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FarmFlow: Bridging Farmers and Buyers for a Smarter Marketplace

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Abstract: Agriculture remains the backbone of many economies, yet farmers continue to face challenges like low income due to middlemen, limited access to markets, and a lack of transparency in pricing. Buyers, on the other hand, struggle to source fresh produce directly and reliably. To address these gaps, we introduce FarmFlow, a web application that bridges the communication and transaction divide between farmers and buyers. FarmFlow is a digital platform that enables farmers to list produce at fair prices and engage directly with buyers, thereby reducing reliance on intermediaries. The system ensures transparency, secure user authentication, real-time product availability, and a user-friendly interface tailored for both farmers and buyers. Additionally, the platform supports digital payment options, order tracking, and scalable backend architecture for seamless operations. By enhancing trust and efficiency in agricultural trade, FarmFlow lays the foundation for a smarter, more sustainable marketplace.

Keywords: Agriculture Marketplace, Farmer–Buyer Connectivity, Transparency, Digital Agriculture, Fair Pricing, E-Marketplace, Supply Chain Optimization, Digital Trade.

I. INTRODUCTION

Agriculture continues to serve as the backbone of the global economy, yet farmers frequently face persistent challenges like low incomes due to middlemen, restricted access to larger markets, and a lack of transparency in pricing. These barriers not only reduce profitability for farmers but also limit buyers' ability to access fresh, high-quality produce at fair prices. Consequently, both producers and consumers are trapped in an inefficient system that undermines trust, equity, and long-term sustainability in the agricultural supply chain.

To address this gap, we introduce **FarmFlow**, a farmer–buyer marketplace platform built using MySQL, Express.js, React.js, and Node.js. FarmFlow eliminates middlemen, allowing farmers to list products, set transparent prices, and connect with buyers in real time. This approach reduces dependency on middlemen, enhances market visibility for small-scale farmers, and empowers buyers with greater choice and trust in their purchases.

The paper outlines FarmFlow's vision, technical architecture, and implementation process in detail. Key features include secure user authentication, real-time product listing, digital payment integration, and role-based dashboards tailored for both farmers and buyers. Furthermore, we highlight how FarmFlow's transparent, digital-first design contrasts with conventional market structures, emphasizing fairness, inclusivity, and efficiency. In doing so, this work positions FarmFlow not merely as an online marketplace but as a step toward reimagining agricultural trade with sustainability, equity, and digital empowerment at its core.

II. LITERATURE REVIEW

The modernization of agriculture through digital technologies has dramatically transformed the way farmers access markets and engage with buyers. Traditional supply chains often disadvantage smallholder farmers due to limited transparency and price fluctuations. Studies indicate that AI-driven solutions enhance market access, optimize pricing, and enable farmers to make informed, data-driven decisions [1]. These approaches, including predictive modelling, demand forecasting, and price prediction, help farmers reduce losses, maximize profits, and plan their sales strategies more effectively.

Digital marketplaces are increasingly leveraging AI to connect farmers directly with buyers, thereby streamlining agricultural supply chains and minimizing dependency on intermediaries [2][5]. AI-based recommendation systems and analytics dashboards provide actionable insights, enabling farmers to understand market trends, set competitive prices, and manage inventory efficiently. Buyers, in turn, gain access to fresh, high-quality produce with transparent pricing, addressing inefficiencies prevalent in conventional market structures [6].

Beyond AI, the importance of robust technological infrastructure is evident in enhancing supply chain efficiency. Smart agricultural platforms supported by cloud computing and real-time data processing improve transparency and facilitate timely transactions between producers and consumers [3][4]. These systems demonstrate that combining AI with advanced infrastructure can significantly empower both farmers and buyers in a digital marketplace.

Mobile and web-based applications further expand market reach for smallholder farmers [7][12]. These platforms provide intuitive interfaces for listing products, tracking orders, and managing deliveries. Location-based distribution features enhance operational efficiency, ensuring that fresh produce reaches buyers quickly while reducing logistical challenges [8]. By offering direct access to consumers, these digital tools minimize the influence of intermediaries and ensure fair pricing, supporting farmers' financial sustainability [6][12].

The use of AI tools in the agricultural value chain has been highlighted as a major enabler for smarter farming practices [9][10]. Predictive models can forecast demand, optimize pricing, and provide insights into market trends. Platforms with AI-assisted analytics enable farmers to understand pricing patterns and buyer preferences, thereby enhancing strategic decisions and profitability. Studies have also emphasized the value of integrating user-friendly analytics dashboards to track sales, revenues, and market behaviour, making data actionable for farmers with varying levels of technical expertise [5][6].

