

FARM2MARKET: A SMART CONTRACT DRIVEN MARKETPLACE FOR FARMERS

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Blockchain Technology, Smart Contracts, Agricultural Supply Chain, Traceability, Transparency, Price Prediction, Decentralized Marketplace, QR Code Tracking, Farmer-Centric Platform, Agri-Tech Innovation.

Introduction:

1. Agricultural supply chains are essential for economic stability and food security, yet they face persistent challenges such as data fragmentation, lack of transparency, price volatility, and heavy reliance on intermediaries. These issues reduce farmer profitability and weaken consumer trust due to inefficient and opaque processes. Emerging technologies like blockchain and artificial intelligence (AI) offer promising solutions. Blockchain enables secure, decentralized, and tamper-proof transaction recording, while AI supports data-driven decision-making through accurate price forecasting. This paper presents **Farm2Market**, a blockchain–AI integrated platform designed to address these challenges through an end-to-end implementation. The system includes a mobile application that enables direct farmer–buyer interactions, product listing, order management, and real-time tracking. Ethereum-based smart contracts ensure secure, immutable transactions and automated escrow mechanisms, reducing payment risks.
2. Additionally, a QR code-based traceability system provides end-to-end visibility of product provenance and shipment details. An AI-driven price prediction module, trained on historical data, forecasts crop prices with high accuracy, helping farmers make informed decisions. Overall, the proposed framework enhances transparency, improves pricing fairness, reduces intermediary dependency, and offers a scalable solution for modern agri-food supply chains, particularly in resource-constrained environments.

Objectives:

1. To design and develop a blockchain-based framework that enables secure, flexible smart contracts and supports transparent and efficient dispute resolution among stakeholders.
2. To create a decentralized, farmer-centric platform that ensures equitable access for smallholder farmers while promoting direct interaction with buyers.
3. To enhance transparency and traceability in the agricultural supply chain using blockchain and QR-based tracking mechanisms.
4. To integrate AI-driven price prediction models for improving decision-making and reducing price uncertainty in agricultural markets.

Methodology:

The proposed Farm2Market system is developed using a layered architecture that integrates blockchain, artificial intelligence, and a mobile-based interface. A farmer-centric mobile application is designed to enable product listing, order placement, and real-time tracking, supported by a backend framework that manages user authentication, data processing, and API communication. Blockchain integration is implemented using Ethereum to ensure secure and immutable transaction recording. Smart contracts are developed to automate agreements, enforce transaction rules, and facilitate secure payments through escrow mechanisms. Each transaction and shipment is associated with a unique QR code, enabling seamless traceability and easy access to product provenance and transit details. An AI-based price prediction module is built using historical agricultural data, employing machine learning models such as LSTM to forecast crop prices with high accuracy. The AI module is integrated into the application to provide real-time pricing insights to farmers. The system undergoes functional testing to ensure proper interaction between components, along with performance evaluation for responsiveness and scalability, and security analysis to verify data integrity and reliability.

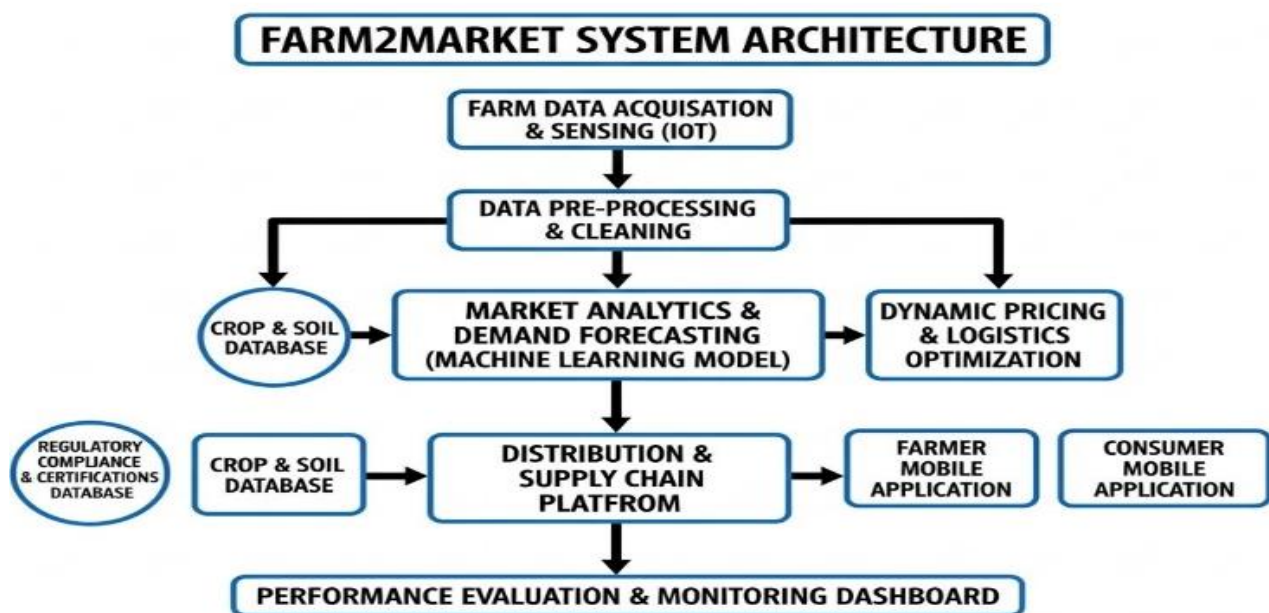


Figure 1: Flow of Application

Result and Conclusion:

In conclusion, the experimental evaluation of the Farm2Market system demonstrates significant improvements in transparency, efficiency, and reliability within the agricultural supply chain. The blockchain layer ensures secure and tamper-proof transaction recording, enhancing trust among stakeholders, while smart contracts enable automated and fair transactions. The QR code-based traceability mechanism provides real-time tracking and easy access to product provenance, reducing information asymmetry. The AI-based price prediction module achieves high accuracy, supporting farmers in making informed pricing decisions. The system also exhibits low latency and stable performance, ensuring smooth

operation of the mobile application for order management and tracking. Compared to traditional supply chain models, the proposed framework reduces intermediary dependency, improves data accessibility, and enhances pricing fairness. Overall, Farm2Market presents a scalable and practical solution that strengthens transparency, trust, and efficiency in modern agri-food supply chains.

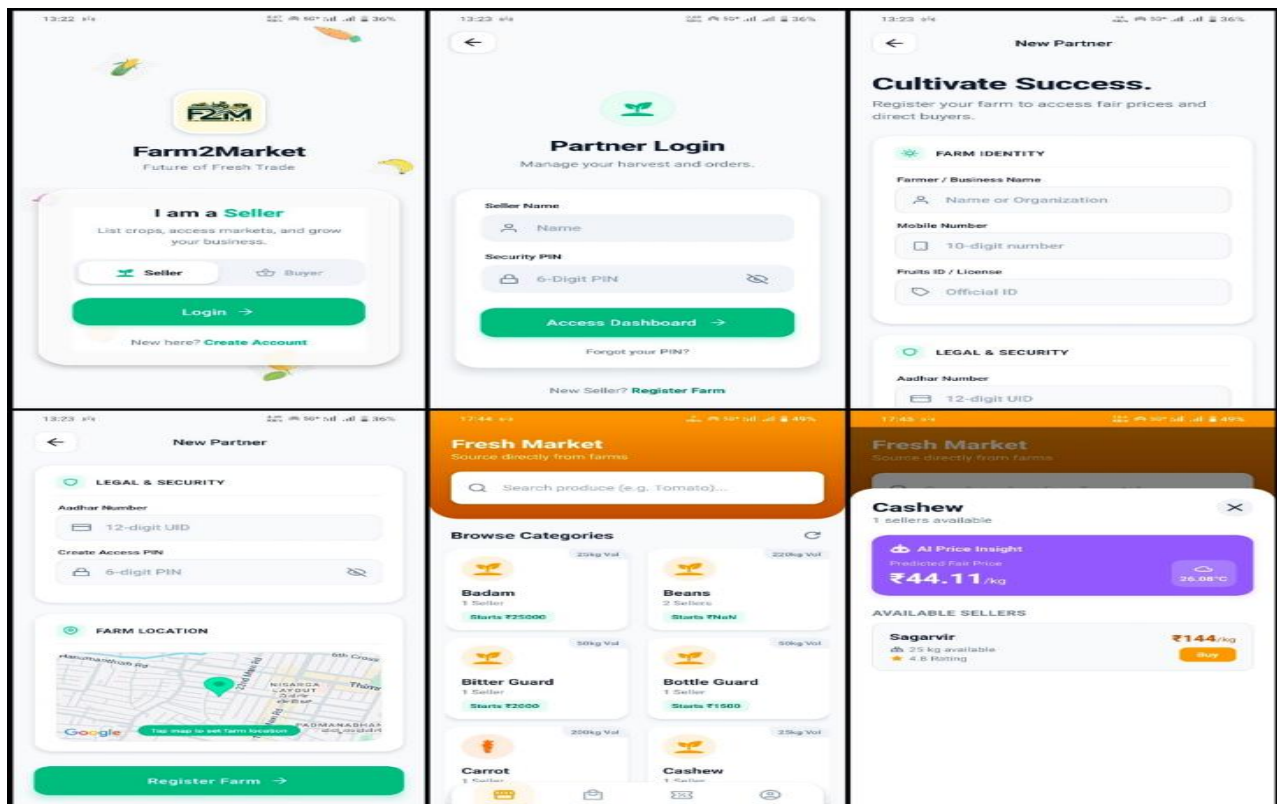


Figure 2: Application interface

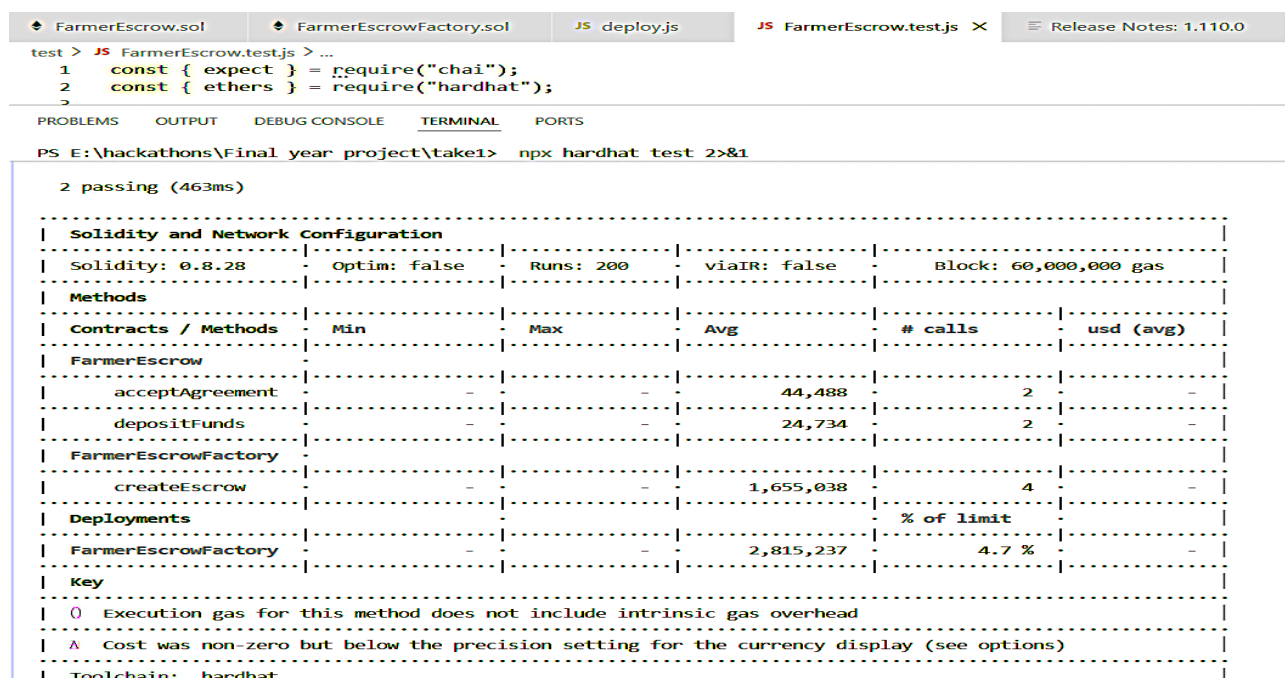


Figure 3: Block chain Transactions

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Project Outcome & Industry Relevance:

1. The Farm2Market system delivers a transparent, secure, and efficient agricultural supply chain by integrating blockchain, artificial intelligence, and mobile technologies into a unified platform. It enables direct farmer-to-buyer interaction, significantly reducing dependency on intermediaries and allowing farmers to retain a larger share of profits. The implementation of smart contracts ensures automated, fair, and timely payment settlements, eliminating delays and disputes commonly seen in traditional systems.
2. Blockchain-based record keeping enhances trust by providing tamper-proof and verifiable transaction data accessible to all stakeholders. Additionally, QR code-based traceability enables end-to-end visibility of products, improving consumer confidence in food quality, safety, and origin. The AI-driven price prediction module further strengthens the system by offering data-driven insights, helping farmers make informed decisions and reducing market uncertainty.
