed to empower the farming community through technology. Developed using Java and XML for a robust native Android experience and backed by Firebase for real-time data synchronization, the platform provides a multifaceted solution to modern agricultural problems. The system features three core modules: an AI-driven Multilingual Chatbot to assist users with low technical literacy, a Waste-to-Wealth Marketplace that allows farmers to sell crop residue to industrial buyers and an Equipment Rental Portal for affordable access to machinery. By replacing traditional intermediaries with a direct-to-user digital interface, AgriSaarthi aims to enhance farmer income, reduce the environmental impact of stubble burning and provide easy access to government schemes. The application's architecture ensures high reliability and scalability, making it a vital tool for sustainable agricultural development.*
Beyond the functional modules, AgriSaarthi focuses on creating a secure and transparent environment for agricultural transactions. By utilizing Firebase for real-time data management, the application ensures that market prices and equipment availability are updated instantaneously, preventing information asymmetry for rural users. The integration of an intelligent helper simplifies complex processes such as navigating government subsidies and verifying buyer credentials, which are often barriers for small-scale farmers. Ultimately, this digital ecosystem fosters a circular economy by transforming agricultural waste into a valuable resource, thereby improving the overall socio-economic conditions of the farming community while promoting environmental sustainability.

Keywords: AgriSaarthi, Android Application, Java, XML, Firebase, Intelligent Agriculture Helper, Waste-to-Wealth, AI Chatbot, Equipment Rental, Real-Time Data, Rural Development

I. INTRODUCTION

The agriculture sector is the backbone of the economy, yet it faces numerous hurdles, including a lack of modern technical awareness, limited market access and the recurring environmental issue of crop residue burning. Traditional methods of managing agricultural waste often lead to environmental degradation, while small-scale farmers struggle to access expensive machinery required for modern farming. AgriSaarthi – The Intelligent Agriculture Helper is designed to address these challenges by providing a comprehensive digital platform that connects farmers with industrial buyers and equipment owners. The application is built using a native Android framework with Java and XML to ensure a smooth and responsive user experience, while Firebase provides the necessary cloud infrastructure for real-time data synchronization and secure storage. By integrating an intelligent multilingual chatbot, the platform simplifies technical interactions for users with varying levels of digital literacy. This project aims to transform the agricultural landscape by creating a transparent marketplace for waste, enabling a shared economy for machinery and providing direct access to essential government information, ultimately leading to higher profitability and sustainable farming practices.

The agricultural sector serves as the primary livelihood for a vast majority of the population, yet it remains hindered by a persistent gap between traditional farming practices and modern technological advancements. Farmers frequently encounter obstacles such as fluctuating market prices, the presence of exploitative intermediaries and a lack of

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awareness regarding beneficial government initiatives. These challenges often result in low profitability and financial instability for small-scale landholders who lack the resources to optimize their operations. AgriSaarthi – The Intelligent Agriculture Helper is conceived as a comprehensive digital solution to address these systemic inefficiencies by providing a centralized platform for information and commerce.

One of the most critical environmental and economic issues in contemporary agriculture is the management of crop residue, which is often burned by farmers to clear fields quickly. This practice not only leads to severe air pollution and soil degradation but also represents a lost opportunity for additional income. The AgriSaarthi system introduces a Waste-to-Wealth Marketplace that enables farmers to list agricultural waste for sale to industrial buyers who use such materials for biofuel, paper, or packaging production. By facilitating this direct connection, the application transforms an environmental liability into a sustainable revenue stream for the farming community.

In addition to waste management, the high cost of modern agricultural machinery poses a significant barrier to productivity for marginal farmers. Purchasing equipment like tractors, harvesters, or specialized seeders is often financially unfeasible, leading to a reliance on manual labor or outdated tools. AgriSaarthi addresses this by incorporating an Equipment Rental Module, creating a shared economy where owners can lease out their idle machinery to those in need. This peer-to-peer rental system ensures that advanced technology is accessible to all farmers regardless of their capital, thereby improving overall crop yields and reducing physical labor.

