



## Blockchain Technology: A Boon to Indian Agriculture

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### Abstract

Blockchain technology is revolutionizing the Indian agricultural sector by providing a secure, transparent, and immutable platform to store data. This technology can be used to track and monitor agricultural products from farm to fork, reducing paperwork and decreasing costs. Moreover, it can help farmers get better prices for their produce by connecting them directly with buyers. Additionally, blockchain technology can enable farmers to access finance more easily by allowing them to create digital identities that can be used as collateral for loans. Blockchain Technology is an extremely promising technology that has the potential to reinvent agriculture by speeding up processes and delivering services, at a much lower cost. The possibilities offered by this technology are endless and have the potential to transform the Indian agricultural sector for the better.

**Keywords:** Agriculture, Blockchain, Distributed Ledger Technology, Transparency

### Introduction

Distributed Ledger Technology (DLT) is based on an encoded and distributed database that stores transaction records. A distributed ledger is a database that is distributed among several computers, nodes, institutions, or nations and is accessible to multiple individuals all over the world. Blockchain is one sort of distributed ledger. Blockchain stores transactions as a chain of blocks, and each block generates a distinct hash that may be used to prove that the transaction was really genuine. As shown in figure 1, a block contains a record of data as well as a value representing the preceding block's hash and, lastly, a value representing its own hash. The hash represents the cryptographic fingerprint of a block's quantity of data. The connection between the hashes of the current and previous blocks reveals the significance of the cryptographically connected chain of blocks. If the data is tampered with, the digital fingerprint is altered, and the chain becomes invalid. It is more transparent since a copy of the ledger is stored on each node. It is also known as an "Internet of value," which refers to a safe mechanism to store and trade value - anything from cash to stocks, contracts, and even votes - from one organisation to another. To allow blockchain applications, blockchain employs a number of technologies, including digital signatures, distributed networks, and encryption/ decryption methods, as well as distributed ledger technology.

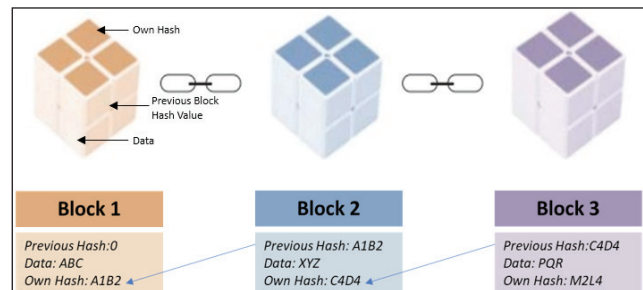


Figure 1: A Blockchain (Sylvester, 2019)

### Blockchain in Agriculture

Food demand is rising in tandem with population growth and the food supply chains are threatened at several points by counterfeit goods, which are brought on by a rise in demand for food. Consumers are increasingly concerned about the origins and quality of food, which has led to a trend to pay extra for foods whose origin is verified. Despite the advanced technology now in use, the great majority of traceability systems are frequently centralised, asymmetric, and out of date in terms of data exchange and interoperability. The demand from customers for needs-specific digital services continues to rise along with the human population. Because the agriculture business is so large, it must overcome several obstacles that threaten its viability. Every problem, from

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labour employment to a competitive market, needs to be solved because otherwise the ecosystem would collapse. As presented in figure 2, blockchain can be used for storing different data like soil moisture, farm, seed quality, harvest and yield, demand, sale price, climate and environmental data. Precision farming, farmland mapping, Internet of Things (IoT) sensors, vertical farming systems, location intelligence, crop management software, transportation technology and blockchain are enabling agricultural firms to achieve better results in terms of food production and supply chain management.

Blockchain can help the agriculture and food industries deal with and control known risks while maintaining affordability across the ecosystem. It has the potential to boost agricultural supply chain efficiency, transparency, and confidence. By establishing trustworthy partnerships, blockchain for agriculture supply chain may empower all market participants. It enables peer-to-peer transactions to happen openly and without the need for a middleman in the agriculture industry. By removing the requirement for a central authority, trust is now provided to peer-to-peer architecture and cryptography rather than an authority. As a result, it aids in rebuilding consumer and producer trust, which can lower the price of transactions in the agri-food industry (Xiong et al., 2020).

Blockchain technology provides a trustworthy method of tracking transactions between unidentified players. This makes it possible to identify fraud and problems rapidly. Additionally, the use of smart contracts allows for the instantaneous reporting of issues. Due to the agri-food system's complexity, this helps handle the problem of tracing items along the extensive supply chain. Since food quality and safety are major concerns for customers, the government, etc., technology offers solutions.

