



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 11, November 2025

Agrichain: Smart Contract for Managing the Agricultural Supply using Blockchain

Prof. V.M. Joshi¹, Bhukan Saurabh², Mutkule Akshay³, Shinde Vishal⁴

Associate Professor, Department of Computer Engineering, VACOE, Ahilyanagar, Maharashtra, India¹

U.G. Student, Department of Computer Engineering, VACOE, Ahilyanagar, Maharashtra, India²

U.G. Student, Department of Computer Engineering, VACOE, Ahilyanagar, Maharashtra, India³

U.G. Student, Department of Computer Engineering, VACOE, Ahilyanagar, Maharashtra, India⁴

ABSTRACT: The traditional agricultural supply chain is frequently hindered by inefficiencies, a lack of transparency, and a significant reliance on intermediaries, which increases costs and results in unfair pricing for producers. This project introduces AgroChain, a decentralized application designed to revolutionize the agricultural procurement process. By leveraging a decentralized and immutable ledger, the system enhances security, transparency, and traceability for all agricultural goods. This platform enables farmers to list their products directly, allowing retailers to engage in a transparent bidding and auction process. Key processes, such as auction finalization, payment, and ownership transfer, are automated through smart contracts. This automation reduces the potential for fraud, eliminates costly middlemen, and builds trust between farmers and retailers. This platform aims to streamline operations, lower transaction costs, and redefine market dynamics by creating a more efficient, direct, and secure agricultural ecosystem.

I. INTRODUCTION

The landscape of agricultural supply chain management has long relied on traditional methods that are proving insufficient in the modern digital world. These conventional systems are characterized by a heavy dependence on intermediaries, complex logistical chains, and manual processes that are both time-consuming and prone to error. This approach often leads to a lack of transparency in pricing and provenance, creating an environment where data is not trusted among participants and traceability is difficult to achieve. This opacity makes it challenging to verify product quality and ensure fair market prices for farmers.

This project proposes a revolutionary shift by incorporating blockchain technology into the agricultural procurement process. Blockchain offers a decentralized, immutable, and secure ledger that can fundamentally transform agricultural trade. This technology facilitates peer-to-peer interactions between farmers and retailers, removing the need for traditional middlemen. The goal is to build a system that not only automates and secures the trade lifecycle through a transparent auction mechanism but also fosters a new level of trust and efficiency, redefining the relationship between all parties involved.

II. SYSTEM GOALS

This system is designed to transform the complex process of agricultural procurement into an efficient and transparent experience for both farmers and retailers. It makes trade more accessible by providing a single platform for verifying product information, managing bids, and executing payments

For Farmers: The system offers significant benefits, such as direct access to a wider market of retailers, the ability to list products with verifiable data (e.g., growth data, certifications), and the assurance of receiving fair market value through a competitive auction.

For Retailers: The system provides access to a transparent marketplace of verified farm products, the ability to bid confidently based on immutable data, and a direct way to procure goods, which improves the overall procurement experience.

By increasing transparency, accountability, and security, the platform simplifies the entire trading process for all parties involved.

III. ABBREVIATIONS AND ACRONYMS

1. ASC - Agricultural Supply Chain
2. IoT - Internet of Things
3. PoS - Proof of Stake
4. PoW - Proof of Work
5. IPFS - InterPlanetary File System

IV. MODULES

The proposed system is composed of several integrated modules designed to handle the end-to-end agricultural auction process:

- **Identity and Profile Management Module:** This module allows farmers and retailers to create secure, verifiable digital identities on the blockchain. It handles the registration and authentication of users, ensuring that all participants in the network are legitimate. This is crucial for a consortium chain where participants are known entities.
- **Product Listing and Discovery Module:** Farmers can use this module to list their agricultural goods for auction. They can upload detailed descriptions, images, quality certifications, and even IoT sensor data related to crop growth. This data can be stored off-chain on IPFS to reduce blockchain bloat, with only the hashes stored on-chain for verification. Retailers can then browse and search for these listings in a transparent manner.
- **Smart Auction and Bidding Module:** This is the core of the system. A farmer initiates an auction by deploying a smart contract, defining parameters such as the base price, product quantity, and auction duration. Retailers submit their bids by sending transactions to this smart contract. The contract automatically tracks all bids, identifies the highest bidder, and enforces the auction rules, ensuring no party can tamper with the bidding process.
- **Automated Payment and Settlement Module:** This module leverages smart contracts to automate payment collection and settlement. Bids from retailers can be held in escrow by the smart contract. Once the auction concludes, the contract automatically releases the funds to the farmer and transfers a digital token representing ownership of the goods to the winning retailer. This eliminates disputes and the need for third-party payment processors.
- **Decentralized Ledger and Traceability Module:** This is the underlying blockchain network that functions as a distributed and immutable database. It records every transaction—from the initial product listing to every bid and the final sale. This creates a permanent and unalterable audit trail, which serves as the crucial "first-mile" data for the product's entire traceability lifecycle.

V. TOOLS AND TECHNOLOGY

The development of this system relies on a combination of foundational blockchain principles and associated modern technologies:

- **Blockchain Platforms:** The system can be built on platforms that support smart contracts, such as Ethereum or Hyperledger Fabric. Hyperledger Fabric, as a consortium chain, is particularly well-suited for supply chain applications involving multiple known enterprises.
- **Core Concepts:** The architecture is built on a peer-to-peer network maintaining a distributed ledger. The automation of the auction and enforcement of rules are handled by Smart Contracts.
- **Consensus Mechanisms:** To secure the network and validate transactions, consensus algorithms like Proof of Work (PoW) or Proof of Stake (PoS) could be utilized, or platform-specific mechanisms in the case of Hyperledger Fabric.
- **Associated Technologies:** To enhance functionality, the system can integrate with:
- **InterPlanetary File System (IPFS):** Used for decentralized, off-chain storage of large files like product images, and certification documents, with immutable hashes stored on the blockchain.

VI. SYSTEM ANALYSIS AND INNOVATION: LIMITATIONS OF EXISTING SYSTEMS

Traditional agricultural procurement systems suffer from several critical weaknesses:

- **Manual and Inefficient:** The reliance on brokers, phone calls, and manual record-keeping is slow, inefficient, and susceptible to human error.
- **Lack of Transparency:** Centralized record-keeping and opaque pricing structures mean there is no single, shared source of truth. This leads to data distrust among participants and information asymmetry.
- **High Costs:** The involvement of intermediaries such as brokers, auctioneers, and agents adds significant fees and complexity to the procurement process.
- **Security and Fraud Risks:** Centralized databases are vulnerable to data tampering, and the lack of traceability makes it difficult to verify product authenticity and quality.

