

Concept Paper

Blockchain: a tool for a secure, safe and transparent way of food and agricultural supply chain

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ABSTRACT

Agriculture is the backbone of Indian farmers for their livelihood and also plays an integral part in our economy and its development. In the globalized market consumers are well aware of the products that exist in the market and are very specific about their need from the product. The present supply chain operates with many issues that have to do with the reliability of information, consumer trust, supply chain transparency, product quality, logistic issues, environmental impact, personal consumer data, fraud, food safety etc. In India traceability towards backward linkages for food and other agricultural products is always minimal or nil. Blockchain allows for peer to peer transactions of currency, commodities or any other thing of value to occur transparently. Blockchain has enormous potential to significantly impact the way agricultural business is done. Blockchain technology can increase trust between parties, facilitate information sharing throughout the supply chain and significantly reduce agricultural transaction costs.

Keywords: Blockchain; food; supply chain; backward integration; tracing

INTRODUCTION

A blockchain is a growing list of records called blocks which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a time stamp and transaction data (generally represented as a merkle tree root hash). By design a blockchain is resistant to modification of the data. It is an open distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way. For use as a distributed ledger a blockchain is typically managed by a peer to peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks which requires consensus of the network majority. Although blockchain records are not unalterable, the blockchains may be considered secure by design and exemplify a distributed computing system with high byzantine fault tolerance. Thus decentralized consensus has been claimed with a blockchain. Blockchain was invented by Satoshi

Nakamoto in 2008 to serve as the public transaction ledger of the cryptocurrency bitcoin. The invention of the blockchain for bitcoin made it the first digital currency to solve the double-spending problem without the need of a trusted authority or central server. The bitcoin design has inspired other applications and blockchains which are readable by the public and are widely used by crypto currencies. Blockchain is considered a type of payment rail. Private blockchains have been proposed for business use. Sources such as the computer world called the marketing of such blockchains without a proper security model snake oil (<https://en.wikipedia.org/wiki/Blockchain>).

Agriculture is the backbone of Indian farmers for their livelihood and also plays an integral part in our economy and its development. In the globalized market consumers are well aware of the products that exist in the market and are very specific about their need from the product. Consumers are becoming health conscious and their concern over food and its origin is increasing. In India traceability towards backward linkages for food and other agricultural products is

always minimal or nil. This takes away the farmer's chance to compete in the global market among other nations through exports. Another major problem for the farmers in our country is their replaceable role of middlemen and third party in selling their products who eat farmer's profit. The present supply chain operates with many issues that have to do with the reliability of information, consumer trust, supply chain transparency, product quality, logistics issues, environmental impact, personal consumer data, fraud, food safety etc (Trienekens et al 2012). The blockchain is one such technology through which we can overcome the problem of opacity, unaccountability and non-traceability. It helps to identify the real origin and safe and secure condition of the product. This can increase the competitive nature of the Indian products in the global market and it also ensures consumers with the satisfaction of worth of money. Blockchain technologies are receiving a great deal of attention from businesses across a broad range of industry sectors and for very good reasons (<http://www.nortonrosefulbright.com/files/unlocking-the-blockchain-chapter-1-141574.pdf>).

The blockchain is a unique information storage technology that allows all members to record transactions in a digitized, decentralized data log maintained on a network of computers rather than a physical ledger or a single database. It allows for peer to peer transactions of currency, commodities or any other thing of value to occur transparently. In other words to be simple, blockchain is an electronic system that allows for record-keeping of transactions in real time. When participants in a blockchain system complete a transaction the time, date, nature and cost of the exchange are recorded. Once the parties have confirmed the accuracy of the information it is then permanently and indelibly recorded and can be made accessible to every other participant in the system. Blockchain technology therefore instantaneously creates a consolidated record that constitutes a single and shared version of the truth. Improved informational transparency and accuracy increase trust between parties, reduce costs and boost efficiency.