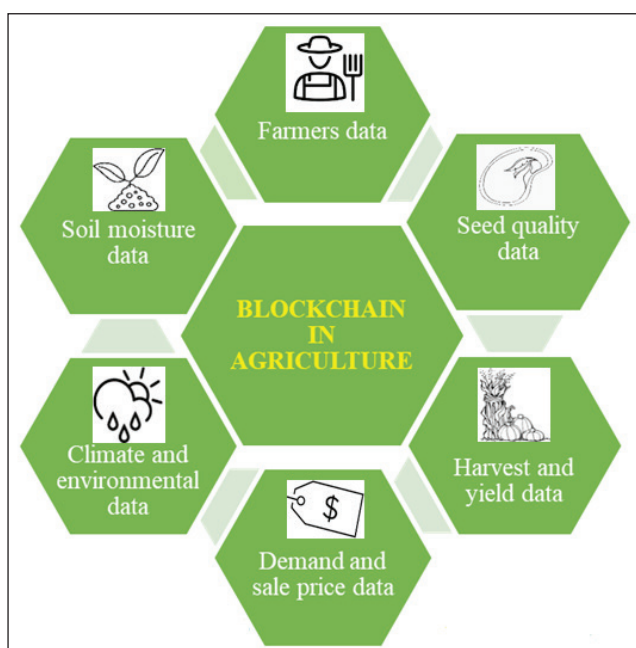


Figure 2: Different data stored in blockchain (Anonymous, 2022)

The Directorate of Agriculture, Jharkhand, and SettleMint, an international blockchain technology company, jointly announced the successful launch of a seed distribution programme for farmers based on blockchain technology. The first state in the nation to employ blockchain for tracking seed delivery is Jharkhand. This is a significant development that will revolutionise agriculture in the nation. The blockchain platform tracks the distribution of seed supplies, from the Directorate of Agriculture issuing supply orders to the District Agriculture Officer placing seed demands, and then following the distribution of seed from the government agency that is authorised to produce seeds to distributors, retailers, LAMPS/PACS, FPOs, and finally to farmers. Using blockchain technology will increase the validity and transparency of the seeds that farmers obtain through seed exchange programmes and other programmes (Anonymous, 2022).

**Applications**

**1. Food Supply Chain**

Food supply chains have gotten longer and more complicated than ever before as a result of rising globalisation and market competitiveness. Food supply networks frequently have issues with food traceability, food safety and quality, food trust, and supply chain inefficiencies, all of which pose threats to the entire society, the economy, and human health. Manufacturers may create trust with consumers and enhance the reputation of their products by making specific product information available to the public on the blockchain. By increasing the value of their goods, businesses may become more competitive. The agriculture and food sectors would be forced to raise the quality of their products as a result of this, which would make it hard for sellers of dishonest and subpar goods to continue operating in the market. The blockchain enables customers to get accurate and trustworthy information on the production and distribution of food.

**2. Fair Pricing**

Many farming groups do not receive the proper compensation for their produce that they are entitled to. Despite the quality of the crops' production, many wholesalers don't genuinely provide their products the value they deserve. Blockchain technology has the potential to alter the situation. Farmers may sell their products to honest buyers via the blockchain-based marketplace, and they can even reach more buyers than they could before. This will enable them to bargain for the price in a more fair and reasonable manner. In this way, the farmers may receive what they truly deserve.

**3. Small to Medium-sized Farmer Microloans**

Small to medium-sized farmers require loans on a regular basis in order to sustain and run their businesses. However, banks have a high interest rate loan policy and interest payments may burden them with more debts. Blockchain can let farmers obtain microloans via the network from lenders all around the world. With a little amount of loan, they can bear the expense of low interest rates, helping them to sustain and continue the business for a long time.

#### 4. Agricultural Insurance

Better insurance plans will be made feasible by self-executing smart insurance contracts built on distributed ledger technology for individual farmers, agricultural holdings, and other supply chain partners. The process of evaluating insurance claims won't include a person anymore, making it simpler, faster, and more open. Smart contracts will also lessen the chance of false claims and insurance provider corruption because no party will be able to amend insurance policies after they have been agreed upon. For smallholders that wish to invest in farming, the blockchain can make financial transactions, credit histories, and financial agreements transparent.

#### 5. Smart Agriculture

Traditional methods manage data in a centralised manner and are vulnerable to cyber-attacks, exploitation of data, faulty data and data distortion. Smart agriculture uses information and communication technologies (ICTs), the internet of things (IoT), and a variety of contemporary data collecting and analysis tools, including as unmanned aerial vehicles (UAV), sensors, and machine learning. The value-added process of producing an agricultural product, from seed to sale, involves various actors and stakeholders and is recorded by the blockchain technology. It guarantees that all recorded data is unexchangeable and that it is transparent to all actors and stakeholders.

