RESEARCH ARTICLE

RSP Science Hub

AGRI CONNECT - A Transparent Digital Marketplace for Empowering Farmers and Bridging Agricultural Products

Dr. S Mohana[1], Sudarsan Sathishkumar[2], Surendran B R[3], Reneil Joshua S[4], Vignesh S[5]

[1]*Professor – Computer Science and Engineering, Saranathan College of Engineering, Trichy, Tamil Nadu, India*

[2,3,4,5] *UG - Computer Science and Engineering, Saranathan College of Engineering, Trichy, Tamil Nadu, India*

Emails: *mohana-cse@saranathan.ac.in[1], sudarsansathish17@gmail.com[2], surendran210703@gmail.com[3], reneiljoshua28@gmail.com[4], vickyselvaraj977@gmail.com[5]*

Abstract
Agri Connect is a web-based platform designed to revolutionize the agricultural ecosystem by seamlessly connecting farmers, input sellers, and customers. The platform consists of three core modules: Input Sellers, Farmers, and Customers. The Input Sellers module enables vendors to list essential products such as equipment, fertilizers, and livestock, allowing farmers to connect, negotiate, and purchase directly. The Farmers module provides a Story System for tracking crop-related events and a Ledger System for managing financial transactions, ensuring complete visibility into farming operations. The Customers module facilitates transparent, direct purchasing from farmers, incorporating a Negotiation System to promote fair pricing. AgriConnect enhances the agricultural marketplace with Invoice Management, generating invoices after successful payments and automatically mailing them to users. It supports Stock Management, helping farmers track product availability efficiently. The Expert Connect feature enables farmers to consult agricultural professionals for guidance, while an integrated API Logger tracks platform activity for better system monitoring. Additionally, Razorpay integration ensures seamless and secure payment processing. By promoting transparency, optimizing resource utilization, and empowering farmers with digital tools, AgriConnect aims to create a fair, efficient, and technology-driven agricultural marketplace.

1. Introduction

Agriculture remains the backbone of many economies, providing livelihoods for millions and sustaining food security. However, traditional agricultural trade and supply chains suffer from inefficiencies such as price manipulation, lack of transparency, delayed payments, and dependence on multiple intermediaries. Farmers often struggle to access high-quality agricultural inputs, maintain financial stability, and directly connect with consumers, leading to market exploitation. In recent years, advancements in precision agriculture, blockchain-enabled traceability, AI-driven crop monitoring, and digital marketplaces have started transforming the agricultural sector. While these

technologies aim to streamline farming operations and improve profitability, many existing solutions either focus on isolated aspects of agriculture or fail to provide an end-to-end marketplace where farmers, input sellers, and consumers can interact seamlessly. To address these challenges, this work introduces AgriConnect, a MERN stack-based AgriTech digital platform designed to connect key agricultural stakeholders in a structured and efficient ecosystem. Unlike conventional models, AgriConnect integrates a dedicated module for input sellers, enabling them to supply authentic agricultural products such as seeds, fertilizers, and machinery at fair prices. At the same time, farmers can sell their harvested products directly to consumers with features like real-time negotiation, robust authentication and authorization, invoice generation, and stock management ensuring transparency and efficiency. Other proposed solutions do not provide a comprehensive event and financial tracking system like AgriConnect's Story (Ledger & Event Management) System, which allows farmers to record their crop activities and track transactions effectively. Additionally, the Negotiation System ensures that farmers can engage in direct price discussions, eliminating unfair pricing practices. By integrating these features, AgriConnect aims to empower farmers, optimize resource utilization, and establish a seamless, transparent agricultural marketplace that leverages modern technology for sustainable growth. [1-3]

2. Literature Survey

Nitin M. Shivale, Dr. Parikshit Mahalle, Samiksha Kadam, Vedant Bhoge, Nikita Kale, and Pratik Koli in their 2024 study, "Implementing a New Framework to Sell Farmer Goods in Modern Era for Affordability & Profitability of Farmers & Consumers," addressed inefficiencies in the traditional vegetable supply chain, where intermediaries reduce farmers' profits and inflate consumer prices. To resolve this, they introduced a digital platform that enables direct farmer-to-consumer transactions, aiming to enhance affordability for consumers and profitability for farmers. The framework incorporated a vending machine system integrated with the supply chain to boost efficiency. While this approach offers fair pricing and reduces dependency on middlemen, it also poses challenges due to the high investment costs required for vending machines and potential resistance from stakeholders entrenched in traditional systems. Pritam Ramteke, Sandeep Pathak, Pooja Raut, Pradnya Sarade, and Naina Palandurkar in their 2025 study, "Development of Web-Based System for Farmers to Consumers," focused on eliminating the dependency on middlemen to establish direct connections between farmers and customers. Their web-based system aimed to empower farmers with real-time market data, profitability tracking, access to e-learning resources, and solutions to agricultural challenges. The platform emphasized direct farmer-to-customer transactions, supporting local language communication to enhance usability. The system's goal was to improve farmers' economic conditions by facilitating fair trade and better communication. However, concerns were noted regarding payment security, resistance from traditional intermediaries, and the logistical challenges of delivering produce directly to consumers. Aryan S. Nipane, Darshan B. Kadam, Herschel P. Pawar, Manish S. Thorat, and Madhuri Patil in their 2024 study, "Efficient Farmer to Consumer WebApp," proposed a MERN stack-based platform aimed at directly connecting farmers, consumers, and dealers. The system allowed farmers to list and promote their produce, consumers to browse and purchase fresh, local agricultural items, and dealers to market their agricultural supplies. By eliminating intermediaries, the platform focused on fostering transparent transactions and increasing efficiency across the supply chain. It enabled fair pricing, improved profit margins for farmers, and provided dealers with a focused marketplace. Despite its advantages, the system faced challenges such as payment security concerns, transportation logistics, and resistance from users accustomed to traditional sales channels. Dr. B. Jalendar, K. Nagaraju, Md Abdul Qadir, Md Khaja Naseeruddin Bhaba, and S. Ajay in their 2023 study, "Farmasite: A Web Application Portal Designed for Farmers", introduced an online platform aimed at connecting farmers directly with consumers. The application enabled farmers to list and sell produce such as fruits, vegetables, and grains, eliminating intermediaries to reduce labor costs and increase farmer income. Consumers benefited from access to fresh, locally sourced goods at reasonable prices. The platform incorporated features like easy product uploads, secure payment handling, location-specific searches, and order tracking to

