

Agrihub Connect

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Abstract: This project introduces a hyper-local agricultural commerce platform built using the MERN stack, designed around village-level digital micro-hubs rather than a traditional marketplace. Farmers within each locality form digital clusters where they list, price, and manage their produce collectively. Buyers are automatically matched to the nearest microhub using geolocation intelligence, reducing delivery distance, ensuring fresher supply, and lowering logistics costs. The system integrates dynamic route optimization to streamline last-mile distribution, cutting transport time, fuel usage, and spoilage. To strengthen planning and profitability, predictive demand forecasting analyzes locality-wise purchase patterns, seasonal trends, and supply fluctuations - guiding farmers on crop choices, optimal stocking, and restock timing. The platform supports transparent transactions, real-time inventory visibility, and role-based dashboards for farmers, buyers, and hub coordinators. By transforming isolated transactions into community-powered supply networks, this solution accelerates delivery, minimizes waste, boosts farmer earnings, and builds a sustainable, datadriven rural economy with stronger local resilience.

Keywords : Hyper-Local Commerce, Micro-Hub Network, MERN Stack ,Geolocation Intelligence, Route Optimization, Demand Forecasting, Real-Time Inventory Management, Sustainable Rural Economy.

I.INTRODUCTION

Agriculture plays a vital role in sustaining rural livelihoods and supporting the overall economy. However, traditional agricultural supply chains are often inefficient, involving multiple intermediaries, delayed distribution, price fluctuations, and significant post-harvest losses. As a result, farmers frequently struggle to receive fair compensation for their produce, while consumers face challenges such as inconsistent quality, higher prices, and limited transparency in the sourcing of agricultural goods. These issues highlight the growing need for a localized and technology-driven system that can directly connect farmers with buyers while improving efficiency in distribution and inventory management. AgriHub Connect addresses this need by introducing a smart village micro-hub network that transforms conventional agricultural trade into a digitally connected ecosystem. Instead of operating as a centralized marketplace, the platform organizes farmers into locality-based digital clusters known as micro-hubs, which function as community-level aggregation points where farmers collectively list, manage, and price their produce. This collaborative model enhances product

visibility, strengthens collective bargaining power, and reduces farmers' dependence on intermediaries.

The system is developed using the MERN stack to ensure scalability, real-time updates, and efficient data management. Through role-based dashboards, farmers can update stock information and pricing, buyers can explore available produce within their nearest hub, and coordinators can oversee hub operations and logistics.

The integration of geolocation intelligence automatically connects buyers with the closest micro-hub, minimizing delivery distances and ensuring the availability of fresher produce. This hyper-local matching mechanism significantly reduces transportation time and operational costs while improving supply chain responsiveness. To further enhance efficiency, AgriHub Connect incorporates dynamic route optimization for last-mile delivery, which is particularly important for perishable agricultural products where timely distribution is essential to prevent spoilage and financial loss. By calculating optimal delivery paths, the system reduces fuel consumption and ensures faster service.

Additionally, predictive demand forecasting analyzes purchase trends, seasonal variations, and supply patterns to assist farmers in making informed decisions regarding crop planning and stocking levels, thereby minimizing waste and improving profitability.

By shifting agricultural trade from isolated farm-level transactions to community-driven digital supply networks, AgriHub Connect promotes economic resilience at the village level. The platform empowers farmers through improved technological access, enhances buyer convenience, and strengthens local economies through efficient resource utilization. By integrating modern web technologies with intelligent logistics management and predictive analytics, the system establishes a sustainable and scalable model for rural commerce. Ultimately, AgriHub Connect contributes to building a transparent, resilient, and data-driven agricultural ecosystem that supports farmer livelihoods while delivering high-quality produce to consumers.

II.LITERATURE SURVEY

[1] Kumar, A., & Reddy, S. (2025). AI-Driven Demand Forecasting in Agricultural Supply Chains. *International Journal of Smart Agriculture, Vol. 12, Issue 2*.

This study explores the use of artificial intelligence and machine learning algorithms to forecast agricultural product demand based on historical sales, seasonal variations, and market trends. The system improves supply planning and reduces wastage through predictive analytics, enhancing decision-making for farmers and distributors. However, the research does not integrate hyper-local micro-hub distribution or geolocation-based buyer matching mechanisms.

[2] Zhang, L., & Chen, Y. (2024). Hyper-Local Food Distribution Systems Using Digital Platforms. *Journal of Sustainable Computing, Vol. 18, Issue 4*.

