Crop2Cart – Farmer to Consumer Market Place in Cloud

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doi.org/10.64643/IJIRTV12I11-195940-459

***Abstract*—Agriculture is still the backbone of many economies but the farmers are facing a lot of restrictions like there is no direct access to markets, pricing power, high dependence of middlemen further in the supply-chain etc. So, the farmers don't earn much and transparency is lost in the fray. Crop2Cart is a cloud-based marketplace that allows a farmer to sell directly to consumers from produce and doesn't depend on middlemen. This marketplace is an attempt at solving these problems. Concise Summary. The main purpose of this web-based application is to allow the farmer to add the products directly from his farm and sell them to customers. We would be using the Next.js stack for the interface layer in implementation. Appwrite also utilizes cloud technology to furnish a secure database environment, offer OTP-based authentication services, and employ Cloudflare for hosting high-resolution product photographs and videos. Advantages. The complete automation of the entire process of buying and selling fresh grocery items from the farmers and without any third party. The system would help in easy and fast selling/buying which would reduce the total time taken in offline dealing. The vending price logic of the system is also automated and access to inventory is allowed only to the farmer. Apart from that, the system will allow the vendor. Crop2Cart demonstrates strong potential to modernize Agri-commerce while ensuring equitable benefits for both producers and consumers.**

***Index Terms*—Agri-commerce, Cloud marketplace, Direct farmer-to-consumer trade, Next.js, Fair pricing, Smart supply chain.**

I. INTRODUCTION

Agriculture is important sector as it is one of the crucial sectors for economic development. It contributes to the food supply demanded by the community and not controlled by the government. It is clear from the boot as well as in the farm that the farmers are suffering from certain structural problems i.e. absence of direct buying and selling options, middle-man exploitation, etc. Due to this, the farmer's crops do not get a fair price for their crops and their profit margin is reduced as well.

Farmers and consumers must be in direct contact through technology for an effective marketing system that helps the farmer as well as agricultural development in the long run. The integration of new digital technologies and cloud-native computing can help make agri-commerce more efficient, transparent and scalable [4]. The rate of people in the rural segment starting to use mobile and internet services is growing faster than ever because of initiatives taken by governments. In today's world, we can have a complete trading system using the technology which can remove the middlemen, lower the processing cost and facilitate an automated and intelligent price discovery agency which can offer most competitive best price to customers.

The paper discusses Crop2Cart, a cloud-based e-commerce platform through which farmers can sell their produce directly to consumers. Crop2Cart makes use of Next.js for Responsive Application. It also utilizes Appwrite Cloud for authentication, database, and storage scalable cloud services. It helps in listing and managing products and their stock. It lets the system work too.

The low-tech-savvy people can use the OTP based ID verification system [18]. This system also integrates a cloud media management system for image hosting to ensure proper presentation and consumer confidence [19]. Subsequent work will consist of an AI-based price forecasting, blockchain-based transaction tracking and IoT-based produce tracking that will enhance reliability, supply-chain visibility and accuracy of demand prediction. The new capabilities will help overcome shortcomings of existing digital agriculture solutions and enhance scale and trust between producer and consumer over longer time

duration. The objective of this study is to confirm the successful implementation of Crop2Cart architecture that aims to reduce over-dependence on middlemen while improving supply chain visibility. They also help control farmers' incomes and improve final buyers' quality agricultural produce

II. RELATED WORK

Over the past ten years, there has been a lot written on this. Several of the research has concentrated on technology, which facilitates different bottlenecks in the architecture of supply chains. Typically, early agricultural marketing systems are characterized by involvement of various intermediaries, segmentation of information flow, and localized trade. Farmers lack awareness of fair prices and viable market opportunities as a result. Besides, the high segmentation of trading process leads to a low farmer share of the consumer rupee. Numerous scholars contend that digital platforms can surmount these limitations by establishing direct connections between producers and consumers.

According to Verma and Sharma [3], the intermediaries have impact on market outcome, as they are able to capture large margins. This is to say, farmers earn very low amounts of the profit even though consumers pay more. The findings have spurred the development of a variety of technologies to facilitate greater market access and equitable participation in supply chains. Of all techno components, cloud computing is certainly one of the most crucial enablers of the development of new agri-commerce frameworks. According to Patel [4], cloud-enabled systems for agriculture are discussed. Patel argues that cloud platforms offer distributed computing, elastic data storage, and real-time data availability. These components dramatically decrease infrastructure costs and enhance system responsiveness.

