Crop Connect AI: An AI-Driven Farmer-To-Farmer Marketplace with Integrated Advisory and Predictive Analytics

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***Abstract*—Agriculture continues to face significant challenges related to unfair market pricing, dependency on intermediaries, lack of timely expert guidance, and limited access to real-time information. Although several digital platforms attempt to support farmers, most of them operate in isolation and fail to provide a unified solution. This paper presents Crop Connect AI, an artificial intelligence–driven web platform designed to enable direct farmer-to-farmer and farmer-to-buyer interaction while integrating essential agricultural services. The proposed system combines machine learning–based price prediction, image-based crop disease detection, retrieval-augmented generation (RAG) for intelligent advisory, and real-time weather and market analysis. By eliminating intermediaries and offering data-driven insights, Crop Connect AI improves transparency, decision-making, and operational efficiency for farmers. The system demonstrates the potential to enhance agricultural trade, optimize resource utilization, and support sustainable farming practices through an integrated and user-centric digital ecosystem.**

***Index Terms*—Smart Agriculture, Farmer Marketplace, Artificial Intelligence, Machine Learning, RAG, Price Prediction, Crop Advisory**

I. INTRODUCTION

Agriculture plays a vital role in the economic and social development of India, supporting a large portion of the population. Despite technological advancements in various sectors, the agricultural ecosystem continues to face challenges such as unfair pricing mechanisms, dependence on intermediaries, fragmented service delivery, and limited access to real-time information. Small and marginal farmers are particularly affected due to a lack of market transparency and timely decision-support tools.

In recent years, digital agriculture platforms and government initiatives have attempted to improve market access and information availability for farmers. Systems such as e-NAM, DeHaat, and various mobile advisory applications provide services including market prices, crop recommendations, and weather updates. However, these solutions are often standalone in nature and do not offer an integrated environment that combines market access, advisory services, labour management, and farmer-to-farmer interaction. Additionally, the limited use of advanced artificial intelligence techniques restricts the ability of existing platforms to deliver personalized and predictive insights.

Artificial intelligence and machine learning have demonstrated strong potential in agriculture through applications such as crop yield prediction, disease detection, weather forecasting, and decision support systems. The integration of AI-driven analytics with real-time data can significantly improve accuracy and responsiveness in agricultural operations. Furthermore, recent advancements in large language models and retrieval-augmented generation enable intelligent, context-aware advisory services that can support farmers in multiple regional languages.

To address the limitations of existing systems, this paper proposes Crop Connect AI, an AI-powered web platform designed to create a unified digital ecosystem for agricultural stakeholders. The platform enables direct farmer-to-farmer and farmer-to-buyer trade, provides AI-based price prediction, supports real-time communication, and integrates expert advisory, disease detection, and weather analysis within a single interface. By combining social interaction with intelligent analytics, Crop Connect AI aims to reduce intermediary dependence, enhance transparency, and empower farmers with actionable insights for sustainable and profitable farming.

II. LITERATURE SURVEY

Recent research highlights the growing role of digital technologies and artificial intelligence in improving agricultural productivity, advisory services, and market access. Sharma et al. reviewed machine learning techniques such as Support Vector Machines, Random Forests, and Convolutional Neural Networks for applications including crop yield estimation, soil analysis, and disease detection, demonstrating the effectiveness of data-driven decision support in precision agriculture [1]. However, their study emphasized the need for practical deployment models suitable for small and marginal farmers.

Gupta et al. proposed a weather-based crop prediction system using big data analytics and time-series models to recommend suitable crops based on climatic conditions [2]. While the system achieved high prediction accuracy, it lacked integration with agricultural marketplaces and real-time pricing mechanisms. Similarly, Reddy and Babu surveyed big-data approaches for agricultural weather prediction and identified the importance of real-time analytics, though market linkage was not addressed [15].

Digital advisory platforms have also gained attention. Singh et al. introduced an AI-powered multilingual chatbot for smallholder farmers, enabling conversational access to agricultural knowledge using retrieval-augmented generation techniques [3]. Although effective in delivering advisory services, the system did not provide features for crop selling, labour hiring, or farmer-to-farmer interaction. Digital Green’s LOOP initiative demonstrated the benefits of aggregating farmers for market access using mobile technologies, but its implementation remained limited to pilot regions [19].

