IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Decentralization of Supply chain using Blockchain

Ms.Kanchan Dhoot, Mr.Amritanshu Singh, Mr.Aditya Bonde, Ms. Vrushali Wale, Ms. Chaitali Dholi,

Prof. Dr. A. J. Patankar

D.Y.Patil College of Engineering Akurdi, SPPU University

Abstract: Blockchain technology can benefit in many ways in the supply chain as it does in many other application areas. Employing blockchain in supply chain processes provides transparent, decentralized, secure, faster and low cost transactions. By eliminating unnecessary third parties and covering more daily life processes in digital systems minimizes paperwork. Blockchain establishes trust among trading partners. Making more detailed data available in blockchain, improves supply chain monitoring ability and safety. Thus, increasing focus on providing integration and cooperation with technologies such as Artificial Intelligence, Big Data Analytic, Cloud Computing and IoT will help to realize advanced supply chain systems.

Index Terms: Blockchain, crops supply chain, smart con- tracts, traceability, efficiency, transparency.

I. INTRODUCTION

In recent years, the integration of blockchain technology into various industries has sparked transformative changes, and one such sector experiencing a paradigm shift is the supply chain. Traditionally characterized by centralized systems, the supply chain is undergoing a revolutionary transformation through the implementation of blockchain. This technology, originally designed to support cryptocurrencies like Bitcoin, is proving to be a game-changer in fostering transparency, security, and efficiency within supply chain operations. The decentralized nature of blockchain, a distributed ledger technology, ensures that information is securely stored across a network of computers, eliminating the need for a central authority. This decentralized approach addresses several longstanding challenges within traditional supply chain systems, such as data silos, fraud, inefficiencies, and lack of transparency. By leveraging blockchain, companies are reimagining their supply chain processes, creating a more resilient and responsive ecosystem.

Smart contracts automate and enforce predefined actions within the supply chain, streamlining processes, reducing delays, and minimizing errors. Blockchain's immutable ledger ensures transparent and traceable records of transactions and movements, providing end-to- end visibility for stakeholders. Decentralization enhances supply chain resilience by eliminating single points of failure. As the supply chain embraces a decentralized model using blockchain, businesses stand to benefit from increased transparency, security, and efficiency. This report explores these key components of transformation, envisioning a supply chain ecosystem characterized by resilience, agility, and trustworthiness.

II. PROBLEM STATEMENT

India's agricultural sector faces numerous challenges, notably in the crop supply chain, where farmers endure high fees imposed by middlemen, resulting in diminished returns. The lack of transparency and traceability in the current system further compounds the issue, leaving stakeholders uncertain about the origin of produce and the fairness of payments to farmers. Such opacity undermines trust and reliability within the supply chain. To address these concerns, blockchain technology emerges as a viable solution, offering transparency, traceability, and trustworthiness.

Additionally, unpredictable weather conditions pose a significant risk to crop yields, emphasizing the importance of accurate weather prediction and monitoring. Furthermore, the lack of transparency contributes to uncertain pricing dynamics, affecting both farmers and consumers. Blockchain's ability to provide real-time

data tracking and smart contract functionalities can mitigate these challenges, facilitating fairer pricing and enabling efficient crop insurance processes. This paper explores the potential of blockchain to decentralize India's agricultural supply chain, focusing on enhancing transparency, traceability, and weather risk management to foster a more resilient and equitable ecosystem.

III. RELATED WORK

In the evolving landscape of e-agriculture, blockchain emerges as a pivotal technology reshaping the entire sector to address food challenges in the modern era. By amalgamating smart farming and precision agriculture techniques, blockchain ensures data privacy and integrity, thereby enhancing farm productivity. The comprehensive analysis conducted explores existing blockchain-based agricultural technologies and innovations, emphasizing their diverse applications within the agricultural ecosystem. Key aspects covered include the data storage ecosystem and various application platforms relevant to blockchain technology. Furthermore, the article delves into the challenges encountered in implementing blockchain solutions in agriculture, such as scalability, integration with legacy systems, and security and privacy concerns. Solutions to these challenges are proposed to foster the seamless adoption and integration of blockchain technologies across the agricultural sector, ultimately benefiting all stakeholders involved.

