

AGRICHAIN: BLOCKCHAIN-ENABLED AGRICULTURAL SUPPLY CHAIN MANAGEMENT

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Keywords:

Blockchain, Agricultural Supply Chain, Transparency, Traceability, Smart Contracts, Food Safety, Supply Chain Efficiency.

Introduction:

Supply chain management is crucial for modern businesses, ensuring the smooth flow of goods and services from production to consumption. Traditional supply chains face issues like data integrity, transparency, and transaction security, leading to inefficiencies, delays, and fraud risks. Blockchain technology offers a solution with its decentralized, immutable, and transparent ledger, enhancing efficiency and security. Unlike centralized databases, blockchain ensures transaction integrity and transparency through its distributed network and cryptographic protocols. It securely records transactions and tracks products, giving stakeholders real-time visibility into the movement and origin of goods. This transparency reduces fraud, improves inventory management, and streamlines contract execution.

In the agricultural sector, supply chain management ensures efficiency, transparency, and sustainability. Blockchain technology has transformed agricultural supply chains by allowing stakeholders—farmers, processors, distributors, retailers, and consumers—to track products at every stage. Each transaction is recorded on the blockchain, creating an immutable and transparent record accessible to all authorized parties. Blockchain enhances traceability, allowing consumers to access detailed

information about the origin and quality of their products. It also streamlines processes, reduces paperwork, and minimizes errors. Smart contracts can automate various aspects of agricultural transactions, such as payments and quality control.

Objectives:

The project aims to implement blockchain technology in agricultural supply chain management to address challenges and create opportunities for improvement. Key objectives include:

- **Enhanced Traceability:** Blockchain creates a transparent and unchangeable record of each stage in the supply chain, allowing accurate tracking from farm to fork.
- **Improved Food Safety:** Blockchain enables quick identification of contaminated products, helping to swiftly contain foodborne illness outbreaks and protect public health.
- **Supply Chain Efficiency:** Blockchain streamlines processes, reduces paperwork, and eliminates unnecessary intermediaries, leading to cost savings and faster transactions.
- **Transparency and Trust:** Blockchain fosters transparency by providing a tamper-proof ledger accessible to all authorized parties, building trust and reducing the risk of fraud and disputes.

Methodology:

The methodology involves developing a blockchain-based system with the following components:

1. **System Requirements:** The system requires a computer with at least 8 GB of RAM, an operating system like Windows, macOS, or Linux, and software tools such as VS Code with Solidity and Web3 extensions, Ganache server, and Metamask Chrome extension.
2. **System Specifications:**
 - a) **Product Creation:** Enter product details and manufacturer info, initialize product history, and store data on the blockchain.

- b) **Third-Party Purchase:** Allow third-party sellers to buy products, update ownership, record transactions, and initiate shipping.
- c) **Customer Purchase:** Enable customers to buy from third-party sellers, manage shipments, update product history, and verify product integrity.
- d) **Product Retrieval:** Retrieve product data and history efficiently using unique identifiers.

3. Software Analysis:

- a) **Solidity Smart Contract:** Develop smart contracts to automate supply chain processes and ensure data integrity.
- b) **Truffle.js and Ganache:** Use Truffle.js for contract compilation, migration, and deployment, and set up Ganache for local blockchain testing.
- c) **Web3.js Integration:** Integrate Web3.js for frontend communication with smart contracts and the blockchain.
- d) **React.js Frontend:** Develop the frontend using React.js for a modular, responsive user interface.
- e) **User Interface Design:** Design a user-friendly, intuitive interface with React.js.

4. Implementation:

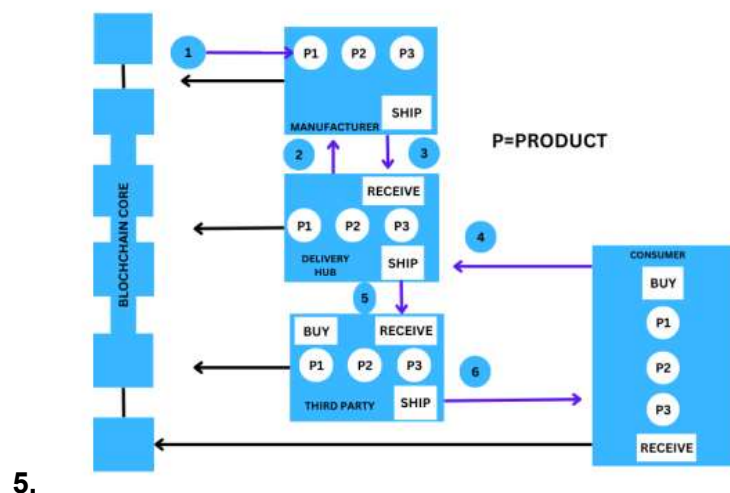


Figure 1 Flow Diagram of Proposed System

Result and Conclusion:

The implementation of blockchain technology in agricultural supply chains is expected to enhance transparency, traceability, and efficiency. By providing real-time visibility into the movement and origin of goods, blockchain enables more accurate inventory management and streamlined contract execution. This not only reduces inefficiencies and fraud risks but also promotes greater trust among stakeholders. The system ensures data integrity and traceability throughout the supply chain, improving food safety and supply chain efficiency.

Future Scope:

1. Expand the blockchain system to monitor product conditions in real-time during transportation.
2. Use AI to forecast demand and optimize supply chain operations.
3. Improve accessibility for a broader audience, including small-scale farmers and consumers.
4. Explore the use of drones for monitoring and logistics to boost efficiency and sustainability in the agricultural supply chain.
5. Conduct comprehensive studies to assess costs, benefits, and scalability for widespread adoption.