International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/CSEIT2390256

Fertilizer Supply Chain Management using Blockchain

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ARTICLEINFO

Article History:

Accepted: 01 April 2023
Published: 21 April 2023

Publication Issue
Volume 10, Issue 2
March-April-2023

Page Number
457-462

ABSTRACT

This paper explores the potential use of blockchain technology in fertilizer supply chain management. The project begins by identifying the current issues and challenges in the fertilizer supply chain and how blockchain technology can address them. The project team then designs and implements a blockchain-based supply chain management system for the fertilizer industry. The allocation of subsidies is also covered in the study, along with problems including corruption, poor management, and a lack of openness.. The team utilizes smart contracts, decentralized data storage, and consensus mechanisms to improve transparency, traceability, and efficiency in the fertilizer supply chain. The system is evaluated through user testing, and feedback is collected to identify strengths and weaknesses. The results show that the blockchain-based supply chain management system can significantly improve the efficiency and accountability of the fertilizer supply chain. The project concludes by providing recommendations for the implementation of blockchain technology in the fertilizer industry, emphasizing the need for standardization, collaboration, and stakeholder engagement. This project aims to contribute to the practical application of blockchain technology in the fertilizer industry and provide a foundation for further research in this field.

Keywords: Blockchain, Fertilizer, Subsidy, Consensus, Supply Chain, Decentralized, Stakeholder, Smart Contracts.

I. INTRODUCTION

In many nations, fertilizer subsidy schemes have been a vital instrument for boosting agricultural output and maintaining food security. However, problems with corruption, poor administration, and a lack of transparency frequently hamper the provision of subsidies, which can cause delays and increased expenses. The supply chain for fertilizer subsidies involves a number of parties, including fertilizer producers, distributors, and retailers. It is frequently complicated and prone to inefficiencies, which can lead to greater costs and delays in the delivery of subsidies. By the elimination of intermediaries, automation of the subsidy distribution process, and provision of a tamper-proof and auditable record of all transactions, blockchain technology has the ability to address these issues and enhance the management of the fertilizer subsidy supply chain.This study investigates how blockchain technology might be

used to increase the effectiveness and transparency of the fertilizer subsidy supply.Farmers in India receive fertilizers at discounted prices as determined by the Directorate of Fertilizers (DoF). Upon the sale of the fertilizer, the manufacturer receives the subsidy. The second-largest component of India's subsidy programme is fertilizer subsidies, and the total expenditure anticipated in the 2019–20 budget was Rs. 7,996 crores. One of India's leading fertilizer manufacturers, Gujarat Narmada Valley Fertilizers & Chemicals (GNFC), sells its products all over the country. Due to its size and presence over all of India, GNFC operates over a vast and complicated supply chain. India currently uses a manually operated supply chain management system for its fertilizer delivery infrastructure. As a result, a lot of difficulties and crucial problems are becoming the main considerations for managing the fertilizer distribution process.

We have proposed a blockchain-based framework for the fertilizer supply chain system. Our system describes the process to create a blockchain-based system to make an automated solution for the fertilizer supply chain and the distribution of subsidies directly to the manufacturers. In the presently accessible supply chain network framework, there are various instances of information altering because of the absence of information unchanging nature. In this way, our principal objective of the proposed framework is to guarantee production network information unchanging nature with the goal that information cannot be altered.

II. LITERATURE SURVEY

The paper presented Agri BlockET, a fully-decentralized traceability system for the Agri-Food supply chain management. Specifically, the proposed solution can rely either on the Ethereum or the Hyperledger Sawtooth publicly available blockchain implementations, while it is able to integrate various IoT sensor devices. [1]

The paper proposes unlike traditional co-lateral systems, blockchain generates credit history to prohibit manipulation. Lastly, Jaffer et al. proposed a blockchain-based distributed system that is immutable and secures the transaction logs. The self-executing smart contracts were used to automatically execute real-world contracts for auto disbursement of subsidies on meeting specific conditions. [2]