The research focuses on hyper-local food supply systems

aimed at reducing delivery distance and carbon emissions. It highlights the importance of localized distribution centers in improving freshness and minimizing logistics costs. The platform ensures efficient order processing and delivery coordination. However, it does not emphasize collaborative farmer clustering or predictive demand forecasting for crop planning.

[3] Sharma, V., & Kulkarni, P. (2024). Smart Rural E- Commerce Framework for Direct Farmer-Buyer Interaction. *International Journal of Advanced Computer Science, Vol. 15.*

This paper proposes a rural e-commerce model that connects farmers directly with consumers through a web- based platform. It improves transparency in pricing and reduces intermediary involvement. The system enables digital payments and basic inventory management. However, it lacks route optimization techniques and advanced analytics for supply-demand balancing.

[4] Rahman, T., & Ahmed, S. (2023). Optimization Techniques in Agricultural Logistics. *Procedia Computer Science, Vol. 220.*

This study presents optimization algorithms designed to improve transportation efficiency in agricultural supply chains. It reduces fuel consumption and delivery delays through intelligent route planning. The research demonstrates improved logistics performance in large-scale distribution networks. However, it does not integrate localized micro-hub structures or real-time inventory coordination.

[5] Survey Paper on Digital Agricultural Marketplaces. (2023). *International Journal of Innovative Research in Technology (IJIRT), Vol. 10, Issue 7.*

This survey reviews various digital agricultural marketplace platforms and analyzes their strengths and limitations. It identifies issues such as intermediary dependency, price fluctuations, and lack of transparency in traditional systems. The study emphasizes the need for centralized digital tracking and improved farmer access to markets. However, it does not address hyper-local deployment or predictive analytics integration.

[6] Patel, R., & Singh, D. (2023). Community-Based Digital Marketplaces for Farmers. *Journal of Rural Development Technology, Vol. 9, Issue 3.*

The research highlights the benefits of community-driven digital marketplaces in empowering farmers collectively. It improves visibility of farm produce and strengthens farmer bargaining power. The platform supports online listing and order management features. Nevertheless, it lacks geolocation intelligence and dynamic delivery route optimization.

[7] Lee, H., & Park, J. (2022). Real-Time Inventory Management in Agricultural Platforms. *International Journal of Information Systems, Vol. 14, Issue 2.*

This study introduces real-time inventory management systems to improve stock tracking in agricultural markets. It reduces manual record errors and ensures better availability monitoring. The platform enhances transparency between sellers and buyers. However, it does not incorporate predictive demand forecasting or localized distribution hubs.

[8] Alnssayan, A., Abdullah, H., & Hassan (2022). BlockAgri: A Blockchain-Based Agricultural Supply Chain System. *EBSCO, Vol. 40, Issue 3.*

The authors propose a blockchain-based agricultural transaction management system to ensure data transparency and security. The system improves traceability and prevents tampering of trade records, thereby enhancing trust among stakeholders in the supply chain. However, it does not focus on micro-hub clustering or demand forecasting mechanisms.

[9] Mehta, S., & Nair, K. (2022). Role-Based Access Control in Rural E-Commerce Systems. *Journal of Cyber Systems, Vol. 11,*

Issue 1.

This paper discusses secure implementation of role-based dashboards for rural digital commerce platforms. It improves system security and ensures controlled access to sensitive operations. The research supports structured management of users and administrative functions.

However, it does not address agricultural logistics optimization or crop planning analytics.

[10] Salawu, O. (2021). Implementation of Web-Based Model for Agricultural Product Distribution Integrated with SMS Notification. *IJRAS, Vol. 8, ISSN: 2394-4404.* This study presents a web-based agricultural distribution system integrated with SMS alerts for order confirmation and delivery updates. It improves communication between farmers and buyers and enhances transparency and order tracking efficiency. However, it lacks scalability and advanced predictive analytics features.

[11] Johnson, P., & Lee, M. (2021). Geolocation-Based E-Commerce Models. *International Journal of Web Engineering, Vol. 10, Issue 4.*

The research introduces geolocation-based buyer-seller matching systems to reduce delivery time and improve localized service efficiency in digital commerce platforms. The system enhances customer convenience through automated location detection. However, it does not integrate agricultural-specific supply chain features.

[12] Ahmed, S., & Rahman, T. (2021). Digital Transformation in Rural Supply Chains. *Procedia Computer Science, Vol. 171.*

This paper discusses digital transformation strategies for improving rural supply chain operations. It highlights the importance of online marketplaces and logistics coordination and improves efficiency through digitized record management. However, it does not include predictive demand analysis or micro-hub clustering.

