ZKG INTERNATIONAL

ISSN: 2366-1313

EXPLORING TRANSPARENCY AND TRACEABILITY OF AGRICULTURE-BASED PRODUCTS WITH BLOCKCHAIN TECHNOLOGY

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ABSTRACT: A number of factors are currently impeding the efficiency of agriproduct supply chains: inclement weather, challenges associated with centrally managed supply chains, insufficient storage capacity, insufficient adherence to best practices, an increase in counterfeit product counterfeiting, errors in shipping, product hoarding by distributors, transportation complications, an overabundance of intermediaries in the market, dishonest behavior, inaccurate product grading, lack Farmers are heavily impacted by these challenges. Although some components of the climate, such as supply chain management, are beyond our control, other factors can be changed to improve the situation.

To solve the aforementioned challenges, blockchain technology can be utilized to construct an immutable block traceability system that tracks a food item from manufacturing to customer delivery. By combining smart contracts with Hyperledger Fabric, a public preview of this system is created. The technical components of this project include authentication, consent-required processes, structural data, and SHA-256 algorithm-based cryptography. A decentralized application framework is built into a computer network to ensure that transactions are secure, reliable, and irreversible. Blockchain technology's functionality makes it easier to maintain transaction records, increases their security and resistance to tampering, shortens transaction settlement times, and allows for the creation of digital currencies. Our goal is to address issues raised in the most recent study findings.

Keywords: Blockchain, Smart Contracts, Supply-Chain Management, Agricultural Food Products,

I. INTRODUCTION

Supply chain management (SCM) is the process of efficiently and successfully transferring products from the manufacturer to the retailer. It basically comprises overseeing the entire manufacturing process, from component fabrication to ultimate product delivery. Customers, producers, suppliers, and retailers work together to manufacture and ship products. Each of these groups either collaborates with the others or functions alone. The content covers all of the topics required to support these endeavors, including item enhancement, procurement, production, coordination, and the formation of relevant data frameworks. Supply chains have existed since the beginning of commerce and the manufacturing of products and services. The interface between the various components of the Supply Chain Management (SCM) process is a significant factor influencing the system's overall performance. Globalization and industrialization have heightened the complexities of supply chain management (SCM). This allows businesses to make the most use of their resources throughout product and service creation. Because agricultural goods are volatile and influenced by weather and time, each stage of the supply chain is crucial. Today's technology allows firms to predict failure and strategically deploy preventative measures. They provide precise estimates, allowing

ISSN: 2366-1313

them to meet their clients' financial objectives and expectations. It is vital that each component of the supply chain network is built on consensus, capable of meeting consumer requests, and skilled at managing issues about commodity tracking, trading, and shipping techniques, among other critical factors. Today, organizations can anticipate and detect possible losses, allowing them to take preventative action. Each component of the supply chain network must be able to reach an agreement, adapt to client preferences, and deal with issues like as tracking, commodity trading, shipping methods, and other key factors. They provide precise estimates, allowing them to meet their clients' financial objectives and expectations. As we discuss SCM, we notice a few difficulties with how it is currently operating. These include the following:

- The existing blockchain (BC) is centralized, resulting in exorbitant prices, longer development delays, and the lack of crucial market research functionalities.
- The complexity of value networks and supply chains contributes to increased costs borne by chain players, which are eventually absorbed by consumers. The vast majority of the document data is saved on BC, which is an expensive solution.
- Currently, all firms are housed in the same structure, with administrators in charge of handling all data. This information is easily erroneous and detrimental to the company's expansion; as a result, firms may lose trust in the organizations. Furthermore, brokers obscure basic pricing visibility.
- Due to present supply chain management practices, commodities can only go in one direction, resulting in defective products.

While total resolution of these issues may be impossible, decentralized databases may aid in resolving some of them. They can be used to create decentralized networks, minimizing control over the various components of supply chain management and increasing trust in the system.

Blockchains are distributed ledgers or shared records that connect many computer nodes. When digital data is kept on a blockchain, it works similarly to a computer database. Blockchains are critical to decentralized and secure financial systems like Bitcoin because they record transaction data. A blockchain ensures integrity and security, and trust may be formed without relying on a third party.

Blockchain supply chains allow members to document and retain data such as price, date, temperature, location, quality, and certification. This leads to enhanced supply chain management. Before any transactions are added to a block, all parties involved must provide their assent. In a blockchain, an interconnection between blocks is formed by attaching the previous block's hash value to its own. Blockchain technology can help a company become a more prominent leader in responsible manufacturing by streamlining material supply chain tracking, reducing losses from counterfeit and illegal products, and improving compliance and transparency when compared to outsourced contract manufacturing.