The "Intelligent" component of the application is realized through the integration of an AI-driven Multilingual Chatbot designed to assist users who may have limited technical or digital literacy. Recognizing that many farmers struggle with complex application interfaces, this chatbot acts as a virtual assistant that can communicate in local languages to guide users through the platform's features. Whether a farmer needs help listing a product, understanding a new government subsidy, or checking weather-related advisories, the AI helper provides real-time, simplified responses that make digital tools more approachable and inclusive.

Ultimately, AgriSaarthi – The Intelligent Agriculture Helper aims to foster a more resilient and transparent agricultural ecosystem. By removing unnecessary middlemen and providing direct access to markets and information, the project empowers farmers to take control of their economic outcomes. The integration of waste monetization, equipment sharing and AI assistance creates a holistic support structure that promotes both financial growth and environmental stewardship. As digital adoption continues to grow in rural areas, AgriSaarthi stands as a vital tool for modernizing agriculture and ensuring a more prosperous future for the global food supply chain.

II. LITERATURE REVIEW

1. Agricultural Waste Management and Economic Potential

Research indicates that a significant portion of agricultural residue is treated as a liability rather than a resource. Existing studies highlight that the practice of stubble burning is largely driven by the lack of a structured market for agricultural waste. Literature suggests that creating a transparent, direct-to-industry marketplace can provide the financial incentive necessary to curb environmental degradation while simultaneously increasing a farmer's total revenue.

2. The Impact of the Digital Divide on Rural Farming

Several studies examine the "digital divide," noting that while smartphone penetration has increased, technical literacy remains a barrier for elderly or less-educated farmers. Literature in this domain emphasizes the need for simplified user interfaces and localized support. The integration of AI-driven conversational agents (chatbots) is a recognized solution in recent research to bridge this gap, allowing users to interact with complex databases using natural language rather than navigating traditional, often confusing, menus.

3. Shared Economy and Machinery Accessibility

The high capital expenditure required for modern farming equipment is a frequently cited obstacle in agricultural economic literature. Research into "collaborative consumption" or the shared economy reveals that peer-to-peer rental platforms can drastically reduce the cost of production for marginal farmers.

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4. Government Schemes and Information Dissemination

Literature regarding rural development highlights that many government subsidies and welfare schemes fail to reach their intended recipients due to information asymmetry. Research suggests that a centralized repository of verified information, integrated directly into a farmer's primary transactional tool, can significantly increase the uptake of these beneficial programs.

5. Role of Mobile Technology in Agri-Business

The shift from traditional agricultural practices to digital ecosystems is a major focus in recent literature. Research emphasizes that mobile applications serve as a bridge, providing farmers with the tools necessary for modern entrepreneurship. By utilizing a native Android framework with Java and XML, developers can create robust interfaces that handle the high-performance requirements of real-time inventory management, which is essential for perishable or time-sensitive agricultural products.

6. Supply Chain Optimization and Middlemen Elimination

A recurring theme in agricultural studies is the detrimental impact of excessive intermediaries on farmer income. Literature suggests that digital platforms can effectively deconstruct these traditional supply chains, allowing for a direct "Farmer-to-Industry" model.

7. Conversational AI for Inclusive Technology

Academic discussions regarding rural technology adoption often highlight user frustration with complex navigation. Studies on Natural Language Processing (NLP) integration in mobile apps show that conversational interfaces significantly lower the barrier to entry.

8. Data Security and Real-time Synchronization

The integrity of financial transactions in a marketplace depends heavily on the underlying database architecture. Research into Firebase features like Real-time Database and Cloud Firestore highlights their ability to handle concurrent users while maintaining data consistency.

9. Environmental Sustainability via Waste Valorization

Current research in environmental science supports the "valorization" of agricultural byproducts—turning waste into higher-value products. Literature confirms that when farmers are provided with a platform to sell crop residue, the incidence of open-field burning decreases.

10. Peer-to-Peer Rental Systems in Agriculture

The adoption of sharing economy models in the agricultural sector is a growing area of academic interest. Research indicates that peer-to-peer (P2P) platforms significantly reduce the idle time of expensive machinery, allowing owners to recoup their investment faster while providing affordable access to non-owners. Literature suggests that such systems are most effective when they include built-in trust mechanisms, such as user ratings and secure transaction logs, which are facilitated by the real-time capabilities of the Firebase backend.