[13] Li, X., & Zhang, Y. (2020). Intelligent Agricultural Distribution Systems. *Computers and Electronics in Agriculture, Vol. 175.*

This study explores intelligent distribution models for agricultural produce using automation tools. It improves transportation planning, reduces spoilage rates, and enhances supply chain visibility. However, it lacks community-based digital clustering and forecasting features.

[14] Sharma, P., & Verma, S. (2020). Smart Agriculture Supply Chain Using IoT. *International Journal of Engineering Research & Technology, Vol. 8, Issue 6.*

The research proposes IoT-based monitoring systems for tracking agricultural product quality during storage and transportation. It improves product safety and reduces losses through sensor-based environmental monitoring. However, it does not address digital marketplace integration or localized hub distribution.

[15] Rao, M., & Kumar, V. (2019). Online Marketplace for Farmers. *Journal of Emerging Technologies, Vol. 6, Issue 3.*

This paper presents a centralized online marketplace enabling farmers to sell products directly to consumers. It improves accessibility and price transparency and supports digital listings and payment processing. However, it lacks hyper-local distribution and route optimization features.

[16] Thomas, J., & George, A. (2018). ICT Applications in Agricultural Marketing. *International Journal of Rural Studies, Vol. 25, Issue 2.*

This study explores the use of ICT tools to improve agricultural marketing communication. It enhances information flow between farmers and buyers and promotes awareness of market prices and demand trends. However, it does not implement predictive analytics

or micro-hub networking.

[17] Kumar, S., & Rao, P. (2015). Technology Adoption in Rural Agricultural Markets. *Journal of Rural Innovation, Vol. 3, Issue 2*. This early research analyzes challenges in adopting digital technologies in rural agricultural markets. It highlights barriers such as low digital literacy and limited infrastructure and emphasizes the need for user-friendly and localized digital solutions. However, it does not provide an integrated technological framework for supply chain optimization.

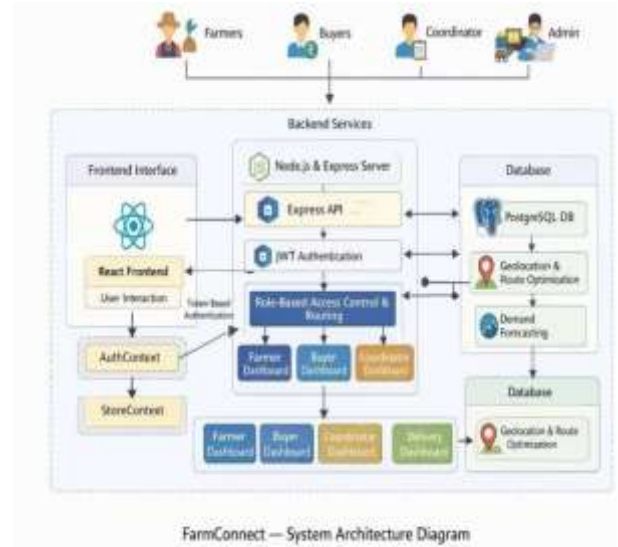
III. PROPOSED SYSTEM

The proposed system, **AgriHub Connect**, introduces a smart village micro-hub network designed to overcome the limitations of traditional agricultural supply chains. Instead of relying on intermediaries and centralized marketplaces, the system establishes locality-based digital micro-hubs where farmers collaboratively list, manage, and sell their produce. This decentralized structure enables direct farmer-to-buyer interaction, improves price transparency, and strengthens collective bargaining power within rural communities. The platform utilizes geolocation intelligence to automatically connect buyers with the nearest available micro-hub, ensuring faster order fulfillment and fresher produce for consumers while reducing spoilage for farmers. It also provides real-time inventory visibility, allowing buyers to instantly check product availability before placing orders. To further improve logistics efficiency, the system integrates dynamic route optimization for last-mile delivery, which calculates optimal delivery paths to minimize fuel consumption, reduce delivery time, and enhance overall operational efficiency. In addition, predictive demand forecasting analyzes historical transaction data, seasonal trends, and locality-based consumption patterns to help farmers make informed decisions about crop planning and stock management, thereby reducing overproduction and waste. The system also incorporates role-based dashboards for farmers, buyers, and hub coordinators to ensure structured operations, secure access control, and effective monitoring of micro-hub activities. Through transparent digital transactions, real-time updates, and centralized coordination, AgriHub Connect establishes a scalable, sustainable, and data-driven platform that strengthens rural economies by transforming conventional agricultural trade into a smart, community-powered digital network.