enhance user experience. While the system streamlined agricultural trade and encouraged sustainable practices, it also presented challenges related to online transaction security, regulatory compliance, and the technical investment required for scalability. Vanditha M, Surendra R Hegde, Snehith K, Anitha S Prasad, and Eshwari A Madappa in their 2023 work, "Agricultural Supply Chain Management System Using Blockchain," proposed a decentralized solution using Ethereum blockchain and smart contracts to enable secure tracking and tracing of crops. The system eliminated the need for intermediaries and centralized authorities by storing transactions on an immutable ledger integrated with IPFS. While the approach ensured transparency and tamper-proof records, it posed challenges such as high energy consumption, fluctuating gas fees, and the risk of inaccurate data entry. Anurag Gangane, Jayesh Kavitkar, Akshay Uparikar, and Himani Kale, in their 2024 study "E-Commerce Platform for Farmers," proposed an online system that allows farmers to sell crops at self-determined prices and communicate directly with buyers. The platform helps farmers access modern agricultural practices, compare market rates, and track sales and profits. While it supports better pricing control and market reach for smallholder farmers, the system lacks secure transaction mechanisms and advanced features like inventory management and expert support, limiting its overall effectiveness. Wilm Fecke, Michael Danne, and Oliver Musshoff, in their 2018 study "E-Commerce in Agriculture," examined the willingness of German farmers to adopt e-commerce through a discrete choice experiment involving 165 participants. The findings revealed that lower prices and timely delivery are key drivers for adoption, while risk attitude, education, and prior online experience significantly influence willingness. Although insightful, the study is limited to a regional context and focuses narrowly on input purchases, lacking consideration of broader supply chain integration or multi-stakeholder ecosystems. Tao Chen, Liang Lv, Di Wang, Jing Zhang, Yue Yang, Zeyang Zhao, Chen Wang, Xiaowei Guo, Hao Chen, and Qingye Wang, in their 2024 study "Empowering Agrifood Systems with Artificial Intelligence," provided a detailed review of AI techniques in agriculture, animal husbandry, and fisheries. The study highlighted applications like classification, growth monitoring, yield prediction, and quality assessment, emphasizing AI's transformative potential. Hua Lu, Guo Sun, Laiyou Zhou, Weiyun Zhang, and Jinlang Zou, in their 2025 study "The Impact and Mechanism of E-Commerce of Agricultural Products," analyzed how e-commerce influences non-grain cultivation in rural China. The study found that digital platforms improve access to market data, encourage land-use shifts to profitable crops, and benefit large-scale and trained farmers. However, it mainly focuses on land-use optimization rather than full supply chain integration, and its China-specific context may limit broader applicability without localization. [4-7]

3. Problem Definition

Agriculture plays a vital role in sustaining economies and food security, yet farmers continue to face numerous challenges in the supply chain. Traditional agricultural trade systems are often inefficient, leading to price manipulation by intermediaries, lack of transparency, and financial instability for farmers. Small and medium-scale farmers struggle to access quality agricultural inputs at fair prices and lack direct market access to sell their produce. Additionally, consumers and businesses face difficulties in verifying the authenticity and quality of agricultural products.

Existing digital agricultural platforms attempt to bridge these gaps but lack essential features such as real-time negotiation, transaction security, and efficient stock management. Many platforms fail to provide farmers with proper financial tracking, event documentation, and invoice management, making it difficult to monitor their agricultural activities effectively. Furthermore, there is a lack of expert consultation and data-driven insights to help farmers optimize their productivity. To address these challenges, AgriConnect offers an integrated solution that connects farmers, input sellers, and customers in a seamless marketplace. By incorporating features such as Story (Ledger & Event Management) System, Negotiation System, Invoice Management System, Stock Management System, and Expert Connect, AgriConnect ensures transparency, financial accountability, and efficiency in agricultural trade. This platform eliminates unnecessary intermediaries, empowering farmers with direct access to quality inputs and a fair marketplace for selling their

produce. [8-10]

4. Proposed System Design
4.1. System Architecture

AgriConnect is designed using a modular and scalable architecture to ensure efficient data flow, secure transactions, and seamless interactions between different stakeholders—input sellers, farmers, and customers. The system is built using the MERN stack (MongoDB, Express.js, React.js, and Node.js) and follows a client-server architecture with RESTful APIs for smooth communication. The system is designed with role-based access control in-order to control and coordinate various user activities.

