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Farmer to Customer: AI-Powered Platform

[1]K Hema, [2]Efsha Perveen, [3]Grecy Suman, [4]Shyant Pandey, [5]Prakash Singh Badal

Department of CSE, Siddharth Institute of Engineering and Technology, Puttur, Andhra Pradesh, India
[1]goldenhema@gmail.com, [2]efshaperveen10@gmail.com, [3]grecysingh2416@gmail.com, [4]pandeyshyant6207@gmail.com, [5]prakashsinghyy00@gmail.com

Abstract: The Farmer to Customer (F2C) AI-powered platform has been set up as a web application aimed at filling the gap between farmers and customers with AI. On the portal, a competent user interface, farmers and customers interact. Farmers can register, log in, add and manage crops, view and manage orders, and track order histories. In addition to this, an AI chatbot implemented using the Gemini API assists users in real-time and resolves issues. Customers register, log in, view crops, place orders, track order history, and chat with the chatbot for a customized experience. MERN assures the highest performance, scalability, and security of data management on this F2C platform. Apart from that, MongoDB, a NoSQL database, stores user records, crop records, and order records. The backend is powered by ExpressJS and NodeJS and manages user authentication, order processing, and API interaction, while ReactJS will be the frontend to provide a highly interactive and responsive user interface. The platform provides farmers and customers with seamless, efficient, and user-friendly interfaces to optimize crop sales, order management, and interaction through cutting-edge AI technology. Functionality adds an intelligent layer with conversational support to engage with users more effectively.

Keywords: Farmer to Customer, Crop Management, MERN Stack, User Authentication, Farmer-Customer Interaction.

1 INTRODUCTION

Agriculture plays a vital role in the economic development of many countries, especially in developing nations like India, where a large percentage of the population depends on farming for livelihood. However, despite its importance, the agricultural supply chain still suffers from several inefficiencies, such as dependency on intermediaries, lack of price transparency, delayed communication between farmers and customers, and limited access to digital platforms. These challenges often reduce farmers' profits and create barriers for customers in accessing fresh agricultural products directly from producers. With the rapid advancement of Artificial Intelligence (AI), cloud computing, and web-based technologies, digital agricultural platforms are emerging as effective solutions to bridge the gap between farmers and consumers. These platforms help eliminate middlemen, improve communication efficiency, enhance transparency in transactions, and provide better control over crop marketing and order management. In recent years, AI-powered applications have significantly contributed to improving agricultural productivity, decision-making processes, and user interaction experiences through intelligent automation and predictive capabilities.

The Farmer to Customer (F2C) AI-powered platform is designed as a web-based solution that directly connects farmers with customers using modern web technologies and artificial intelligence support. The platform enables farmers to register, manage crop inventory, track orders, and monitor customer feedback efficiently through a secure digital interface. At the same time, customers can browse available crops, place orders, track delivery status, and communicate with farmers easily through an integrated system. This direct interaction reduces dependency on intermediaries and improves transparency in agricultural transactions. The proposed system is developed using the MERN stack, which includes MongoDB, ExpressJS, ReactJS, and NodeJS. MongoDB serves as the NoSQL database for storing crop details, user profiles, and order history efficiently. ExpressJS and NodeJS handle backend processing, authentication mechanisms, and API communication, while ReactJS provides a dynamic and responsive frontend interface that enhances user experience. The use of the MERN stack ensures scalability, flexibility, and secure data handling within the system.

A key feature of the proposed platform is the integration of an AI-powered chatbot using the Gemini API. The chatbot provides real-time assistance to both farmers and customers by answering queries, guiding users during crop browsing and ordering processes, and improving overall interaction efficiency. This intelligent conversational support enhances usability and reduces operational complexity for platform users. The main objective of the proposed Farmer to Customer platform is to establish a transparent, efficient, and user-friendly agricultural marketplace that improves communication between farmers and consumers while optimizing crop sales and order management processes. By integrating artificial intelligence with modern web technologies, the system contributes to the development of a smart agricultural ecosystem that supports digital transformation in the farming sector.