11. Impact of Native Mobile Frameworks on User Retention

Studies comparing hybrid and native mobile applications for rural populations find that native frameworks, such as those built with Java and XML, offer superior performance and responsiveness. Research highlights that farmers operating in low-connectivity environments are more likely to retain and use applications that provide a smooth, lag-free interface.

12. Digital Transformation of the Circular Economy

The concept of the circular economy in agriculture—where waste from one process becomes the input for another—is heavily supported by modern research. Literature emphasizes that digital intermediaries like AgriSaarthi are necessary to bridge the gap between rural supply and urban industrial demand.

13. Information Architecture for Agricultural Policy

Academic reviews of agricultural extension services often point to the failure of top-down communication from governments to farmers. Research argues that integrating government scheme databases into a multi-functional application allows for a "pull" rather than "push" information model.

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No.	Paper Title	Key Contributions	Research Gaps	Proposed Solution
1	Smart Agriculture System for Waste Management	Focuses on general waste disposal methods.	No direct marketplace for industrial buyers.	Provides a direct Waste-to-Wealth marketplace for companies.
2	AI-Driven Agricultural Assistance Tools	Uses AI for crop disease detection.	No multilingual support for technical navigation.	Features a multilingual AI chatbot for user assistance.
3	Mobile-Based Agricultural Equipment Sharing	Provides a list of available equipment.	No real-time synchronization or secure booking.	Offers real-time equipment rental via Firebase cloud syncing.
4	Optimization of Rural Supply Chains	Theoretical models for reducing logistics costs.	Lacks a real-world working mobile application.	Implements a fully functional Java-based mobile platform.
5	Digital Platforms for Farmers' Information	Aggregates government schemes and news.	Static data that is hard for low-literacy users to find.	Uses an AI helper to guide users to relevant government schemes.
6	IoT-Based Soil and Crop Monitoring	Monitors environmental conditions via sensors.	Does not address the financial monetization of waste.	Enables farmers to generate revenue from crop residue.
7	Blockchain for Agricultural Transactions	Secures financial data between parties.	High technical barrier and complex user interface.	Simplified UI via XML with secure Firebase authentication.
8	Rural E-Commerce Platforms	Rural E-Commerce Platforms	Rural E-Commerce Platforms	Specifically targets the industrial sale of agricultural waste.
9	NLP Interfaces for Rural Development	General language translation tools.	Not integrated with a transactional marketplace.	Integrates NLP Chatbot directly into the buying/selling workflow.
10	Cloud-Based Farming Management Systems	Centralized management of large farm data.	Often requires high-speed, stable internet.	Designed as a PWA/Native app with offline data persistence.
11	Circular Economy in Modern Agriculture	Explores the theory of waste recycling.	No platform to connect farmers with biofuel industries.	Facilitates direct Farmer-to-Industry connections for biofuel.
12	Mobile Applications for Rural Literacy	Educational apps for learning farming techniques.	No practical economic or marketplace features.	Combines education (AI helper) with economic tools (Marketplace).
13	Peer-to-Peer Machinery Leasing Models	Localized sharing of farming tools.	No cloud-based tracking or automated listings.	Provides automated real-time listings and equipment tracking.
14	Stubble Burning Prevention Strategies	Focuses on government bans and regulations.	Offers no financial alternative for waste disposal.	Provides a financial incentive to sell waste instead of burning it.

