
BLOCKCHAIN TECHNOLOGY: REVOLUTION IN AGRICULTURE

Shubham B. Walunj^{*1}

^{*1}Department Of Information Technology, B K Birla College,
Mumbai, Maharashtra, India.

DOI : <https://www.doi.org/10.56726/IRJMETS30247>

ABSTRACT

Farming is known as the main occupation because it nurtures people, feeds people, and makes them healthy to do other work. Similarly, it helps in strengthening the economy of the country. The farmers who are producing the crops are not reaping abundant benefits from it. They are facing many problems today. Today many technologies have been discovered, which are proving to help increase the income of the farmer. Blockchain technology is also one of them. Blockchain technology is a type of digital ledger technology where in all the nodes are connected that are securely linked together using cryptography. Farmers can buy everything related to agriculture and also sell their products to consumers without no interference from middlemen on one platform using the smart contract. These smart contracts provide much security to farmers and consumers also. It also resists the Sybil attack, by blocking the intruder with multiple counterfeit identities to trade with consumers thereby increasing the profit of the farmers.

Keywords: Blockchain, Digital Ledger Technology, Cryptography, Smart Contracts, Sybil Attack.

I. INTRODUCTION

India had a great history in agriculture since the Neolithic age. India has an unbroken relationship with agriculture, it is known to us from the Vedas and Puranas. Indian agriculture began in 9000 BCE in northwest India with the first cultivation of plants, and domestication of crops and animals [1]. Indian subcontinent agriculture was the largest producer of wheat and grain at that time. Their settled life soon followed with implements and techniques being developed for agriculture people of India have been doing agriculture for thousands of years. The use of drainage, sewer system, and animal plow found in the Indus Valley Civilization is proof that agriculture was very advanced in India even at that time [1]. The construction of water works and aspects of water technology in Medieval India is also proof of the great work of Indians in the agriculture sector. In British Era, Few Indian commercial crops such as Cotton, indigo, opium, wheat, and rice India made it to the global market.

According to the report of FAO of the UN, 59% of India's population is dependent on agriculture, accounting for 23% of the nation's GDP. Agriculture, with its allied sectors, is the largest source of livelihood in India [2]. 70 percent of its rural households rely totally on agriculture for their livelihood, with 82 percent of farmers being little and marginal. India is the largest producer (25% of worldwide production), the consumer (27% of world consumption), and the importer (14%) of pulses within the world. India's annual milk production was 165 MT (2017-18), making India the largest producer of milk, jute, and pulses, with the world's second-largest cattle population of 190 million in 2012 [2]. It is the second-largest producer of rice, wheat, sugarcane, cotton, and groundnuts, as well as the second-largest fruit and vegetable producer, accounting for 10.9% and 8.6% of the world's fruit and vegetable production, respectively. All these statistics are proof that India is contributing to fulfilling the need for the world's food while fulfilling its food requirement.

This sector, which has such a grand history, is facing many problems today. Once upon a time, the business on which the whole country was dependent, today no one wants to do it. No farmer is not wanting his son to become a farmer, it is horrific for the future of the nation. In 2012, the National Crime Records Bureau of India according to 13,754 farmer suicides [3]. There are so many reasons behind this. Activists and scholars have offered several conflicting reasons for farmer suicides, such as monsoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues, and family problems. High-yielding seeds, the right fertilizers, and pesticides are not available on time, and not getting the right price for the price, are also reasons for the bad condition of the farmer today. Many initiatives have been taken up by the government, NGOs, and many companies to ease the burden of the farmers and use technology to make their

lives better. Blockchain is of nice facilitate during this sector. A clear and sure system is engineered by govt to shoot all the data concerning agricultural events on a blockchain. Farmers also can get instant information associated with the seed quality, climate environment-related information, payments, soil wetness, demand and sale value, etc. all on a single platform.

II. RELATED WORK

Our paper aims to understand the includes of 3 areas: blockchain, smart contract, and agri-food traceability, which is introduced in this section.

A. BLOCKCHAIN

A blockchain is a purely peer-to-peer network of electronic cash that would allow online payments to be sent directly from one party to another without going through a financial institution [4]. A “block” consists of a set of records, a timestamp, and a hash code. That hash code is calculated from the content in the block and the previous block. Then the block will add to a network where it will verify by other parties. After verification, it will be updated on the server and further server will show all changes on another node of servers.