The paper proposed Medical chain storage using permissioned blockchain and how counterfeit drugs will be tracked.A Medical Chain Data Storage in Blockchain proposed structure for storage of transaction data, represents the similarity with Bitcoin transaction data. Each participant will share theirpublic key, hash value of previous transaction, encrypted QR(Quick response) code by manufacturer. QR code consists of the details of medicine which is manufactured by a pharmaceuticals agency [3]

The paper proposes blockchain technology for supply chain management system. The paper discusses the current system of supply chain management across different sectors like food supply, agriculture etc. It also features the implementations via companies in the real world. We can conclude that the general system is available but there is no such proper implementation of the traceability program by any company. [4]

The paper discusses smart contracts and use cases in blockchain technology. The paper discusses the underlying blockchain technology including basics, working of smart contracts and principles of the same. The paper also discusses the potential use cases of the technology – Supply Chain, IOT, Healthcare, Digital Right Management, Insurance etc. We can conclude that the smart contract architecture is depicted properly across different sectors and can be worked upon – specifically supply chain management. The supply chain management system can be combined with healthcare system to increase its effectiveness. [5]

III. LIMITATIONS OF EXISTING SYSTEM

There are a number of drawbacks to the manual fertilizer distribution supply chain management system and subsidies that make it less effective at helping farmers. These restrictions consist of a small audience, ineffective distribution, lack of transparency, expensive prices, fraud, and detrimental environmental effects.

The manual system's constrained range is one of its most significant drawbacks. The manual system's lack of transparency may also make it difficult to monitor the distribution process and ensure that fertilizers are reaching the farmers who need them the most. Another drawback of the manual technique is its high cost. In particular, if manual distribution systems demand a sizable labour or a sizable transportation infrastructure, they may be more expensive than automated or electronic distribution systems. Government budgets may be strained as a result, reducing funding for other crucial social initiatives. Because of the reliance on manual procedures and paper-based records, middlemen and government agents may find it simpler to manipulate or fabricate documents, diverting money meant for farmers. The current fertilizer distribution supply chain management system has a number of shortcomings that prevent it from effectively assisting farmers. Little audiences, inefficient distribution, a lack of transparency, high costs, fraud, and negative environmental effects are just a few of these limitations.

IV. IMPLEMENTED SOLUTION

We have implemented a blockchain-based framework for the fertilizer supply chain system. Our system describes the process to create a blockchain-based system to make an automated solution for the fertilizer supply chain. In the presently accessible supply chain network framework, there are various instances of information altering because of the absence of information unchanging nature. In this way, our principal objective of the proposed framework is to guarantee production network information unchanging nature with the goal that information cannot be altered. The project intends to shorten the turnaround time for subsidy activation by combining the various transaction records, such as challans, invoices, and claims, and to demonstrate a transparent and tamper-proof ledger for the track and trace of fertilizer movement across the value chain.