Types of blockchain

Agricultural supply chains can transact business using a public or private blockchain. The ability of the user to record transactions and access historical information recorded on the distributed ledger is the primary difference between the two options. A public

blockchain is often referred to as permission less because the software is open source and the user base is not restricted. A private blockchain referred to as permissioned is restricted and access to information may be limited to certain users. And there is the third type which is also restricted. The three major types of blockchains based on user privacy are public, private and consortium or federated blockchain.

Public blockchain: A public blockchain as its name suggests is more of democratic in nature. This is the blockchain of the public meaning a kind of blockchain which is for the people, by the people and of the people. Here no one is in-charge and anyone can participate in reading/writing/auditing the blockchain. Another thing is that these types of blockchains are open and transparent hence anyone can view anything at a given point of time. Here the decision-making process is done by various decentralized consensus mechanisms such as proof of work (PoW) and proof of stake (PoS) etc.

Private blockchain: Private blockchain as its name suggests is a private property of an individual or an organization. Unlike public blockchain here there is an in-charge who looks after of important things such as read/write or whom to selectively give access to read or vice versa. Here the consensus is achieved on the whims of the central in-charge who can give mining rights to anyone or not give at all. This makes it centralized again where various rights are exercised and vested in a central trusted party but yet it is cryptographical secured from the company's point of view and more cost-effective for them. But it is still debatable if such a private thing can be called a blockchain because it fundamentally defeats the whole purpose of the blockchain.

Consortium or federated blockchain: This type of blockchain tries to remove the sole autonomy which gets vested in just one entity by using private blockchains. Here instead of one in-charge it has more than one in-charge. Basically it has a group of companies or representative individuals coming together and making decisions for the best benefit of the whole network. Such groups are also called consortiums or federations and so it is named after it.

Chain of work

During a typical blockchain transaction:

1. Users create a permanent, unchangeable record of a transaction (a block of information)

through what is known as distributed ledger technology (DLT).

2. The record is encrypted and stored on a network of computers that includes all participants in the transaction.
3. An identical copy of the transaction history or ledger is shared among participants which eliminates the need for a third-party verification of the transaction's accuracy.
4. Each new transaction is permanently recorded to the ledger through verification by the network creating a chain of information.

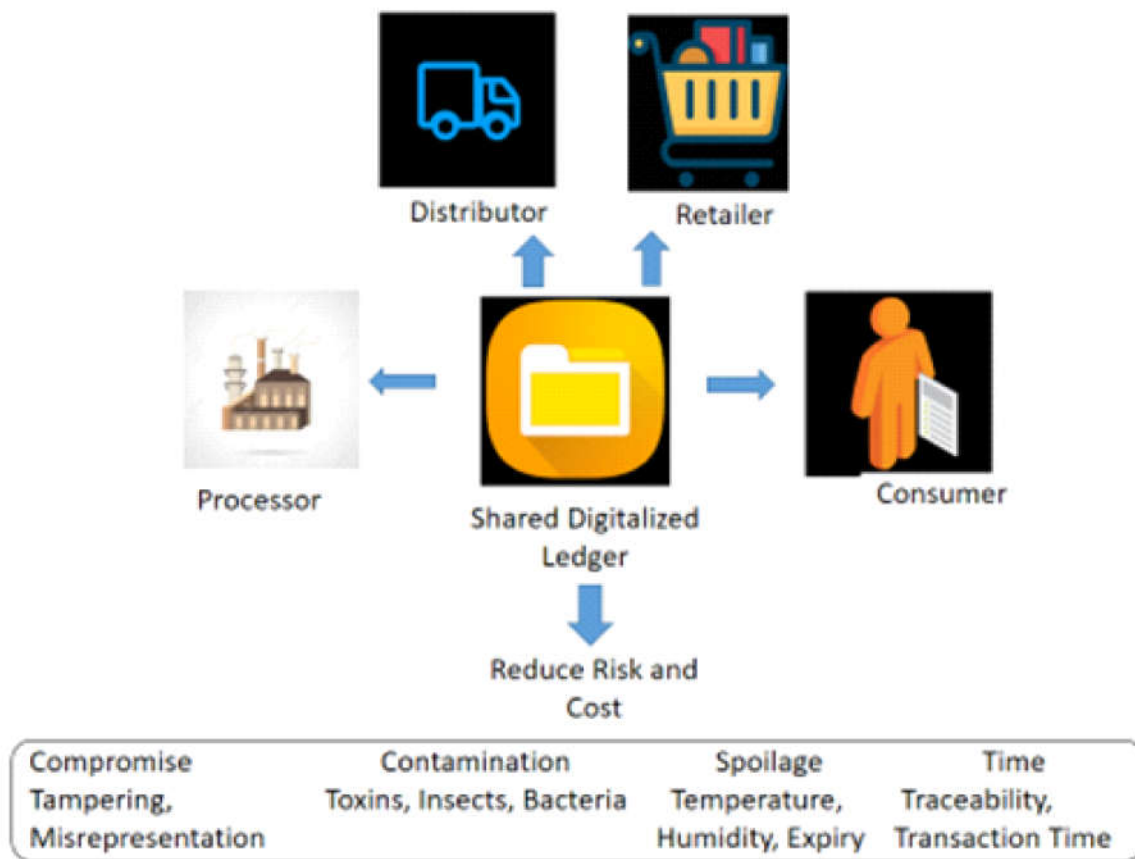
Application of blockchain technology in agriculture: Blockchain technology can also assist in the tracking of bulk commodities and reduce the overall presence of fraud.