4.2. Signup and Login Module

In the signup process, new users begin by providing essential information such as their {full name, email address, password, user role (Farmer, Customer, or Input Seller), country, and contact number}. The password is hashed using the bcrypt algorithm before being stored in the database, ensuring that raw passwords are never saved directly. MongoDB is used to persist the user data, where the email field is uniquely indexed to avoid duplicate accounts. Depending on the user role and country-specific regulations, the platform enforces KYC verification. Only upon successful KYC verification can these users proceed to access role-specific functionalities. Figure 1 shows Login and Signup Flow Chart During login, users provide their registered email and password. The system first checks the existence of the email in the MongoDB user collection. If a matching record is found, the entered password is compared against the hashed version stored in the database using bcrypt.compare(). If authentication is successful, additional checks are performed, such as ensuring the user's KYC status is approved (if applicable) and verifying whether the account is active. Upon clearing these validations, the backend generates a secure JWT using the jsonwebtoken package. This token contains payload data like {user ID, role, token expiry time}, and is signed using a secret key defined in the environment configuration.
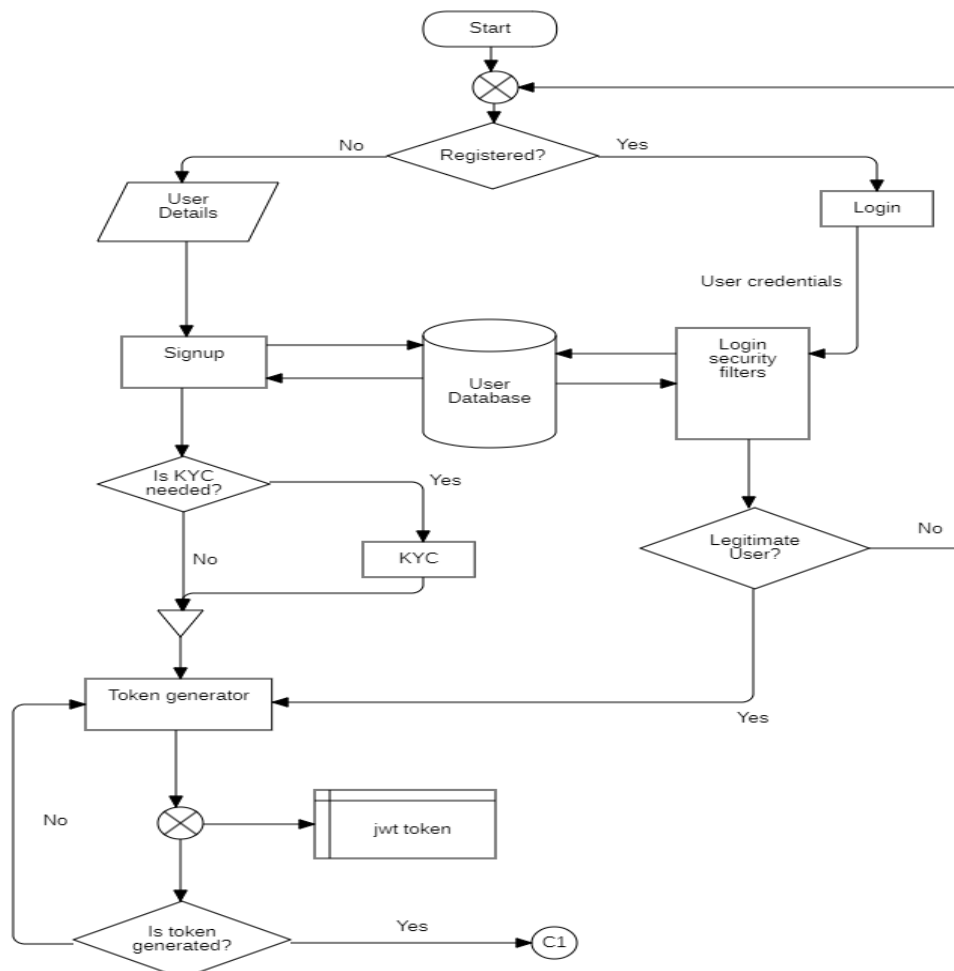
Figure 1 Login and Signup Flow Chart

4.3. Input Seller and Farmer Module

In the AgriConnect platform, Input Sellers and Farmers interact through a well-structured module that enables seamless agricultural transactions. Input Sellers are authorized users who can perform CRUD operations (Create, Read, Update, Delete) on their listed agricultural products such as seeds, fertilizers, pesticides, and machinery. These operations are handled via secure RESTful APIs, with all data persisted in the database using Mongoose models. Sellers can also initiate negotiations when a farmer shows interest in a product, leveraging real-time socket communication or request-based messaging to facilitate price discussions. Upon successful negotiation or direct purchase, the seller processes the order for delivery. On the other hand, Farmers login securely and are granted access to explore input products listed by various sellers. They can view product details, add items to their cart, and proceed to checkout. The cart supports single or multiple product purchases and is synchronized with the backend to reflect stock status. Farmers also have the option to initiate negotiation requests if the seller has enabled that feature for a product.

