FARMING AND POVERTY ALLEVIATION SYSTEM

ZHANG DIMING

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ABSTRACT

This project develops an Agricultural Poverty Alleviation System designed to help rural farmers overcome challenges such as limited market access, lack of agricultural knowledge, and poor pricing strategies. The main objective is to increase farmers' income and promote sustainable farming through a smart platform that integrates e-commerce, agricultural guidance, and digital services. The system is developed using Node.js and Express.js for the backend, Vue 3 for the frontend, MongoDB as the database, and Python for crop data analysis and price forecasting, while ECharts is used for visualizing sales and trend patterns. Key modules include user authentication, product management, crop recommendation, comment filtering, price prediction, real-time chat, and a monitoring feature for detecting abnormal behaviours or errors in communication. Testing was conducted through functional validation and user acceptance testing to ensure system reliability. This project contributes to rural development by empowering farmers with intelligent tools, encouraging data-driven decisions, enhancing agricultural productivity, and creating a more connected digital farming ecosystem

1 INTRODUCTION

Due to the rapid development of global science and technology, most people's life quality and economic conditions are advancing. While the problem of the digital divide caused by differences in Internet access and use has become more and more prominent, rural populations have become ever more on the line. Rural people are moving to cities in search of paying manufacturing and service jobs. The rapid urbanization has led to decreasing rural population (Wen Xingqi et al., 2023).

The decline in rural populations has led to several critical challenges. Rural areas have been experiencing an economic decline as the younger generation leaves for city jobs, leading to the deterioration of local markets and services. Rural farmers: With fewer hands to work the land, older farmers struggle to grow and harvest crops, intensifying food security problems and dislocating systems of food production. Roads become harder to maintain, transportation costs increase, and access to markets is severely limited, leaving farmers unable to sell their produce effectively. Social disruption: Rural population decline erodes family and community ties, and reinforces downward cycles of poverty, while social cohesion declines.

These trends tend to put rural farmers on the island, feeling isolated and not having a way out of the cycle of poverty. The lack of economic activity in rural regions further increases the rural urban divide and creates long term social economic contribution. These struggles are well known, and thus this project proposes an online economic platform to empower and encourage rural farmers in their sustainable agricultural practices. Big data analysis and artificial intelligence technology are used on the platform to solve these problems. It will provide tools to Directly connect farmers to bigger markets, decreasing dependence on middlemen and decreasing transaction costs, provide custom planting advice and market prediction for farmers to make extra informed decisions and to enhance the manufacturing Create new chance for rural farmers to promote to new larger markets and to boost their revenue potential.

As China continues to promote the integrated development of urban and rural areas and financial digital transformation, digital finance, as one of the five chapters of the financial industry to accelerate the formation of new quality productivity, has become an increasingly hot issue to narrow the gap between urban and rural development and help urban-rural integrated development (Yuan Wu & Wenli Zhu, 2024).

The primary goal of this project is to improve the income rate for rural inhabitants and stabilize the economy of agricultural community by integrating e-commerce with data driven solutions. On top of tackling the systemic issues, it seeks to restore prosperity and cohesion to regions so vital.

2 PROBLEM STATEMNT

Based on interviews with farmers, summarized in appendix 1. Rural areas are often remote, requiring farmers to spend significant time and effort transporting large amounts of agricultural products to markets. For instance, in the Uttar Pradesh region of India, farmers often travel three to four hours to reach the nearest marketplace. However, due to limited demand, they are frequently unable to sell all their product and must transport the remaining products back home. This not only increases transportation costs but also results in higher post- harvest losses, as reported by the Indian Council of Agricultural Research (ICAR, 2019).

One of the major problems in agricultural commodity trade is asymmetry of information – the trade cannot get real time market information .Where about subsidiary prices and demand. Due to lack of knowledge, many farmers are not sure as to where and when their products would find the best market. For example, a study revealed that 70% of smallholder farmers in sub-Saharan Africa lacked access to digital tools or platforms that could provide up-to-date market data, leaving them dependent on middlemen who often exploit their ignorance by under-pricing products（FAO, 2015）. This makes it difficult for farmers to sell their product effectively, resulting in financial losses.

Market volatility is another significant barrier to agricultural sales. With the rise of globalization and open markets, price fluctuations have become more unpredictable making it harder for farmers to plan their sales. For instance, during the COVID-19 pandemic, the sudden drop in demand for fresh product in urban markets forced many farmers in Southeast Asia to sell at a loss or let their crops rot in the fields (OECD, 2020). Without reliable tools to predict demand or determine the best time to sell, farmers are often forced to sell during periods of low prices, which significantly affects their income. Agricultural cooperatives like Amul in India or small-scale farmer groups in Kenya; government programs like India's National Rural Livelihood Mission (NRLM); and non-governmental organizations like Ox Farm or heifer International, which help rural farmers by building skills and providing access to markets.

3 OBJECTIVES OF THE STUDY

In this project, important challenges for farmers will be tackled by identifying problems in the distribution system of agricultural products, building up user friendly e commerce solutions and testing users to assess its usefulness and accessibility. The specific objectives are:

4 RESEARCH METHOD

The Farming and Poverty Alleviation System was developed using the Agile Model, which emphasizes iterative development, continuous feedback, and close collaboration with end-users. By adopting Agile principles, the system was built and refined through multiple development cycles, allowing flexibility to respond to user needs and evolving requirements at each stage. This approach enabled the team to continuously test, improve, and deliver key features that directly address rural farming challenges—such as inefficient resource distribution, limited market access, and lack of real-time agricultural data. Through each sprint, functions like data visualization, product listing, and market analysis were gradually enhanced based on stakeholder input. The system now provides personalized insights on farming techniques, market trends, and subsidies, while integrating with government platforms to support data sharing and informed decision-making. Its scalability and adaptability promote long-term agricultural growth, poverty reduction, and alignment with sustainable development goals.