#### 6. Agribusiness on Internet

E-commerce and agricultural product trading confront several critical issues to address. The most significant difficulties faced by e-commerce businesses, particularly in developing nations, are Cash on delivery and logistics service. Additionally, e-commerce sellers must deal with time-consuming small orders for a variety of goods, which drives up operating expenses for e-commerce businesses. Blockchain technology has the potential to offer suitable solutions. This technology offers private key encryption, a potent instrument that satisfies the authentication needs. Every link in the supply chain, including the manufacturer, the origin, the shipping business, the destination, the multimodal transport, the warehouse, and the last mile, represents a "block" of information, with the benefits of visibility, aggregation, validation, automation, and robustness. Blockchain offers a zero-rate digital payment system. The use of cryptocurrencies in the exchange of agricultural goods will also significantly lower transaction costs. Other applications of blockchain in different verticals of agriculture other are mentioned in figure 3.

#### Limitations

By increasing transparency and removing middlemen in the agricultural value chain, supply chain blockchain projects and services can reduce the danger of counterfeits and boost the effectiveness of blockchain-based agriculture. Distributed ledgers and smart contracts also offer a genuine chance for smaller investors and micro, small, and medium-sized businesses to participate in the market more broadly by lowering uncertainty and fostering trust among market participants. Although there are numerous

potential advantages for blockchain technology in the food and agricultural sectors, there are also some substantial disadvantages. Further study is needed to determine the incentive of the transacting parties to submit real and exact information to the blockchain ledger. The information created throughout the farming process is dispersed and held by individual farmers. The cost of getting data that has

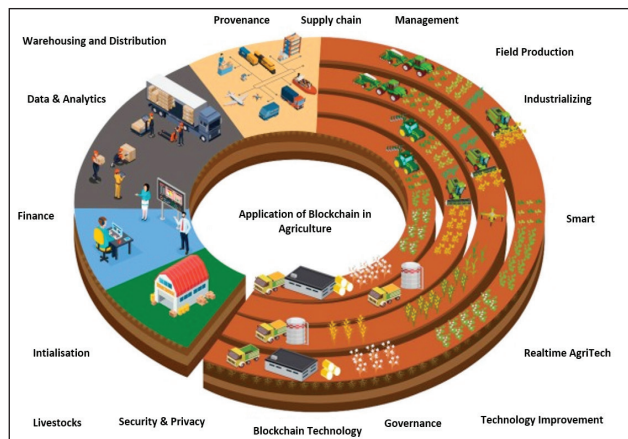


Figure 3: Application of blockchain in verticals of the agriculture domain (Krithika, 2022)

been uploaded to a blockchain might be expensive, which will prevent the industry from adopting the technology. Distributed ledger setup may be very inexpensive, but the cost of obtaining the data needed to make the ledger usable may be high.

#### Challenges

Agriculture has a more complicated supply chain than other industries because it depends on unpredictable and difficult-to-control elements like weather, pests, and illnesses to produce. Financial transactions are sluggish and sometimes require a lot of human labour since the agricultural supply chain lacks traceability. Furthermore, fake goods have the potential to show up at any point in the supply chain and pose a serious risk to the safety of all parties involved in the company, including customers and governments. Transporting goods is the primary difficulty faced by agricultural supply systems. The cryptographic fingerprint that is linked to each transaction makes it possible to track transaction data, but moving a physical good from a farm to a customer via a supply chain necessitates a much more impermeable product-process connection. There are several well-known technologies that may create this connection-crypto-anchor technology for agriculture, enhanced radio frequency identification (RFID) chips, RFID supply chains, QR codes on product and near field communication technology (NFC). Businesses frequently anticipate success as soon as they integrate a blockchain into their daily operations. The blockchain, however, is only a collection of tools that must be used appropriately.

#### Conclusion

Blockchain has ability to revolutionise the agriculture industry. By making agriculture supply networks more open and traceable, it is transforming them. We can address

difficulties for helpless farmers by using blockchain. It has the ability to significantly enhance all facets of agriculture. Blockchain's key characteristics aid in the improvement and facilitation of farm governance and management. Along with the benefits, all ecosystems have problems such as installation, integration, and maintenance, and blockchain is no different. It is not, however, a fix-all for every issue. Any form of solution requires the correct environment and stakeholders to be sustained, and blockchain is no different. Future study might look at the obstacles and constraints and devise solutions to overcome them.

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