Beyond purchases, farmers are equipped with the Story System, which includes:

- Ledger Management.
- Event Logging.

Both modules are tightly integrated, allowing farmers to maintain a comprehensive digital record of their farming practices and expenditures. This flow ensures efficient inventory access for farmers and a structured sales channel for input sellers, all within a secured and authenticated environment. Figure 2 shows Input Seller-Farmer Use Case Diagram
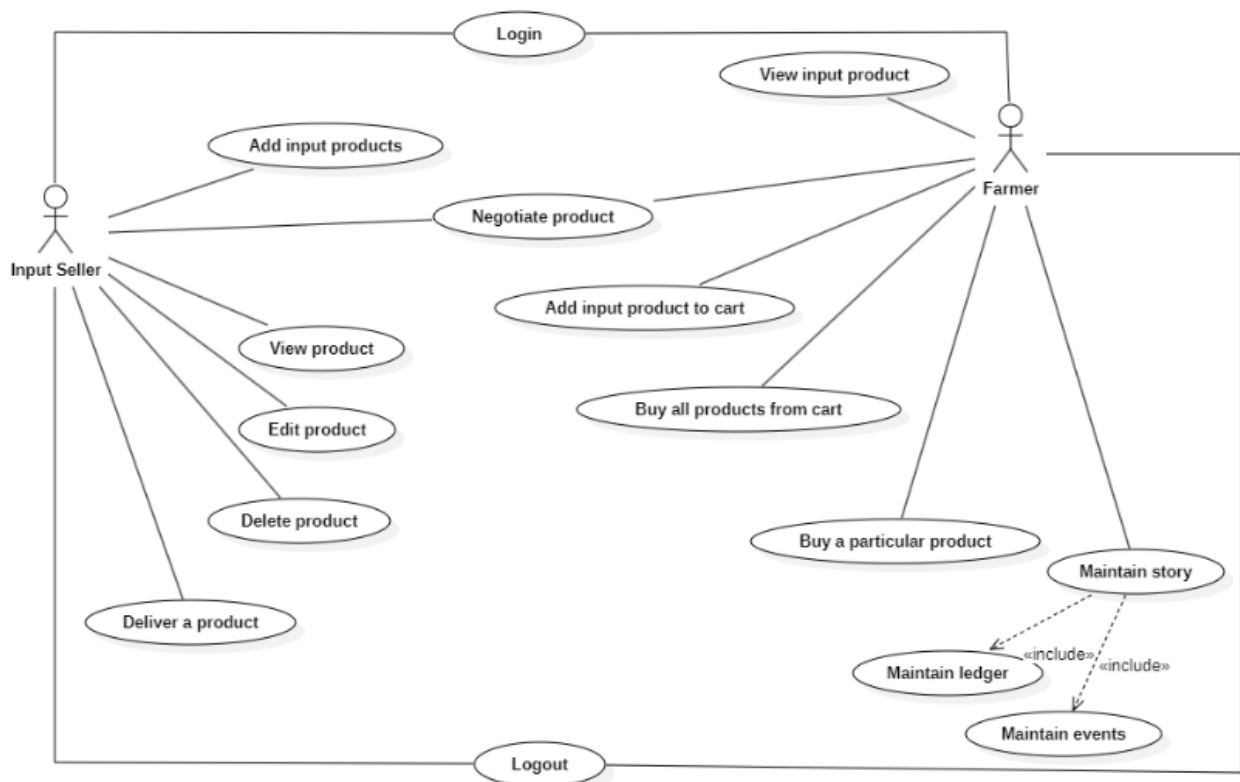
Figure 2 Input Seller-Farmer Use Case Diagram

4.4. Farmer and Customer Module

The farmer and customer modules are integral to the core marketplace functionality of AgriConnect. After successful authentication, farmers gain access to a dedicated dashboard where they can manage their product listings. Using the product management interface, farmers can add new agricultural products, update details like price and stock, and toggle availability status. Each product is