Conducting a thorough review of existing literature and case studies related to the decentralization of supply chains in agriculture using blockchain and smart contracts is essential. This involves analyzing successful implementations, challenges faced, and lessons learned. This phase provides a foundation for understanding the current state of the field and identifying gaps or opportunities for improvement. The blockchain allows us to eliminate intermediaries, but the promises and trust boundaries between the contributing parties typically require something called a smart contract. In the same way that traditional contracts regulate trust between the parties, smart contracts provide organizational terms and conditions that govern trust within the scope of the contract. A smart contract is only different because it is coded in a programming language. Using controlled coding, the rules, terms, and conditions reflected in the agreement are implemented exactly as agreed by all parties.

A smart contract concept has existed since the 1980s, but all it lacked was the removal of intermediaries. Smart contracts were introduced in 1996 by Nick Szabo. A smart contract embeds the contractual terms within a combination of hardware and software, making it difficult for them to be breached, and making them cost- prohibitive. As such, smart contracts increase safety by reducing attacks. Ethereum blockchain popularized the notion of smart contracts and its implementation in real life in 2016. The Ethereum network combines a decentralized Turing-complete blockchain with a smart contract environment and integration tools.

In other words, a smart contract automates processes in blockchain technology. By storing the contract within the blockchain, we can potentially use blockchain in other real-world situations. To automate the steps involved in the system, the authors in use smart contracts as their core technology. Real-time tracking of products in a supply chain and a comprehensive view of the process are both part of the automation. Using a smart contract, incorporates industrial spare parts traceability research to implement the necessary functions, modifiers, and events to implement the logical flow mechanism to automate the entire process. By securing contracts within the blockchain, smart contracts can satisfy the fundamental need for trust between parties. The paper proposes implementing an IoT-based automobile insurance ecosystem known as CAIPY, which implements step-by- step processes and communicates with tamper-proof IoT devices in order to monitor a car’s condition. Smart contracts can be used for intellectual property rights management. It is nearly impossible to alter a smart contract that has been distributed within a blockchain because they are distributed inside the block chain, so you need to deploy them within a blockchain environment for maximum security.

IV. BLOCKCHAIN AND IT’S USE IN AGRICULTURE

Blockchain technology operates as a decentralized network of peer-to-peer nodes, storing transactional records, or blocks, across multiple databases. These blocks form a digital ledger, where each transaction requires the owner's digital signature for authentication and protection against tampering. This ensures the stability and integrity of the data within the ledger. In essence, the digital ledger resembles a Google spreadsheet distributed across numerous machines in a network, allowing anyone to view the data but preventing unauthorized modifications.

One of the key features of blockchain technology is its method of confirming and authorizing transactions. For instance, when two parties wish to engage in a transaction using their private and public keys, the transaction details are linked to the recipient's public key, forming a block. This block contains essential data such as digital signatures, timestamps, and other relevant information, without disclosing the identities of the involved parties. Subsequently, the block is transmitted through the network's nodes, and the transaction is finalized when the rightful party utilizes their private key to authenticate the block alignment.

Blockchain-based decentralized applications (DApps) hold the potential to revolutionize agriculture by addressing a myriad of pressing issues within the sector. As agricultural challenges continue to escalate, blockchain technology offers promising solutions that can significantly benefit the agriculture industry.

Use Cases of Blockchain in Agriculture:

1: Crop and Food Production: The agriculture sector encounters various challenges, including the need to meet the increasing demands of a growing population with limited resources, minimizing environmental impact, ensuring transparency in the supply chain, guaranteeing fair wages for farmers, and managing weather conditions.

2: Food Supply Chain: Ensuring the traceability and origin of food products is crucial for food safety. However, the current state of the food supply chain makes it challenging for producers and retailers to verify product origins. Blockchain technology in the food supply chain can mitigate food risks through steps such as data storage by farmers, distribution to processing companies, supply to wholesalers and retailers, and enabling consumers to trace the supply chain.

3: Controlling Weather Crisis: Farmers often face unpredictable weather conditions, impacting crop survival. Blockchain can aid in predicting and tracking weather patterns, particularly during crises such as floods. Additionally, blockchain's transparency can help stakeholders understand price fluctuations in the food distribution industry, while smart contracts can streamline crop insurance claims.

4: Managing Agricultural Finance: Smallholders and structured financial inclusion encounter obstacles like lack of clarity, credit history, and contract compliance issues. This lack of access to finance can hinder agricultural production and lead to inefficiencies in the value chain. Blockchain offers transparency and fairness in agricultural finance processes, ensuring fair transactions and empowering smallholders.