2 Literature Survey

The integration of artificial intelligence (AI), Internet of Things (IoT), fog computing, cloud platforms, and robotic automation is transforming modern agriculture into a data-driven and intelligent ecosystem. Recent research highlights the increasing importance of algorithm-driven decision-making frameworks that enhance sustainability and productivity in agri-food systems. In this context, Gupta [1] discussed the role of AI-augmented sustainability management in agri-food supply chains and emphasized how algorithmic intelligence supports improved resource optimization, predictive analytics, and environmentally responsible agricultural practices. The study highlighted that AI-based decision frameworks enable farmers and supply-chain stakeholders to manage uncertainties more efficiently while improving transparency and traceability across production and distribution networks.

Precision agriculture relies heavily on smart sensing technologies and distributed computing architectures. Akhtar et al. [2] reviewed the role of edge computing integrated with smart sensing platforms for soil assessment and heavy metal monitoring in agricultural environments. Their work demonstrated how edge-enabled IoT devices reduce latency in data processing and improve real-time decision-making capabilities in precision farming applications. Similarly, Altarturi et al. [3] conducted a bibliometric and content analysis focusing on technological advancements in agricultural e-commerce systems. Their study revealed that digital platforms and online agricultural marketplaces significantly improve market accessibility for farmers while supporting efficient supply chain communication and pricing transparency.

Cloud computing technologies further strengthen agricultural data management and scalability. Hasan et al. [4] explored the transition toward cloud computing as a continuum of services supporting agricultural analytics, remote monitoring, and storage infrastructure. The authors identified major opportunities in adopting hybrid cloud environments for agricultural data processing while also addressing challenges related to security, interoperability, and infrastructure readiness. Complementing cloud systems, fog computing plays an essential role in improving computational efficiency closer to field-level operations. Raghavendra et al. [5] proposed an energy-efficient dynamic service placement framework in IoT–fog environments that enhances service reliability and reduces computational delays. Their approach demonstrated improved deadline-aware processing performance for distributed agricultural sensor networks.

Fog computing applications have also been extended to smart grid-based agricultural communities. Jaiswal et al. [6] examined the implementation of fog computing for realizing smart neighborhood infrastructures within smart grids. Their study showed how decentralized processing nodes support efficient monitoring and energy distribution in agriculture-based rural ecosystems. Furthermore, Mostafa [7] proposed a neural network-based resource selection service in fog computing environments, which enables optimized allocation of computational resources across distributed agricultural monitoring platforms. Such intelligent resource management frameworks improve the scalability and responsiveness of IoT-enabled agricultural services.

Automation through robotics has become another significant research direction in precision agriculture. Arab et al. [8] presented a comprehensive coverage path planning strategy for wheeled agricultural robots used in field operations such as crop monitoring, spraying, and harvesting. Their approach ensured efficient navigation and coverage optimization across large agricultural areas while minimizing energy consumption and operational redundancy. These robotic systems demonstrate the growing importance of autonomous technologies in reducing manual labor dependency and increasing operational precision in modern farming practices. Agricultural research has also emphasized interdisciplinary advancements integrating allied sciences with digital technologies. Almoselhy et al. [9] discussed emerging research trends in agriculture and allied sciences, highlighting the integration of advanced sensing technologies, environmental monitoring systems, and intelligent crop management platforms. Their work illustrated the importance of collaborative innovation in improving agricultural productivity while maintaining ecological sustainability.

In addition, data communication remains a fundamental component of IoT-based agricultural monitoring systems. Ari et al. [10] reviewed data collection architectures, protocols, and communication strategies in IoT networks and emphasized the importance of efficient routing mechanisms and low-power communication technologies for supporting large-scale agricultural sensor deployments. The adoption of AI technologies by farmers is influenced not only by technical feasibility but also by socio-economic and institutional factors. Shuliang et al. [11] investigated farmers' perceptions regarding AI adoption and highlighted the role of government support in facilitating value co-creation between farmers and policymakers. Their findings indicated that institutional encouragement and awareness programs significantly improve technology acceptance among farming communities.