associated with metadata such as crop type, quantity, pricing, and timestamps, all stored securely in MongoDB. Farmers can also engage in dynamic pricing through the integrated Negotiation System, which enables them to respond to customer-initiated price requests in real time. All interactions are routed through RESTful APIs, and negotiation decisions are logged using an internal API Logger for auditing. A unique capability of the farmer module is the Story System, which allows farmers to maintain comprehensive records of their agricultural activities. This includes posting event logs (e.g., seeding, watering, harvesting) and managing a Ledger System for financial tracking. These stories are linked to specific products and are made partially visible to customers to promote transparency and trust. Customers, upon logging in, can browse the product catalog with advanced filters (e.g., category, price, location). They can view each product's history, including associated farming events, and add items to their cart. Before purchasing, customers have the option to initiate negotiation on eligible products. Once satisfied, they proceed to the checkout, where payments are processed via Razorpay integration. Upon successful payment, customers receive a system-generated invoice via email. Figure 3 shows Farmer-Customer Use Case Diagram
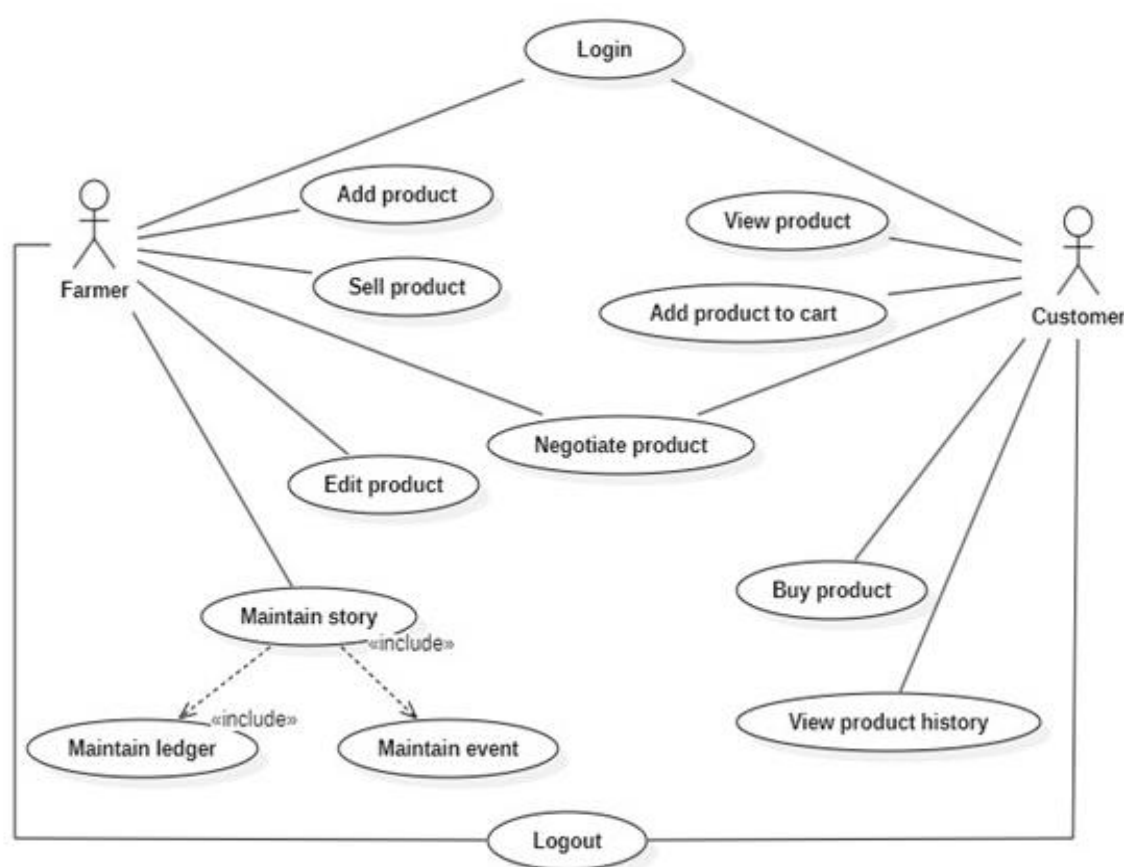
Figure 3 Farmer-Customer Use Case Diagram

4.5. Story Module

The Story Maintenance Process is a structured backend workflow within AgriConnect designed to manage and categorize all entries made by the farmer into two primary record types: Ledger Entries and Event Entries. This module ensures logical flow, accurate classification, and validation of story-related data while maintaining system integrity. The process initiates when a farmer accesses the story section. The system first checks if a story already exists for the selected crop or timeline. If no existing story is found, a new story record is created and associated with the user and

crop. Once the story context is established, the system processes each incoming entry by identifying its type:

- If the entry is flagged as a Ledger Entry, it undergoes a second-level classification:
- If the entry is marked as creditable (such as a sale or profit), it is directed to the Profitable Ledger. [11-15]
- If the entry is non-creditable (like an

expense or purchase), it is logged in the Budgetary Ledger.