V. SYSTEM ARCHITECTURE

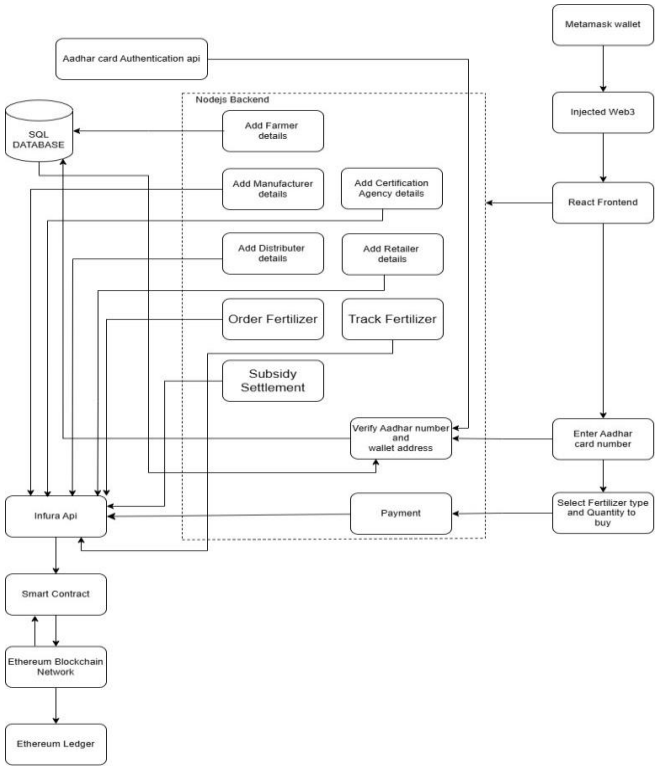

Fig 3. System Architecture

The frontend of the application will be built using React and will include a user interface for all the stakeholders of the supply chain. The frontend will interact with the backend through APIs. A blockchain network will be used for the supply chain management system. Ethereum is a popular blockchain network that provides smart contract capabilities and will be used for the implementation. The smart contract will be used for the storage of transaction data and for the implementation of

business logic. Metamask is a browser extension that allows users to interact with the Ethereum blockchain. It will be used for the authentication of users and for the signing of transactions.Node.js will be used for the development of the backend. It will interact with the blockchain network and the MySQL database. A MySQL database will be used for the storage of farmer data and transaction data as it will reduce the gas fees .In this database we will be storing the details of the farmer such as identity card, limit of fertilizer, wallet address. Infura is an API that provides access to the Ethereum blockchain network. It will be used for the communication between the frontend and the blockchain network. Aadhaar authentication is a biometric identification system used in India. It will be used for the authentication of users. We would be using the aadhaar authentication API for verify the farmer's aadhaar.

VI.DESIGN DETAILS

Fig 2. UML of Registration Contract

In fig 2. we have done registration in which we have stored the details of the users of different roles. In owner variable we are storing the details of wallet address of owner.

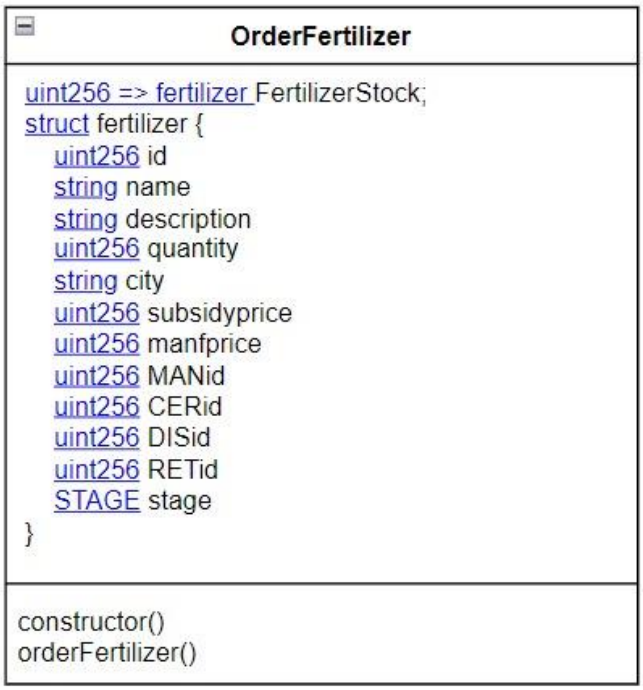

Fig 3. UML of OrderFertilizer Contract

In OrderFertilizer, Owner will order the fertilizers. In FertilizerStock we will be storing the fertlizer details and orderFertiler() function will be used to order and store the fertilizer order. struct fertilizer shows the details of the fertilizer which will be stored in the block as shown in Fig 3.