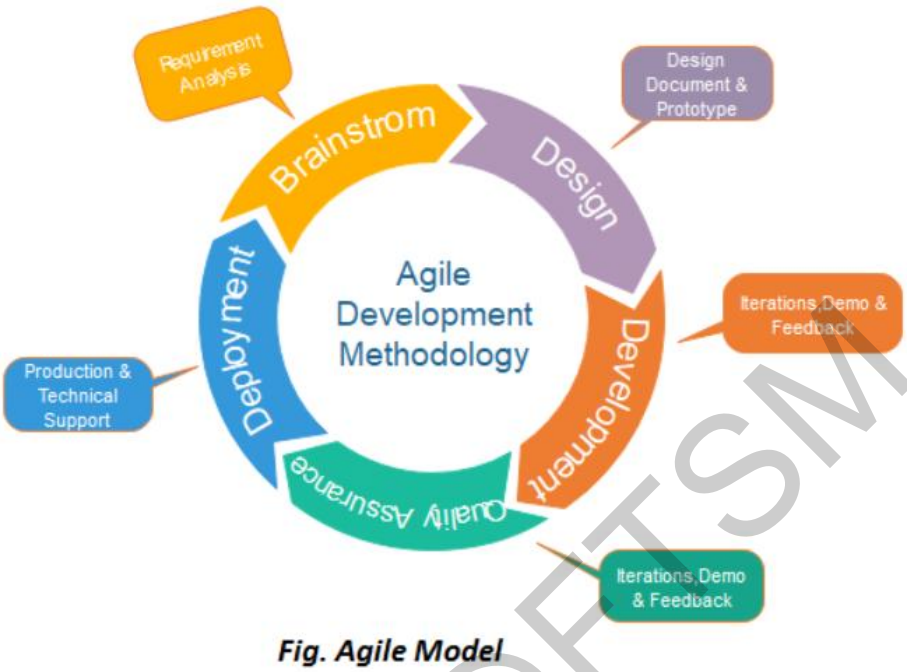


Figure 1 Agile Process Model

4.1 Planning phase

This phase is a critical part of the system development process, especially within the context of the Agile model, where continuous analysis and refinement occur throughout iterative cycles. In alignment with the problem statement, this phase focuses on identifying the core challenges faced by rural farmers—such as limited market access, inefficient data management, and lack of real-time insights—and translating them into actionable development goals. It provides a clear overview of the system's intended functionality and its role in solving real-world agricultural issues. During this phase, the objectives, user needs, and technical constraints of the Farming and Poverty Alleviation System are defined, while potential solutions are proposed and validated collaboratively with stakeholders. This lays the foundation for subsequent Agile sprints, ensuring each iteration moves closer to delivering a system that is both practical and impactful.

4.2 Analysis Phase

This phase focuses on analyzing the system requirements based on the challenges identified in the agricultural context. Both functional and non-functional requirements are gathered to guide

the design of the system architecture in future development iterations. Under the Agile model, requirements are refined progressively, incorporating continuous feedback from stakeholders such as farmers, buyers, and administrators. Additionally, a review of existing agricultural platforms was conducted to better understand industry standards and common functionalities. Observations from relevant systems provided insights into features like product listing, real-time pricing, and market trend analysis, which helped inform the design direction of the Farming and Poverty Alleviation System. This requirements analysis ensures that the system is aligned with user needs and is adaptable throughout the development process.

4.3 Design Phase

This phase focuses on designing the overall system architecture of the Farming and Poverty Alleviation System, ensuring that the structure supports the system's goals and responds effectively to the identified challenges. The functional flow—from user login and product management to market data analysis and transaction processing—is carefully mapped out to support smooth and logical user interactions. Under the Agile model, the design is continuously reviewed and refined throughout development sprints, allowing improvements based on real-time feedback. Special attention is given to ensuring that the user interface is clear, accessible, and well-suited for rural users, including those with limited digital experience. The design aims to balance functionality with simplicity, helping the system meet its objectives of improving agricultural efficiency, market access, and data-driven decision-making.

4.4 Implementation Phase

This phase focuses on the development and integration of all system modules within the Farming and Poverty Alleviation System. Under the Agile model, individual components—such as user authentication, product listing, market insights, and data visualization—are developed in iterative sprints and continuously tested for functionality. These smaller modules are then gradually integrated into a fully functioning platform that aligns with the project's goals of improving rural market access and agricultural data management. This phase also plays a critical