Similarly, Cimino et al. [12] explored the behavioral intentions of small-scale farmers toward adopting digital agricultural platforms. Their research emphasized that usability, perceived benefits, and trust in digital infrastructure play critical roles in shaping farmers' willingness to adopt intelligent agricultural ecosystems. Mobile-based agricultural extension services further enhance knowledge dissemination among farmers in emerging economies. Verma [13] examined the role of mobile-enabled agricultural advisory systems in generating customer wealth among bottom-of-the-pyramid (BOP) farmers.

The study demonstrated that mobile-based platforms improve farmers' access to real-time agricultural information, weather forecasts, crop advisory services, and market price updates, thereby strengthening decision-making capabilities and economic outcomes. Such mobile-enabled solutions represent an important step toward inclusive digital transformation in agriculture. The reviewed literature highlights that integrating AI, IoT, fog computing, robotics, cloud platforms, and mobile advisory systems creates a robust technological foundation for next-generation smart agriculture. These technologies collectively enhance operational efficiency, sustainability, decision intelligence, and farmer engagement. However, challenges related to infrastructure availability, interoperability, adoption barriers, and data security still require further investigation. Future research directions may focus on developing integrated intelligent agricultural frameworks that combine sensing, analytics, automation, and communication technologies into unified precision farming ecosystems capable of addressing emerging agricultural demands.

3 PROPOSED METHOD

The Farmer to Customer (F2C) AI-powered platform is a direct connecting structure for farmers and consumers without intermediaries. Hence, farmers can manage crops, view orders, and track sales; consumers can browse, order, and view their order history. The platform integrates an AI-powered chatbot for real-time support using the Gemini API. This means more efficiency and less cost to the customer on both ends of the process, with added benefits of communication, streamlining operations, and automating operations on both ends. Fig. 1 show the block diagram of the proposed method.

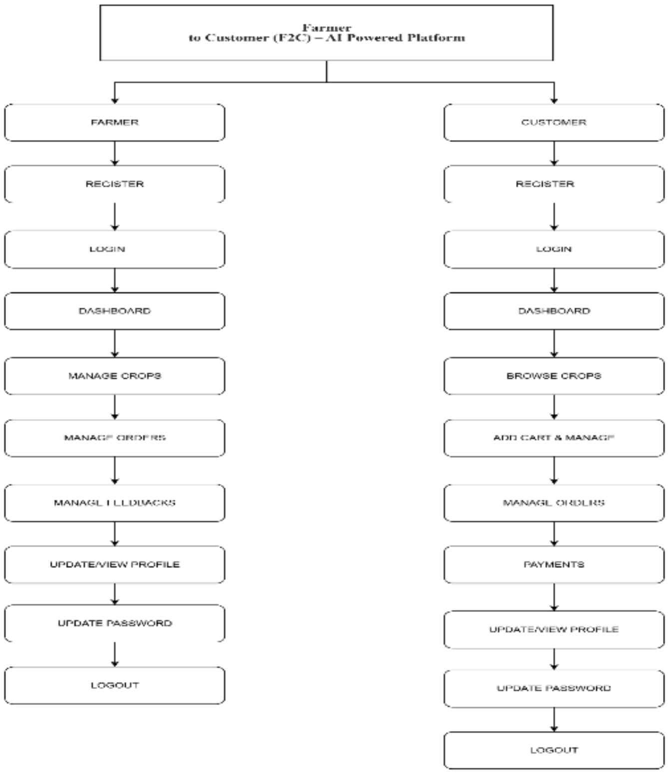

Fig. 1. Block Diagram for Proposed Method

- **Farmer:** Registered and logged-in farmers can manage their crops and orders on the platform. New crops can be added and existing crops updated by the farmers. Farmers can keep track of inventory and customer orders and handle processing and shipping information. The platform also has an AI-driven chatbot integrated with the Gemini API that offers instantaneous assistance with crop management, order queries, and customer interaction. Farmers keep an eye on trends in sales and customer preferences by reviewing past orders and past transactions. The secure login and logout procedure guarantees that their account and data remain protected.