Blockchain components include [5]:

- Cryptography: Strong encryption to allow decryption by approved users only;
- Ledger: A shared and distributed information to store data;
- Consensus: A protocol to stop minor nodes to modify transactions;
- Smart Contract: Rules, penalties, and actions to be mechanically applied to the concerned parties once the condition is met.

Main features and characteristics of blockchain include:

- Decentralization: Nodes (participants) in a peer-to-peer network work together to process and validate data without a need for a single central trust party;
- Trust-less: every participant will participate while not knowing every other;
- Anonymity: every participant will communicate employing a generated virtual identity code;
- Autonomy: every node will safely perform transactions while not third-party intervention;
- Ownership and uniqueness: A block includes transaction information as well as its owner and a unique hash code;
- Irreversibly and Persistency: Cancelling a transaction is impossible once a chain adds the block;
- Immutability: Timestamps and controls ensure that stored data cannot be changed;
- Transparency: concerned parties will access and trace stored data;
- Provenance: Digital information attached to each product can prove its authenticity and origin;
- Censorship resistant: Transactions cannot be censored as a network does not need controllers;
- Open source: Everyone in the network can access the source with a sense of hierarchy.

Not all features are desirable. For instance, permissionless property could introduce security issues since anyone can create a transaction that could be used for malicious purposes. The implementation of a blockchain system could differ in terms of who are the provers and validators of blocks, who can access the system, security and efficiency level, design methods, and blockchain authority. These choices could classify blockchains into three types: public, private, and consortium blockchain (i.e., permission or hybrid blockchain).

This paper does not focus on aspects of blockchain. Rather, we focus on how this feature helps us to understand blockchain technology more effectively as well as this helps to raise issues in agri-food traceability applications.

B. AGRI-FOOD SUPPLY CHAIN

In Maharashtra, mainly jawar, bajra, wheat, rice-like grains, onion, tomato, cabbage, cauliflower, other vegetables like potato, and fruits like orange, banana, mango, and cilantro are produced in large quantities. There are so many local markets in all the districts of Maharashtra for their sale of crops. As the Supply Chain involves many problems like the sudden increase in demand for a product occurs and the producer running out of stock, Supply Chain management becomes necessary. Also, customer satisfaction can be achieved in a better way through Supply Chain Management. The supply chain involves all processes, flow of goods, information, etc., Fig.1 explains that the people involved in these activities such as producers, suppliers, distributors, and retailers have to work along to produce a product for the buyer satisfying their desires. The traditional Supply

Chain's traceability is based on centralized systems like cloud database that uses IoT that provides no transparency and leads to security threats, tampering, data loss, etc.

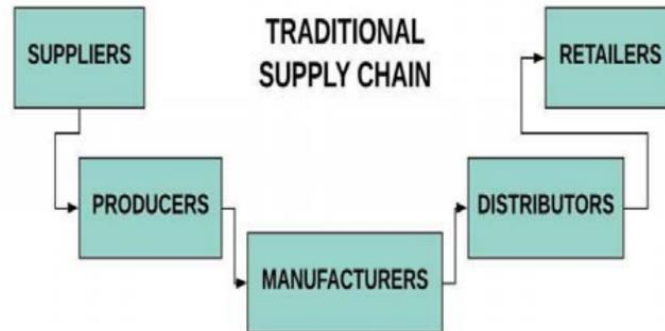


Fig. 1. Traditional Supply Chain

The main drawbacks of the traditional Supply Chain are

1. Food safety can't be assured at any stages
2. The detailed information about the origin of the product will not be available [6]
3. Failed to provide transparency and traceability
4. Controllability – The life span of Control [6]

This can be overcome by using blockchain technology which can make a decentralized system between all above them and create a public ledger over a distributed network. Also, it reduces transaction costs with the help of the online UPI system. The cryptological methodology used here brings out trust among users that helps in demand for the product. The encryption techniques which are used in cryptocurrencies help in the verification of users and blocks. So here in a blockchain, each block contains information about transactions and other details. The chain holds the ledger from the beginning when the genesis block was created. Here each block has reference values using a hashing algorithm. The peer-to-peer network helps in validating new transactions and users. The Proof of Stake (POS) algorithm produces challenges to be solved by users which are then validated and then added to the block if it is valid [6].

C. SMART CONTRACT

We cannot use traditional contracts in blockchain technology. A traditional contract is too slow and it consists of a huge process that takes much time. Also, the traditional supply chains consist of a large number of paper documents which may result in less efficiency during tracking and theft.

