

Blockchain in Indian Agriculture and Food Supply Chain

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ABSTRACT

Blockchain is an emerging digital technology which became quite famous for its financial transactions between distributing untrusted parties, without the need for intermediaries for example: banks and presently known as Bitcoin. This paper examines the effect on agriculture and the food supply chain of blockchain technology. Findings of this research indicate that blockchain is a promising technology towards a transparent supply chain of food and a transparent medium for people involved in agriculture and other food products and food-related issues, but many barriers still exist, which slows its popularity among farmers and systems. These challenges involve technical aspects, education, policies and regulatory frameworks. The following article reiterates the ongoing matters in terms of agriculture and the people associated with it.

1. INTRODUCTION

Blockchain was first conceptualized in 2008 by pseudonymous author Satoshi Nakamoto. The group pseudonymous published the block chain concept with an electronic cash system in mind. This Peer-to-Peer electronics cash system would later become the current popular name as The Bitcoin. This Peer-to-Peer electronics cash system set the basis for the new crypto currency. This is new crypto currency which allowed reliable financial transaction without the need of a centralized system or trusted central authority. Bitcoin solved the problem by elimination of a centralized system i.e. Bank or any financial institution, bitcoin was able to achieve this with the help of block technology. The Bitcoin can be seen as an application to the BlockChain Technology. An accurate example of this can be represented by the internet and the e-mail. Email is dependant of the internet to work just as the Bitcoin in dependant of the Blockchain technology to work. The Blockchain is a digital ledger which is maintained by a group of interconnected multiple computing machines which are not dependant on any centralized system or any third party for trust. Blockchain gets its name from its structure which consists of the actual transactional data, timestamp and the previous hash value. The data is encrypted and the previous hash value is linked to a different block, which forms a block of chains known as blockchain. A hash is generated for every block which is based on the data it holds and then gets linked in the heading of the corresponding block.

Every transaction in the blockchain resolves through the entire network of participating machines and this transaction need to be approved or validated by all the participating machines. This key feature of the blockchain makes this technology extremely secure without the need of any kind of trusted third party since every member in the network plays a part in validation of each and every transaction. Even if any one of the member doesn't validate the transaction, the entire transaction fails.

2. BLOCKCHAIN IN AGRICULTURE AND FOOD SUPPLY CHAIN

The blockchain has proved its worth in the electronic cash system and crypto currencies this technology and its strengths can be very well harnessed in agriculture and food supply chain where a number of untrusted parties get involved in the distribution of the produce. Agriculture and food supply chains are very well interlinked, since the produce in agriculture are used as inputs in some multi-party distributed supply chain, where the consumer is usually at the end of the line.

Worldwide, the food chain is extremely multi-actors-based and distributed, involving countless distinct actors like farmers, shipping businesses, retailers, and local shops. This system is currently inefficient and unreliable. For example, when people buy goods locally, they are not aware of the origins of these goods, or the environmental footprint of produce. Various initiatives have been identified, where blockchain technology could

be used to address practical issues in the agricultural supply chain in real life. These initiatives can be divided into categories below:

2.1 Food Security

Since there is no current system which gives the final consumer the footprints of a particular produce, blockchain technology can help achieve this task by making records and assets verifiable and accessible.

2.2 Support of small farmers

Small group of farmers are the major contributors to the GDP of any developing nation, helping individual farmers get a larger share of the value of the produce they are cultivating. Blockchain can be used to get a crypto-ledger to increase trust among small group of farmers.

2.3 Registration of land title

Blockchain can be very effective and accurate in the field of land registration, which is a highly inconvenient process often very susceptible to fraud. The state of Andhra Pradesh has started working with Chroma Way which is a Swedish startup, which uses blockchain based technology for record keeping. If this project can see success, other Indian states can also work in a similar fashion.

2.4 Diffusing power of MNCs

The present agriculture sector is dominated by multinational corporations that have the industry's biggest shares and dictate to farmers what to grow in a given season. The biggest producers are DuPont India who deals with in Agro based products i.e. seeds, pesticides and insecticides that protect crops such as rice, wheat, vegetables, sugarcane, soybean, pulses, lentils and so on. Moreover the company also deals in healthcare service for domesticated animals to improve the produce. However, community farming and start-ups can again disperse the power of MNCs with blockchain technology. Under this mechanism, the farmer directly sell their produce to the consumers thus eliminating the middleman altogether. Thus, the farmers receive the adequate amount of funds to stabilize the financial growth and allow them to grow.

Blockchain agriculture can solve some distribution, food security issues. Smart contracts-based distribution and tokenized shareholding can help community-sponsored Farming to increase effectiveness by creating direct links between farmers and consumers.

2.5 Subsidy disbursement

The agriculture industry relies heavily on government subsidies for funding every year. However the government schemas and plans have a lot of departments involved and only a marginal amount of the planned sum reached the farmers. The inherent transparency of the blockchain model can remove all the departments involved in the middle and government and directly get involved with the farmers itself. Although this method would be very cumbersome actual implementation would require some changes. Blockchain might seem like an array of diverse issues which have been affecting the agricultural and food. Firstly for blockchain to work in India a stable internet connection is very vital, considering most of the farmers are in remote location, connectivity should be reliable. With the rise telecommunications in India with Reliance telecommunications, urban areas has been getting very reliable and high speed internet connectivity.

