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Direct Market Access for Farmers

Amruth V [1], Lokesh Chapate[2], M K Anirudha[3], Mohammed Ramzi Koteshwar[4], Kiran Kashyap G[5]

[2,3,4,5]*Department of ISE, MIT Mysore, Mysuru, Karnataka, India*

[1]*Professor, ISE, MIT Mysore, Mysuru, Karnataka, India*

***Abstract*— Traditional agricultural supply chains are dominated by multiple intermediaries, resulting in low profit margins for farmers and inflated prices for consumers. Limited market access, poor transparency, and the absence of modern digital tools further weaken farmers' participation in competitive markets. This paper presents a Direct Market Access (DMA) platform that leverages e-commerce architecture, real-time pricing, multilingual interfaces, and secure digital transactions to connect farmers directly with buyers. The system integrates product listing, inventory management, order tracking, and advisory support within a unified web and mobile platform. Designed using a modular architecture with React front-end, Supabase PostgreSQL backend, and role-based access control, the platform ensures scalability, usability, and secure data management. Evaluation based on ISO/IEC 25010 quality attributes demonstrates improvements in efficiency, accessibility, and farmer engagement. The proposed DMA system provides a sustainable and transparent alternative to conventional agricultural markets.**

***Keywords*— Direct Market Access, E-Commerce, Agriculture, Supply Chain, Farmer Empowerment, Digital Platforms, Supabase, React.**

I. Introduction

Agriculture in developing regions continues to suffer from structurally inefficient supply chains where farmers rely heavily on intermediaries, commission agents, and wholesalers for product distribution. These intermediaries often capture a significant share of profit margins, leaving small and medium-scale farmers with minimal returns. Existing market systems also lack transparency in pricing, creating opportunities for exploitation and reducing farmer bargaining power.

Digital technologies have transformed numerous industries, but agricultural marketing still faces barriers such as poor digital literacy, low internet penetration, and inadequate infrastructure. While some farmers utilize unstructured digital channels such as social media groups, these methods lack secure payments, structured listings, and large-scale transaction capabilities.

To address these constraints, this work introduces a comprehensive Direct Market Access (DMA) platform designed to connect farmers directly with consumers, retailers, and institutions through an e-commerce interface.

The system reduces dependence on intermediaries, ensures fair pricing, and provides transparent market mechanisms optimized for low-literacy and low-connectivity regions.

II. Objectives

- *Direct Farmer-to-Consumer Connectivity:* Enable farmers to list products online and reach buyers without intermediaries, improving income and reducing wastage.
- *Pricing Transparency:* Display real-time prices and allow farmers to make informed decisions on product valuation and sales timing.
- *User-Friendly Navigation:* Offer a multilingual, voice-assisted interface tailored for users with limited digital literacy.
- *Secure Digital Transactions:* Integrate reliable payment channels to reduce fraud and delayed payments.
- *Efficient Product & Order Management:* Support product uploads, inventory updates, order processing, and delivery coordination.
- *Scalable and Inclusive Design:* Provide a platform that can accommodate growing user bases, multiple crop categories, and diverse buyer needs.

III. Literature Review

[1] Chauhan et al. (2025) propose a mobile application that enables farmers to sell produce directly to consumers by bypassing intermediaries. The app supports multilingual and voice-based inputs, AI-driven price recommendations, secure digital payments, logistics tracking, and weather forecasts. Pilot results show increased farmer income, faster payments, and reduced dependency on middlemen, though challenges such as internet connectivity and resistance from older users remain.

[2] Badwaik et al. discuss the design and development principles of an effective e-commerce website. The study emphasizes user-centered design, secure payment gateways, inventory management, SEO practices, and AI-based personalization.

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It concludes that combining usability, security, and continuous performance optimization is essential for sustainable e-commerce platforms.

[3] Morepje et al. analyze the influence of e-commerce platforms on sustainable agricultural practices among smallholder farmers in Sub-Saharan Africa. Through a systematic literature review, the study finds that digital platforms improve market access, pricing, and adoption of sustainable farming practices. However, digital illiteracy and poor infrastructure limit widespread impact, requiring policy and capacity-building support.

[4] Krishna et al. introduce "Farm Mart," a digital agricultural marketplace designed to eliminate intermediaries and improve price transparency. The platform uses machine learning for dynamic pricing, recommendation systems, and optimized logistics. Results show improved farmer profitability, efficient supply chains, and timely payments compared to traditional market systems.

[5] Lesmana et al. explore the use of AI forecasting models for market trend analysis. The study compares traditional statistical models with machine learning techniques such as LSTM, Random Forests, and SVM. Results show that AI-based models, especially LSTM, provide more accurate and reliable predictions, supporting better decision-making in volatile markets.

[6] Khan et al. propose a decentralized blockchain-based payment framework for regions with poor internet connectivity. Using Ethereum with auxiliary nodes, the system ensures secure and efficient transactions even under unstable network conditions. Simulation results demonstrate significant improvements in transaction speed, throughput, and energy efficiency compared to traditional blockchain systems.