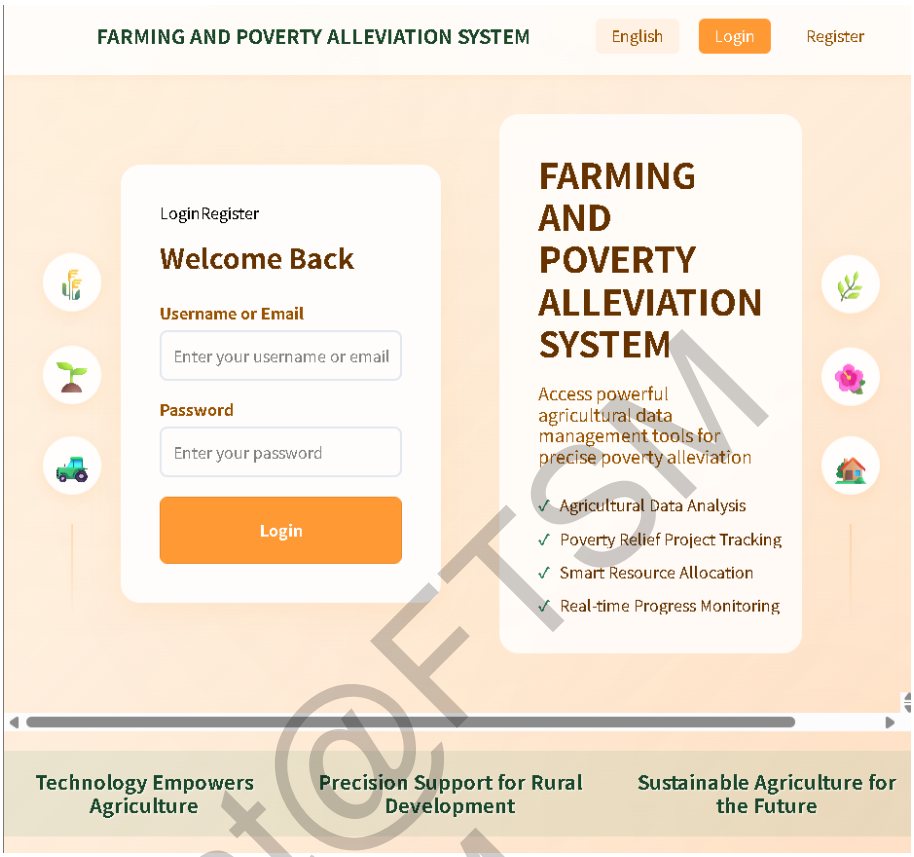
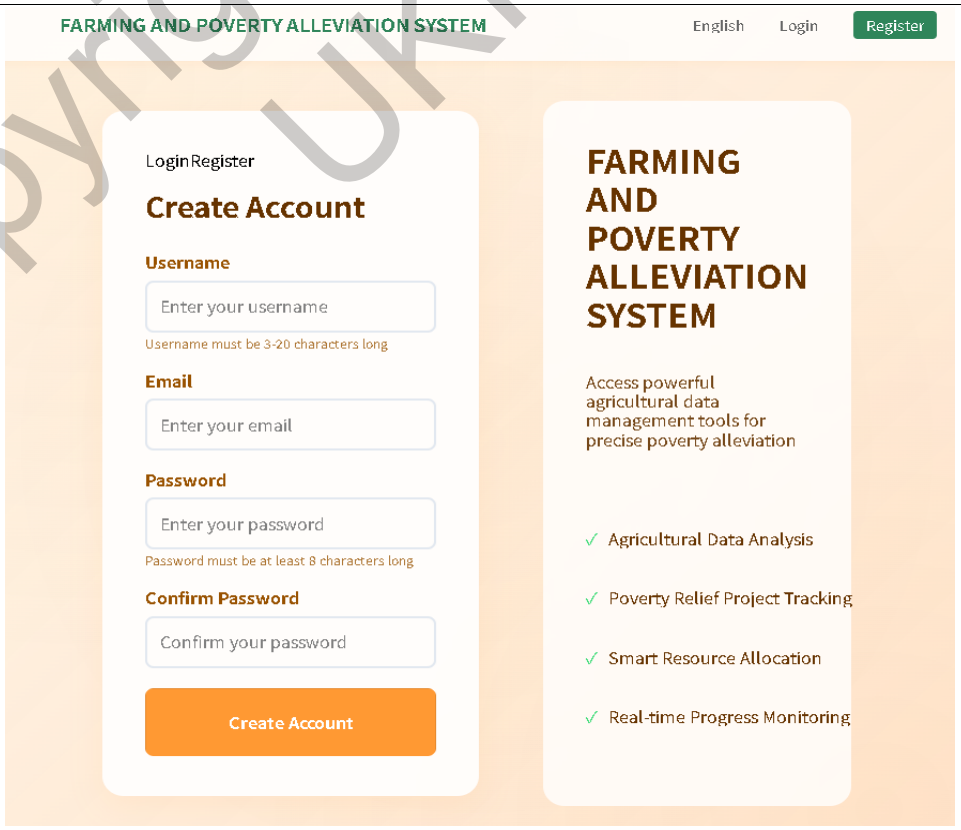
role in identifying potential weaknesses and performance issues during real-world execution, enabling the development team to apply timely refinements based on ongoing testing and user feedback.

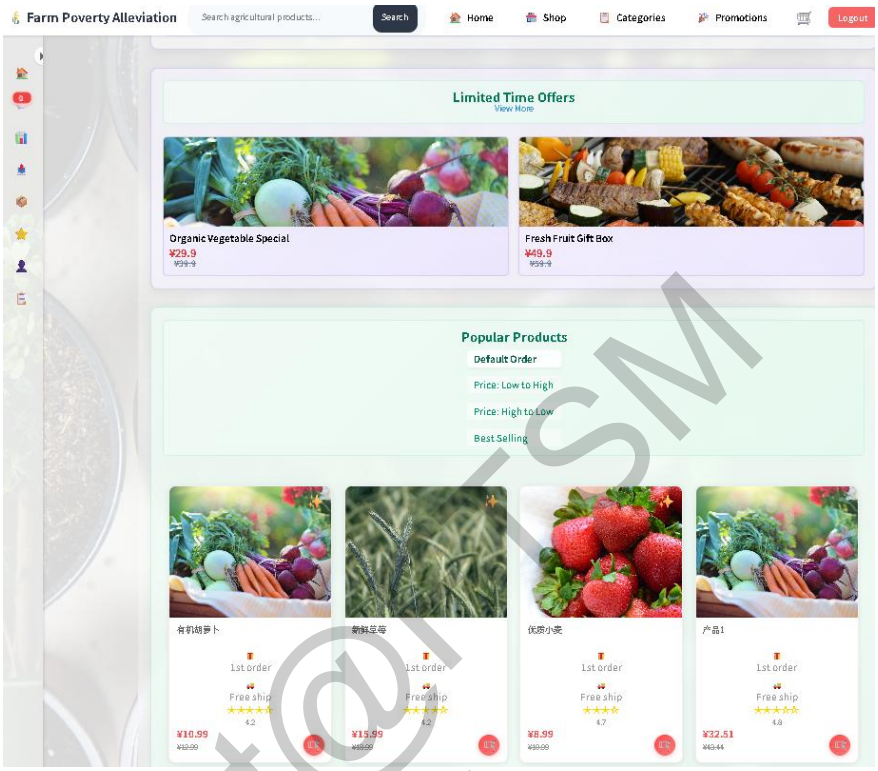
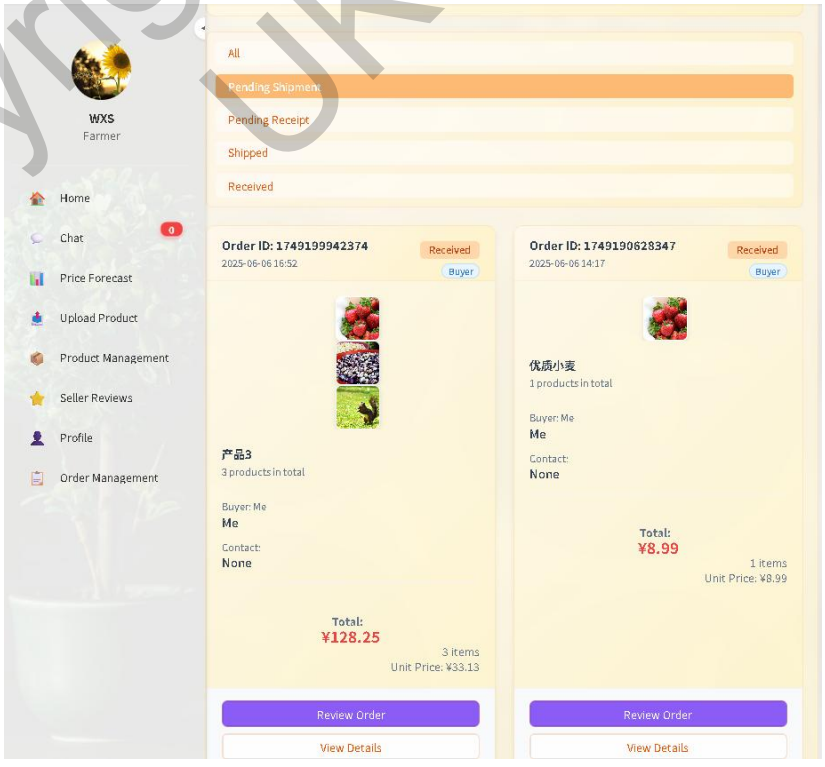
4.5 Testing Phase