- **Customers:** Customers can register and log in to browse the listed crops by farmers. They can proceed to view crop details, including price, availability, and type. Further to selecting the required crops, customers can place orders with time to pay for them. The platform also has a history feature available for customers to track their previous orders, including order status and delivery details. The AI chatbot lends real-time support in assisting the customer to process the order, recommend crops, and answer questions. Customers can log in and log out securely, ensuring that their information remains safe.

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3.1. Methodology

The "Farmer to Customer (F2C) – AI Powered Platform" has been developed by following a systematic approach using the MERN stack (MongoDB, Express, ReactJS, NodeJS) for purposes of performance enhancement, scalability, and secure data management. The following methodology depicts the steps taken for the building and implementation of the platform:

- **Requirements Gathering and Analysis:** In the beginning, there was a need to identify the different needs of farmers and customers, key features, and the objectives of the platform. These include simple procurement of crops, order tracking, real-time support using an AI-powered chatbot, and secure interactions among the users.

- **UI/UX Design:** A user-friendly and responsive design was created for both farmer and customer interfaces, ensuring ease of navigation and interaction. Wireframes and prototypes were built for farmer and customer modules, such as crop listing, order management, and history tracking.

- **Database Schema:** MongoDB was used as the NoSQL database to store user data (farmers and customers), crop information, and order details. The schema was designed to ensure data integrity and quick retrieval of information.

- **Backend (Node.js & Express.js):** The backend handles user authentication, crop data management, and order processing. RESTful APIs were developed using Node.js and Express.js to support communication between the frontend and database. Secure authentication mechanisms, such as JWT (JSON Web Tokens), were implemented for both farmers and customers.

- **Frontend (React.js):** The frontend was built with React.js to ensure a dynamic and responsive user experience. The frontend allows users to register, log in, view crops, place orders, and interact with the AI chatbot. React's component-based architecture ensures reusability and maintainability.

- **AI-Powered Chatbot Integration:** The platform integrates the Gemini API to power the AI chatbot. This chatbot offers real-time assistance, answering queries related to crop management, orders, and customer interactions. The AI provides personalized recommendations to customers and helps farmers with operational tasks.

3.2. Modules And Their Implementation

Farmer-Side:

1. Register: Farmers can register on the platform after furnishing their personal and farm details so as to begin listing their crops for sale.
2. Login: Farmers can securely log in to their accounts to access the dashboard and undertake farming operations.
3. Dashboard: This is a centralized interface where farmers can view quick stats, recent activity, and navigate to crops, orders, and feedback management.
4. Managing Crops: Farmers can add new crops, update details, and manage inventory accordingly so that the listings remain updated and accurate.
5. Managing Orders: Farmers can view customer orders, update order status, manage availability, and shipping or delivery instructions.
6. Managing Feedback: Farmers can view feedback from customers and respond to reviews, thus allowing transparent communication and enhancing customer trust.
7. Update/View Profile: Farmers can view or edit their profile info, such as contact details, farm name, and business description.
8. Update Password: Farmers can change their password to a new one securely.
9. Logout: A farmer can log out of the platform when the session is completed, ensuring account safety.

Customer Side:

1. Register: Customers will sign up on the platform to be able to browse for crops, put items into their cart, and place orders.
2. Login: Customers will log into their accounts in order to place orders, view their profile, and otherwise interact with the platform.
3. Dashboard: A panel where customers may download the status of their orders, recent purchases, and jump to key features.
4. Browse Crops: Customers can browse the crops put forth by the farmers along with information on price, crop type, and availability.
5. Add to Cart and Manage: Add desired crops to the cart while adjusting quantities and preparing the order for checkout.