To successfully execute a Blockchain transaction, all of the conditions indicated in the applications must be met. Work is performed by the Ethereum Virtual Machine (EVM), which is a component of the Ethereum network. The EVM is supplied with information about each active account and smart contract. Its role is to keep the blockchain in a consistent state at all times. The smart contract contains the entire code for the agreement. The EVM executes each line of this program individually. When a smart contract's program is invoked, a transaction begins. A condition statement is a collection of all transactions that require a signature. Each condition must be met before the next action may occur. After the transaction has been completed, it must be added to a block. This is

ISSN: 2366-1313

an undertaking that the mines must carry out. Multiple miners compete to be the first to enter a transaction into the block. The miner in charge of resolving the issue adds the transaction to the block and updates the other miners on their progress. The transaction is attached to the block when it has been verified and validated as accurate. This task is referred to as Proof of Work (PoW). Increasing the size of the Blockchain improves the security of the exchange. These articles explain how combining blockchain technology with the Internet of Things (IoT) can have a big impact on agriculture. The document also discusses the procedures for applying this unique technology in established but vital sectors such as agriculture.

There are various reasons for the increasing popularity of BC technology.

Unalterable/anti-tampering transactions: Blockchain prevents changes to processes by progressively logging transactions. This means that a freshly added block to a living blockchain is immutable and cannot be erased or changed. This protects the lifetime of each exchange and fosters openness.

Fraud prevention: Reaching agreements and exchanging information can help to lessen the financial impact of fraud and larceny. Logistics-focused firms might save expenses by deploying BC as a monitoring method.

Reliability: Each participant obtains an authentic copy of the blockchain. This enables the continuous functionality of distributed ledger technology (DLT) notwithstanding the failure of a significant number of nodes.

Time reduction: Trade settlement can be sped by Blockchain (BC) technology, which eliminates the time-consuming processes of verification, settlement, and clearing. This is accomplished by providing all participants with access to a solitary copy of the data that is preserved in the shared record and on which all parties concur.

Collaboration: Communicates between two parties directly, eliminating the demand for a middleman.

Security:BC ensures that the individuals identifying themselves are who they claim to be. This strategy minimizes expenses, removes extraneous records, and expedites transactions.

Transparency: The BC assures that transactions are immutable and clarifies the situation. We can monitor and track a range of objects utilizing a blockchain network, including orders, payments, accounts, and the production process. As a consequence, Blockchain technology offers the visibility of the whole transaction history, so promoting enhanced confidence and developing innovative avenues for optimizing processes.

II. RELATED WORK & EXISTING SYSTEMS

Walmart found a strategy to cut the period of mango supply chain management from seven days to two seconds, hence making tracking easier.

The authors used BC and smart contracts to improve the visibility and monitoring of the soybean supply chain during business transactions.

"Distributed ledger-ready blockchain manufacturing supply chain": This study explains how to build a worldwide supply network utilizing blockchain technology.

The authors have built a BC-enabled system for monitoring the registration, storage, distribution, and self-reporting of adverse events to the COVID-19 vaccination.

The authors created and tested an Ethereum-based Blockchain (BC) system. This solution uses smart contracts and decentralized off-chain storage to make it easier to monitor drugs along the pharmaceutical supply chain.

Offers clients an e-commerce platform through which they can acquire products that have been authenticated to verify they come from a legitimate source. This article also discusses the food supply chain's logistics and distribution environment, as

ISSN: 2366-1313

well as the temperature, humidity, and other circumstances under which meal constituents are gathered.

Shigeru Fujimura, Hiroki Watanabe, and colleagues created a BC-based distributed permission management system in 2015 to verify credentials and ensure information sharing integrity between supply chain nodes.

Feng Tian et al. (2016) developed an agricultural product supply chain monitoring system using RFID and BC technology. This method uses RFID and blockchain technology to collect and store data in an automated form.

Miguel introduced the AgriBlockIoT technique in 2018. This strategy combined IoT and blockchain technology to create a food monitoring system based on Hyperledger Sawtooth and Ethereum. AgriBlockIoT offers the ability to make data in agricultural food tracking systems transparent, defect-tolerant, auditable, and immutable.

Sudhan et al. demonstrated a BC system that uses BC technology to increase transparency about product condition, hence strengthening the producer-buyer relationship.

A blockchain system based on smart contracts and a consensus mechanism was created to allow pharmaceutical supply chain players to share information anonymously.

III. PROPOSED WORK

Methodology approach: We used the following study approaches in our research:

Formulation of research problem and objective: We investigated the obstacles faced by middle-class producers and attempted to pinpoint the specific issues impeding their operations in the current market.

Paper reviews: We reviewed more than twenty current research publications that addressed agricultural challenges in the context of supply chain management (SCM) and technologies that maintain consistency. This version contains a comprehensive review of the possible applications of blockchain technology in supply chain management (SCM).

Architectural definition: Create a list of potential solutions for our problem.

Results and Conclusion: We concluded by reviewing the data and discussing how this strategy could be used again in the future.

