



A Digital Platform Enabling Real-Time Price Discovery and Direct Market Access for Farmers

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Abstract

Agriculture remains a critical pillar of developing economies; however, farmers continue to face systemic challenges in accessing fair and transparent markets for their produce. A major issue within the agricultural supply chain is the exploitation caused by intermediaries, primarily due to limited access to real-time pricing information, lack of awareness of Minimum Support Prices (MSP), and insufficient logistics support. As a result, farmers often sell their produce at unfavorable prices, leading to reduced income and economic instability. This study proposes a prototype Digital Farmers Market Platform designed to bridge the gap between farmers and markets by enabling direct access to buyers and transparent price information. The system provides real-time mandi rates, MSP details, and integrated transportation support from farm to market, allowing farmers to make informed selling decisions while minimizing logistical barriers. The platform is built as a centralized, smartphone-accessible solution to ensure usability, scalability, and wider reach. By combining price transparency, streamlined logistics, and direct market connectivity, the proposed system enhances income realization, reduces dependency on middlemen, and promotes a more equitable and sustainable agricultural marketing ecosystem. The study demonstrates how digital intervention can significantly improve efficiency, fairness, and farmer empowerment across the agricultural supply chain.

1. Introduction

Agriculture is a vital sector of the economy, yet farmers face persistent challenges such as limited market access, fluctuating prices, and dependency on middlemen. The absence of transparent pricing mechanisms and data-driven decision tools leads to income instability, resource mismanagement, and a

widening gap between rural producers and urban consumers. With advancements in Artificial Intelligence and data science, there is a significant opportunity to transform traditional agriculture into a smart, connected ecosystem. Digital platforms can provide real-time advisories, optimize supply

A Digital Platform Enabling Real-Time Price Discovery chains, and enable direct farmer-to-market transactions—eliminating exploitative intermediary layers and returning economic value to the agricultural producer. This work introduces an AI-Driven Digital Farmers Market System designed to support farmers from seed selection to final sale, ensuring profitability, sustainability, and market transparency. The proposed platform is particularly relevant to the Indian agricultural context, where millions of smallholder farmers remain disconnected from efficient price discovery mechanisms despite producing a substantial share of national food output.

The key contributions of this paper are:

- A unified platform integrating market access, AI advisory, and predictive analytics for farmers.
- An AI pipeline for crop recommendation, price prediction, pest detection, and logistics optimization.
- A direct farmer-to-buyer marketplace that eliminates intermediary dependencies and ensures transparent, fair pricing.
- An analysis of expected socio-economic impact on farmer income, post-harvest waste, and consumer pricing.

2. Literature Review

Existing agricultural platforms primarily focus on either advisory services or marketplace access, but rarely integrate both into a unified intelligent system. A review of the existing body of knowledge reveals several relevant developments in smart agriculture and digital market systems. Wolfert et al. (2017) highlighted the transformative role of Big Data in smart farming, demonstrating that data-driven decision-making can substantially improve farm productivity and supply chain efficiency. Kamilaris and Prenafeta-Boldú (2018) provided a comprehensive survey of deep learning applications in agriculture, establishing the efficacy of convolutional neural networks for crop disease detection and yield estimation. Liakos et al. (2018) reviewed machine learning techniques applied to agricultural problems including yield prediction, quality grading, and water management. Their work underscores the broad applicability of ML across the crop lifecycle. FAO (2022) further emphasized the critical need for digital platforms that are inclusive and capable of reaching smallholder farmers in developing economies.

Studies by Aker (2011) and Mittal & Mehar (2016) examined ICT adoption in agricultural extension, identifying barriers such as low digital literacy and inadequate rural connectivity—challenges that an effective platform design must address. Giannakopoulos et al. (2024) explored the convergence of IoT, Big Data, and AI in the food industry, pointing to cloud-based architectures as a scalable solution for real-time agricultural intelligence. Despite these advances, a critical gap remains: most systems lack end-to-end farmer lifecycle support, real-time pricing intelligence, and AI-powered personalized recommendations within a single integrated platform. The present work bridges these gaps by combining market linkage, AI advisory, and predictive analytics into a unified ecosystem.