6. Manage Orders: Track the status of placed orders, view shipping information, and cancel or raise inquiries regarding the orders.
7. Payments: A secured interface allowing consumers to finalize payment for their orders of crops.
8. Feedback Management: Farmers may provide customer feedback and oversee responses to reviews.
9. Update/View Profile: Customers will view or update their profile information, such as their address, phone number, and preferences.
10. Update Password: Customers can change their password to enhance the security of their accounts.
11. Logout: This is where customers can leave the platform.

4 RESULTS AND DISCUSSION

The Farmer to Customer (F2C) AI-powered platform was successfully developed and tested using the MERN stack architecture. The system integrates farmer modules, customer modules, crop management functionalities, order tracking mechanisms, and an AI-powered chatbot to ensure efficient interaction between farmers and customers. The experimental results demonstrate that the proposed platform provides a user-friendly interface, a secure authentication system, and an efficient crop transaction workflow.

Landing Page

The landing page serves as the entry interface of the platform, where both farmers and customers can access registration and login features. The interface is designed using ReactJS to provide a responsive and interactive experience. The landing page allows new users to create accounts and existing users to securely log in to the system using authentication credentials. Fig. 2 shows the loading page.

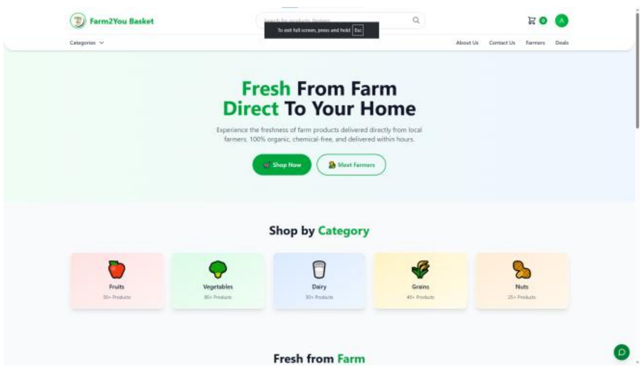

Fig. 2. Loading Page

Farmer Registration and Login Module

The farmer registration module allows farmers to enter their personal details and crop-related information to create accounts on the platform. After successful registration, farmers can securely log in to the dashboard to manage their crop listings and monitor order activities. The authentication mechanism ensures secure access to farmer accounts. Fig. 3 shows the farmer registration page. Fig. 4 shows the farmer login page.

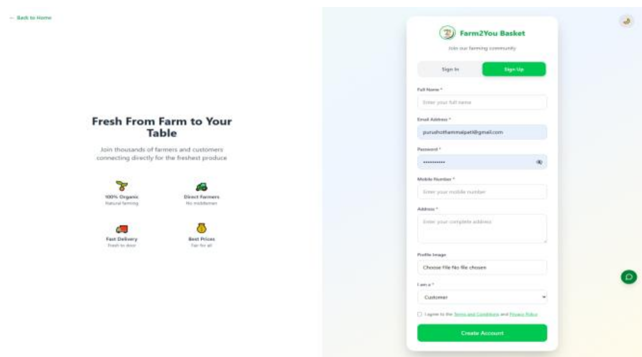

Fig. 3. Farmer Registration Page

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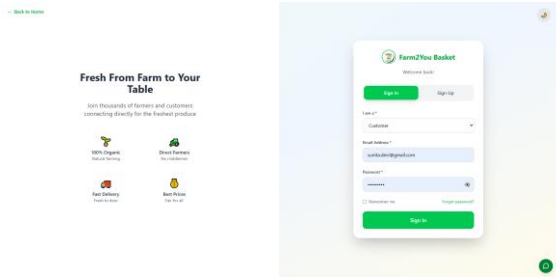

Fig. 4. Farmer Login Page

Farmer Dashboard

The farmer dashboard provides a centralized interface where farmers can manage crops, track orders, and monitor feedback received from customers. The dashboard improves operational efficiency by presenting all important activities in a single interface. Fig. 5 shows the farmer dashboard page.