V. BLOCKCHAIN AND SMART CONTRACT

Smart contracts are computer programs that run when certain conditions are met and recorded on a blockchain. They are often utilized to automate the execution of a contract so that all parties are instantly in-formed of the results, without the need for any middlemen or time waste. Traditional contracts are no longer efficient for blockchain technology. The traditional supply chain also contains a huge amount of paperwork and documents which is not a good approach for tracking and records proofs. Smart contracts are automatically executed and triggered when preset criteria are fulfilled, can assist to address these drawbacks of transparency, efficiency, security, and tracking, and eliminate the role of a mediator. These auto-executed code-based contracts enable agreed-upon activities (such as payments) to occur quickly upon the completion of the terms of the contract. This is a major function that differentiates blockchain from Ethereum. For example, when a client verifies their shipment, according to the instructions a smart contract will transfer money to the carrier.

Smart contracts are unique in that they allow you to write code that executes itself without the need for a third party, which helps to save a lot of money, time, and effort, also no chance of errors or frauds. In comparison to a traditional contract, a smart agreement between two parties participating in a transaction holds each participant responsible for their participation in the transaction and also ensures that the contract is implemented. Smart contracts increase a supply chain's transparency, traceability, and efficacy, allowing it to be more flexible in establishing connections between partners. A unique address is assigned to every smart contract. This address never changes one of the contracts deployed in the blockchain. User transactions can only send to a contract address. Every consensus node in the network will execute the transaction to achieve a consensus on its output. The two forms of smart contracts are deterministic and non- deterministic smart contracts. A deterministic smart contract executes without the need for any information from a third party. A non-deterministic smart contract relies on third-party data (database). A smart contract works by following simple "if/when … then …" statements which are written into the blockchain code.

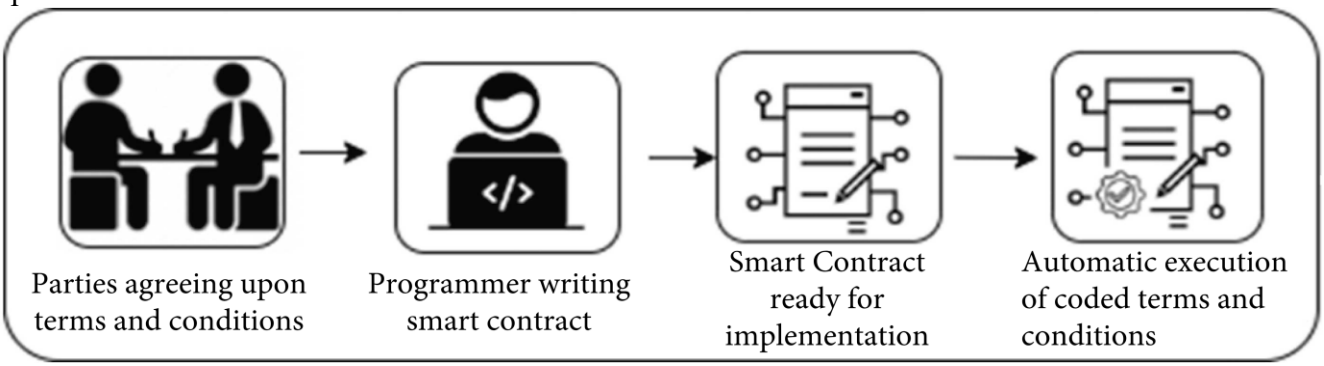

Fig. 1. Smart contract building steps.

Benefits of Smart Contract over the Traditional Supply Chain:

1. ***Transparency:***

Through smart contracts, the provenance of goods can be recorded, enhancing supply chain transparency. The blockchain stores information such as the date, location, and quality, which are helpful in verifying a product's origin. Consumers will have more confidence that they are purchasing good products, and manufacturers will have the assurance that their raw material comes from a reliable source. Smart contracts can also be used to enable transparent credentialing among supply chain partners by creating and storing digital forms of identification. With this system, parties can easily verify that other parties have the requisite certifications to be able to do their duties. Blockchain technology can also be used to manage reputations and reliability.