Table1. Comparison of Existing Work and Proposed System

DOI: 10.48175/IJARSCT-35360

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III. METHODOLOGY

The development of AgriSaarthi – The Intelligent Agriculture Helper follows a structured Waterfall Model to ensure each phase of the agricultural marketplace and AI integration is thoroughly validated before proceeding. This methodology is divided into several systematic stages, ranging from initial requirement analysis to final system deployment:

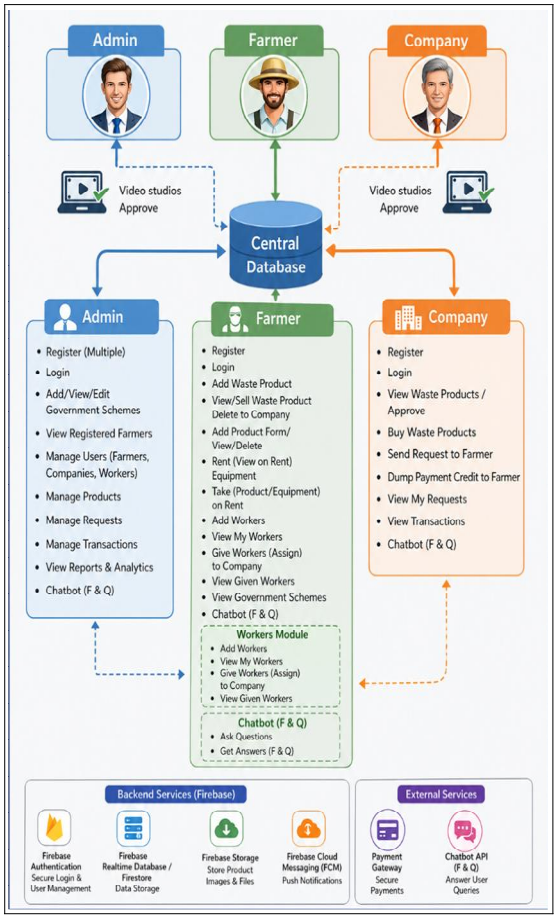

Figure1 Architecture Diagram

1. Requirement Analysis and Feasibility Study

The process began with an extensive study of the challenges faced by rural farmers, specifically focusing on the lack of market access for crop residue and the high cost of machinery. During this phase, the technical requirements for a native Android application were defined, identifying Java and XML as the primary development tools and Firebase as the cloud infrastructure. A feasibility study was conducted to ensure the proposed AI chatbot could function effectively in a multilingual rural context.

2. System Design and Architecture

In this stage, the system architecture was mapped out to handle three distinct user roles: Admin, Farmer and Company/Equipment Owner. The UI/UX was designed using XML to prioritize simplicity and ease of navigation for non-technical users. The database schema was designed in Firebase to support real-time data synchronization, ensuring that waste listings and equipment availability are updated across all devices simultaneously.

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The provided diagram illustrates the operational workflow of the **AgriSaarthi** application, specifically focusing on the interaction between users and equipment owners within a shared economy model.

User Authentication and Access

- **Registration and Login**: Both the general **User** (Farmer) and the **Equipment Owner** must register and log in through the smartphone interface.
- **OTP Verification**: The system uses a **Generate OTP** (One-Time Password) mechanism to ensure secure access and verify user identities.

Equipment Owner Workflow

- **Listing Products**: Owners can **Post Equipments& Products on Rent** by adding essential details such as the name, description, photo and amount.
- **Geospatial Tracking**: Owners include their **GPS Location**, allowing the system to map where the equipment is physically located for potential renters.
- **Request Approval**: When a user makes a request, the owner must **Approve** it, which then triggers a notification back to the user.

User (Farmer) Workflow

- **Nearby Search**: Users can **Search for Nearby Equipments**, which displays how far the items are from their current location.
- **Filtering and Sorting**: The system allows for viewing equipment in **ascending order** and filtering based on the date and time duration required.
- **Booking Parameters**: Users can book equipment for a **maximum of 5 days** and must enter specific time durations and amounts.

Application Core Functions

The smartphone interface serves as a hub for five primary actions:

- **Add Products**: For owners to list new inventory.
- **Call Driver**: Facilitates communication for transportation of equipment.
- **My Orders**: A personal dashboard to track current transactions.
- **Book**: The interface for finalizing a rental agreement.
- **View Market**: A browsing module to see all available agricultural waste or machinery.

Transaction Completion

- **Direct Communication**: Users can **Send a Message** to the owner to discuss terms or coordination.
- **Information Exchange**: Once a booking is confirmed, the system provides **Book History & Contact Details** to both parties, allowing them to coordinate the physical exchange of equipment or products.