When a product is consumed by a consumer and sold in many marketplaces, its value increases linearly. A product generated by a cultivator is then sold to a trader. After the seller sells it, a wholesaler distributes it to a large number of stores. The consumer eventually obtains the merchandise. Conventional supply chain management is plagued by numerous issues, such as inaccurate shipping information, distributor stockpiling, transportation complications, an excessive number of intermediaries, unethical behavior, product misclassification, unreliability, retailers selling expired merchandise, and insufficient security protocols for agricultural products. Farmers are having difficulty because of these flaws. Implementing centralized procedures makes the process of auditing, holding accountable, and providing transparency impossible. Supply chain management (SCM) is a labour-intensive and time-consuming process. Several components of modern supply chains continue to use paper-based technologies for a variety of activities, despite their ability to handle massive and complicated data sets. This is particularly true for the chain's lower echelons. This is particularly visible in the transportation business.

Blockchain help in improving the current supply chain management

Blockchain technology can be used to track information such as price, date, location, humidity, size, color, defect-free status, natural/manure-free/organic status, cultivation time, quality, and certification, among other things, to improve supply chain management. Blockchain technology has the

ISSN: 2366-1313

potential to greatly improve supply chains by facilitating product tracking, accelerated and cost-effective delivery of goods, and promoting more partner collaboration.

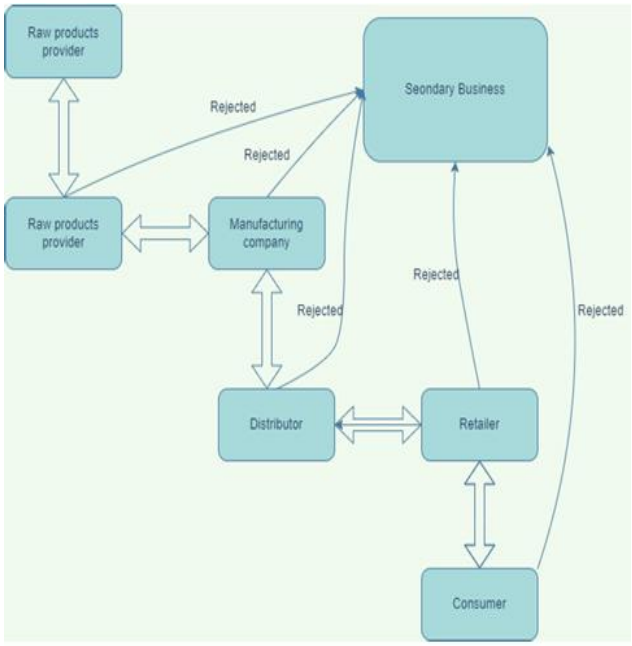

Fig 1: Expected SCM flow

As part of our proposed approach, we check to see if the expected and actual transaction sequences match. A small number of distributors or dealers are allowed to buy items from a group of producers. A transaction is confirmed when the anticipated value matches the block data id. There is no immediate reason to discard these unconfirmed products. In contrast, we may outsource value estimate and block data recognition to other firms. The word "secondary businesses" refers to operations like fertilizer manufacture and animal husbandry. Using the same verification mechanism previously used, traders and dealers can send their merchandise to wholesalers, allowing the wholesalers to sell the goods.

One approach to implementing the aforementioned principle is to use a QR code that contains all authentication information. The suggested system's front end is developed using JavaScript. The farmer uses this application to enter accurate and verifiable data about his product on the blockchain. The verifier confirms the legitimacy of transactions that enable the storing of item information. The smart contract describes all of the requirements that must be met for the system to work properly. The data is securely stored in blockchain blocks, and only the block proprietor or a centralized authority has access to it. This information is unchangeable and cannot be changed by any other person.

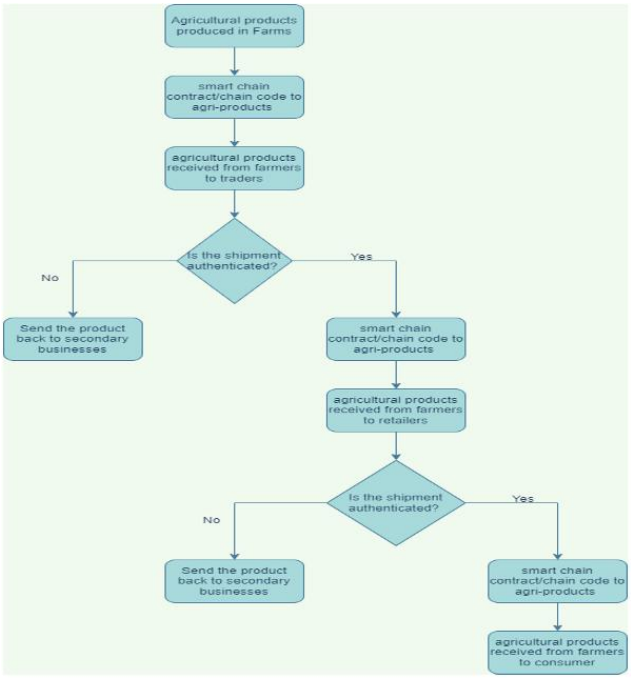

Fig 2: Flowchart

IV. CONCLUSION

As a result, blockchain technology has improved the monitoring and tracing of each level of the agricultural food supply chain. Furthermore, smart contracts have the ability to reduce the inefficiency and long timelines associated with paper-based procedures.

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