2. ***Traceability:***

Using smart contracts, traceable inventory can be tracked from its raw material source to its delivery to its end-user, which can improve supply chain traceability. A serial number, RFID tag, or smart sensor can be used to accomplish this. In addition to location and environmental data, smart sensors can provide information about product quality (especially for perishable goods). The ability to make better and faster decisions will be improved with real-time information and updates about product status. In this case, it is easier to activate a reserve batch of goods midway through the supply chain process rather than to wait until the bad batch arrives before making a decision. As a result, delays can be 15 reduced, and the supply chain can remain agile. Natural disasters, factory strikes, and delivery accidents will also be dealt with well by the organizations. With the increase of product competition, ensuring continuity of supply can significantly enhance a brand's image among consumers.

3. ***Efficiency:***

A smart contract can improve the efficiency of the supply chain from both an operational and cost perspective. Using distributed ledgers to perform smart contracts simplifies multiparty supply chains, improving process efficiency. Because smart contracts execute themselves automatically, they can automatically execute "contractual rights and obligations, including payment and delivery terms". Reduced processing time and work are the results of reducing paperwork. Cost reduction is another way to enhance efficiency. As contractual agreements are executed using trusted computer code that can easily be customized, fewer physical documents need to be created and maintained by each party's purchasing, accounting, or legal departments. By eliminating physical records, a great deal of manual work can be reduced.

Smart Contract challenges:

Fig. 2. Challenge

VI. ARCHITECTURE

The architecture for the decentralization of the supply chain using blockchain and smart contracts involves the integration of key entities, including suppliers, smart contracts, farmers, retailers, and customers. The architecture ensures transparency, traceability, and automation of processes within the supply chain.