If the entry is not a ledger item, the system checks whether it qualifies as an Event Entry (e.g., seeding, irrigation, pesticide use). Valid event entries are stored chronologically under the Event History, providing a timeline of actions related to crop development. Figure 4 shows Story Module
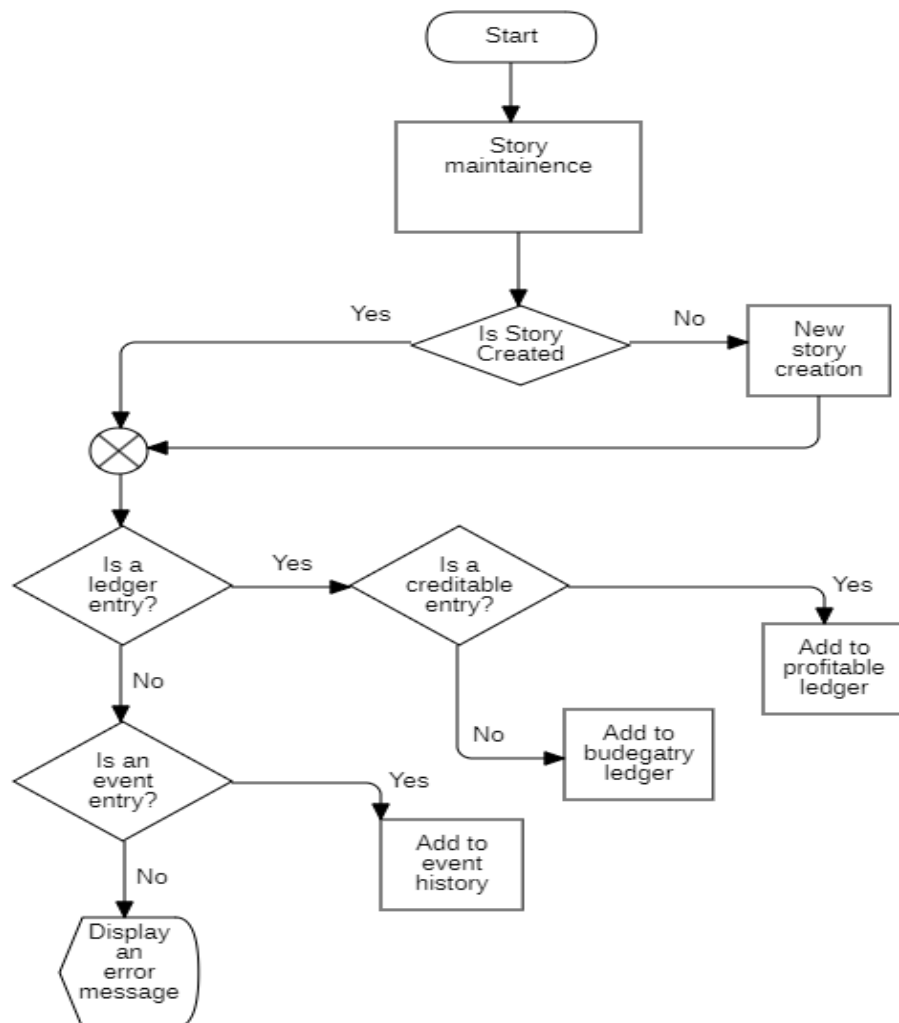
Figure 4 Story Module

4.6. Invoice and Payment Module

A seamless and transparent financial transaction system is implemented to ensure security and efficiency in all payments.

4.6.1. Payment Gateway Integration

- Razorpay API handles secure payments with multiple payment options (UPI, credit/debit cards, net banking).

4.6.2. Invoice Generation System

- Generates a detailed invoice upon successful payment, including product details, pricing, and seller information.
- Helps farmers and input sellers maintain proper financial records.

4.6.3. Automated Emailing System

- Sends invoices to customers and farmers via

Nodemailer.

- Confirms order status and logs the transaction in the database.

4.6.4. Handling Failed Payments

- If a payment fails, the system triggers a failure response, allowing users to retry the transaction.
- Logs failed transactions for future analysis and issue resolution.

4.7. Expert Connect Module

This module serves as a knowledge hub for farmers, enabling them to consult agricultural experts for guidance and problem-solving.

- Users can ask questions and seek advice on topics such as crop selection, disease management, soil health, and pest control.
- Experts provide solutions based on scientific research and real-time agricultural data.

4.8. API Logging Module

To enhance security and performance, an API logging system has been implemented to track and monitor all API requests. The key features of API logging module are listed.

Activity Tracking:

- Logs every API request made to the system, including product purchases, negotiation attempts, payment processing, and expert consultations.

4.9. Error Detection & Debugging

- Helps in identifying failed requests, ensuring system stability.

4.9.1. Security Monitoring

- Detects unusual activities, such as unauthorized access attempts, and triggers security alerts.

5. System Requirements

The drafted system requirements are based on the assumption of handling 1 million API requests per month for a better system to handle multi users with different role-based access control over the user request.

5.1. Hardware Requirements

- Process CPU – 8 Core Intel I7 or Ryzen 7.
- Hard Disk Capacity – 50 GB SSD.
- RAM – 16 GB of RAM.
- 5Mbps of Network Bandwidth.
- MongoDB.
- Mail Server.
- JWT Authenticators.
- Logs Server.

5.2. Software Requirements

- React.js.
- Express.js.
- Tailwind CSS.
- Node.js.
- Razorpay API.
- Browser Support to Access the Website.