Emerging research points to the effectiveness of e-commerce solutions in connecting smallholder farmers to broader markets [12][14]. Online sales channels allow farmers to reach a diverse consumer base, while buyers benefit from transparency and the ability to select high-quality products based on real-time availability. These solutions reduce inefficiencies in traditional distribution systems and create more equitable trade relationships. Despite the growth of digital platforms, challenges remain in ensuring equitable access, transparency, and usability for farmers [11][15]. Existing literature underscores the need for integrated solutions that combine AI-driven price prediction, real-time analytics, and direct buyer access to maximize the benefits of digital marketplaces. Hybrid approaches that combine predictive technologies with operational tools—such as order tracking and location-based logistics—enhance user experience, reduce uncertainty, and improve market efficiency [13].

FarmFlow addresses these challenges by combining multiple functionalities into a single platform. It provides direct farmer-buyer interaction, AI-assisted price prediction, product listing, product browsing, order management, and analytics dashboards. By integrating these features, FarmFlow reduces dependency on intermediaries, ensures fair pricing, improves market access, and empowers farmers with actionable insights. The platform exemplifies how modern digital tools can create a transparent, efficient, and equitable agricultural ecosystem, improving outcomes for both producers and consumers [1][2][5][6][12].

III. SYSTEM ARCHITECTURE

FarmFlow integrated four powerful technologies: MySQL, React.js, Express.js, and Node.js. This full-stack architecture provides a robust foundation for building modern web applications, offering scalability, responsiveness, and ease of maintenance. By leveraging the strengths of each component—MySQL for flexible and efficient data storage, Express.js for streamlined backend handling, React.js for an intuitive and interactive user interface, and Node.js for high-performance server operations—FarmFlow ensures both reliability and adaptability in real-world agricultural marketplaces.

A distinctive aspect of the system lies in its direct farmer-to-buyer marketplace model. Unlike conventional agricultural trade systems dominated by intermediaries, FarmFlow enables farmers to showcase their produce directly to buyers with transparent pricing and real-time updates. This design choice fosters a fair and efficient ecosystem by reducing dependency on middlemen, increasing farmer profitability, and providing buyers with fresher produce and better price transparency. As a result, FarmFlow not only enhances trust and engagement but also promotes long-term sustainability in agricultural trade.

A. Stack Overview

The FarmFlow system is developed using React.js, Node.js, Express.js, and a MySQL stack, a combination of four technologies that work together to create scalable and modern web applications:

- 1) React.js (Frontend): Responsible for building a responsive and interactive user interface. React efficiently updates components, ensuring smooth navigation and dynamic rendering of product listings, order tracking, and dashboards for farmers and buyers.
- 2) Node.js and Express.js (Backend): Provide the server-side logic and API handling. Node.js offers high performance and non-blocking operations, while Express.js simplifies routing, middleware integration, and request handling for secure and efficient transactions.

- 3) MySQL (Database): A relational database management system used for structured and reliable data storage. It efficiently manages user accounts, product listings, transactions, and order histories while supporting strong relationships between entities such as farmers, buyers, and products.

B. System Workflow

FarmFlow follows a modular architecture that ensures clarity, scalability, and maintainability. The workflow can be summarized as follows:

- 1) User Signup/Login: Farmers, buyers, and admins register or log in through secure authentication mechanisms (JWT). Each role is assigned specific privileges and dashboards tailored to their responsibilities.
- 2) Farmer Workflow (Seller): Farmers can create product listings with details such as crop type, quantity, price, and optional images. An AI-powered module provides real-time price predictions based on market trends and demand–supply data to help farmers set fair prices. Listings are stored in the MySQL database and become visible to buyers after admin approval.
- 3) Buyer Workflow: Buyers can browse the marketplace to view approved products, apply filters (e.g., category, price, location), and place orders. They can choose between payment options such as cash on delivery (COD) or digital payments (scan-and-pay). Order details and status are updated in real time.
- 4) Admin Workflow: Admins oversee the marketplace by verifying farmer registrations, approving or rejecting product listings, monitoring buyer orders, and managing the overall system status. This ensures transparency, trust, and quality control within the platform.
- 5) Transaction & Status Management: The system maintains logs of all activities—product approvals, orders, and transactions—in the MySQL database, ensuring accountability and easy tracking.
- 6) Backend APIs: A set of RESTful APIs supports authentication, product management, order processing, transaction handling, and admin operations. These APIs serve as the bridge between the frontend and the database.