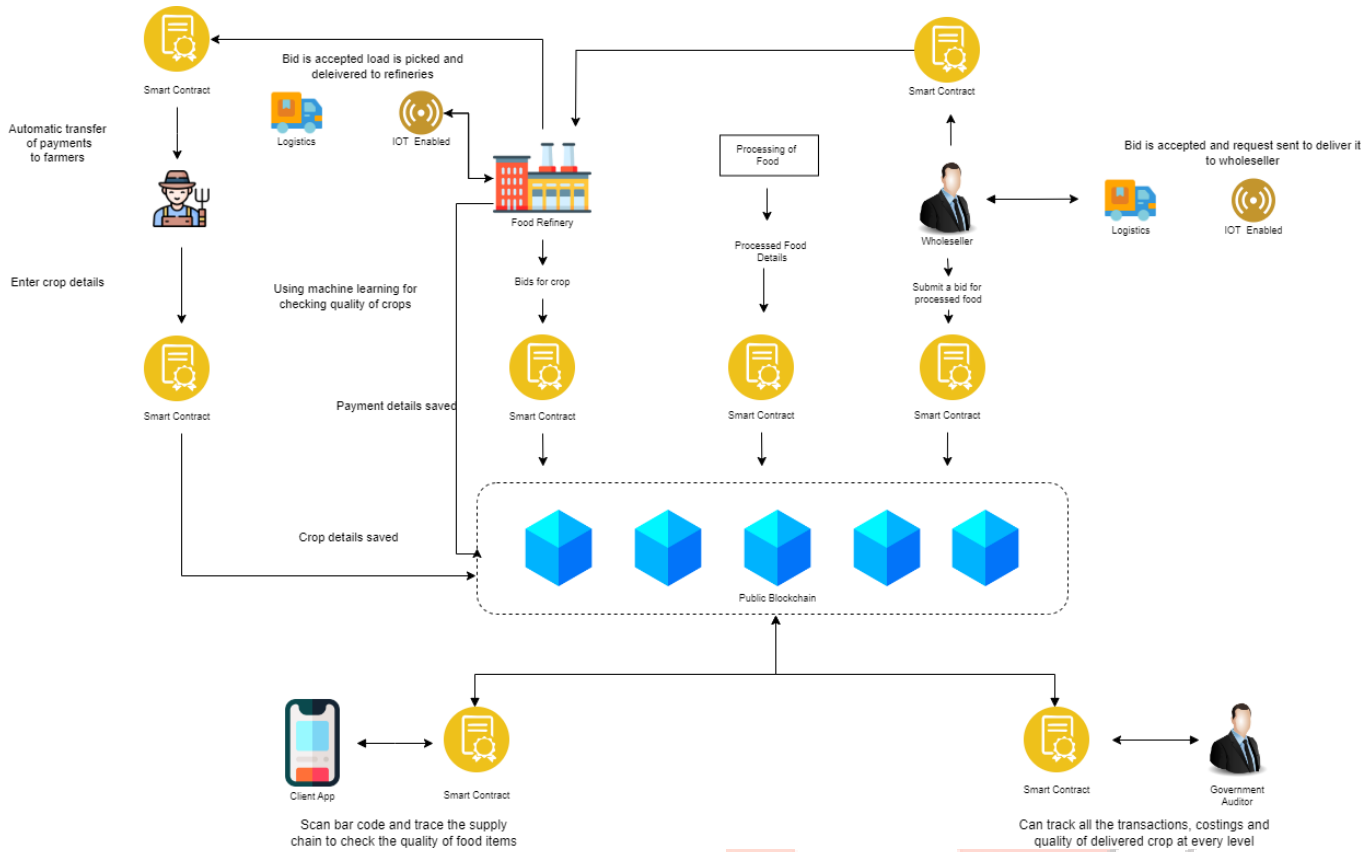

Fig. 3. Architecture of supply chain

Architecture Flow:

Data Recording: Each entity involved (supplier, farmer, retailer) records relevant information on the blockchain, creating a transparent and immutable ledger.

Smart Contract Execution: Smart contracts are triggered based on predefined conditions, automating processes such as payment, quality assurance, and product transfer.

Verification and Transparency: All participants in the supply chain have access to the decentralized ledger, allowing them to verify information and ensuring transparency at every stage. This architecture promotes a decentralized, secure, and efficient agricultural supply chain, where information is recorded transparently, and processes are automated through smart contracts, benefiting suppliers, farmers, retailers, and customers alike.

Description:

Smart Contracts: Smart contracts are self-executing contracts with predefined rules and conditions encoded in code. Smart contracts automate and enforce agreements between various stakeholders. For example, when a supplier delivers a batch of seeds to a farmer, a smart contract can automatically trigger the payment process once the delivery is confirmed. Smart contracts also play a crucial role in quality assurance and other predefined conditions in the supply chain.

Farmer: Farmers are responsible for cultivating and harvesting crops. Farmers engage with the blockchain network by recording key events such as planting, harvesting, and quality assessments. Smart contracts associated with payment and quality assurance are executed based on the fulfillment of predefined conditions. This ensures that farmers are fairly compensated and that the quality of the produce is verified on the blockchain.

Supplier: Suppliers provide the raw materials, seeds, or other inputs necessary for agricultural production. Suppliers participate in the blockchain network by recording the transfer of goods or materials onto the decentralized ledger.

This entry is transparent and secure, establishing a verifiable origin of the agricultural inputs.

Retailer: Retailers acquire agricultural products from farmers and supply them to end customers or consumers. Retailers participate in the blockchain network by recording the receipt and distribution of agricultural products. This entry ensures transparency in the supply chain, allowing retailers to verify the authenticity and quality of the products they receive. Smart 20 contracts may automate payment processes between retailers and farmers, streamlining transactions.

Customer: Customers are the end consumers who purchase products. Customers benefit from the transparency provided by the blockchain network. They can access information about the origin, cultivation practices, and distribution journey of the agricultural products they purchase. This transparency fosters trust and allows customers to make informed choices.

VII. DESIGN AND IMPLEMENTATION

Design

Blockchain Infrastructure: Implement a blockchain framework that supports decentralization, transparency, and data immutability. Consider using platforms such as Ethereum or Hyperledger Fabric for this purpose.

Smart Contract Development: Write smart contracts in a programming language like Solidity for Ethereum or Chaincode for Hyperledger Fabric. These smart contracts will automate essential processes, including payments, quality assurance, and tracking products.

User Interfaces: Design intuitive user interfaces for various participants, including suppliers, farmers, and retailers. These interfaces should enable easy data entry, transaction validation, and information access.

Decentralized Storage: Incorporate decentralized storage solutions to manage off-chain data. Use technologies like IPFS to store large datasets, such as those related to crop monitoring and quality assessments.

Algorithm flow

Transaction Initiation: Participants initiate transactions by submitting relevant data (delivery receipts, quality reports) to the blockchain.

Smart Contract Execution: Smart contracts automatically execute based on predefined conditions, automating processes like payment, quality verification, and product traceability.

Consensus Verification: The decentralized network reaches consensus on the validity of transactions, ensuring accuracy and tamper resistance.