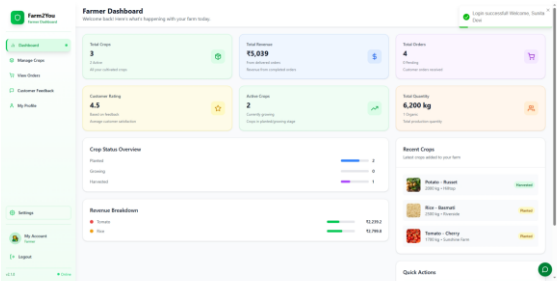

Fig. 5. Farmer Dashboard Page

Crop Management Module

The crop management module enables farmers to add new crops, update crop details, and manage crop availability dynamically. Farmers can modify pricing information, crop types, and inventory levels, ensuring accurate product listings for customers. Fig. 6 shows the crop management page.

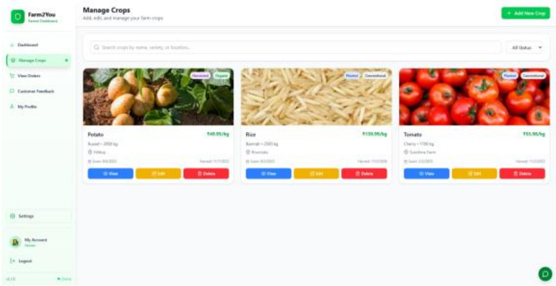

Fig. 6. Crop Management Page

Order Management Module

The order management interface allows farmers to track customer orders, update delivery status, and manage shipping information. This module improves transparency in transactions and ensures efficient communication between farmers and customers. Fig. 7 shows the order management page.

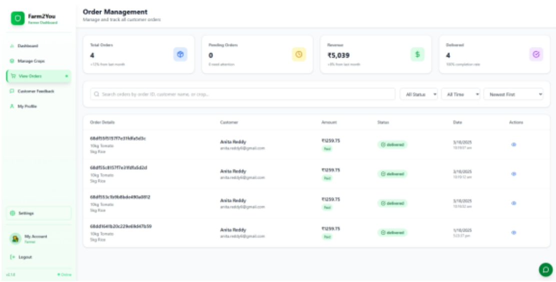

Fig. 7. Order Management Page

Feedback Management Module

The feedback module enables farmers to review customer responses and suggestions regarding crop quality and delivery services. This feature improves trust and enhances communication transparency between stakeholders. Fig. 8 shows the feedback page.

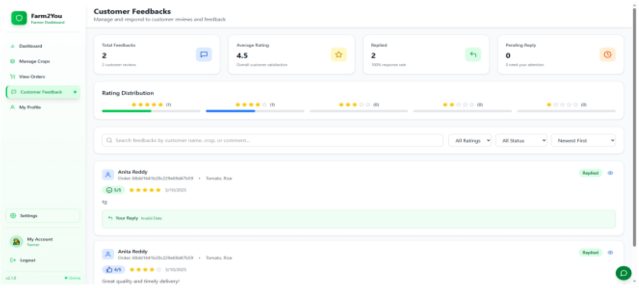

Fig. 8. Feedback Page

Customer Dashboard

The customer dashboard provides access to crop browsing, order tracking, and chatbot interaction features. Customers can easily navigate through available crops and monitor their order activities. Fig. 9 shows the customer feedback page.

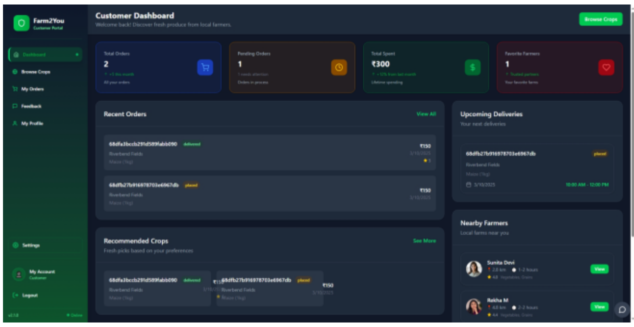

Fig. 9. Customer Page

Crop Browsing Module

The crop browsing interface allows customers to explore crops listed by farmers along with price details, crop types, and availability status. This module simplifies the crop selection process. Fig. 10 shows the crop browsing page.