Blockchain can help to overcome these drawbacks of transparency, efficiency, security, and tracking by smart contracts which are automatically activated when predefined conditions are met. Smart contracts are digital contracts stored on a blockchain that is automatically executed when predetermined terms and conditions are met [7]. Smart contracts work by simple "if/when...then..." statements that are written into code on a blockchain [6]. A network of computers executes the actions once planned conditions are met and verified. The blockchain is then updated once the group action is completed. meaning the group action can't be modified, and solely parties United Nations agency are granted permission will see the results. inside a sensible contract, there will be several stipulations pro re nata to satisfy the participants that the task is going to be completed satisfactorily. To establish the terms, participants should confirm that transactions and their information are delineated on the blockchain, agree on the "if/when...then..." rules that govern those transactions, explore all doable, and define a framework for resolving disputes.

Benefits of smart contracts:

1. Speed, efficiency, and accuracy

Smart contracts are digital contracts where your document submission and documentation did online it reduces time, helps to increase accuracy, and makes it process so efficient.

2. Trust and transparency

Because there's no third party concerned, and since encrypted records of transactions are units shared across participants, there's no got to question whether or not data has been altered for private profit [7].

3. Security

All of the records of smart contracts are encrypted on servers, which makes them very hard to hack. Moreover, as a result of every record being connected to the previous and consequent records on a distributed ledger, hackers would need to alter the whole chain to alter one record.

4. Savings

Smart contracts take away the necessity for intermediaries to handle transactions and, by extension, their associated time delays, and costs.

The smart contract is a promise among parties involved in a transaction that holds each party in authority for their role in the transaction to a traditional contract and also ensures that the contract is enforced. Smart contracts improve the transparency, traceability, and effectiveness of a supply chain allowing it to be more agile in strengthening the relationships among the parties. Every smart contract is assigned a unique address of 20 bytes. The contract code will never be modified once the contract is deployed into the blockchain; the user will solely send a deal to the contract's address. This group activity can then be dead by each agreement node within the network to achieve an agreement on its output. There are unit 2 forms of sensible contracts, deterministic and non-deterministic. A deterministic smart contract is that once executed it doesn't need associated information from an external party. A non -deterministic good contract may be a contract that depends on info (database) from an external party.

III. AGRI-FOOD SUPPLY CHAIN-PROPOSED MODEL

This solution provides blockchain technology that can be accessed or tracked, control and monitor every farming activity, product delivery, shipment, and event. It makes the system more efficient than the traditional method. With the help of this, we try to reduce error, increase transparency, prevent product delays, better management, and eliminate unethical and illegal activities.

Customer demands area unit increasing daily Associate in Nursing to satisfy that we'd like an improved supply chain. To make a better environment, we can use blockchain technology in the supply chain. Farmers are unable to sell it on time even after getting good produce. At the first stage of the model, they will send their agriculture product to the nearest warehouse for quality, quantity check, and packaging of the product. Apart from this, they themselves can do this process and send it to the distributor. Warehouse staff checks the quantity of product, quality of product, producer's details, and many more. After verification of the product, all data will be uploaded to the system. The Food product is then tagged with an RFID chip [8]. The tags are placed on things, starting from individual elements to delivery labels. Inside the RFID tag, it consists of a silicon chip and antennae. Identifying information from the Special printers is used to print the tags which wirelessly load the identifying information to the tags. The information on the tags can be used for various tasks. When RFID scanners scan the item, information is read from the tag which could include some necessary information that could be very effective in maintaining Supply chains such as:

1. ID number
2. Serial numbers for individual product
3. Location logs
4. Bin location of the product
5. Order status
6. Its components

The information can that RFID can provide will be matched with the information given by farmers. Also, with the help of RFID, we can track shipment and stock locations automatically as the product moves through warehouses which the farmer can see. Implementation of RFID in these systems can ensure that both the correct products and the correct qualities of products are collected at both points, thereby eliminating errors. Tracking of products helps to ensure that theft and other illegal activities can be discovered immediately and enforced. It also helps to provide safety and security of products to farmers.

Then the product moves from warehouses to distributors, and the distributor automatically receives a notification about the product. Then Distributors choose suiting 3PL (Third Party Logistics) based on fully

available data on the customer, delivery date, and other user information [9]. Then 3PL (distribution, warehouse, and fulfillment services) is informed about the origin and destination of food products. It flexibly optimizes network flows. Now retailer runs machine learning-based forecasting and also provides an app for end customers.