PROPOSED SYSTEM AND INNOVATION

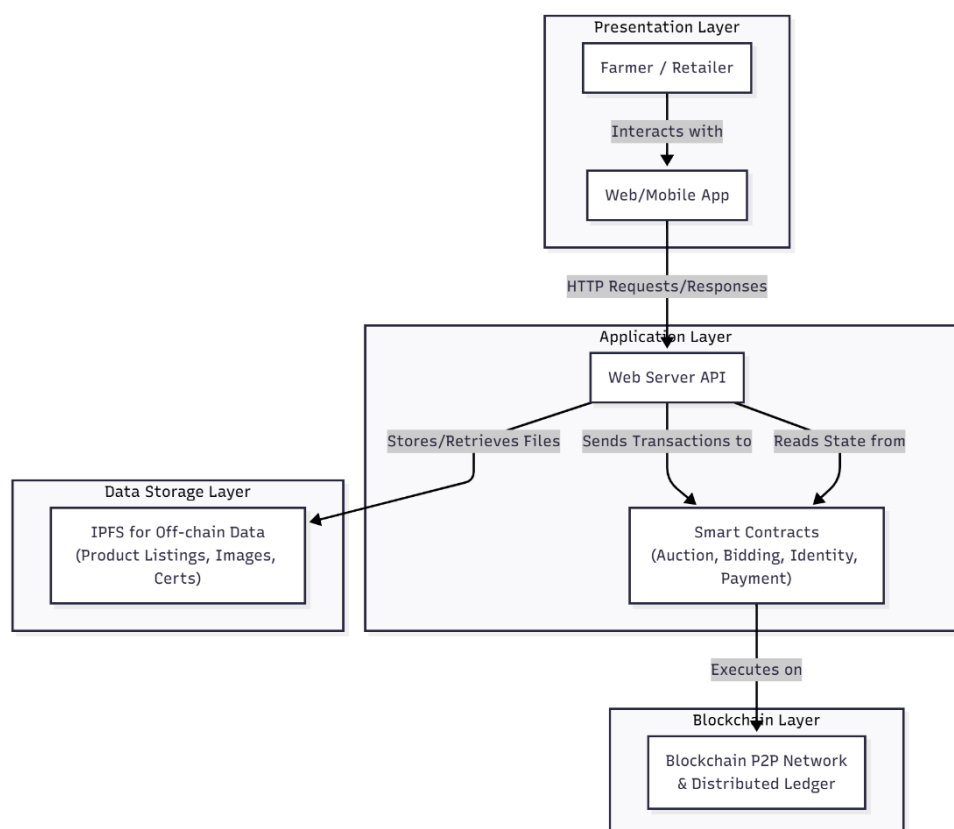


Fig: Proposed System Architecture

- **Enhanced Trust and Transparency:** The system's core innovation is its use of a decentralized ledger. This provides a shared, single source of truth for all product listings and bid histories, fostering unprecedented trust between farmers and retailers.
- **Process Automation with Smart Contracts:** By automating the entire auction lifecycle—from listing to bidding to final payment—smart contracts eliminate the need for manual intervention, reduce delays, and ensure the auction rules are executed precisely as written.

- Disintermediation: The platform facilitates direct peer-to-peer transactions, removing the need for costly intermediaries. This innovation not only reduces transaction costs but also ensures that a larger portion of the profit goes directly to the farmer.
- Immutable Records: Every bid and transaction recorded on the blockchain is cryptographically secured and cannot be altered. This immutability provides a robust and tamper-proof history of the product's origin and price, which is foundational for full supply chain traceability.vulnerabilities". This transforms the system from a simple detection tool into a powerful decision-support advisor, significantly reducing the cognitive load on administrators and enabling a much faster, more effective response.

VII. BACKGROUND REVIEW AND LITERATURE REVIEW

The application of blockchain technology to supply chain management is an emerging field of research. A review of existing literature reveals several key areas of exploration. Initial research focused on using technologies like RFID, QR codes, and barcodes to track products; however, these systems often rely on centralized databases, which are vulnerable to tampering and do not solve the problem of data distrust.

The advent of blockchain technology has been proposed as a solution to these trust and transparency issues. Many studies have demonstrated the potential of using blockchain to manage the traceability of agricultural products "from farm to fork". These systems focus on tracking the movement of a product through various stakeholders, such as processors, distributors, and retailers. Research has highlighted the use of smart contracts to execute business logic and the use of IPFS to handle the large storage requirements of traceability data.

However, a significant portion of the existing literature focuses on the post-production traceability of goods. There is a notable research gap concerning the initial procurement and price discovery phase. While some systems trace products, they do not address the foundational problem of how those products are first sold and priced in a fair and transparent manner. Our project, AgroChain, addresses this gap by proposing a comprehensive architecture for a decentralized auction platform. This system not just tracks a product but, more importantly, creates a transparent, automated, and competitive market for its initial sale, establishing a tamper-proof record of its origin and market value from the very first transaction.

VIII. APPLICATIONS

The primary application of this system is to revolutionize the agricultural procurement industry by improving transparency, fairness, and efficiency. Specific applications include:

- Secure Auction Management: Creating, storing, and enforcing auction rules on an immutable ledger, reducing disputes.
- Automated and Transparent Bidding: Using smart contracts to manage bids, ensuring a fair and auditable auction process for all participants.
- Verifiable Farmer and Product Identity: Securely storing farmer credentials and product certification data on-chain or on IPFS to build trust.
- Trustworthy Product Listings: Providing a transparent platform for product discovery where data is verifiable and resistant to fraudulent entries.
- Broader Commodity Trading: The principles of this platform can be applied beyond local farm goods to manage the auction and trading of other assets and commodities.