The viewpoint corresponds to the requirements of an ever-present electronic market, allowing fast search and secure multi-person access. Mishra et al. [5] discussed a cloud-based e-commerce model in the agri-business sector. Their findings showed how decentralized architecture drastically modernizes the conventional trading model in a systemic way.

Verification and security schemes have become a key aspect of the design of infrastructure of reliable agricultural projects. Mehta and Thomas [6] researched OTP based verification platforms and determined these were suitable for locations where users lack digital know-how or first-time users of cumbersome password platforms. The majority of the user base in the agricultural ecosystems is first-time or has low technological proficiency. Hence this observation is essential. Kumar and Goyal (2019) studied distributed cloud database capabilities to support high concurrency, and data integrity where updates on availability, price and orders reflect on all platforms. Where authorization needs to be monitored and privilege mis-use must be prevented Liu's governance over RBAC [8] adds operations layerhnliche schöpfung.

The system allows farmers, consumers, and administration staff to perform their respective roles while the admin controls it. RBAC is a critical Agrela platform security feature. Many studies have been undertaken on the implementation of blockchain in agriculture. The blockchain-based systems help reduce fraudulence and better transparency through attendance and payment tracking, proved Jain [9]. Due to the unchangeable nature of linked blockchain records, any changes or fraud in records can be immediately visible. In agricultural environments as well, creating a chain of verifiable records for movement, certification and payment can enhance trust and eliminate fraud.

This is especially helpful for markets where the products of farmers suffer from unauthorized adulteration or misrepresentation to earn greater profits. There is a constant demand for increased agricultural production because the demand for food is ever increasing worldwide day by day. The breakdown of food production problems entails various factors. Prices of items are changing with the changing of these factors.

Enhancing harvesting tools There are many sub-areas within the agri-tech domain that applications can focus on. Decision-making with perishable will also benefit from enhanced IoT-enabled monitoring systems. production logistics. An IoT system was developed for monitoring by Huang and Li [11]. temperature and

moisture variation of the storage and transport chain. Were showy. The abilities to reduce spoilage through constant monitoring and support routing decisions. that are vital for any digital marketplace seeking to consistently provide fresh and high-quality goods. Ahmed [12] further assesses the socio-economic benefits of digital agriculture platforms. He demonstrates how. A trade model directly from farmers to consumers minimizes waste and optimizes bargaining power.

This helps country farmers develop a better and traditional livelihood. These findings support. The prior arguments state that direct-trade cuts middlemen and boosts economic and also operational. Effectivity of agricultural market. An essential field of research is Warehouse and Storage Optimization. off. Bansal and Sethi [13] make comparisons of traditional and cloud warehouse management system.

The design of real-time e-commerce systems using modern JavaScript frameworks, demonstrating how asynchronous processing, API-driven communication, and modular front-end design improve user interaction reliability characteristics highly relevant to agricultural e-commerce scenarios involving fluctuating user activity.

Safety issues are another important part of the e-commerce literature. Roy and Das [15] identified a host of vulnerabilities in the selected online retail system and presented an assortment of requirements for authentication, encryption and real-time Detection of attack. Findings from agricultural marketplaces, which benefit from financial transactions, know your customer identity checks and sensitive farm-level data, will be important for secure scaled adoption. Singh and Arora [16] assessed direct marketing models for improving the profitability of small-scale farmers and demonstrated how apps help to avoid price manipulation.

The research underscores the need to develop a trustworthy and user-friendly digital platform for the farmers with limited first-time access to organized market systems. In general, literature on the optimization of supply chains constitutes another stream that necessitates digital systems. Kumar [17] examined strategies for enhancing reverse and utbound logistics flows of perishable products and showed routing and demand forecast could significantly reduce waste and cost. Lee and Park examined interface design strategies for groups with low digital literacy. The evidence suggests that the adoption rate will dramatically increase when guided workflows, simple designs and local language support is provided. Rural agricultural users who are new to digital commerce resonate strongly with these themes. Another area of systems research was the performance of cloud storage. The large-scale market efficiency of cloud storage was analysed by Zhang [19].

III. METHODOLOGY

The proposed cloud-enabled agri-commerce platform, Crop2Cart, is developed to overcome long-standing market access limitations and pricing inequalities experienced by small and mid-scale farmers within conventional agricultural supply chains [1], [3]. Traditional marketing channels often rely heavily on intermediaries, resulting in reduced profit margins and limited transparency in real pricing structures [2]. Crop2Cart provides a direct trade mechanism by digitally connecting farmers and consumers, thereby enhancing operational fairness, accelerating distribution processes, and reducing supply chain inefficiencies [16]. The platform is designed using a modular, service-oriented architecture supported by cloud infrastructure to ensure system scalability, operational resilience, and secure real-time interaction among diverse stakeholders [4], [7].