The product information will remain the same. Then the product is ready for sale, it moves to market by retailers. The store has full transparency on delivery time. They adopt orders, promos, etc. accordingly. All these transactions take place in a Smart contract. Now at each process involved in the production, each organization scans the RFID and updates the details using the mobile app to the blocks which are stored in the cloud. So, the cloud also plays a major role in storing blocks. The verification, validation, transactions, etc., are all square measures done through the app or website. A mobile app and a website function as a platform for communication.

The Blockchain Technology will start to work when the genesis block is created, the details are stored in that and the first transaction made is also added to it. Customers Scan the QR code via an app and can view the product's details from its origin, aging, duration, expiry, and so on. Here Ethereum acts as a decentralized platform for maintaining data. The platform consists of three parts: Server, API (web3 API), and Provider consumer Software [10].

The Server connects Nodes that are run on Ethereum to the software. The API of the Ethereum a virtual machine, which is present in the form of an android library provides all the necessary functionalities of blockchain to the Software. The Provider-consumer Software allows the user to sign transactions, and interact with smart contracts in any blockchain network.

A mobile app and a website function as a platform for communication. There will be two different platforms, one for farmers, distributors, and sellers and the other for customers. Now at each process involved in the production, the organization present in the network scans the RFID and updates the details using the mobile app to the blocks which are stored in the cloud [9]. So, the cloud conjointly plays a significant role in storing blocks. The verification, validation, transactions, etc., and all area units are done through the app or website. If the product is rejected due to a defective product, then a notification will be sent to the farmers about it. After selling the product, the money will be deposited in the farmer's account automatically. There will be some deduction charges here regarding packaging cost, and distributor-sellers commission which will be pre-decided. All transactions will be online which creates more safety in the process.

IV. CONCLUSION

Every year a lot of food grains are getting spoiled due to not being able to sell more grown food, it has become a problem in some countries. Blockchain is the solution to this problem, which will help the farmer not only to sell but also to produce. It can dramatically increase the economic status of the country, reducing the corruption rate and increasing the satisfaction of producers and consumers." Agri-food supply chain" is one of the best examples of food traceability systems of blockchain technology. We described the information about blockchain and the uses of smart-digital contracts in supply chain management.

V. REFERENCES

- [1] History of agriculture in the Indian subcontinent, Available at Wikipedia: https://en.wikipedia.org/wiki/History_of_agriculture_in_the_Indian_subcontinent#:~:text=Indian%20agriculture%20began%20by%209000,techniques%20being%20developed%20for%20agriculture
- [2] FAO report, Indian at glance, Available at Wikipedia: [https://www.fao.org/india/fao-in-india/india-atglance/en/#:~:text=Agriculture%2C%20with%20its%20allied%20sectors,275%20million%20tonnes%20\(MT\)](https://www.fao.org/india/fao-in-india/india-atglance/en/#:~:text=Agriculture%2C%20with%20its%20allied%20sectors,275%20million%20tonnes%20(MT))
- [3] Dr. Pisal Anita Sambhaji, "Farmers suicide in India: Introduction" International Journal of Research in Social Sciences and Humanities (IJRSSH), Vol. No. 3, Issue No. II, October-December 2014
- [4] C. S. Wright. (2019). Bitcoin: A Peer-to-Peer Electronic Cash System. Available: <https://bitcoin.org/bitcoin.pdf>
- [5] Atima Tharatipyakul, Suporn Pongnumkul, "User Interface of Blockchain-Based Agri-Food Traceability Applications: A Review" IEEE, Vol. No. 9, June 2021

-
- [6] S. Madhurima, P. Siva Ranjani, U. Vandhana, B. Venmuhilan, "A Theoretical Implementation: Agriculture-Food supply chain Management using Blockchain technology "s IEEE 978-1-7281-1034, September 2019
- [7] IBM article, "What are smart contracts on a blockchain?", Available at: <https://www.ibm.com/in-en/topics/smart-contracts#:~:text=Smart%20contracts%20are%20simply%20programs,intermediary's%20involvement%20or%20time%20loss>
- [8] A Zebra Technologies White Paper," Barcoding and RFID Enables Food Supply Chain Traceability and Safety" Available at: <https://www.abr.com/wp-content/uploads/2014/04/Zebra-food-traceability-en-us.pdf>
- [9] Liu, C.H., & He, S.Y., Research on "RFID – based agricultural products logistics systems". Rural economy.2012, (10),91-94.
- [10] Mischa Tripoli, Josef Schemidhuber," Emerging Opportunities for the Application of Blockchain in the Agri-Food industry". Available at: <http://www.fao.org/3/CA1335EN/ca1335en.pdf>