IX. FUTURE DIRECTIONS AND RESEARCH OPPORTUNITIES

While the proposed system offers a robust foundation, there are several avenues for future enhancements and research: Integration with IoT: A key future direction is to integrate the platform with IoT sensors. These sensors could provide real-time, automated data feeds about crop growth, soil quality, or storage conditions, further enhancing the trustworthiness of product listings.

Volume 14, Issue 11, November 2025**|DOI: 10.15680/IJIRSET.2025.1411041|**

Addressing Scalability: Future work must focus on solving scalability issues to ensure the system can manage a high volume of auctions and bids efficiently, which is a known limitation of some blockchain technologies.

Developing Regulatory Frameworks: A significant opportunity lies in collaborating with regulatory bodies to create legal and regulatory frameworks that recognize and govern smart contract-based auctions and ownership transfers.

Enhancing System Intelligence: The platform can be further developed to integrate with advanced AI for dynamic pricing recommendations, assessing bidder reputations, or optimizing logistics post-auction.

Smart Contract Security: Continuous research is needed to address and mitigate potential security vulnerabilities in smart contract code, as once deployed, they are immutable and often open source.

Decentralized Payment Mechanisms: Further development of decentralized, automated payment mechanisms is needed to ensure all system entities can transact seamlessly and securely.

X. CONCLUSION

This project demonstrates the transformative potential of blockchain technology in the agricultural supply chain. By designing a system that is transparent, secure, and efficient, we address the fundamental weaknesses of traditional procurement processes, namely opacity, high costs, and a reliance on intermediaries. The automation of the auction and bidding process through smart contracts creates a streamlined, cost-effective, and trustworthy environment for both farmers and retailers. This work provides a strong foundation for a future agricultural market that is fairer, more efficient, and more transparent for all participants.

REFERENCES

- [1] L. Wang, L. Xu, Z. Zheng, S. Liu, X. Li, L. Cao, J. Li, and C. Sun, "Smart Contract-Based Agricultural Food Supply Chain Traceability," *IEEE Access*, vol. 9, pp. 9296-9307, 2021, doi: 10.1109/ACCESS.2021.3050112.
- [2] X. Zhang, P. Sun, J. Xu, X. Wang, J. Yu, Z. Zhao, and Y. Dong, "Blockchain-based safety management system for the grain supply chain," *IEEE Access*, vol. 8, pp. 36398-36410, 2020.
- [3] K. Salah, N. Nizamuddin, R. Jayaraman, and M. Omar, "Blockchain-based soybean traceability in agricultural supply chain," *IEEE Access*, vol. 7, pp. 73295-73305, 2019.
- [4] S. Wang, D. Li, Y. Zhang, and J. Chen, "Smart contract-based product traceability system in the supply chain scenario," *IEEE Access*, vol. 7, pp. 115122-115133, 2019.
- [5] Y. P. Tsang, K. L. Choy, C. H. Wu, G. T. S. Ho, and H. Y. Lam, "Blockchain-driven IoT for food traceability with an integrated consensus mechanism," *IEEE Access*, vol. 7, pp. 129000-129017, 2019.
- [6] G. Baralla, A. Pinna, and G. Corrias, "Ensure traceability in European food supply chain by using a blockchain system," in *Proc. IEEE/ACM 2nd Int. Workshop Emerg. Trends Softw. Eng. Blockchain (WETSEB)*, May 2019, pp. 40-47.
- [7] F. Tian, "An agri-food supply chain traceability system for China based on RFID & blockchain technology," in *Proc. 13th Int. Conf. Service Syst. Service Manage. (ICSSSM)*, Jun. 2016, pp. 1-6.
- [8] F. Tian, "A supply chain traceability system for food safety based on HACCP, blockchain & Internet of Things," in *Proc. Int. Conf. Service Syst. Service Manage.*, Jun. 2017, pp. 1-6.
- [9] Q. Lin, H. Wang, X. Pei, and J. Wang, "Food safety traceability system based on blockchain and EPCIS," *IEEE Access*, vol. 7, pp. 20698-20707, 2019.
- [10] R. Kamath, "Food traceability on blockchain: Walmart's pork and mango pilots with IBM," *J. Brit. Blockchain Assoc.*, vol. 1, no. 1, pp. 1-12, Jul. 2018.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details