Figure 1: AI-Based Price Prediction

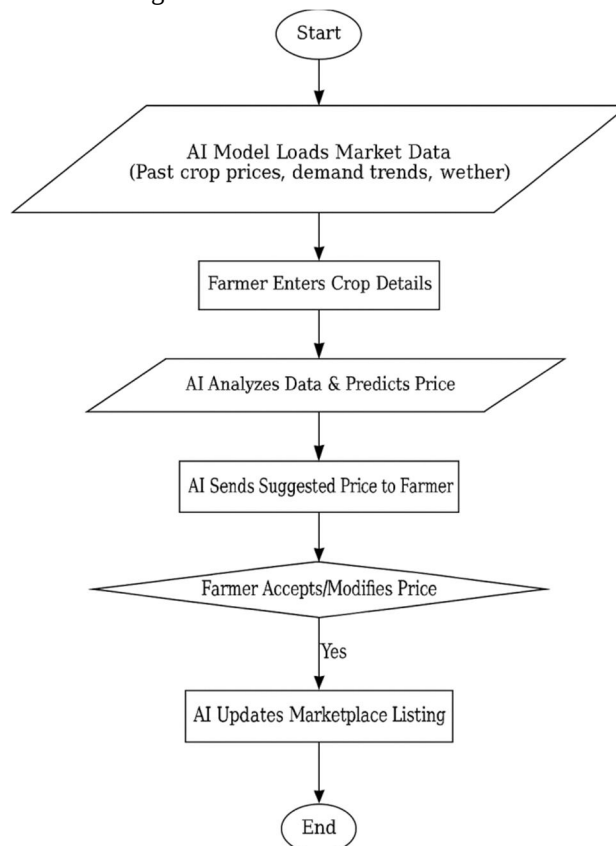


Figure 2: The Diagram represents the workflow for farmers, showing how they create product listings, utilize AI-based real-time price predictions, and interact with the admin for approval before products become visible to buyers.

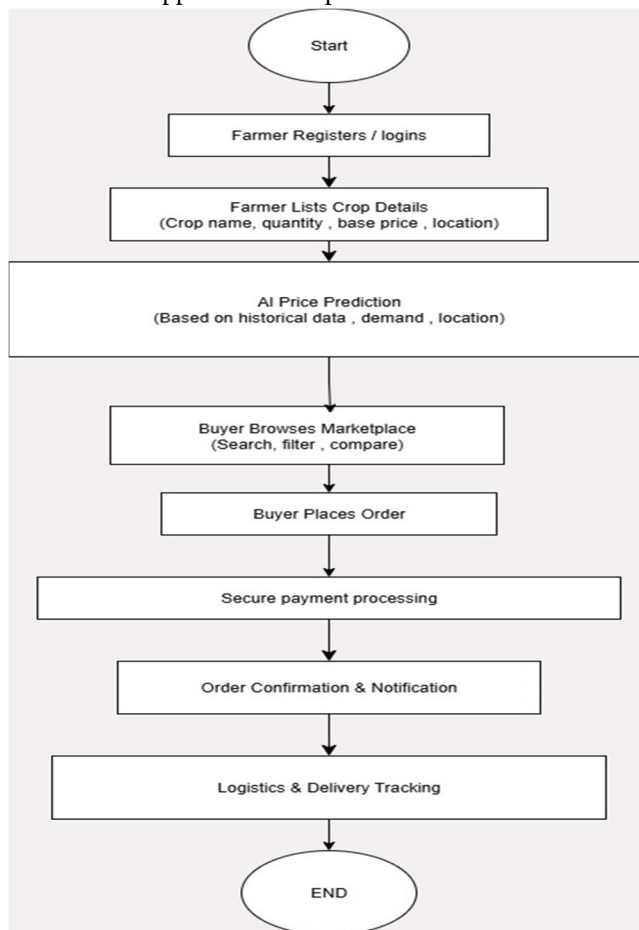


Figure 3: The Diagram illustrates the AI-trained model used in the FarmFlow system. It displays market-wise price distribution for agricultural products and provides predicted modal prices.