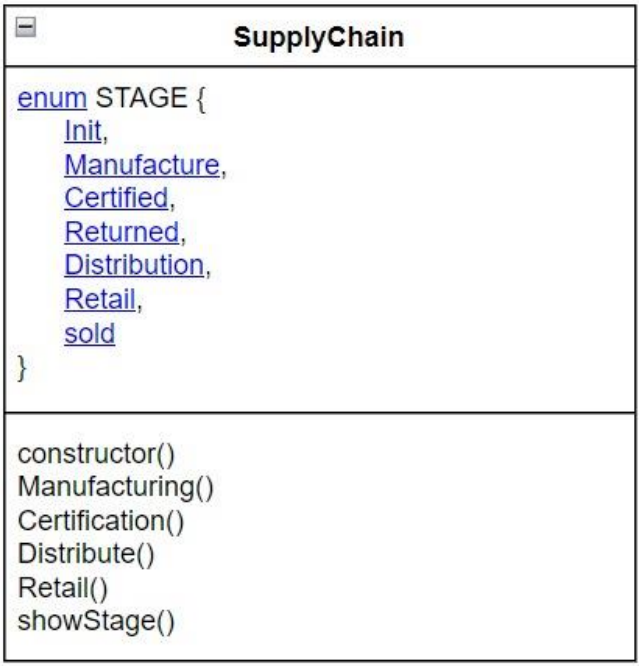

Fig 4. UML of SupplyChain Contract

As shown in fig 4, the enum STAGE shows the various stages of the ordered fertilizer in the supply chain. The showStage() function returns the stage of the ordered fertilizer. Manufacturing(), Certification(), Distribute(), Retail() updates the stage of the ordered fertilizer.

VII. RESULTS

The implementation of blockchain technology in the fertilizer supply chain management has shown promising results. By utilizing blockchain's inherent properties of transparency, immutability, and decentralization, the fertilizer supply chain becomes more secure, efficient, and cost-effective. We have successully implemented the tasks register, order fertilizer, fertilizer tracking and subsidy allocation by owner which would be a government body and different web pages using ReactJS, Infura API, Metamask wallet, NodeJS, MySQL database, Aadhaar authentication, and Ethereum blockchain has greatly enhanced the supply chain management process Only authorised individuals can participate in the supply chain thanks to the register category, which enables farmers, distributors, and manufacturers to register and verify themselves. Owner can order fertilizers through the order category, and such orders are then documented on the blockchain. The different web pages using ReactJS make the user interface more user-friendly and efficient, while the Infura API enables seamless integration with the Ethereum blockchain. The use of Metamask wallet ensures secure and easy access to the Ethereum blockchain, while the NodeJS and MySQL database provide reliable and efficient data storage and retrieval.Overall, the implementation of blockchain technology in the fertilizer supply chain management using the above-mentioned technologies and tools has greatly improved the efficiency, transparency, and security of the supply chain management process. The use of blockchain technology in other supply chain management processes could lead to similar benefits, and it is an area that is worth exploring further.

VIII. CONCLUSION

The proposed framework specially focused on security enhancement and ensured tamper-proof data management in the fertilizer sector in agriculture. The system will create the opportunity where the farmer can find a reasonable and trustable system which will make the supply and availability of fertilizers as well as subsidies by removing the paper based traditional method. With the help of the blockchain mechanism, we try to acquire the trust of all level users such as manufacturers, distributors, retailers and farmers while they will interact with the fertilizer supply chain system. To sum up, a supply chain network that is decentralised and enabled by blockchain will benefit greatly from this. All elements of the supply chain will be connected thanks to the blockchain, which will also increase data security, traceability, and organisation. Customers, manufacturers, and delivery services will all benefit from this, as well as the other stakeholders.

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Cite this article as :

Pravin Jangid, Sachin Maurya, Aniket Kushwah, Shivamkumar Tiwari, Amanullah Shaikh, "Fertilizer Supply Chain Management using Blockchain", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 2, pp.457-462, March-April-2023. Available at doi : https://doi.org/10.32628/CSEIT2390256
Journal URL : https://ijsrcseit.com/CSEIT2390256