[7] Wagh et al. present a farmer-to-consumer e-commerce application aimed at eliminating middlemen and increasing farmer profits. The platform enables direct sales, multilingual access, secure payments, and logistics integration. Results indicate improved transparency, higher farmer income, and better consumer access to fresh produce.

[8] Singh et al. introduce Farmer.Chat, an AI-powered multilingual chatbot that delivers real-time agricultural advisory services. Deployed across multiple countries, the system uses generative AI and retrieval-augmented generation to support farmers with low literacy. The study reports high user satisfaction, scalability, and improved access to agricultural knowledge.

[9] Goyal and Garera focus on building low-latency, high-accuracy automatic speech recognition systems for streaming voice search. Using neural transducer-based models and optimized decoding strategies, the study achieves reduced response time and improved recognition accuracy, making voice-based interfaces more practical for real-time applications.

[10] Hinojosa et al. propose AgroTIC, a smartphone-based platform that connects farmers, agronomists, and merchants using machine learning. The system supports voice queries, image-based crop diagnostics, and expert recommendations. Results show improved decision-making, faster expert access, and reduced crop losses through timely interventions.

[11] Pesci et al. examine the digital divide in online sales and marketing among direct-market farmers in California during the COVID-19 pandemic. The study shows that farmers who adopted digital tools such as websites, e-commerce platforms, and social media were more resilient and profitable. However, unequal access to broadband, digital skills, and financial resources created disparities, indicating that digital adoption can both enable growth and reinforce inequality.

[12] Lodi et al. introduce E-BAZAAR, an e-commerce platform connecting farmers directly with consumers to reduce post-harvest losses and intermediary exploitation. Built using the MERN stack, the system supports product listings, secure payments, order tracking, and multilingual access. Results show improved farmer income, reduced wastage, and high user acceptance among both farmers and consumers.

[13] Ladhar et al. present an AI-based market intelligence system for farmer collectives in India, focusing on soybean producers. By combining machine learning price forecasting with behavioral economics principles, the system helps farmers decide optimal selling times. Field trials indicate improved price negotiation, better planning, and modest income gains, especially when decisions are made collectively.

[14] Yi proposes a data mining–based online agricultural product demand analysis model to improve e-commerce marketing effectiveness. The model applies clustering, classification, and regression techniques to analyze consumer behavior and predict demand. Experimental results show accurate demand forecasting, improved inventory management, and reduced shortages in online agricultural sales.

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[15] Hussien et al. provide a comprehensive overview of recommendation systems used in e-commerce. The paper reviews collaborative filtering, content-based, demographic, knowledge-based, and hybrid approaches. It highlights the strengths and limitations of each method and concludes that hybrid recommendation systems offer the best performance for personalization and scalability in modern e-commerce platforms.

[16] Maulana and Pramudwiatmoko describe the development of an Android-based mobile application for shoe washing services using Kotlin. While not agriculture-focused, the study demonstrates how mobile applications can automate service delivery, order management, and payments. The design principles and architecture are applicable to agricultural service and marketplace platforms.

[17] Sukumar et al. present a text-based smart answering system for agriculture using natural language processing and deep learning. The chatbot uses an RNN model to understand farmer queries and provide accurate responses. With an accuracy of 97.83%, the system improves access to agricultural knowledge, especially for farmers with limited literacy and technical skills.

[18] Dormido and Malicdem introduce AGRITECHNO, a mobile application designed to forecast agricultural product demand and connect farmers with traders in the Philippines. The app supports demand–supply matching, location-based tracking, and authenticated transactions. Results indicate improved market transparency, reduced crop wastage, and better pricing for farmers.

[19] Silvestri et al. study the use of radio and SMS to scale sustainable agricultural practices among smallholder farmers in Tanzania. Findings show that combining radio and SMS improves knowledge and adoption rates, while radio alone is the most cost-effective. The study highlights ICT's role in awareness-building but also notes literacy and resource constraints.

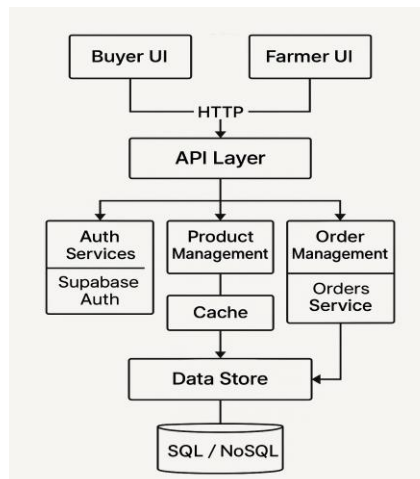
[20] Van Campenhout et al. evaluate ICT-based agricultural advisory tools in Uganda using videos, IVR, and SMS. A randomized controlled trial shows that video-based training significantly improves knowledge, adoption of best practices, and maize yields. IVR and SMS had limited additional impact, suggesting video is the most effective digital extension method.

