

Enhancing Supply Chain Visibility and Responsiveness with Blockchain Technology and Feedback Loops

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Abstract—Supply chains are highly complex networks and continuously evolving with the advancement in every field and becoming an important source of potential benefit for the modern world. The growing number of food safety problems or issues and contamination risks has established the need for a management system that could provide high traceability. Today's Agri-supply chains involve various in-between stakeholders making the process more inefficient. Our proposed solution eliminates the need for a between stakeholders and centralized systems. The blockchain helps to keep track of the complete chain with the help of distributed ledger. Each transaction that is carried out, the quality of food, and the time required to reach its destination is saved. Supply chain management carries out all the processes from raw material to the final product. Although the blockchain food supply chain provides immutability of data and records in the network. In the proposed system, all transactions are written to blockchain which ultimately up-loads the data to the Storage System, along with the feedback system. The storage system returns a hash of the data which is stored on the blockchain and ensures an efficient, secure, and reliable solution. Our system provides smart contracts and their algorithms to show the interaction of entities in the system.

Index Terms - Block Chain, Smart Contract, Distributed Ledger, Ethereum Blockchain

I. INTRODUCTION

The agri-food supply chain is a complex and multi-faceted system that involves numerous stakeholders, including farmers, processors, distributors, retailers, and consumers. The efficient management of this supply chain is crucial for ensuring that food is produced, processed, and delivered to consumers in a safe, timely, and cost-effective manner. However, the agri-food supply chain is also vulnerable to various challenges, such as food fraud, food safety incidents, and supply chain disruptions.

One technology that has shown promise in addressing these challenges is blockchain. Blockchain is a decentralized and distributed ledger technology that enables secure and transparent data sharing among participants in a network. By leveraging blockchain technology, the agri-food supply chain can enhance transparency, traceability, and accountability, and improve food safety and quality.

In this paper, we explore the potential of blockchain technology for agri-food supply chain management. We discuss the key features and benefits of blockchain technology, including its ability to provide end-to-end visibility, enhance traceability, and enable smart contracts. We also examine the challenges and limitations of implementing blockchain in the agri-food supply chain, such as regulatory barriers and technical complexity.

Finally, we provide a review of the existing literature on blockchain applications in the agri-food supply chain and highlight some of the promising use cases, such as traceability and certification, supply chain optimization, and food safety and quality management. Overall, this paper aims to provide insights into the potential of blockchain technology for improving the efficiency and resilience of the agri-food supply chain.

A. System Module

The proposed System, we have provided traceability from the raw material from the farmer to the end products to the consumers.

The model follows a three-layer architecture. The first layer is data layer which handles interactions between various entities. The second layer contains transactions. Transactions can be initiated by any participant in the supply chain, and all transactions are recorded on the blockchain ledger. The third layer is storage layer. The blockchain prevents unauthorized read and write to the storage layer.

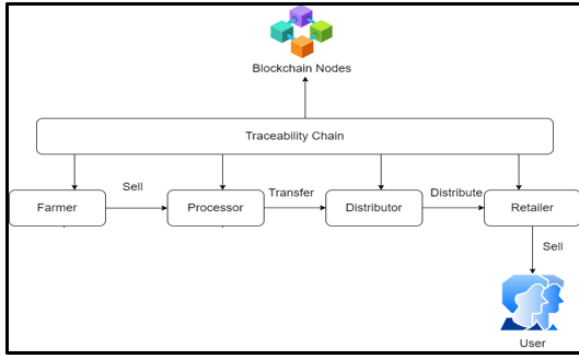


FIGURE 1: Blockchain-based end to end solution for supply chain

II. OBJECTIVE

- Explore the potential benefits of blockchain technology in the agriculture and food supply chain management sector.
- Present case studies and real-world examples of blockchain-based Agri food supply chain management systems that have been successfully implemented.
- Identify the key features and technical requirements of a blockchain-based Agri food supply chain management system.
- Implementing a blockchain-based Agri food supply chain management system, including potential cost savings, increased efficiency, and improved transparency.
- Highlight the potential role of blockchain technology in ensuring food safety and security, reducing food waste, and promoting sustainability in the Agri food industry.
- Propose recommendations for policymakers, industry stakeholders, and researchers to support the adoption and integration of blockchain technology in the Agri food supply chain management system.
- Overall, the objective of the paper is to demonstrate how blockchain technology can transform the Agri food supply chain management system and contribute to a more efficient, transparent, and sustainable Agri food industry.