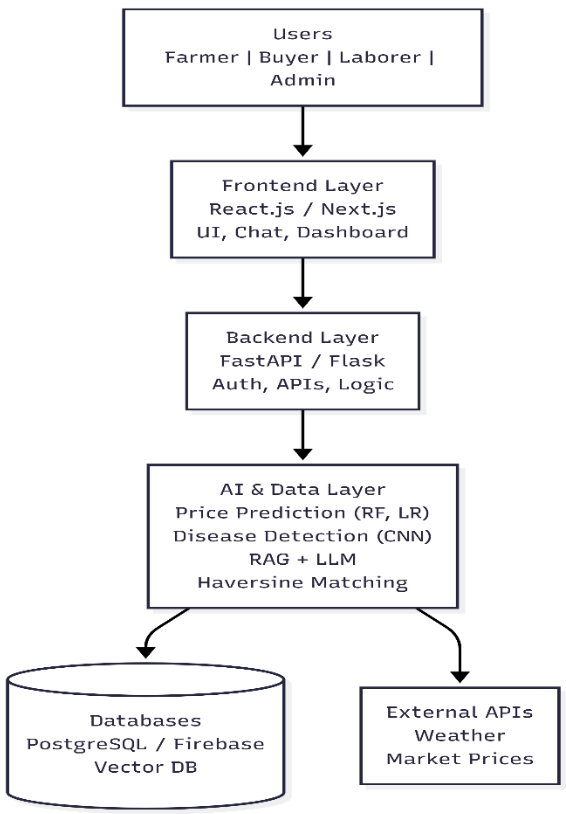
Market-oriented platforms such as DeHaat and e-NAM aim to connect farmers with buyers and input suppliers. Studies indicate that these platforms improve market transparency and income opportunities; however, they primarily focus on supply-chain management and do not fully leverage AI-based price prediction or social networking among farmers [5]. Daum et al. explored Uber-style digital matching models for tractor rentals and reported improved access to mechanization, though challenges related to trust and payment systems persisted [13].

Research on intelligent crop recommendation and disease detection systems has shown promising results. Doshi et al. developed an ML-based crop recommendation system using classification algorithms, achieving high accuracy under controlled conditions [11]. CNN-based approaches for crop disease detection have also been widely studied, demonstrating reliable performance in image-based diagnosis [12]. Despite these advances, most solutions operate as standalone tools without integration into a broader agricultural ecosystem.

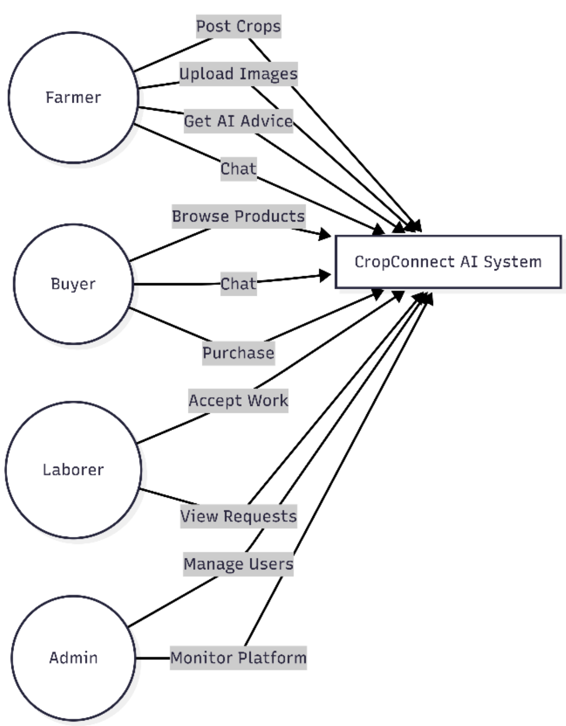
2.1 ARCHITECTURE

The architecture of the proposed system is organized into three distinct layers to ensure modularity, scalability, and efficient data processing:

- FRONTEND LAYER: This layer is implemented using React.js and Next.js to deliver a responsive and intuitive user interface. The design follows a social-media-inspired layout, enabling farmers to easily post products, interact with other users, and access services across different devices.
- BACKEND LAYER: The backend is developed using Python with Fast API/Flask, which manages user authentication, business logic, application workflows, and communication between system modules. It also handles artificial intelligence operations such as price prediction, disease detection, and chatbot responses.
- DATA LAYER: The data layer employs PostgreSQL/MySQL and Firebase for reliable storage of user data, product listings, and transaction records. Redis is used for real-time caching to support fast data access, while vector databases enable efficient retrieval for the RAG-based intelligent advisory system.



2.2 USE CASE DIGRAM



2.3 ALGORITHMS AND TECHNOLOGIES USED

A. AI-BASED PRICE PREDICTION
Random Forest Regression and Linear Regression models analyse historical market prices, crop type, geographical location, seasonal trends, and supply-demand patterns. The models generate fair and optimized price recommendations to assist farmers in making informed selling decisions.

B. CROP DISEASE DETECTION
Convolutional Neural Networks (CNN) are used to process crop leaf images uploaded by farmers. The model extracts visual features to identify potential diseases and provides preventive or corrective measures to minimize crop loss.

C. FARMER AND SERVICE MATCHING
The Haversine distance algorithm calculates geographical distances using latitude and longitude values to identify nearby farmers, laborers, fertilizer stores, and agricultural experts. This enables location-based recommendations and faster service access.

D. INTELLIGENT ADVISORY SYSTEM
A Retrieval-Augmented Generation (RAG) framework combined with Large Language Models (LLMs) delivers accurate, context-aware responses to farmer queries related to crops, fertilizers, weather, and farming practices.

E. REAL-TIME COMMUNICATION
WebSocket-based communication supports instant messaging and notifications between users, ensuring real-time interaction and collaboration within the platform.

2.4 ALGORITHMS AND TECHNOLOGIES USED
1.User registers and logs into the platform.
2.Farmers post products with crop details and images.
3.Backend fetches real-time market and weather data.
3.AI models process data to suggest prices and insights.
4.Buyers and farmers interact via chat and social feed.
5.All transactions and interactions are stored securely.

III. EXISTING BARRIERS AND LIMITATIONS

Despite the increasing adoption of digital technologies in agriculture, several challenges continue to limit their effectiveness and widespread acceptance among farmers. The key barriers and limitations observed in existing agricultural systems are discussed below.

1. DEPENDENCE ON MIDDLEMEN
A large number of farmers still depend on intermediaries to sell their produce. This reliance often results in unfair pricing, delayed payments, and reduced profit margins. Most existing platforms have not completely eliminated the role of middlemen.

2. LACK OF INTEGRATED SERVICES
Current agricultural platforms provide fragmented solutions. Farmers are required to use different applications for accessing market prices, weather information, expert guidance, and labour services. The absence of a unified system increases operational complexity and reduces overall usability.

3. LIMITED USE OF ARTIFICIAL INTELLIGENCE
Many existing systems offer static or historical information rather than intelligent and predictive insights. Advanced features such as AI-based price prediction, demand analysis, and personalized recommendations are either unavailable or insufficiently developed.

4. INADEQUATE REAL-TIME DATA AVAILABILITY
Access to real-time market prices, weather updates, and demand trends is often limited. Delayed or outdated information can lead to poor decision-making and financial losses for farmers.

5.ABSENCE OF FARMER-TO-FARMER COMMUNICATION
Most current platforms do not support direct interaction among farmers. The lack of social connectivity restricts knowledge sharing, collaboration, and collective decision-making.

6. LANGUAGE AND ACCESSIBILITY BARRIERS
Several digital platforms are not fully optimized for regional languages. Farmers with limited digital literacy face challenges in navigating complex user interfaces, which reduces adoption rates.

7. LACK OF STRUCTURED LABOR AND SERVICE MATCHING
Existing systems rarely provide effective mechanisms for hiring agricultural laborers or connecting with service providers such as veterinarians and fertilizer suppliers in real time.