User Verification and Transparency: Participants and customers verify transactions on the blockchain, fostering transparency and trust in the supply chain.

Sequence diagram

A consumer can check the origin and processing of the product. This new supply chain model enables the agricultural industry to gigantically grow. The use of blockchain enables the consumer to trace all the products from origin to delivery. The main benefit of this model is the confidence of the final consumer that will increase the sales a lot. Figure shows the sequence diagram for the proposed model.

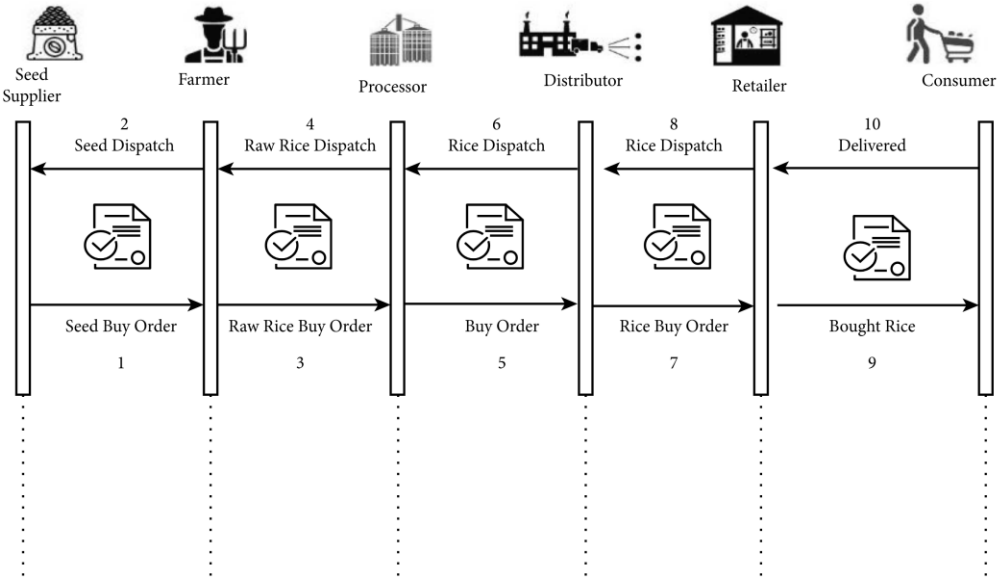

Fig 3. Sequence diagram

Implementation

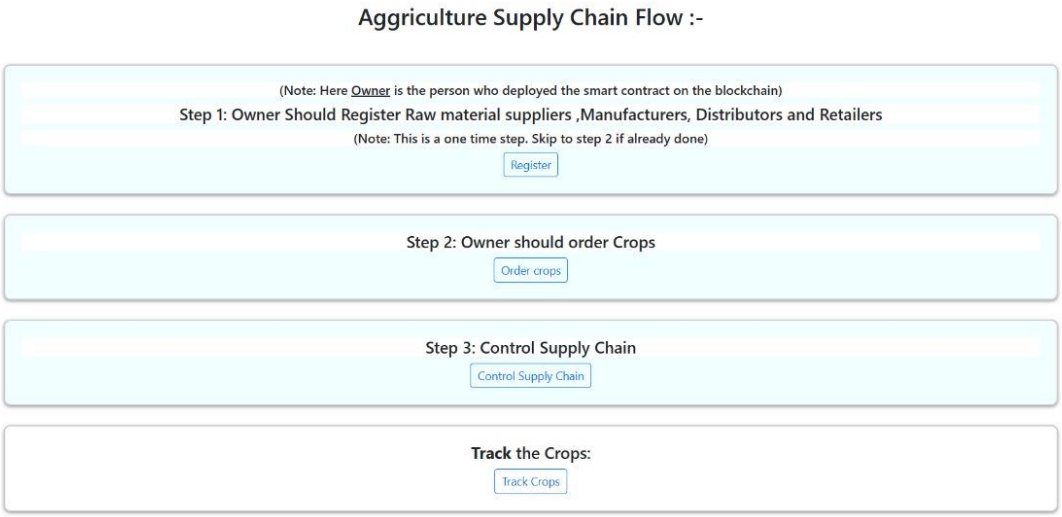

Fig 4. Home Page

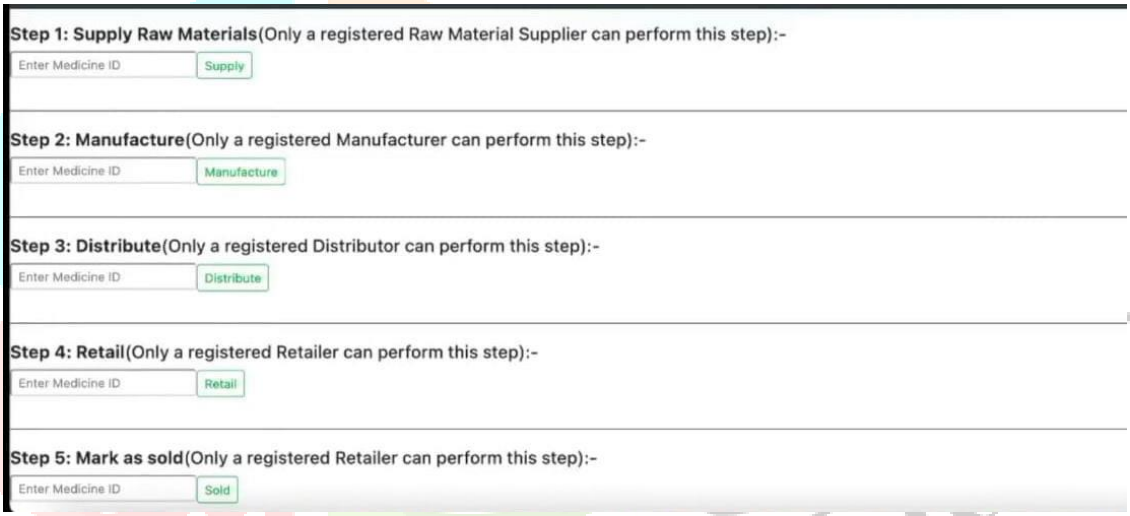

Fig 5. Registration Page 1

Fig 6. Registration Page 2

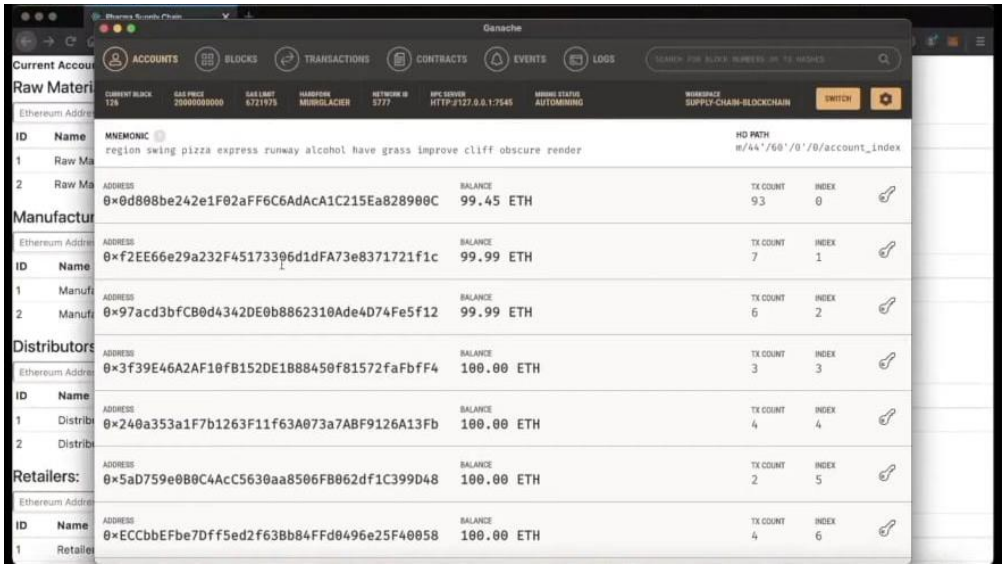

Fig 7. Local Ethereum Node Setup

Fig 8. Track Order 1

Fig 9. Track Order 2

VIII. **FUTURE SCOPE**

The integration of blockchain technology in agriculture supply chains paves the way for seamless collaboration with precision agriculture technologies. Smart contracts automate data-sharing agreements among farmers, equipment providers, and stakeholders, fostering precise and data-driven farming practices. Blockchain's transparency enables provenance tracking for organic and sustainable farming, empowering consumers to make informed choices. Decentralized marketplaces facilitated by blockchain empower direct connections between farmers and consumers, fostering fairer pricing and reduced transaction costs. Smart contracts in blockchain streamline supply chain finance, particularly benefiting small holder farmers by ensuring timely payments and access to financial services. Coupled with IoT devices, blockchain facilitates climate-smart agriculture monitoring, incentivizing sustainable practices. Moreover, blockchain facilitates secure and collaborative research and development efforts advancements. Future in agriculture, integration with accelerating