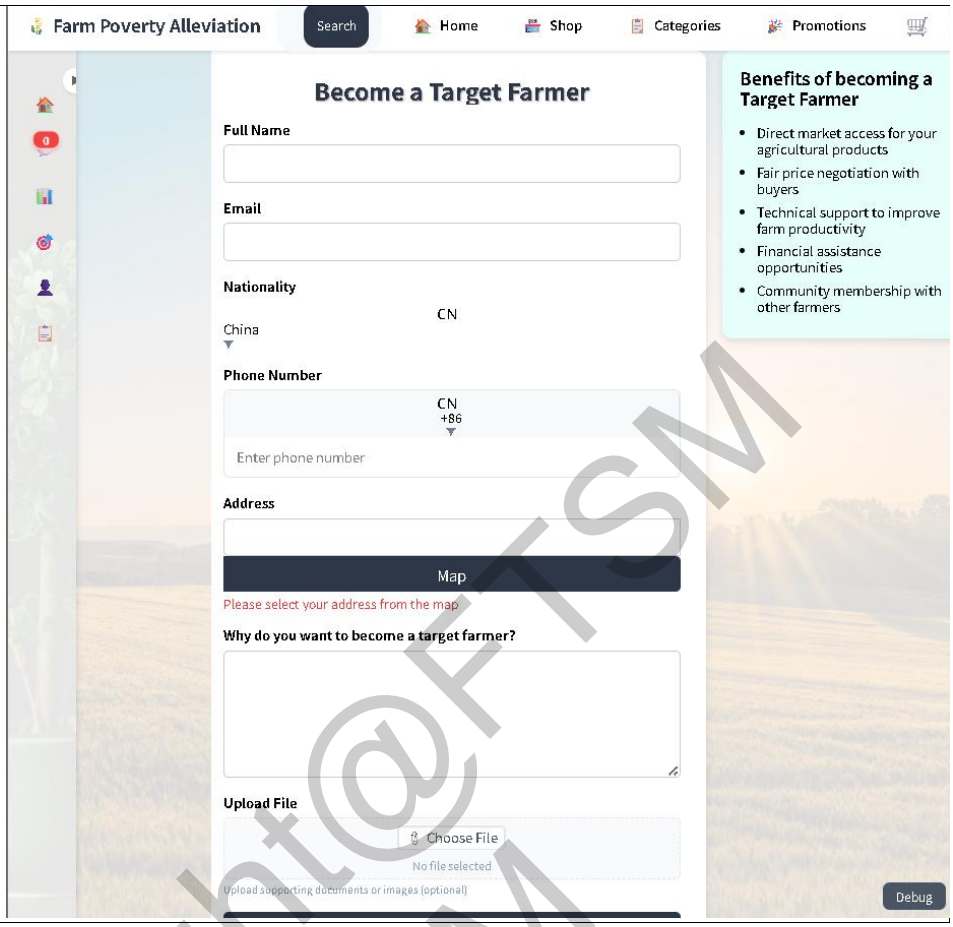
The Farming and Poverty Alleviation System will undergo comprehensive testing to evaluate whether it meets its intended objectives. The system will be tested by users from various backgrounds, including lecturers and students at FTSM, to assess its overall effectiveness and practical usability. In line with the Agile model, feedback gathered during testing will guide further refinements in future iterations. Additionally, a user survey will be conducted to evaluate the user-friendliness, accessibility, and satisfaction level of the system, particularly among non-technical users such as rural farmers. This phase ensures that the system is not only functional, but also intuitive and impactful for its target audience.