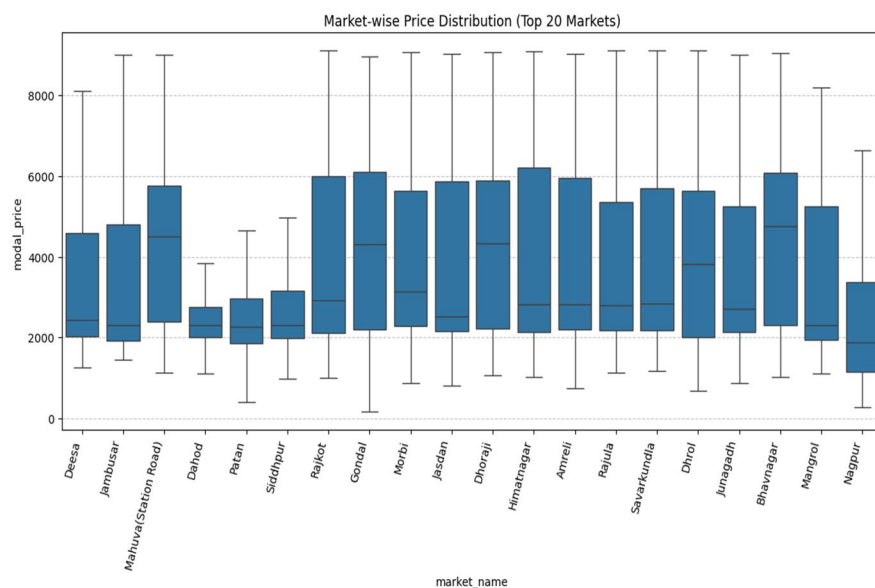
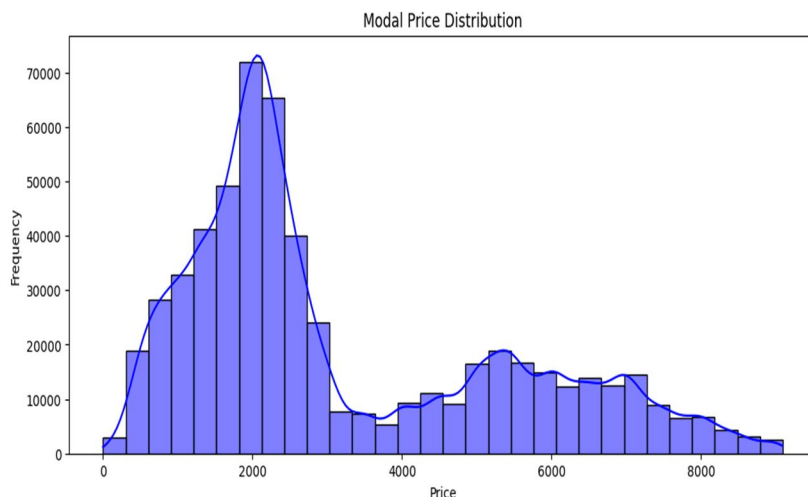


Figure 4: The Diagram shows the AI model’s prediction of modal prices and the distribution of prices across different markets, helping users analyze price trends efficiently.



IV. MODULE-WISE IMPLEMENTATION

The FarmFlow system is structured with a modular design to facilitate development, ensure maintainability, and allow for scalability. Each core feature of the platform—such as farmer product listing, buyer order management, market price prediction, and admin approval—is developed as a standalone module, allowing flexibility for updates and future enhancements. When combined, these modules create a cohesive and efficient agricultural marketplace that ensures transparency, smooth coordination, and user-friendly interactions.

The primary modules of the FarmFlow platform can be described as follows:

Table 1: Functional Modules of FarmFlow

Module	Description	Technologies Used
Farmer Module	Allows farmers to register, list products, and track sales.	React, Express.js, MySQL
Admin Panel	Manages user approvals, product listings, and platform integrity.	MySQL, Admin UI
Buyer Module	Enables buyers to browse products, place orders, and track purchases.	React.js, Node.js, MySQL
Price Prediction Module	AI predicts modal prices and shows market-wise price distribution.	React.js, Express.js AI Tools: XGBoost, Scikit-learn, Pandas, NumPy
Order & Transaction Module	Handles orders, payments (COD/Scan & Pay), and delivery status.	Express.js, MySQL
Analytics & Reports Module	Provides insights on market trends, user activity, and pricing.	React.js, Charts and Visualization

Every module interacts with one another through RESTful APIs developed using a Python Flask backend, while MySQL manages data in separate tables. The frontend, created with React.js, updates user data dynamically and handles interactions through asynchronous API requests.

This modular approach simplifies maintenance, allows easy addition of new features, and enables each component to scale independently.