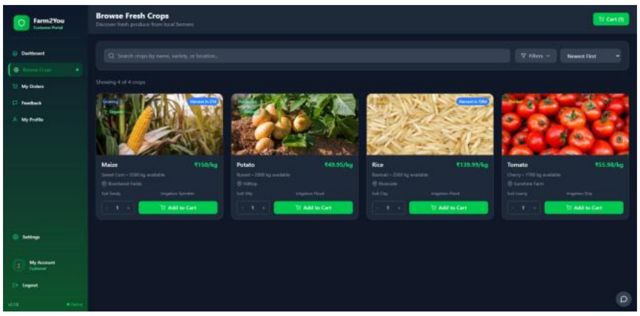

Fig. 10. Crop Browsing Page

Cart and Order Placement Module

Customers can add selected crops to the cart and proceed with order placement through a secure interface. The system allows users to modify quantities before confirming orders. Fig. 11 presents the crop management page.

AI Chatbot Integration

The AI-powered chatbot integrated using the Gemini API provides real-time conversational support to both farmers and customers. The chatbot assists users in navigating platform features, answering queries related to crop availability, and guiding them through order placement processes. This intelligent interaction improves user satisfaction and enhances overall platform usability. Fig. 12 presents the AI chatbot integration page.

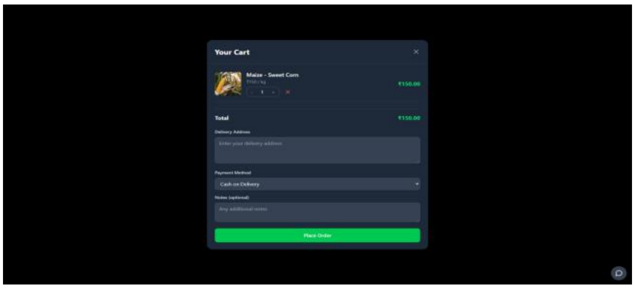

Fig. 11. Cart Management Page

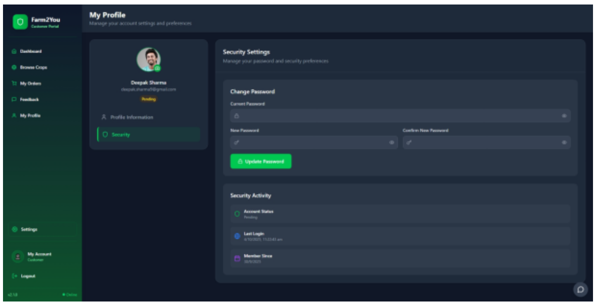

Fig. 12. Chatbot Integration Page

5 Conclusion

The paper fulfils the middle ground between farmers and customers by employing AI to realize communication enhancement and transaction smoothing. With an intuitive design, the application lets farmers make crop and order management, while customers have a tailor-made shopping experience through the AI Chatbot. Being MERN stack-based, it guarantees robust performance, scalability, and secure data management. Henceforth, the platform serves to optimize the selling of crops, order management, and interaction with the user, thereby bringing the entire agricultural supply chain higher, thus creating a modern and efficient marketplace for farmers and customers. The future holds ample scope for expansion of the Farmer to Customer (F2C) AI-powered platform. Enhancements in this regard would incorporate machine learning algorithms to forecast crop demand, suggest optimal prices, and streamline supply chain logistics. Coupling the platform with IoT devices would allow crop health and yield estimates to be tracked in real time. Inclusion of international and regional-language support could serve to make the platform more accessible to a broader array of users. Other implications for improvements include blockchain use for transparent transactions and certifications, instilling greater confidence and security in the agricultural ecosystem, and fostering the development of more sustainable and efficient platforms.

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Ethics Statement

This study did not involve human or animal subjects and, therefore, did not require ethical approval.