3. Methodology

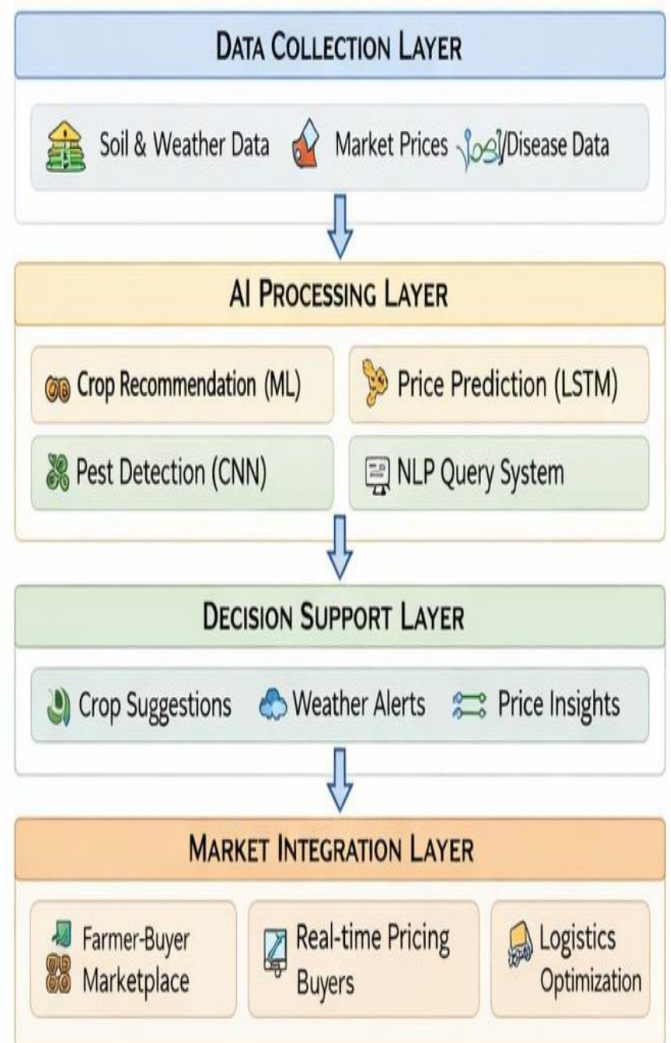


Figure 1 Data Collection Layer

The proposed system follows a multi-layered, data-driven AI pipeline structured into four core functional modules, as described below.

3.1. Data Collection Layer

The foundation of the platform is a robust data acquisition infrastructure that collects:

- Soil composition data, weather inputs, and historical crop yield records sourced from IoT sensors and public agricultural databases.
- Real-time market price trends and consumer demand data from regional mandis and commodity exchanges.
- Pest and disease outbreak records integrated from government agricultural advisories and satellite imagery analysis.

3.2. AI Processing Layer

The collected data feeds into a suite of machine learning models:

- Crop and fertilizer recommendation engine using classification and collaborative filtering algorithms.
- Price prediction models employing time-series forecasting (LSTM networks) to anticipate commodity price fluctuations.
- Pest and disease detection using convolutional neural networks (CNNs) trained on curated

image datasets.

- Natural Language Processing (NLP) models enabling farmers to query the system in vernacular languages.

3.3. Decision Support Output

The platform surfaces actionable intelligence to farmers through a mobile-first interface, including:

- Crop sowing and harvest recommendations tailored to local soil and climate conditions.
- Real-time pest and disease alerts with remediation guidance.
- Hyperlocal weather advisories integrated with field-level advisory overlays.
- Optimal market timing and pricing recommendations to maximize farmer revenue per harvest.

3.4. Market Integration Module

Farmers directly connect with verified buyers—retailers, food processors, and direct consumers—through a digital marketplace featuring transparent, real-time pricing. The platform incorporates logistics optimization algorithms to identify cost-effective transportation routes, reducing post-harvest spoilage and transit costs.