VI. PROPOSED SOLUTION

The proposed solution is a hyper-local digital platform that connects farmers and buyers through village-level micro-hubs, enabling a more efficient and transparent agricultural supply network. In this system, farmers collectively list, manage, and sell their produce within locality-based hubs, while buyers are automatically matched with the nearest hub using geolocation technology. This approach reduces delivery distance, ensures fresher agricultural products for consumers, and minimizes transportation costs. The platform further enhances logistics through route optimization for efficient last-mile delivery and incorporates predictive demand forecasting to support better crop planning and inventory management. Additionally, role-based dashboards, real-time inventory tracking, and transparent digital transactions provide structured system operations and improved accountability. Overall, the solution establishes a smart, efficient, and sustainable agricultural supply network that enhances farmer income while strengthening local rural economies.

MODULES



V. IMPLEMENTATION

1. LOGIN MODULE

The Login Module serves as the secure entry point for all users of the AgriHub Connect platform. Each user must authenticate using registered credentials such as a username or email address and password. The system verifies the user information to ensure that only authorized individuals can access the platform, thereby maintaining the security and privacy of user data and transactions. After successful authentication, the system identifies the user's role and redirects them to their respective dashboards. Features such as form validation and secure authentication mechanisms enhance both system security and user experience.

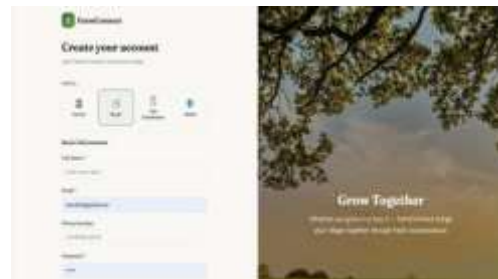


Figure 5.1.1: login page for different roles

2. FARMER MODULE

The Farmer Module enables farmers to manage and sell their agricultural produce through a digital platform. Farmers can register farm details, upload crop information, set product prices, and update the availability and quantity of their produce. This module ensures that buyers receive accurate and real-time product information. Farmers can also monitor incoming orders, track delivery status, and communicate with buyers regarding product details and order confirmations. Additionally, the module provides sales summaries and basic analytics that help farmers understand demand trends and manage their production more efficiently.

3. BUYER MODULE The Buyer Module allows consumers to browse and purchase agricultural products directly from farmers. Buyers can view product details such as price, quantity, and farmer information before adding items to their cart. The module provides a simple and user-friendly interface for placing orders and selecting delivery or pickup options. Buyers can also track their orders and access purchase history through their dashboards. Notifications related to order confirmation, payment updates, and delivery status ensure transparency and convenience throughout the

purchasing process.

4. COORDINATOR (HUB) MODULE

The Coordinator Module enables hub coordinators to manage agricultural activities within the micro-hub network. Coordinators can monitor farmer registrations, manage available products, and oversee orders placed by buyers. They ensure that products collected from farmers are properly organized and prepared for delivery or pickup. The module also allows coordinators to track inventory levels, assign delivery personnel, and update order statuses. Reports and analytics provided in this module help coordinators evaluate hub performance and maintain efficient coordination between farmers, buyers, and delivery services.



Figure 5.4.1: Coordinator module

5. ADMIN MODULE

The Admin Module provides complete control over the AgriHub Connect platform. Administrators can monitor and manage all users, including farmers, buyers, coordinators, and delivery personnel. The admin can approve registrations, manage hubs, oversee product listings, and monitor orders across the system. The centralized admin dashboard displays important analytics such as total users, active hubs, orders, and sales performance. Through system monitoring, report generation, and configuration management, the Admin Module ensures smooth operation and effective management of the entire platform.

6. SOFTWARE ENVIRONMENT

1. VS CODE

Visual Studio Code (VS Code) is the primary Integrated Development Environment (IDE) used for developing the AgriHub Connect system. It is a lightweight and powerful code editor that supports multiple programming languages and frameworks. VS Code enables efficient development of both frontend and backend components within a single environment. Features such as syntax highlighting, IntelliSense, smart code completion, and debugging tools help improve coding efficiency and reduce development errors. Additionally, extensions like ESLint, Prettier, and Git integration assist in maintaining code quality, formatting, and version control throughout the project.

2. FRONTEND

The frontend of AgriHub Connect is developed using React with TypeScript to create a responsive, interactive, and user-friendly interface. React supports reusable components, making the application modular and easier to maintain. Each user role—Farmer, Buyer, Coordinator, Admin, and Delivery—has a dedicated dashboard with role-specific functionalities. TypeScript enhances reliability through strong type checking, while form validation ensures accurate data entry. The frontend communicates with the backend using secure RESTful APIs, enabling real-time updates for products, orders, and delivery status.