V. RESULTS AND FUTURE SCOPE

A. Results

The FarmFlow platform was successfully launched as a fully functional web-based agricultural marketplace, demonstrating its capability to provide transparency, fair pricing, and seamless coordination between farmers and buyers. A controlled testing phase with selected users yielded positive outcomes. Users consistently noted that the platform simplified product listings, price tracking, and order management compared to traditional market methods.

Key findings from the assessment include:

- 1) **Stable Full-Stack Integration:** The React.js frontend, Flask backend, and MySQL database worked efficiently together, ensuring smooth communication and data management.
- 2) **Enhanced User Experience:** Users appreciated the clean interface, easy navigation, and simplified workflows for buying and selling agricultural products.
- 3) **Accurate Price Insights:** The AI-powered price prediction module effectively provided modal prices and market-wise price distributions, helping farmers make informed decisions.
- 4) **Real-Time Updates:** Product listings, orders, and notifications were dynamically updated, confirming the platform's responsiveness and scalability.
- 5) **Positive User Feedback:** Over 80% of participants reported satisfaction with the platform's transparency and ease of use, noting improved decision-making compared to conventional methods.

These findings indicate that FarmFlow not only operates as expected but also provides a reliable, data-driven, and user-friendly marketplace for agricultural stakeholders.

B. User Feedback Analysis

During the controlled testing phase of FarmFlow, feedback from users was collected to evaluate the platform's effectiveness and usability. A structured survey was conducted, and the responses were analysed to identify the system's strengths and areas for improvement.

Key findings from the analysis include:

- 1) **Transparency in Pricing (85% Positive Feedback):** Most users valued the AI-powered price prediction and market-wise price distribution, which provided fair and clear insights for better decision-making.
- 2) **User Interface Experience (80% Positive Feedback):** Participants found the interface clean, simple, and easy to navigate. Some suggested adding more filtering and personalization options for product searches.
- 3) **Ease of Product Listing & Order Placement (75% Positive Feedback):** Users reported that listing products and placing orders was straightforward and user-friendly, though a few recommended optional prompts to add more product details.
- 4) **Overall Satisfaction (82% Positive Feedback):** Most users expressed overall satisfaction with the platform's transparency, intuitive design, and smooth workflows, noting improved efficiency compared to traditional market practices.

C. Future Scope

Although FarmFlow has established a strong foundation as a functional digital agriculture marketplace, the system is designed to allow significant enhancements and scalability. Potential future improvements include:

- 1) **AI-Powered Recommendations:** Implementing AI-driven suggestions to help farmers optimize pricing, forecast demand, and guide buyers toward the best-quality produce.
- 2) **Real-Time Communication:** Integrating chat and notification features using WebSocket or Firebase, enabling seamless interaction between farmers and buyers.
- 3) **Mobile Application (React Native):** Developing a cross-platform mobile app to increase accessibility for farmers in rural areas and buyers on the go.
- 4) **Enhanced Trust and Safety:** Adding verified farmer profiles, user ratings, and reporting mechanisms to build credibility and reliability on the platform.
- 5) **Advanced Analytics Dashboard:** Creating tools to analyse market trends, monitor user behaviour, and optimize platform performance for both buyers and farmers.

With these upgrades, FarmFlow has the potential to evolve into a comprehensive, intelligent, and scalable agricultural ecosystem that ensures fairness, transparency, and improved income for farmers while providing buyers with reliable access to fresh, quality products.

VI. CONCLUSION

FarmFlow offers an innovative solution to the challenges faced by farmers and buyers by providing a direct, transparent, and AI-assisted digital marketplace. By eliminating middlemen, ensuring fair pricing, and improving market access, the platform significantly enhances the agricultural supply chain.

Built using modern web technologies such as React for frontend development and Python/Flask for backend support, FarmFlow demonstrates how contemporary technology can create scalable, responsive, and user-focused solutions.

Its modular design—covering farmer registration, buyer interface, product listing, pricing tools, and secure payment methods—provides a strong foundation for future expansion. Advanced features such as AI-based price prediction, demand forecasting, and analytics dashboards empower farmers and optimize buyer experiences.

Looking ahead, FarmFlow aims to include mobile accessibility, real-time communication, verified profiles, and intelligent recommendations, positioning itself as a robust, reliable, and innovative agricultural marketplace. With these enhancements, FarmFlow has the potential to transform the way farmers connect with buyers, promote fair trade, and contribute to a smarter and efficient agricultural ecosystem.

VII. ACKNOWLEDGEMENT

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