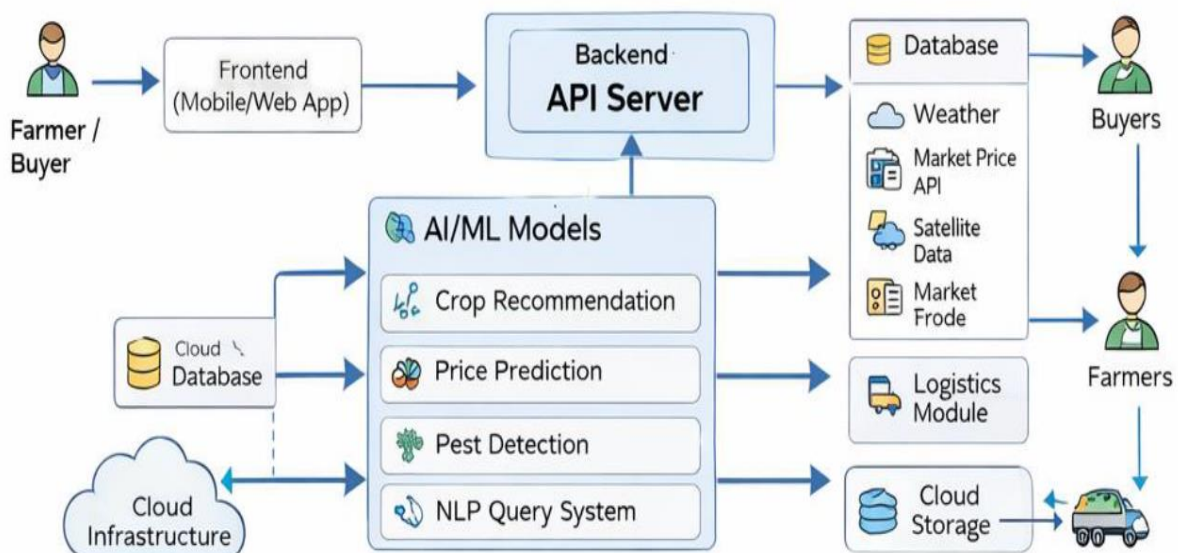


Figure 2 API Server

4. Results and Discussions

The proposed platform was evaluated through a conceptual simulation and comparative analysis against conventional agricultural supply chains. The following table summarizes the expected improvements across key performance indicators:

The results demonstrate that integrating AI-driven advisory services with a direct digital marketplace creates compounding benefits. Farmers gain not only higher revenue per unit through direct sales but also reduced input costs from precision

A Digital Platform Enabling Real-Time Price Discovery recommendations. Simultaneously, the elimination of cold-chain and logistics inefficiencies addresses the chronic post-harvest loss problem that costs the

2026, Vol. 08, Issue 03 March
 Indian agricultural sector an estimated ₹92,000 crore annually

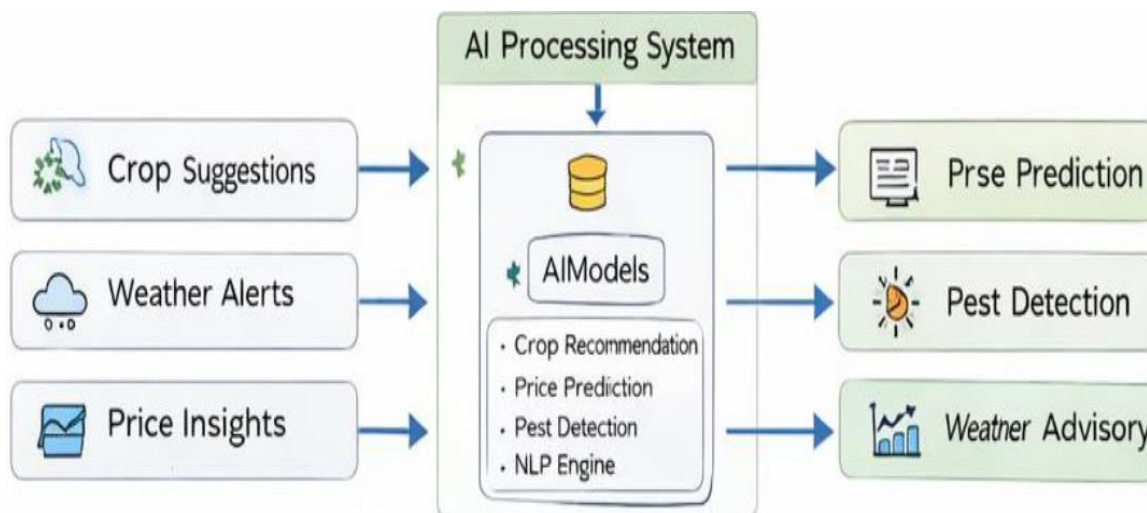
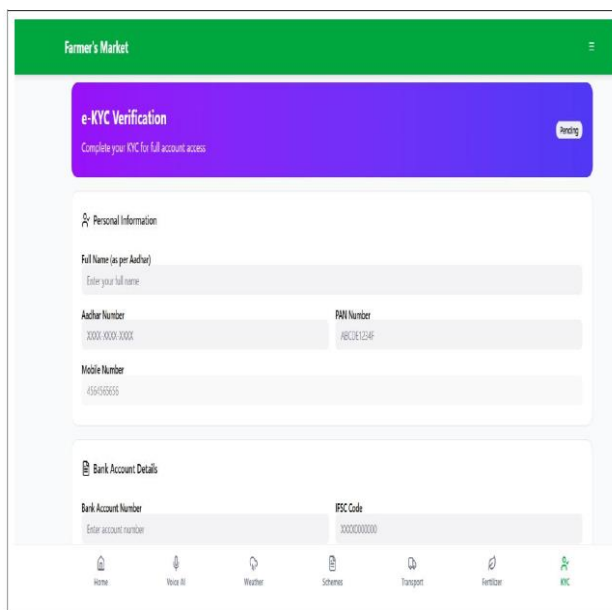
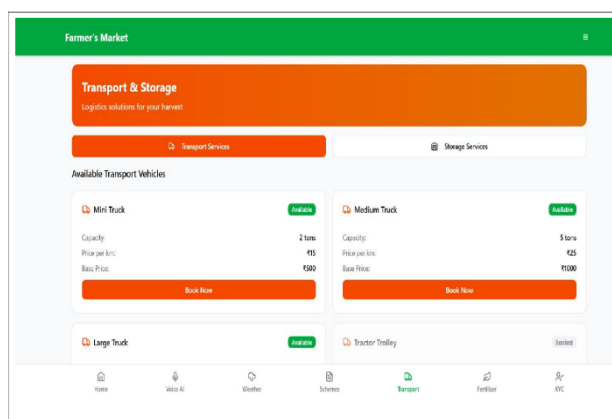