3. Implementation and Coding

The implementation phase involved writing the core logic in Java to manage user authentication, product listing and the rental booking system. The integration of the AI-driven multilingual helper was executed using Natural Language Processing (NLP) modules to translate user queries into actionable platform commands. Frontend layouts were coded in XML to ensure responsiveness across various Android device screen sizes, while Firebase APIs were integrated to handle backend data storage and retrieval.

4. Module Integration

The application was divided into functional modules that were integrated into a single cohesive platform. The Waste-to-Wealth module was linked with the Industry module to facilitate direct transactions, while the Equipment Rental module was synchronized with the real-time database to prevent double-booking of machinery. The AI assistant was layered over these modules to provide a conversational interface for all system functions.

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5. Testing and Quality Assurance

Rigorous testing was performed to verify the reliability of the system under different network conditions. Unit testing was conducted on individual Java methods, while integration testing ensured that the Firebase database correctly reflected changes made by different users in real-time. User Acceptance Testing (UAT) focused on the multilingual capabilities of the AI chatbot to ensure it correctly interpreted agricultural terminology in local languages.

6. Deployment and Maintenance

The final stage involves deploying the application for rural use and establishing a maintenance schedule. Since the application is built on a cloud-based architecture, updates to government schemes and market prices can be pushed remotely via the Firebase console. The system is designed for scalability, allowing for the addition of new features and regions as the user base grows.

IV. RESULTS

Figure2 Login Page

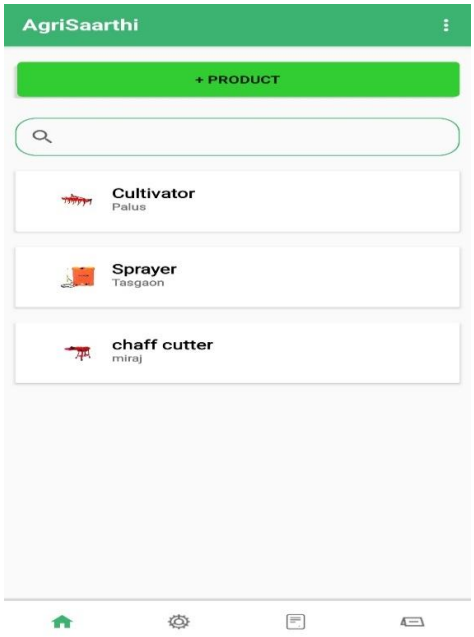

Figure3 Dashboard Page where product is listed

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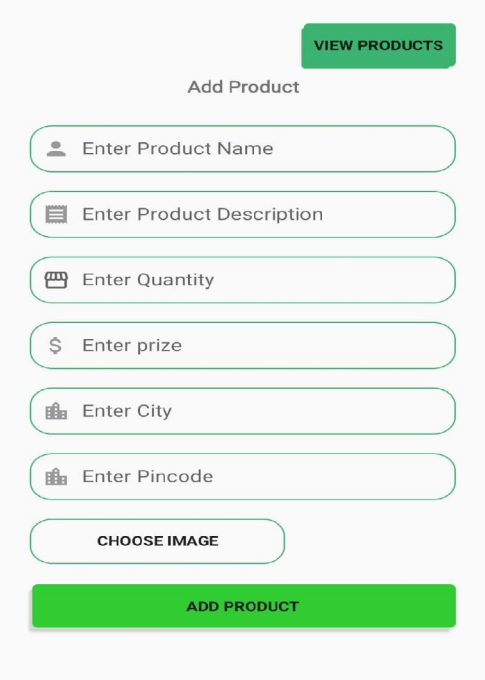