6. Results and Discussion

6.1. Result

6.1.1. Input Seller Portal

Input sellers can list agricultural products like fertilizers, pesticides, seeds, farming tools, safety wear, and electronic devices. They provide details such as name, description, price, and available quantity. Figure 5 shows Input Seller Portal Figure shows 6 Single Product View
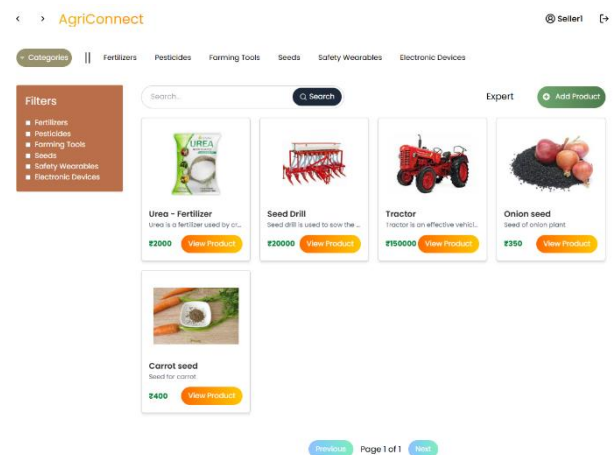
Figure 5 Input Seller Portal
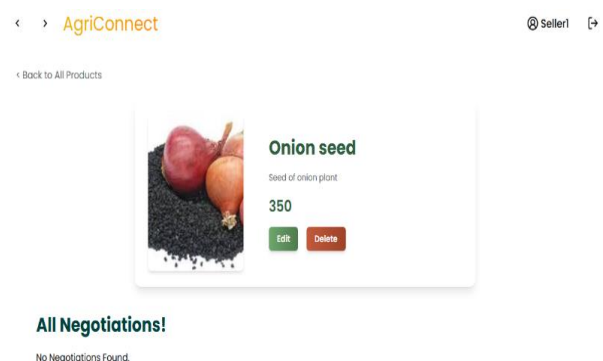
Figure 6 Single Product View

6.1.2. Farmer Portal

Farmers can maintain stories. Each story describes the actual farming process of the cultivation through events. Every financial aspect of the story is tracked under ledger for easy auditing purpose.

Farmers can easily buy and sell through this portal. Figure 7 shows Farmer Portal, Figure 8 shows Story Page, Figure 9 shows Customer Portal
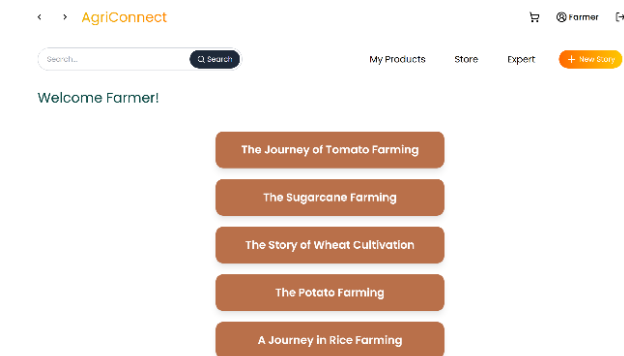
Figure 7 Farmer Portal
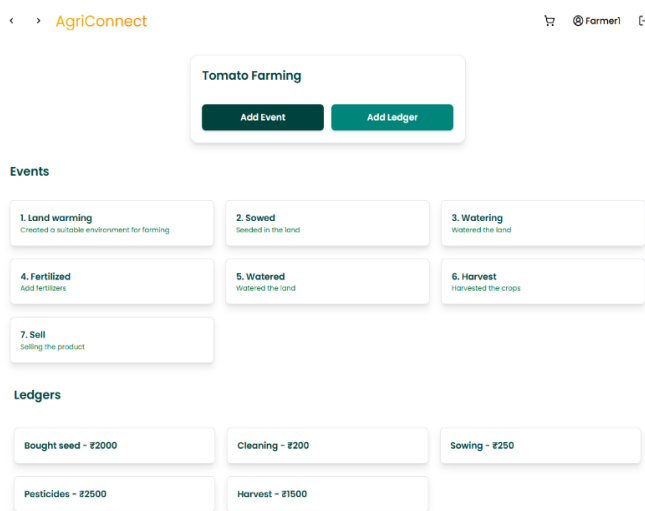
Figure 8 Story Page

6.1.3.   Customer Portal

Customers can buy the cultivated crops from the farmers if enabled they can negotiate the price using this customer portal.
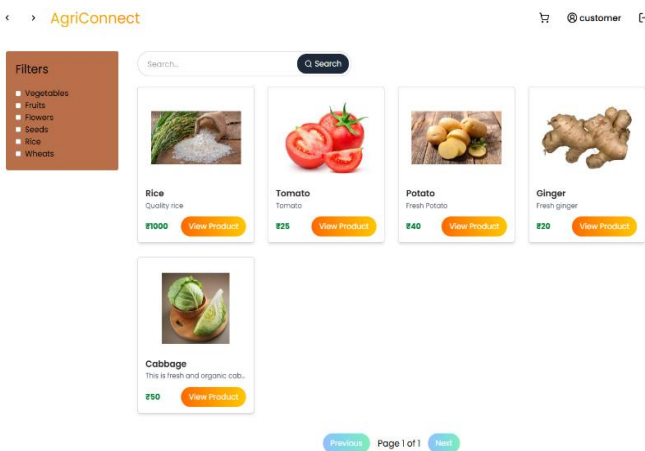

Figure 9 Customer Portal

6.1.4.   Expert Connect Page

Every user such as input sellers, farmers and customers can able to contact the experts of particular crops to gain insights for various purposes using this expert connect module. Figure 10 shows Expert Connect Page
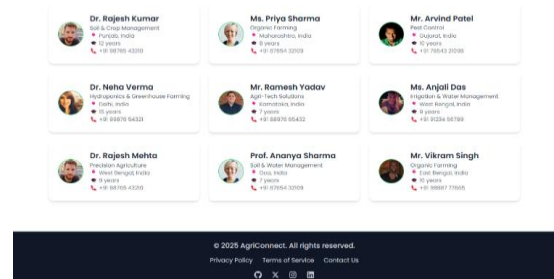
Figure 10 Expert Connect Page