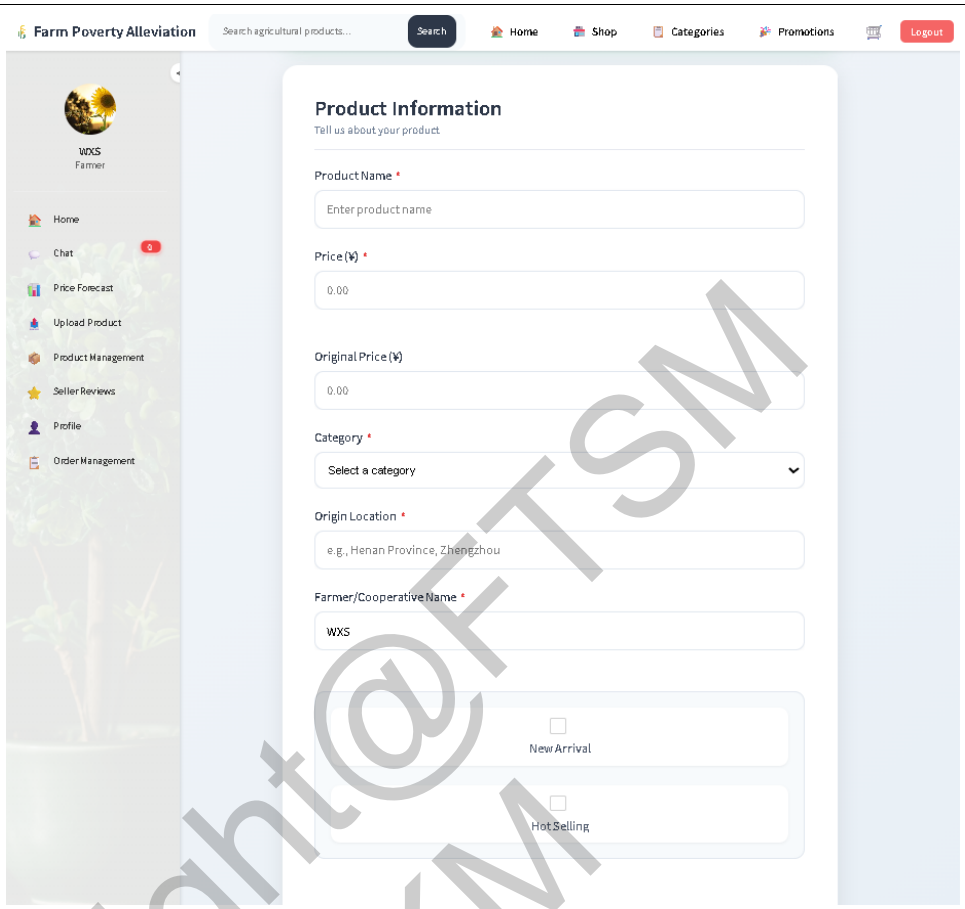
5 RESEARCH RESULTS

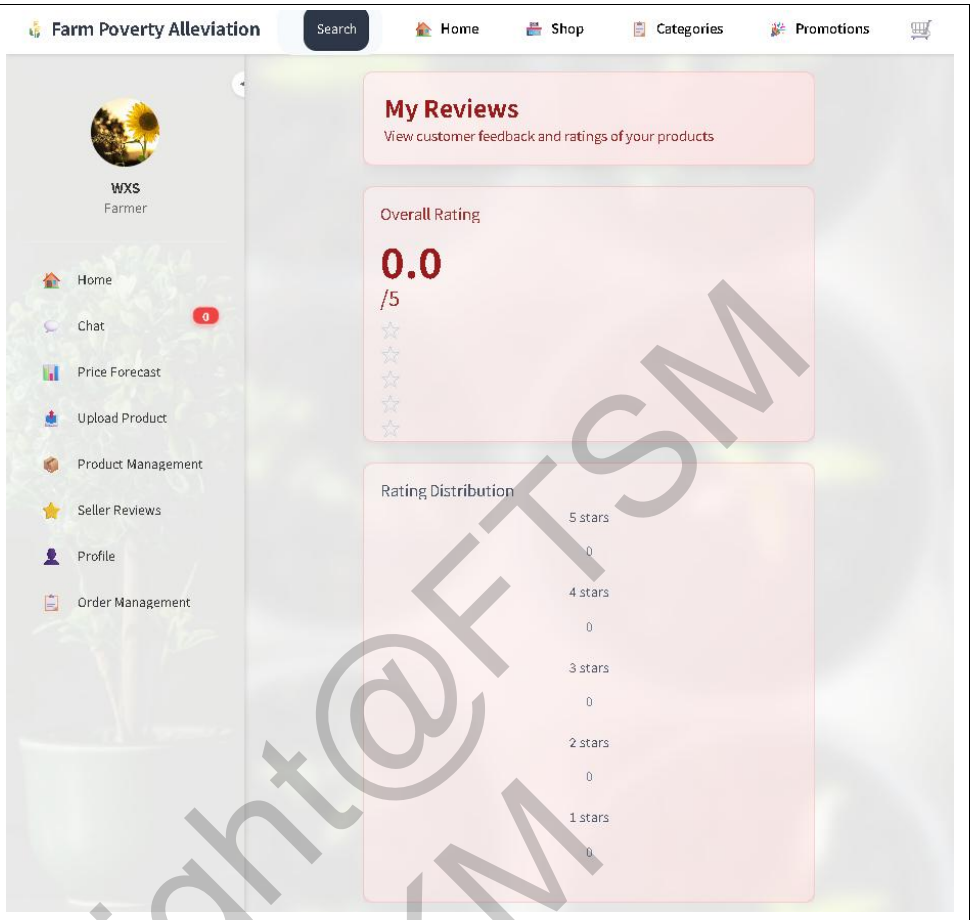
This system aims to develop an agricultural e-commerce and data visualization management platform based on cloud computing services to address the challenges of inefficient data management and lack of real-time market analysis in the agricultural industry. The frontend of the system is developed using Vue.js, while the backend is implemented using Java and Python. Leveraging cloud technology, the system enables real-time processing and access to agricultural data. In addition, it integrates visualization tools such as Chart.js, allowing users (including farmers, buyers, and administrators) to intuitively monitor market dynamics, sales trends, and product price fluctuations. The platform also supports online product listing and management, historical sales tracking, and automated generation of market analysis reports, thereby improving the overall operational efficiency of the agricultural sector.