A. Implementation

Implementation of Blockchain Technology

- *Ethereum Blockchain:*

Ethereum is a decentralized blockchain platform that enables developers to build decentralized applications (DApps) and smart contracts. It was created by Vitalik

Buterin and was launched in 2015. Ethereum is open-source and provides a platform for developers to create decentralized applications on top of the blockchain.

Ethereum has its own cryptocurrency, called Ether (ETH), which is used to pay for transactions and services on the Ethereum network. Ethereum's blockchain technology also allows for the creation of tokens, which are used as a form of digital currency within decentralized applications built on the Ethereum platform.

Ethereum's blockchain technology is more flexible and powerful than Bitcoin's blockchain technology because it allows for the creation of more complex smart contracts and decentralized applications. It has become one of the most popular blockchain platforms for developing decentralized applications and is used by many businesses and organizations around the world.

- *Smart Contracts:*

One of the key features of Ethereum is its ability to support smart contracts, which are self-executing contracts that can automate the execution of transactions between parties. These contracts are coded onto the Ethereum blockchain and can be used to create a wide range of applications, from digital identity and voting systems to financial instruments and supply chain management solutions.

III. METHODOLOGY

Blockchain technology can be used to address several drawbacks in supply chain management, including lack of transparency, Lack of trust, Slow and inefficient processes, Counterfeit products, and security issues.

Here are a few ways in which blockchain can solve these problems:

A. Improved transparency:

One of the biggest advantages of blockchain technology is that it provides a transparent, immutable ledger that can be accessed by all parties in a supply chain. By implementing a blockchain-based supply chain management system, businesses can share information about their products, shipments, and transactions in real-time with all stakeholders. This can help to reduce disputes, prevent fraud, and improve supply chain visibility.

B. Increased efficiency:

Blockchain technology can help to streamline supply chain operations by automating many of the processes that currently require manual intervention. Smart contracts, for example, can be used to automatically execute agreements between different parties in a supply chain, reducing the need for intermediaries and speeding up the flow of goods.

C. Enhanced security:

Supply chain management is often plagued by security issues, such as counterfeiting, theft, and data breaches. Blockchain technology can help to improve security by providing a tamper-proof ledger that is resistant to hacking and fraud. By using blockchain to track products as they move through the supply chain, businesses can ensure that only authentic goods are delivered to their customers.

D. Improved traceability:

Blockchain technology can be used to create a complete, auditable history of a product's journey through the supply chain. This can be useful in industries where traceability is critical, such as food and pharmaceuticals. By implementing a blockchain-based system, businesses can quickly trace the origin of any product and identify any potential quality issues.

IV. CONCLUSION

In conclusion, blockchain technology has the potential to revolutionize the way agri-food supply chains are managed. By enabling secure and transparent data sharing among participants in a network, blockchain can enhance visibility, traceability, and accountability, which are essential for ensuring the safety, quality, and sustainability of food production and distribution. While blockchain is not a panacea for all the challenges faced by the agri-food supply chain, it offers several advantages, such as the ability to verify the authenticity of products and track them from farm to fork. By doing so, blockchain can help mitigate food fraud and prevent food safety incidents, thereby improving consumer confidence and reducing waste. However, the adoption of blockchain technology in the agri-food supply chain is still in its early stages, and several challenges need to be addressed, such as regulatory barriers, technical complexity, and standardization issues. Despite these challenges, there

is growing interest in blockchain among stakeholders in the agri-food supply chain, and several pilot projects and initiatives are underway to explore its potential.

In summary, blockchain technology has the potential to revolutionize supply chain management by improving transparency, increasing efficiency, enhancing security, and improving traceability. By leveraging these benefits, businesses can reduce costs, improve customer satisfaction, and gain a competitive edge in their industry.

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