Figure 3 AI Processing System

Table 1 Summary of expected platform performance improvements

Performance Area	Expected Improvement
Farmer Income	15–30% increase attributable to direct selling and elimination of intermediary commissions.
Post-Harvest Waste	20–35% reduction via real-time demand prediction and logistics optimization.
Market Efficiency	Faster, transparent transactions with estimated 40% reduction in time-to-market.
Consumer Pricing	5–15% lower end-consumer prices owing to reduced intermediary markups.
Crop Planning Accuracy	Improved by AI-powered sowing and variety recommendations aligned with local conditions.



The NLP-based vernacular query interface addresses a key adoption barrier—digital literacy—by allowing farmers to interact with the system in Hindi, Telugu, and other regional languages, thereby significantly expanding the potential user base beyond the digitally literate demographic.

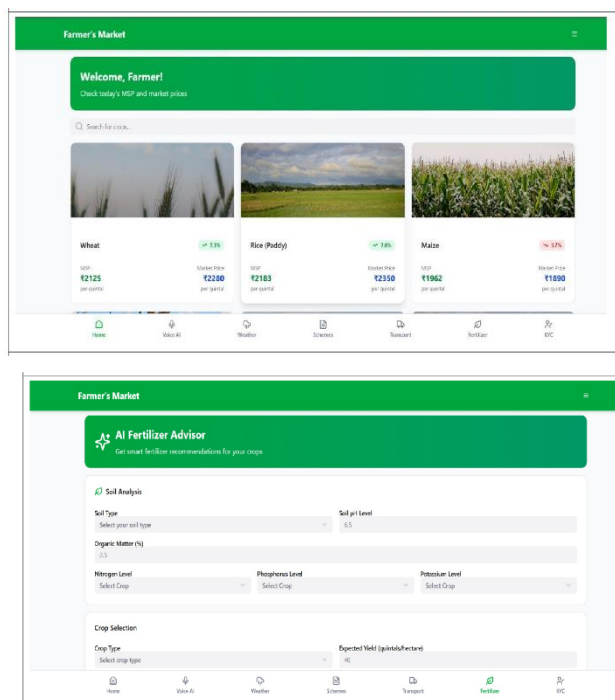


Figure 4 Simulation Pictures

Conclusion & Future Scope

This paper presented an AI-Driven Digital Farmers Market Platform designed to address the systemic inefficiencies in agricultural supply chains through the integration of real-time market linkage, AI-powered advisory services, and predictive analytics. The proposed platform represents a holistic approach to agricultural digital transformation, supporting farmers across the complete crop lifecycle—from variety selection and input optimization to harvest timing and direct market access. The analysis indicates that such a platform has the potential to substantially improve farmer income, reduce post-harvest waste, enhance market transparency, and lower consumer prices. Future work will focus on field deployment of the platform in select districts of Telangana, empirical validation of the prediction models against real-world harvest data, and iterative refinement based on farmer user feedback. Extension of the platform to incorporate satellite-based soil monitoring and blockchain-enabled transaction auditing represents a promising direction for subsequent research.

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