Tracking commodities: More than ever consumers are taking an interest in the origins and contents of their food. Demand for organic products, sustainably raised meat and locally farmed produce has grown substantially in the past few years. But here trustability

is the problem. The evolution in consumer tastes has given rise to an important food fraud industry. Producers can easily sell mislabeled products because the retailer or final buyer has no real way of verifying a product's origin.

With blockchain this can be overcome. Given the fact that it can record unalterable information at every step in the food supply chain, blockchain technology can provide reliable information regarding the origins of food items and the exact journey it took from farm to table. It could enable consumers to verify from which certified farm their mango were picked from or in which field their grass-fed beef was raised with a single screen tap.

Optimizing the supply chain: In addition to helping consumers make informed purchases the improved supply chain transparency could also greatly benefit farmers. The agricultural sector's supply chain is notoriously complex and opaque as shipments change hands multiple times before reaching their final destination. It is difficult for farmers to know where,



Peer to peer transaction

for what price and how much of their products are ultimately sold. This lack of information leaves them vulnerable and at the mercy of traders who can dictate order prices and quantities. Blockchain technology can help rectify this imbalance by recording transactions in real time and providing up to date supply and demand information to participants. Having access to such information could allow farmers to properly set their own prices and optimize the quantities of products they put out on the market. Moreover by keeping an ongoing record of participants' transaction histories blockchain can make it much easier for parties all over the world to due diligence each other and confidently conclude transactions without the need for middlemen and agents.

Better pricing and payment options: Blockchain technology can provide lower cost and faster payment options to agri-commerce participants. In the current system it often takes weeks for farmers to get paid for their goods and traditional payment options such as wire transfers can be quite costly. Blockchain can address some of these inefficiencies. Even making use of smart contracts that trigger payments automatically can also be made as soon as the fulfilment of a certain condition (eg delivery of goods) is confirmed by the buyer.

CONCLUSION

Blockchain has enormous potential to significantly impact the way agricultural business is done. The technology can increase trust between parties, facilitate information sharing throughout the supply chain and significantly reduce agricultural transaction costs. Blockchain will also serve to improve supply chain transparency and accountability but bad actors will still exist and find new ways to defraud buyers. Blockchain technology represents an exciting opportunity to increase transaction efficiencies, reduce friction and improve traceability in the global agricultural supply chain.

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