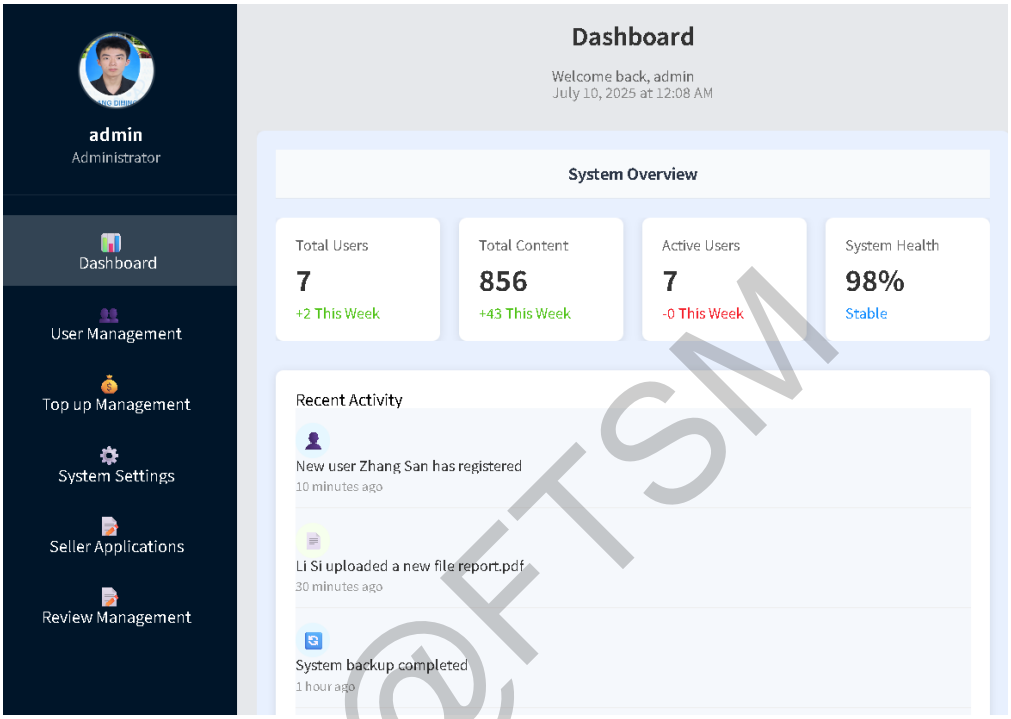
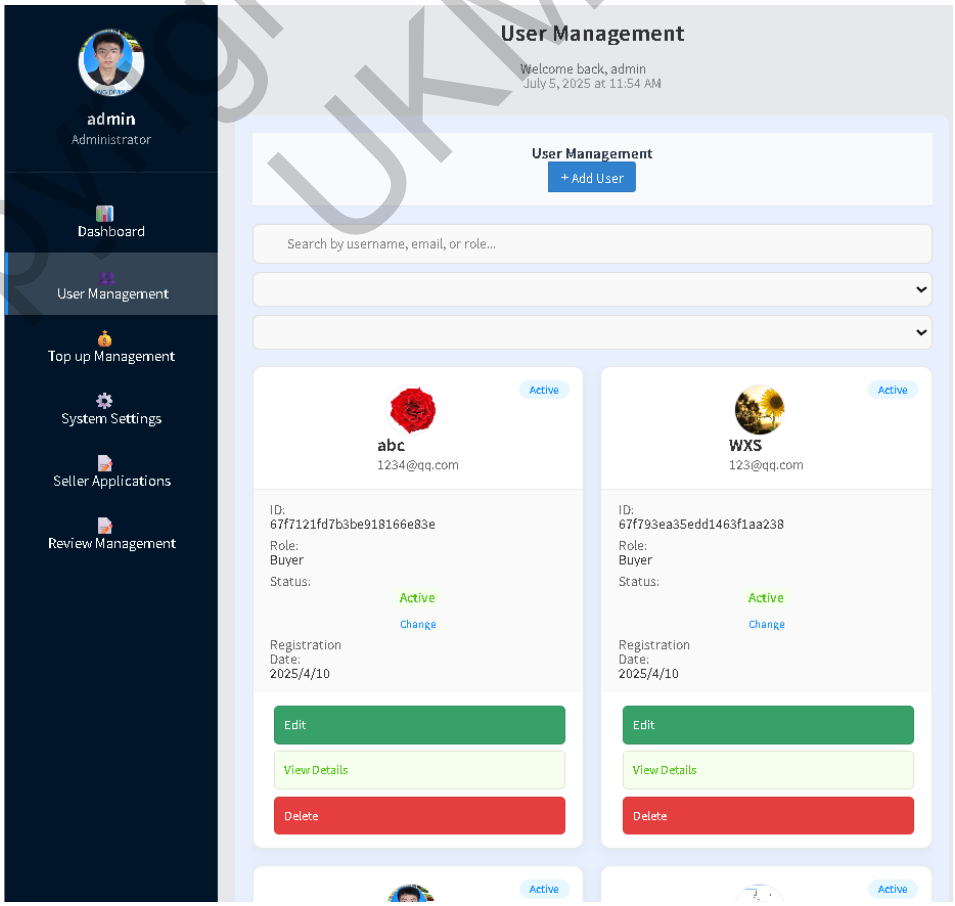
Login page This is the login page of the Farming and Poverty Alleviation System. Users can log in with their email and password to access features such as agricultural data analysis, poverty relief project tracking, smart resource allocation, and real-time progress monitoring. The interface is clean and user-friendly for daily management tasks.	
Register page Users can create a new account by entering their username, email, and password. Once registered, they can access key features such as data analysis, project tracking, and resource monitoring to support effective poverty alleviation efforts.	

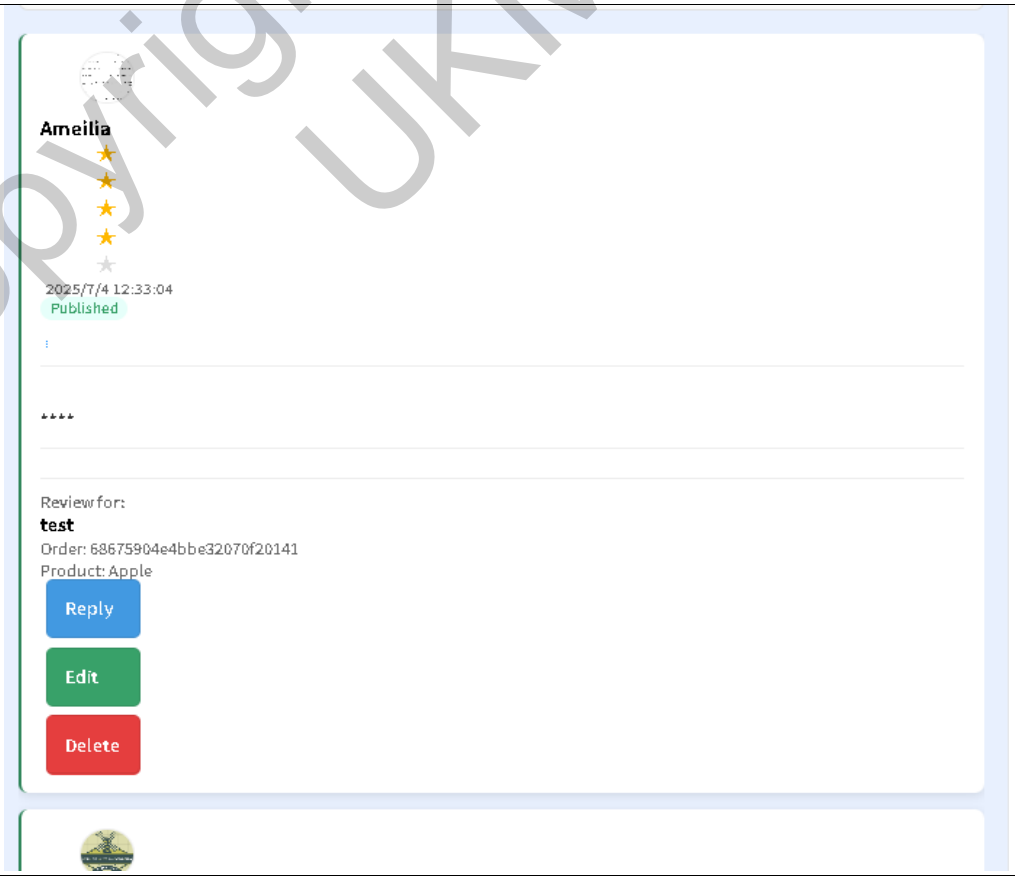
PRODUCT MARKETPLACE Users can browse and purchase a variety of agricultural products, view price trends, and sort items by price or popularity to support rural farmers and promote sustainable consumption.	
ORDER MANAGEMENT Users can track their order status, confirm receipt, and view detailed order information to manage purchases efficiently and transparently.	