A. System Overview

Crop2Cart is built using a three-tier architectural model presentation layer, application layer, and data layer to ensure logical separation of functionalities, maintainability, and system performance efficiency. The application is implemented through the Next.js full-stack framework, enabling server-side rendering and optimized client-side performance for responsive access across devices [14], [23]. Backend logic is handled through integrated API endpoints, enabling seamless communication between the user interface and core processing services. The system utilizes Appwrite Cloud for database management, authentication, and role-based access regulation, supporting both horizontal scalability and dependability under load-intensive operations [8], [22]

B. System Architecture

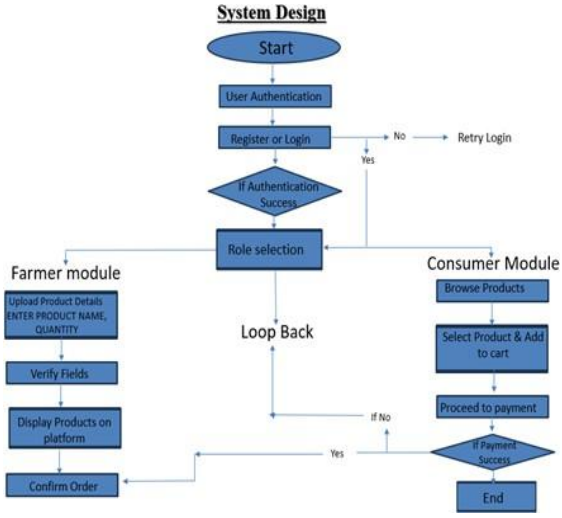

Fig.1. System Design with proposed methodology

The system architecture includes four principal functional modules Farmer Module, Consumer Module, Authentication Module, and Administrative Module. Farmer Module enables producers to upload product information, define pricing structures, and manage inventory availability. The Consumer Module offers product exploration tools, order placement capabilities, real-time purchase tracking, and history management. The Authentication Module leverages OTP-based identity verification, providing enhanced protection against unauthorized access and reducing fraud risks in digital transactions [6], [15]. The Administrative Module supports system oversight using role-based access control to ensure security, accountability, and structured permissions for farmer validation and content approval [8].

C. Data Management and Multi-Tenant Storage

Data storage and retrieval operations are supported by Appwrite's distributed document database architecture, enabling flexible storage and efficient querying across large, fragmented datasets [7], [13]. Farmer-specific product collections ensure data isolation, enabling decentralized inventory control without compromising system coherence. Media assets such as product images are stored using cloud-based resource storage to improve delivery speed, memory efficiency, and global access performance [19]. Multi-tenant database principles safeguard data privacy while supporting concurrent workloads across geographically distributed users [22].

D. System Data Flow

System interaction follows a client–server architecture where user requests are routed through secure API endpoints programmed to validate, authenticate, and process operations such as product creation, update, retrieval, and transaction submission. All operations undergo verification pipelines that maintain consistency, protect data integrity, and guarantee reliable transactional flow [21]. Error logging and service monitoring are embedded to support fault tolerance and recovery mechanisms essential for continuous service availability.

E. Technology Enhancement and Future Integration

The system architecture is engineered to support upcoming enhancements leveraging AI-based pricing intelligence for real-time price forecasting and competitive optimization [10], blockchain-based traceability for validating product origin and building consumer trust [9], and IoT-assisted quality monitoring sensors for tracking produce condition throughout transport [11]. These technologies are expected to advance marketplace transparency, minimize spoilage, and improve logistics efficiency. Additional developmental considerations include multilingual interfaces for digital accessibility, machine-assisted inventory recommendations, and integration with smart supply chain routing engines [12], [20].

IV. RESULTS AND DISCUSSION

In essence, the Crop2Cart solution, when integrated with a cloud-powered digital marketplace, can overcome decades-old inefficient distribution and supply chain processes for any agricultural produce on a global scale. The usability and speed of these systems are used for performance evaluation of the system. Another evaluation parameter of the system was the evaluation for data management requirements and efficient and reliable operation on regular e-commerce loads.