8. LIMITED DISEASE DETECTION AND ADVISORY SUPPORT
Crop disease identification is largely manual or advisory-based in most platforms. AI-driven image-based disease detection and automated diagnosis are not widely implemented.

9. SCALABILITY AND INFRASTRUCTURE CONSTRAINTS
Many agricultural platforms operate only at pilot or regional levels. Limited backend infrastructure, scalability issues, and inconsistent internet connectivity restrict large-scale deployment.

10. DATA SECURITY AND TRUST ISSUES
Farmers are often hesitant to share personal and farm-related data due to concerns about data privacy, misuse of information, and the absence of transparent data governance policies.

IV. CONCLUSION

Crop Connect AI offers an integrated, AI-driven approach to addressing key challenges in the agricultural ecosystem. By combining direct market access, predictive price analytics, intelligent advisory services, and social connectivity within a single platform, the system enables farmers to make informed decisions and engage in transparent trade. The proposed solution demonstrates significant potential to improve operational efficiency, enhance farmer profitability, and support sustainable agricultural practices. Overall, Crop Connect AI contributes toward the development of a reliable and scalable digital framework for modern agriculture.

V. APPENDIX

This section provides supplementary information related to the Crop Connect AI system and briefly describes the system modules, algorithms, and technologies used.

SYSTEM MODULES: The system consists of user management, marketplace functionality, AI-based price prediction, crop disease detection, an intelligent RAG-based chatbot, and real-time communication features.

Algorithms Used: Linear Regression and Random Forest models are employed for price prediction, Convolutional Neural Networks (CNN) are used for crop disease detection, the Haversine algorithm supports location-based farmer and service matching, and a Retrieval-Augmented Generation (RAG) model combined with Large Language Models (LLMs) provides intelligent advisory services.

Technology Stack: The frontend is developed using React.js and Next.js, the backend is implemented using Python with Fast API, and data is stored using PostgreSQL and Firebase. Machine learning models and LLMs are utilized to enable AI-driven functionalities.

This appendix enhances the understanding of the proposed system without affecting the core discussion of the research.

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REFERENCES

(PERIODICALSTYLE)

[1] A. Sharma, R. Patel, and S. Verma, “Machine learning applications for precision agriculture: A comprehensive review,” *IEEE Access*, vol. 9, pp. 48452–48467, Mar. 2021.

[2] R. Gupta, P. Kumar, and S. Mishra, “Weather-based crop prediction in India using big data analytics,” *IEEE Access*, vol. 9, pp. 132245–132258, Aug. 2021.

[3] N. Singh, R. Sharma, and K. Jain, “Scaling AI-powered agricultural services for smallholder farmers,” *ACM Trans. Intelligent Systems and Technology*, vol. 15, no. 2, pp. 1–22, Feb. 2024.

[4] R. J. Murugan, S. Prakash, and A. Kumar, “Artificial intelligence: The promise for an agricultural revolution,” *Agriculture Update*, vol. 15, no. 4, pp. 512–520, 2020.

[5] W. Ma, J. Liu, and Y. Zhou, “Linking farmers to markets: Barriers, solutions, and policy implications,” *Australasian Agribusiness Review*, vol. 32, pp. 1–18, 2024.

[6] P. K. Shukla and R. K. Dubey, “Smart agriculture market using IoT and artificial intelligence,” *Int. J. Innovative Research in Computer and Communication Engineering*, vol. 10, no. 5, pp. 2310–2317, May 2022.

[7] M. R. Patel and A. D. Deshmukh, “AI-based crop prediction and price forecasting system for farmers,” *Int. J. Advanced Research in Computer Science*, vol. 13, no. 4, pp. 45–51, 2022.

[8] S. Singh and A. Sharma, “Farmer-to-consumer digital marketplace: Bridging the agricultural gap,” in *Proc. IEEE Int. Conf. Smart Technologies for Smart Nation*, 2021, pp. 120–125.