TARGET FARMER APPLICATION Farmers can submit personal and location details to apply for Target Farmer status, which provides benefits such as direct market access, technical and financial support, and community resources.	

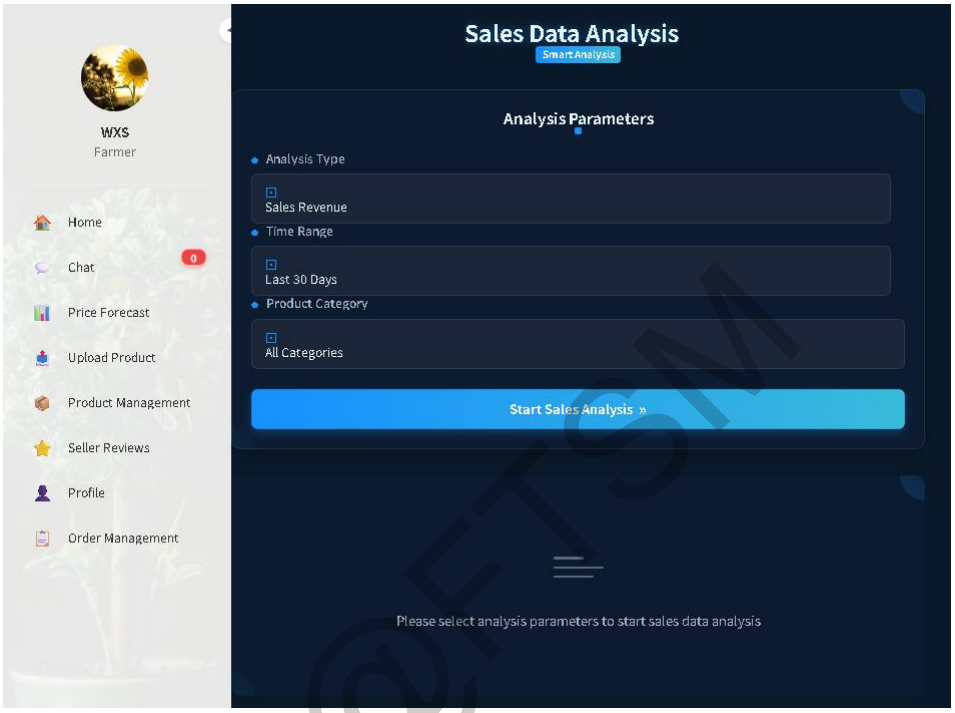
UPLOAD PRODUCT PAGE Farmers can submit product details including name, price, category, and location to list their agricultural goods for sale on the platform, gaining wider market reach and direct access to buyers.	

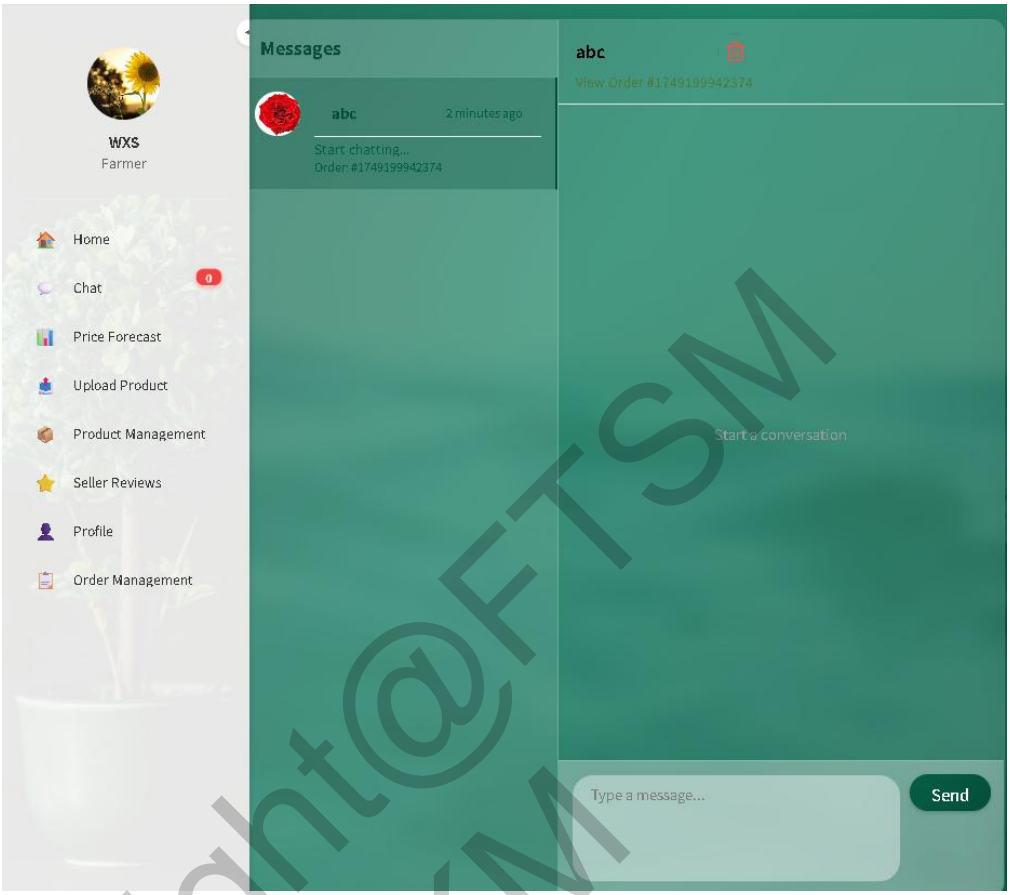
SELLER REVIEWS PAGE Farmers can view customer feedback, overall product ratings, and the distribution of star ratings to understand performance and improve product quality.	