The study's finding shows that the integrated cloud infrastructure together with a distributed storage resource and secure identity management leads to functionally transparent and responsive multimedia trading environment. They work effectively for workload and e-commerce. According to the findings, it demonstrated effective storage and retrieval

methods Cloud-Based Real-Time Agriculture Multimedia Trade Environments with Secure Identity Management, for digital Agriculture Platforms see [1], [2], [12], [16]. The performance testing of System-A, specifically the single client at a time performance testing, comprised of measuring how much time is taken to complete a complete logical walkthrough of the major tasks of uploading a produce, updating the inventory, checking a produce on the consumer side. Table I presents an overview of execution times for a typical activity occurring on the platform. Server for

every transaction tested remained is the average response time.

Table I – Platform Response Time for Key Operations

Evaluation Metric	Positive Response (%)
Ease of Product Upload	87%
Navigation Intuitiveness	83%
Confidence in Independent Use	85%
Clarity of Pricing Controls	79%

Testing indicated that sending OTPs (one-time passwords) and validating OTPs consistently and reliably incur negligible computational cost. The results of our study coincide with other works that deliver lightweight secure authentications of web-based systems [6],[15]. We chose farmers who don't interact with the digital world for usability evaluation. The users are highly confident in their interactions and also the operational learning effort is minimized. As shown in table II, the qualitative response distribution of informal usability trials with early adopters of the platform. Although these results are encouraging, we have identified several design issues and development issues.

The extensive deployment will demand advanced automation of the logistics chain, real-time route optimization, multilingual integration, and more complex empirical field verification. It is generally indicative of the trend witnessed with various agtech or supply chain digitalization interventions [17]. Enhanced system overall.

Table II – User Usability Feedback Summary

Operation	Average Server Response (seconds)	Client-Perceived Response
Product Upload	<1.0	Instant display confirmation
Product Retrieval	<0.9	Smooth UI rendering
OTP Verification	<1.2	Fast identity validation
Inventory Update	<0.8	Real-time refresh

According to this finding, simpler interaction design could play an important role in increasing the acceptance of technology in the low digital literacy agricultural communities. [18], [21]. The feedback also indicated, however, that while the guided workflow and modularity of dashboard layout certainly helped, the overall complexity was still

considerable.

The dialogue promotes the use of role-based access control (RBAC) to keep the operation of the platform healthy and secure. The admin functions provided orderly orderly validation of a farmer's account, whilst moderation feature for a farmer's product.

This confirms [8], [22] on decentralized security and permission-based access control on cloud platforms. After testing, it is discovered that the RBAC module successfully prohibits unauthorized use of any function without causing any major disruption to multi-user environment. Testing of compatibility for future integration showed good potential for expansion. Initial simulation for forecasting indicates price prediction based on models developed using AI is possible for decision making and responsive trading, consistent with previous works on intelligent automation of agricultural price [10] [20]. As identified in the literature on secure supply chain management, traceability by secure blockchain engineering is a potential upgrade for better verifying implementation of product authenticity [9]. It was noted that IoT-enabled storage and transit monitoring can help minimize spoilage and preserve quality. Similar findings were reported in the recent literature on smart agricultural logistics [11].

V. CONCLUSION

The Crop2Cart Study showed that it is very useful to have cloud digital-base installed with emerging e-commerce smart-supply-chain ideas for fair-trade transparent agriculture. Taking off the lower-middle layers unmasked the central likes of price and usability fairness, reducing the delay in actual physical logistics, strengthening the economic node strength of the farmer community, etc. We showed how to use Next.js along with Appwrite's role-based access

control (RBAC) and cloud-hosted media and data services. In addition, it provided scalable and secure setup and delivered real-time product transactions, spread across multiple farmers use scenarios.

The favourable results indicate that an appropriately engineered and technically executed system can be projected to alter the landscape of agricultural trade, taking into account-real world usability and access conditions. Crop2Cart's design reduces the technical harder for the end-users. Even a farmer who has limited exposure to digital platforms can actively participate in the platform. By managing the product catalog, stock availability and directly responding to demand fluctuations.

The platforms strategic feature expansion with AI-supported dynamic price forecasting, blockchain-enabled provenance traceability, and IoT-driven logistics monitoring projects a strong futuristic promise of further automation, trustworthy authentication, and increased accuracy in agricultural decision-making. The use of various technologies can help in further research in areas like improving the analysis of supply signage, enabling cross-platform integration between businesses, and refining the design through the use of rural user experience.

ACKNOWLEDGEMENT

In summary, the evaluation demonstrates that the Crop2Cart architecture provides a strong foundation for modernizing agricultural trade by improving transparency, reducing dependence on intermediaries, and expanding economic access for farmers. The results align with current research trends emphasizing digital transformation and intelligent infrastructure in agriculture [1], [4], [21], supporting the platform's readiness for scaled implementation with continued enhancement.

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