Figure 4 Add Product and Equipment

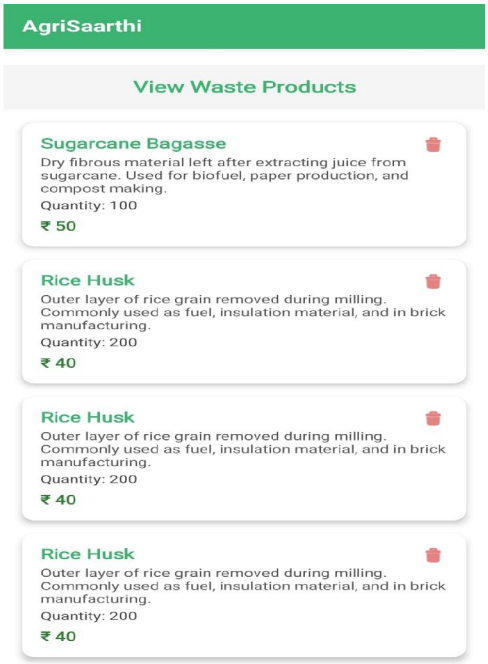

Figure 5. View Waste Products

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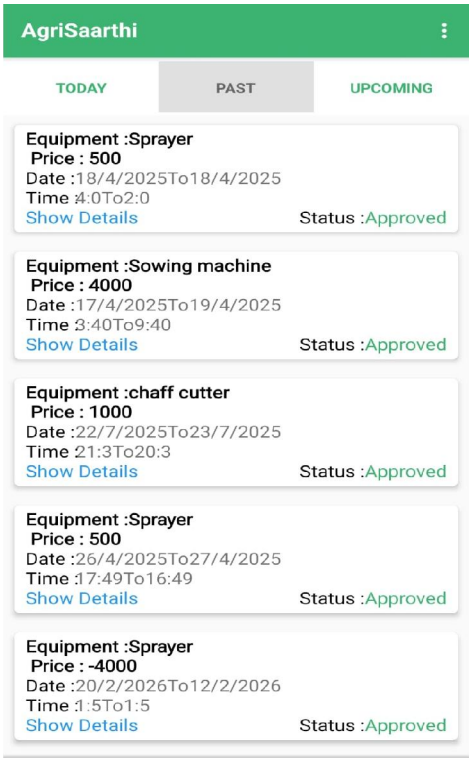

Figure 6 View Past Approved Orders

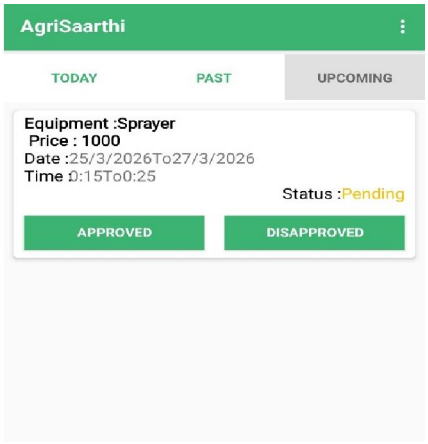

Figure 7 View Upcoming Orders

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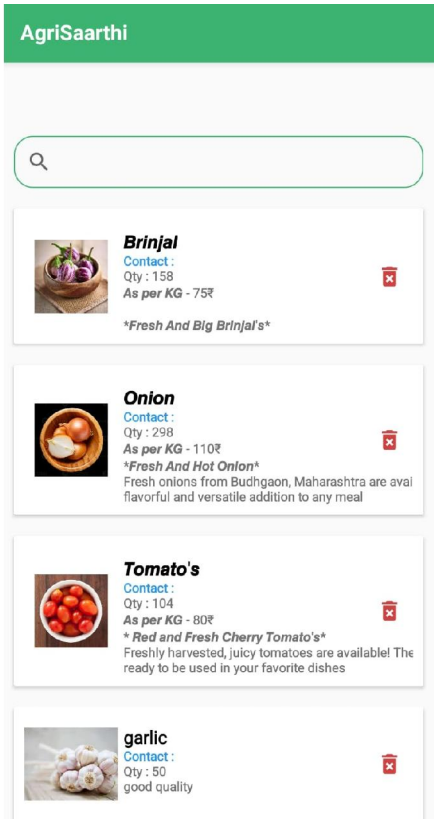