ADMIN DASHBOARD It provides an overview of system activity, including total content, user statistics, and system health, along with a log of recent actions for efficient platform monitoring and management.	
USER MANAGEMENT Admins can view, edit, and manage all user accounts, including their roles, statuses, and registration details, with the ability to add or remove users as needed.	

SELLER APPLICATION Admins can review seller application details, verify supporting documents, and approve or reject applications based on eligibility and completeness	
REVIEW MANAGEMENT Admins can monitor product reviews, filter by status or rating, and take action such as editing, hiding, or deleting inappropriate or abusive content to ensure a healthy platform environment.	

DATA ANALYSIS This is the *Data Analysis Centre* of the Farm Poverty Alleviation system. It provides real-time monitoring and visual analysis of agricultural product sales, system performance, and poverty alleviation impact. Key features include transaction volume tracking, decision-making support, and system stability metrics.	

Sales Data Analysis This dashboard displays sales data, including total sales, order count, average order value, and sales trends for the Farm Poverty Alleviation platform.	
Agricultural Product Price Intelligent Analysis This dashboard provides intelligent analysis of agricultural product prices, showing key metrics such as average, highest, and lowest prices, along with current trend status. It includes visual charts for price trends, category distribution, and regional comparisons to support data-driven decision-making.	

MESSAGE CENTRE Buyers and sellers can communicate directly regarding orders, ensuring faster responses, better support, and smoother transactions.	

5.1 Application Development

The development of the Farming and Poverty Alleviation System (FPAS) was implemented using Node.js for backend services, Vue.js for the frontend interface, and Python with Express for data processing and API management. The system was designed as a comprehensive e-commerce and data-driven platform to enhance agricultural trade, market access, and farmer engagement. The Model-View-Controller (MVC) architectural pattern was adopted to ensure modularity and smooth interaction between the logic, data, and user interface layers.

During the design phase, the platform's interface was built with Vue components, featuring modules such as the Login Page, Marketplace Dashboard, Product Management Page, Real-Time Market Insights, and Sales Analytics Dashboard. Each interface was optimized to ensure intuitive navigation and user-friendly interaction.

The data layer manages core information, including product listings, transaction records, user profiles, and market trends, with seamless database integration. Backend business logic (such as product filtering, pricing updates, and data analysis) was implemented in Java and Python, while interactive components and real-time data visualization were handled using Vue.js and RESTful APIs.

5.2 Key Modules

Several core modules were developed and integrated to complete the Farming and Poverty Alleviation System (FPAS):

- Login and Registration Module: Allows farmers, buyers, and administrators to create and access accounts with role-based functionalities, incorporating validation for duplicate accounts and password rules.
- Marketplace and Navigation Dashboard: Provides users with intuitive navigation, product browsing, and access to tutorials on listing products or making purchases.
- Product Management Module: Enables farmers to upload and manage agricultural products, including price, quantity, and delivery details, while buyers can view and purchase items directly.
- Real-Time Market Insights: Displays current market prices, demand trends, and predictive analytics to help farmers make informed decisions about sales timing and pricing.
- Sales Tracking and Analytics Module: Offers performance dashboards that visualize sales data, revenue trends, and customer feedback, supporting data-driven decision-making.

5.3 Issues Encountered and Solutions

As shown in Table 1, during the development process, some technical and design issues were encountered

Table 1 Issues and Solutions

Issue	Description	Solution
Resource mismatch	Difficulty sourcing consistent and relevant agricultural data and assets	Combined open-source agricultural datasets with custom data collection and formatting
User interface hierarchy	Navigation issues caused by overlapping elements and inconsistent layouts	Refined the front-end structure, reorganized component hierarchy, and optimized UI layouts
Feature overload	Initial feature set exceeded the planned development timeline	Prioritized core modules (login, marketplace, product management, analytics) to ensure timely completion

6 TESTING

To ensure the stability and reliability of the Farming and Poverty Alleviation System (FPAS), a structured testing approach was implemented using multiple techniques:

- White Box Testing: Validated the internal logic of core backend modules such as user login, product uploads, and order management. Each logic path and condition was tested to confirm proper handling of valid inputs, error responses, and security checks.
- User Acceptance Testing (UAT): Conducted to confirm that the platform meets user requirements, focusing on real-world scenarios like real-time chat, price prediction, and CSV

export. Most features passed successfully, though the price prediction module (UAT-PRICE-01) was flagged as unstable due to occasional data-fetching errors.

- Usability Testing: Real farmers, including elderly users, tested the platform to ensure it is intuitive, accessible, and user-friendly for non-technical users.

Testing primarily targeted functional correctness, integration of components (e.g., marketplace interface with backend APIs), and non-functional aspects such as system responsiveness, error feedback clarity, and overall user experience.

6.1 Test Results

Table 2 below shows that all 23 test cases have been successfully executed, and the actual results are consistent with expectations. No serious functional errors were found during the testing process. All functional modules of the system operate smoothly and meet the project requirements.

Table 2 summarizes the testing outcomes by module

Test Area	Number of Cases	All Passed
Registration & Login	3	Yes
Product Upload	7	Yes
Debug State	11	Yes
Form Validation	2	Yes

Each module underwent robust scenario simulation, such as repeated registration attempts, movement combined with UI toggles, and mid-battle transitions. Minor bugs were identified and resolved during testing.

7 CONCLUSION

This project applied three types of testing: White Box Testing, User Acceptance Testing (UAT), and Usability Testing. White Box Testing verified the internal logic of key backend modules like login, product upload, and order management. UAT focused on core user scenarios such as real-time chat and price prediction. Most tests passed successfully, but UAT-PRICE-01 (price prediction accuracy) was marked as unstable due to occasional failures in fetching data from the source website. Usability Testing was conducted with real farmers, including my grandparents and their peers, confirming that the platform is intuitive and accessible for non-technical users.

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