Statement Of Conflict Of Interests

The authors declare that they have no conflicts of interest related to this study.

References

[1] S. K. Gupta, "AI-augmented sustainability management in agri-food supply chain: rethinking decision-making in the era of algorithms," *Journal of Agribusiness in Developing and Emerging Economies*, pp. 1–16, Jan. 2026, doi: 10.1108/jadee-09-2025-0412.

[2] M. N. Akhtar, A. J. Shaikh, A. Khan, H. Awais, E. A. Bakar, and A. R. Othman, "Smart Sensing with Edge Computing in Precision Agriculture for Soil Assessment and Heavy Metal Monitoring: A Review," *Agriculture*, vol. 11, no. 6, p. 475, May 2021, doi: 10.3390/agriculture11060475.

[3] H. H. M. Altarturi, A. R. M. Nor, N. I. Jaafar, and N. B. Anuar, "A bibliometric and content analysis of technological advancement applications in agricultural e-commerce," *Electronic Commerce Research*, vol. 25, no. 2, pp. 805–848, Jan. 2023, doi: 10.1007/s10660-023-09670-z.

[4] Md. M. Hasan *et al.*, “The journey to cloud as a continuum: Opportunities, challenges, and research directions,” *ICT Express*, vol. 11, no. 4, pp. 666–689, May 2025, doi: 10.1016/j.icte.2025.04.015.

[5] M. S. Raghavendra, P. Chawla, and S. S. Gill, “DEEDSP: Deadline-aware and energy-efficient dynamic service placement in integrated Internet of Things and fog computing environments,” *Transactions on Emerging Telecommunications Technologies*, vol. 32, no. 12, Oct. 2021, doi: 10.1002/ett.4368.

[6] R. Jaiswal, R. Davidrajuh, and C. Rong, “Fog computing for realizing smart neighborhoods in smart grids,” *Computers*, vol. 9, no. 3, p. 76, Sep. 2020, doi: 10.3390/computers9030076.

[7] N. Mostafa, “Resource selection service based on neural network in Fog environment,” *Advances in Science Technology and Engineering Systems Journal*, vol. 5, no. 1, pp. 408–417, Feb. 2020, doi: 10.25046/aj050152.

[8] D. P. Arab, M. Spisser, and C. Essert, “Complete coverage path planning for wheeled agricultural robots,” *Journal of Field Robotics*, vol. 40, no. 6, pp. 1460–1503, May 2023, doi: 10.1002/rob.22187.

[9] R. I. M. Almoselhy, R. Chandran, and S. J. A. J. Mary, “Current Trends in Agriculture & Allied Sciences (Volume-1),” Jul. 14, 2023. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4512943

[10] A. A. A. Ari *et al.*, “Data collection in IoT networks: Architecture, solutions, protocols and challenges,” *IET Wireless Sensor Systems*, vol. 14, no. 4, pp. 85–110, Jun. 2024, doi: 10.1049/wss2.12080.

[11] Z. Shuliang, E. Brentuo, E. M. Horsey, and B. A. Osei, “Farmers’ perceptions and government-farmer value co-creation: The roles of artificial intelligence adoption and government support,” *International Journal of Innovation Studies*, vol. 10, no. 2, p. 100165, Nov. 2025, doi: 10.1016/j.ijis.2025.10.004.

[12] A. Cimino, I. M. Coniglio, V. Corvello, F. Longo, J. K. Sagawa, and V. Solina, “Exploring small farmers behavioral intention to adopt digital platforms for sustainable and successful agricultural ecosystems,” *Technological Forecasting and Social Change*, vol. 204, p. 123436, May 2024, doi: 10.1016/j.techfore.2024.123436.

[13] P. Verma, “Generating customer wealth by mobile-based agricultural extension services: BOP farmers in the emerging markets,” *Journal of Science and Technology Policy Management*, vol. 16, no. 9, pp. 1473–1496, May 2024, doi: 10.1108/jstpm-06-2023-0091.