3. The platform is scalable and adaptable to various agricultural markets and regions, making it suitable for both local and large-scale deployment. It also promotes digital inclusion by offering a simple and user-friendly interface, encouraging participation from smallholder farmers with limited technical expertise. From an industry perspective, the system aligns with the increasing demand for transparent, efficient, and technology-driven supply chains. Overall, Farm2Market contributes to the advancement of AgriTech innovations and supports the development of a sustainable, reliable, and trust-driven agricultural ecosystem.

Working Model vs. Simulation/Study

The project involves the development of a functional working model rather than a purely theoretical study or simulation. A prototype of the Farm2Market system has been implemented, including a mobile/web-based interface for farmer–buyer interaction, blockchain-based smart contract integration for secure transactions, QR code-based traceability, and an AI-driven price prediction module. The system has been tested for core functionalities such as product listing, order management, transaction recording, and price forecasting. Hence, the project represents a practical, working prototype demonstrating real-world applicability of the proposed framework.

Future Scope:

The future scope of this project includes:

1. **Scalability and Expansion:** The system can be scaled to support larger agricultural markets across regions and integrated with government platforms for subsidies, regulations, and wider adoption.

2. **Advanced AI and Data Integration:** The price prediction module can be enhanced using advanced deep learning models and real-time data from IoT devices such as weather and soil sensors for better accuracy.
3. **Enhanced Features and Services:** Future improvements can include logistics management, crop recommendation systems, and real-time analytics dashboards to optimize the entire supply chain.
4. **Improved Accessibility and Usability:** Adding multilingual support, optimizing performance for low-bandwidth environments, and conducting farmer training programs can increase usability and adoption.