emerging technologies like AI and 5G connectivity further enhances blockchain's potential in agriculture by providing advanced analytics and real-time monitoring capabilities.

IX. **REFERENCE**

[1] A. Shahid, A. Almogren, N. Javaid, F. A. Al-Zahrani, M. Zuair, and M. Alam, "Blockchainbased agri-food supply chain: a complete solution," IEEE Access, vol. 8, pp. 69230–69243, 2020.

[2] S. Umamaheswari, S. Sreeram, N. Kritika, and D. R. Jyothi Prasanth, "BIoT: blockchain based IoT for agriculture," in Proceedings of the 2019 11th International Conference on Advanced Computing (ICoAC), pp. 324–327, IEEE, Chennai, India, 18 December 2019.

[3] J. Duan, C. Zhang, Y. Gong, S. Brown, and Z.Li, "A content-analysis based literature review in blockchain adoption within food ssupply chain," International Journal of Environmental Research and Public Health, vol. 17, no. 5, p. 1784, 2020.

[4] S. F. Wamba and M. M. Queiroz, "Blockchain in the operations and supply chain management: benefits, challenges and future research opportunities," International Journal of Information Management, vol. 52, no. xxxx, Article ID 102064, 2020.

[5] M. Torky and A. E. Hassanein, "Integrating blockchain and the internet of things in precision agriculture: analysis, opportunities, and challenges," Computers and Electronics in Agriculture, vol. 178, no. April, p. 105476, 2020.

[6] J. Lin, A. Zhang, Z. Shen, and Y. Chai, "Blockchain and IoT based food traceability for smart agriculture," in Proceedings of the ACM Int. Conf. Proceeding Ser., pp. 1–6, ACM, Singapore, 28 July 2018.

[7] D. Kondor, M. P´ osfai, I. Csabai, and G. Vattay, "Do the rich get richer? An empirical analysis of the BitCoin transaction network," PloS one, vol. 9, no. 2, p. e86197, 2014.

[8] S. Meiklejohn, M. Pomarole, G. Jordan, K. Levchenko, D. McCoy, G. M. Voelker, and S. Savage, "A fistful of bitcoins: characterizing payments among men with no names," in Proceedings of the 2013 conference on Internet measurement conference. ACM, 2013, pp. 127–140.

[9] L. Xiaoming and F. Olorunniwo, "An exploration of reverse logistics practices in three companies," Supply Chain Man agement International Journal, vol. 13, no. 5, pp. 381–386, 2008.

[10] D. Magazzeni, P. Mcburney, and W. Nash, "Validation and verification of smart contracts: a research agenda," Computer, vol. 50, no. 9, pp. 50–57, 2017.

[11] C. Turner, C. Walton, S. Hoashi, and M. Evans, "Breath acetone concentration decreases with blood glucose concentration in type I diabetes mellitus patients during hypoglycaemic clamps," Journal of breath research, vol. 3, no. 4, pp. 1-9, 2009.

[12] Md. Mahbubur Rahman, A. J. Saleh Ahammad, Joon- Hyung Jin, Sang Jung Ahn and JaeJoon Lee, "A Comprehensive Review of Glucose Biosensors Based on Nanostructured Metal-Oxides:" Sensors, vol. 10, pp. 4855-4886, 2010.

[13] Z. Nehai, P. Piriou, and F. Daumas, "Model-checking of smart contracts," in Proceedings of the IEEE Smart Data (Smart Data), pp. 980–987, Halifax, NS, Canada, July 2018.

[14] The supply chain management of kirana stores," Blockchain Applications in IoT Ecosystem,pp. 275–287, EAI/Springer In novations in Communication and Computing, Europe, 2021.

[15] M.YooandY.Won,"A study on the transparent price tracing system in supply chain management based on blockchain," MDPI AG, vol. 11, p. 4037, 2018