Figure 8 View Upcoming Orders

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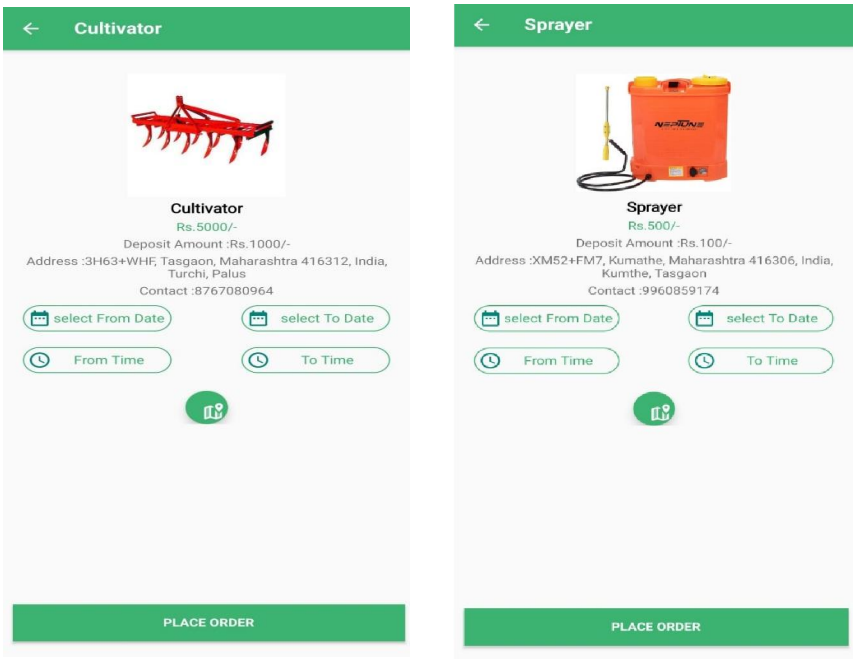

Figure 9 Book Products

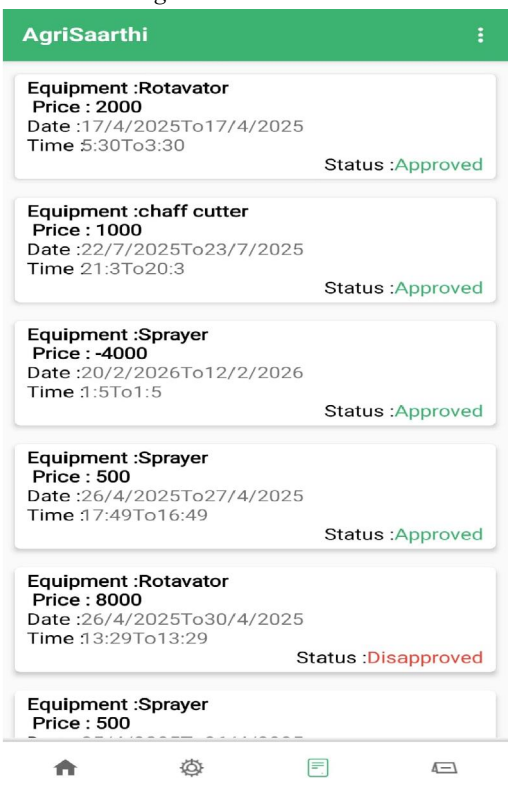

Figure 10 History

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V. CONCLUSION

The development of AgriSaarthi – The Intelligent Agriculture Helper addresses the critical need for digital transformation within the rural agricultural landscape. By successfully integrating a Waste-to-Wealth marketplace with an equipment rental system, the application provides a dual economic benefit: it enables farmers to monetize previously discarded crop residue and reduces the financial burden of purchasing expensive machinery. The utilization of a native Android framework consisting of Java and XML, supported by a real-time Firebase backend, ensures that the platform is both robust and capable of handling high-frequency data exchanges in a secure environment.

A primary achievement of this project is the removal of traditional intermediaries, allowing for direct Farmer-to-Industry and Farmer-to-Farmer transactions that maximize profit for the primary producer. Furthermore, the inclusion of an AI-driven multilingual assistant effectively bridges the digital divide, making sophisticated market tools accessible to users with varying levels of technical literacy. By offering a decentralized solution for resource sharing and waste management, AgriSaarthi not only promotes the financial stability of the farming community but also contributes significantly to environmental sustainability by providing a viable alternative to the practice of stubble burning.

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