[9] N. Kaur and S. Gupta, “Enhancing agricultural trade using blockchain and machine learning,” *Journal of Emerging Technologies and Innovative Research*, vol. 8, no. 10, pp. 56–63, Oct. 2021.

[10] P. S. More and V. R. Patil, “Design and implementation of digital agriculture using AI techniques,” *International Journal of*

Computer Applications, vol. 184, no. 17, pp. 25–29, 2022.

[11] R. Doshi, S. Shah, and A. Patel, "Agro Consultant: Intelligent crop recommendation system," in *Proc. IEEE Int. Conf. Computing, Communication, Control and Automation*, 2018, pp. 1–6.

[12] N. Gandhi, P. Patel, and R. Mehta, "Rice crop yield prediction in India using SVM," *Journal of Computer Science and Software Engineering*, vol. 7, no. 3, pp. 145–150, 2016.

[13] T. Daum, J. Buchwald, and R. Birner, "Uber for tractors? Opportunities and challenges of digital tools for tractor hire," *World Development*, vol. 144, pp. 105–118, 2021.

[14] M. Evouna, J. Mbarga, and L. Tchamda, "Sustainable food systems and market governance," *Frontiers in Sustainable Food Systems*, vol. 8, pp. 1–14, 2024.

[15] A. Reddy and B. Babu, "Survey on weather prediction using big data analytics," in *Proc. IEEE Int. Conf. Electrical, Electronics, Communication and Computer Technologies*, 2017, pp. 1–5.

[16] Z. Balhara and S. Dahiya, "Role of digital platforms in connecting farmers to markets," *Vigyan Varta*, vol. 6, no. 2, pp. 35–40, 2025.

[17] N. Manogna and R. L. Reddy, "Determinants of small farmers' access to online markets," *SN Business & Economics*, vol. 5, no. 1, pp. 1–18, 2025.

[18] P. D. Sonawane, V. S. Gholap, O. D. More, Y. S. Rathore, and S. B. Punjabi, "Farmer-to-farmer marketplace," *International Journal of Innovative Research in Technology (IJIRT)*, vol. 12, no. 6, pp. 2057–2059, Nov. 2025.

[19] Digital Green, "LOOP: Pooling technology and extension networks for market access," *Digital Green Brief*, pp. 1–12, 2017.

[20] IFPRI, "Generative AI for agriculture (GAIA) project," *IFPRI Report*, 2025.

[21] Open AI and Digital Green, "Building agricultural databases for farmers," *Open AI Index*, 2024.

[22] R. J. Vidmar, "On the use of atmospheric plasmas as electromagnetic reflectors," *IEEE Trans. Plasma Science*, vol. 21, no. 3, pp. 876–880, Aug. 1992.

[23] H. Balabaygloo and M. Alipour, "Smart connected farms and networked farmers," *ar Xiv preprint arXiv:2312.12338*, 2024.

[24] Z. Ma and Y. Zhou, "Digital agriculture platforms and farmer inclusion," *Agricultural Economics Review*, vol. 29, no. 2, pp. 89–101, 2024.

[25] M Farm Kenya, "Mobile-based market pricing and group selling for farmers," *Wired Magazine*, 2012.

[26] e-Choupal, "Digital market access for Indian farmers," ITC Ltd., 2015.

[27] R. Lin, M. Wu, and J. Bloom, "Data-driven analytics for agricultural marketplaces," *IEEE Trans. Information Systems*, vol. 18, no. 4, pp. 340–350, 2020.

[28] A. K. Jain and S. Verma, "AI-based demand forecasting in Agri-markets," *International Journal of Data Science*, vol. 6, no. 3, pp. 211–220, 2022.

[29] S. Mehta, "A review on smart agriculture using IoT and AI," *International Research Journal of Engineering and Technology*, vol. 9, no. 6, pp. 1505–1511, Jun. 2022.

[30] R. Kumar and P. Singh, "AI-enabled marketplaces for sustainable agriculture," *Journal of Smart Systems*, vol. 11, no. 1, pp. 25–34, 2023.

[31] J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility," *IEEE Trans. Electron Devices*, vol. ED-11, pp. 34–39, Jan. 1959.