6.1.5.   Cart and Checkout Page

Buyers can able to add products to their cart for bulk purchasing and proceed to checkout using RazorPay integration. Since integrating a Payment Gateway for processing the transaction, making easier for the system to handle and track financial flow within the application across users from various geographically varying locations. Figure 11 Cart and Checkout Page
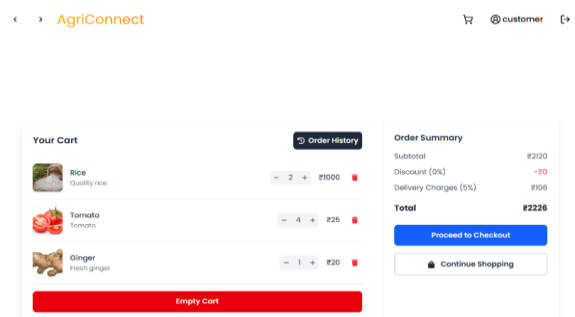
Figure 11 Cart and Checkout Page
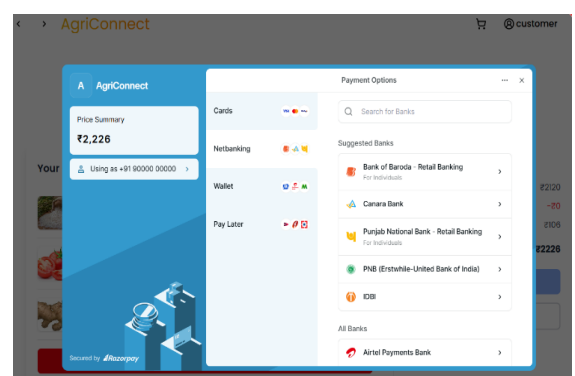
Figure 12 Razor Pay Payment Page

6.1.6. Order and Invoice Page

For every successful transaction an invoice will be generated and displayed to the user. The invoice will be available to the user in various forms such as e-mail attachment, web-view and even downloadable PDF document. Every order will be listed in the order page with their delivery status. Figure 13 shows Order Summary Page, Figure 14 Invoice Figure 15 shows Invoice Attached E-Mail

Figure 13 Order Summary Page

Figure 14 Invoice

6.1.7. Mailing Module

For every successful transaction the user will be notified with order and invoice attached email as confirmation of their payment.

Figure 15 Invoice Attached E-Mail

6.1.8. Negotiation Module

Figure 16 Negotiation Module

6.2. Discussion

The system presented demonstrates a significant step toward bridging the gap between farmers and end consumers by leveraging web-based

technology. Unlike traditional supply chains, which often involve multiple intermediaries, this platform enables direct communication and transactions, ensuring fair pricing and improved profit margins for farmers. From the implementation, it is evident that simplifying the user interface, integrating transparent product tracking, and supporting role-based access were key in fostering trust and usability among diverse stakeholders. The modular design of the system accommodating farmers, input sellers, and consumers mirrors the complexity of real-world agri-commerce while maintaining operational clarity. The system's ability to allow negotiation, display crop-related events, and automate ledger entries adds a layer of intelligence that distinguishes it from standard ecommerce platforms. These features not only streamline operations but also provide data-driven insights that can empower farmers in decision-making and improve transparency for buyers. Table 1 shows Comparison of AgriConnect with Traditional and Other AgriTech Solution However, practical deployment may face challenges such as internet access limitations in rural areas, digital literacy gaps, and the need for secure payment and logistics integrations. While these are external to the system design, addressing them is crucial for real-world effectiveness and adoption.

Table 1 Comparison of AgriConnect with Traditional and Other AgriTech Solutions

Feature	Agri Connect	Traditional Marketplaces	Other AgriTech Solutions
Direct Farmer-Consumer Interaction	✓ Yes	✗ No	Limited
Negotiation System	✓ Yes	✗ No	✗ No
Invoice & Stock Management	✓ Yes	✗ No	Basic
Secure Payments	✓ Yes	✗ No	✓ Yes
Traceability	✓ Yes	✗ No	✓ Some
Expert Consultation	✓ Yes	✗ No	✗ No

Conclusion

AgriConnect serves as a transformative solution in the agricultural sector, addressing critical challenges such as inefficient supply chains, price manipulation, and limited market access for farmers. By leveraging modern technology, the platform fosters direct interactions between farmers, input sellers, and customers, ensuring transparency, fair pricing, and financial security.

Key features like Story (Ledger & Event Management) System, Negotiation System, Invoice Management System, and Stock Management System provide a structured and data-driven approach to agricultural trade. The integration of Razorpay for seamless payments, expert consultation for informed decision-making, and API logging for secure activity tracking further enhances the system's efficiency.

With its user-friendly interface and robust functionality, AgriConnect is not just a marketplace but an ecosystem that empowers farmers, optimizes resource utilization, and promotes digital transformation in agriculture. Future enhancements, including AI-driven insights, predictive analytics, and improved supply chain integrations, will further refine the platform, making it a scalable and sustainable solution for the evolving needs of the agricultural community.

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