IV. System Design And Methodology

The DMA platform follows a modular, layered architecture integrating front-end interfaces, API communication, backend service modules, caching layers, and secure data storage. The system supports two primary user roles—farmers and buyers.

A. Architecture Overview

The platform architecture includes:



The architecture of the Direct Market Access (DMA) system follows a layered and modular design to ensure clarity, security, and scalability. At the top level, the system consists of two separate user interfaces: the Farmer UI and the Buyer UI. These interfaces are designed according to user roles, allowing farmers to manage products and orders, while buyers can browse products, place orders, and track purchases. Both interfaces communicate with the backend through standard HTTP requests, ensuring a responsive and role-specific user experience.

The API Layer acts as the central communication bridge between the front-end interfaces and the backend services. It handles all incoming requests such as user authentication, product uploads, and order placements, preventing direct access to the database. This abstraction improves security and allows the system to support future platforms, such as mobile applications, without modifying core backend logic.

Behind the API layer, the system is divided into three main service modules: Authentication Services, Product Management, and Order Management.

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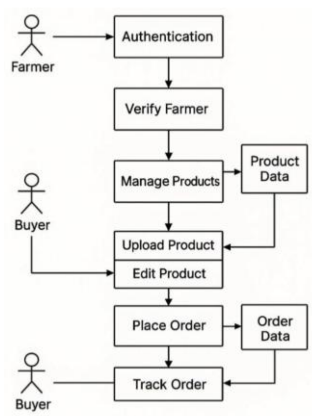
Authentication Services manage user registration, login, and role validation using secure mechanisms. Product Management handles product listings, updates, images, and stock availability, while Order Management controls the entire order lifecycle, including order creation, acceptance, rejection, and status updates. This separation of responsibilities improves maintainability and enables independent feature expansion.

At the data level, a cache layer is used to store frequently accessed data, reducing database load and improving performance. All persistent data is managed through a Data Store layer connected to a SQL/NoSQL database, implemented using Supabase PostgreSQL.

B. Data Flow



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Farmers upload product details → System validates input → Records stored in database → Buyers browse or filter products→ Orders placed and routed to farmer dashboard →Farmers process orders → Status updated and visible to buyers.

C. Functional Workflow

- *User Registration:* Users declare roles and authenticate via secure channels.
- *Product Listing:* Farmers add price, quantity, description, and images.
- *Product Browsing:* Buyers explore items using category and price filters**.**
- *Order Lifecycle:* Orders move through phases—pending, accepted, completed.
- *Role-Based Access:* Farmers manage only their listings; buyers view only public product information.

V. Working Principle

The DMA platform operates through coordinated interactions among system modules:

1. *Farmer Onboarding:* User details are verified and assigned roles through Supabase Auth.
2. *Product Upload:* Farmers list produce with images and metadata, stored in structured records.
3. *Buyer Interaction:* Buyers browse products, apply filters, and place orders.
4. *Order Coordination:* Farmers process incoming orders and update order statuses to ensure transparency.
5. *Security Enforcement:* Role-based controls ensure appropriate data access across the platform.
6. *Data Synchronization:* The caching layer maintains fast load times, especially in low bandwidth regions.

This workflow streamlines the agricultural value chain and promotes equitable market participation.

VI. Results And Discussion

The platform was evaluated using ISO/IEC 25010 standards for usability, performance, maintainability, and reliability, and the results demonstrate significant improvements across key quality attributes. The multilingual and simplified user interface greatly enhanced accessibility, especially for farmers with low digital literacy, while the ability to list products directly reduced reliance on intermediaries and improved farmers' revenue potential. The modular order management system supported efficient processing with minimal latency, and the layered system architecture ensured strong scalability, enabling seamless onboarding of additional users and products. Furthermore, transparency was markedly improved, as buyers could easily view detailed product information, pricing, and farmer profiles, strengthening trust and fostering more direct market relationships. Collectively, these outcomes show that the system effectively addresses major gaps in traditional agricultural markets by providing a structured, transparent, and user-focused digital marketplace.

VII. Conclusion And Future Work

The Direct Market Access platform delivers a comprehensive solution for eliminating intermediaries, improving farmer profits, and providing consumers with fresh, fairly priced agricultural produce.

By integrating e-commerce features, real-time data access, multilingual interfaces, and secure digital systems, the platform enhances both market efficiency and user experience.

Future enhancements may include:

- *A.* AI-based price forecasting
- *B.* Blockchain-enabled payment transparency
- *C.* IoT-based crop quality and stock monitoring
- *D.* Mobile-native apps for offline support
- *E.* Logistics automation for last-mile delivery

The DMA platform offers a viable, scalable, and sustainable model for modernizing agricultural value chains and empowering farming communities.

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