3. BACKEND

The backend manages the core functionality of the AgriHub Connect system, including user authentication, data processing, product management, and order handling. It processes requests from the frontend and interacts with the database to store and retrieve information related to users, products, and transactions. Role-based access control ensures that different users such as farmers, buyers, delivery personnel, and administrators can access only their respective features. The backend also performs data validation, error handling, and logging to maintain system reliability and security, while supporting scalable architecture for future enhancements.

4. DATABASE

The database is responsible for storing and managing all system data, including user profiles, product listings, orders, and transaction details. A database system such as PostgreSQL or MongoDB ensures reliable data storage and efficient retrieval. The database schema connects entities such as farmers, buyers, products, and orders to maintain consistency and reduce redundancy. ORM tools like Prisma or Mongoose simplify database operations, enabling efficient data management. Additionally, the database supports order tracking, analytical reporting, and secure data access through encryption, role-based control, and regular backups.

7. CODE IMPLEMENTATION

Step 1: Authentication System Setup

The authentication system in AgriHub Connect provides secure login access for Farmers, Buyers, Coordinators, and Admin users. It uses JWT-based authentication along with bcrypt password hashing to protect user credentials and maintain data security. After successful authentication, the system identifies the user's role and redirects them to the appropriate dashboard.

Step 2: Role-Based Dashboard Setup

The role-based dashboard allows different users to access functionalities specific to their roles. Once logged in, Farmers can manage product listings, Buyers can browse and place orders, Coordinators can manage hub activities and delivery coordination, and Admin users can monitor overall platform operations.

Step 3: Product Management System Setup

The product management module enables farmers to add, update, and delete agricultural products such as vegetables, fruits, and grains. Buyers can view available products along with their prices and quantities in real time, allowing them to make informed purchasing decisions.

Step 4: Order and Transaction Management Setup

This module allows buyers to place orders directly with farmers through the hub-based system. Coordinators oversee order confirmations, manage delivery coordination, and update order statuses to ensure transparency and smooth transaction processing.

Step 5: Database Integration Setup

The system integrates a centralized database to store user information, product details, and order records. This ensures efficient data storage, quick retrieval of information, and seamless communication between different modules of the AgriHub Connect platform.



Figure 5.2.1: FARMER MODULE

8. RESULT AND DISCUSSION

The AgriHub Connect system demonstrates a fully functional, secure, and efficient web-based agricultural supply platform that connects farmers, buyers, coordinators, and administrators through a digital ecosystem.

Functional Outcomes

- **Farmer Dashboard:** Enables farmers to manage product listings, update crop details such as quantity and price, and monitor orders placed by buyers.
- **Buyer Dashboard:** Allows buyers to browse available agricultural products, compare prices, and place orders directly through the platform.
- **Coordinator (Hub) Dashboard:** Supports coordinators in managing product collection, delivery coordination, and order tracking between farmers and buyers.
- **Admin Dashboard:** Provides administrators with system monitoring capabilities, user management, transaction oversight, and report generation.

Performance and Usability

- Fully responsive design accessible across desktop, tablet, and mobile devices.
- Secure login and role-based authentication ensure controlled access for farmers, buyers, coordinators, and administrators.
- Real-time updates and notifications improve communication and order tracking within the system.
- MongoDB/PostgreSQL ensures centralized, reliable, and secure data storage.
- Administrative dashboards support monitoring, reporting, and data-driven decision-making.

Overall, AgriHub Connect meets the project objectives of digitizing agricultural trade, improving market accessibility for farmers, reducing dependency on intermediaries, and strengthening local agricultural supply networks through an efficient and transparent digital platform.

VI.CONCLUSION

The **AgriHub Connect** project provides a digital platform that connects farmers and buyers through a simple and efficient online marketplace. The system enables farmers to list and sell their agricultural products directly, while buyers can browse, select, and purchase products conveniently through the platform. Features such as secure login, product management, order tracking, and centralized data storage improve transparency and communication among users. By reducing the dependency on intermediaries, the platform helps farmers receive fair prices for their produce and improves overall market accessibility. Overall, AgriHub Connect demonstrates how modern technology can transform traditional

agricultural trading by creating a reliable, transparent, and user-friendly digital marketplace that supports farmers and enhances the efficiency of agricultural commerce.

VII.REFERENCES

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