The same doesn't apply to rural areas. Unreliable connections jumps up dramatically when the computation is done in rural regions. Therefore, the lack of telecommunication infrastructure has to be addressed before the adoption of blockchain technology in Indian agriculture.

2.6 Soil health cards

Even before the prospect of a domestic blockchain India began to work on the soil health card project now in existence. Standardized soil sample collection and analysis is carried out on a regular basis by universities and other contracted third parties, at a nominal cost to the farmers^[1]. Farmers can get suggestions on how to handle the property for sustainability and optimum returns based on the data fed into the scheme.

The strategy is to bring this information on the blockchain so that it can be linked to the plants and other data generated, further automated and managed more safely. It can also be evaluated and linked more readily and efficiently to other kinds of blockchain information. For instance, to get better long-term forecasts by crossing climate data with soil quality information. A reliable blockchain system for land cards can also help

tie more efficiently into India's wider agricultural system. For instance, by ensuring that the allocation of subsidies to farmers is as effective as possible^[1].

2.7 Crop tracking

Indian agriculture has seen a rise in organic farming where produce is grown without the assistance of fertilizers. For consumers organic farming and organic produce is very attractive but organic produce comes with a hefty price as compared to normal produce. With blockchain a crop or a batch of produce can be backtracked to its farm. This will in turn help in reducing the fake counterfeit organic products. Blockchain will also be able to link soil to a particular batch of produce with the soil having its own set of data where its soil history is being tracked and maintained.

Blockchain in organic farming can have a huge implementation especially in India where recently Indian agriculture has seen shortages and high price of agricultural fertilizers. Crop monitoring and soil health cards can reduce the crop invested diseases which see reduction in crop failures. Soil health cards are also an answer to this problem, aimed at helping farmers find the correct additives for their property. Meanwhile, crop monitoring can encourage the economic viability of non-additive products, free up supply and help control fertilizer prices. In addition, it can bring the blockchain advantages of enhanced logistics management and bring changes to India's agricultural sector around effectiveness and monitoring

2.8 Land rights

India isn't the only country turning to blockchain land rights solutions. Ghana, Sweden and many others also see blockchain technology as a manner to solve a growing problem which seems to be very difficult to trace. Indian agriculture is scattered into different small scale agriculture and these small scale agriculture contribute to the 15.87% of the GDP, which roughly estimates to around \$1500 billion.

These small scale farming are done on disputed lands, hence these figures has the ability to rise even more. India has the largest number of land disputes where landlords are often bullying the helpless farmers. Keeping a digital ledger to record the all the land transaction, this might help in reducing the land based disputes. But this implementation will still be a long way ahead. Digital ledger for land is still to be implemented around the world successfully so whether it's actual implementation is still unknown. On paper blockchain being used in this sector seems like a very probable idea.



Fig. 1: Overview

3. BLOCKCHAIN IN FOOD SUPPLY CHAIN

3.1 Food traceability

Since the rise of the food refrigeration and the nature of perishable food, most of the world population depends up to the food which has to refrigerate. The dependency on fresh produce has reduced drastically over the years. Since perishable food constitutes most of the food in the food industry, food traceability comes into the picture. Food traceability currently in the food industry is a very cumbersome process since many parties are involved in the production and transport of the produce or product. Perishable food because of their nature is very vulnerable to foodborne diseases which in turn threaten public health.

Public health services always track down food contamination but usually it takes a lot of time to precisely track down the source of these foodborne diseases and the results can be inaccurate as well. Hence, food traceability is essential in the food supply chain whether it perishable food is the question or no. The model of the blockchain makes sure every party involved in the process of producing or manufacturing or transporting the food or food products would generate and save data points to create a systematic traceable system. This system will generate vast amount of data which can be organized using simple labels and every data point. These labels help to record and trace the journey of a food item or a product from farm to the household in an instance.

3.2 Balancing market access

Using blockchain in the food supply chain not only ensures food safety but also can make an impact in how a food product is priced. Currently many parties are involved in the process of manufacturing and transporting, blockchain can help maintain a ledger in the supply chain to track how many parties are involved and can help reduce the prices of a particular product. The consumers can a look at how many parties are involved and judge the listed price, rather than the information provided by the wholesaler. Giving such a picture to the consumer can help adequate pricing of any product the food chain. Despite many such advantages of blockchain, implementing such a system still remains unknown.

3.3 System Complexities

The current food industry is dominated by government backed company and even private company which holds majority of the stakes in the industry. Penetrating such a vast industry is a challenge in its own. Any new company or a startup entering this industry needs to have a complete understanding of how different food products have different forms of manufacturing process, harvesting process, storage methods and handling process. The blockchain needs to be built in a way that would be able to sort different products and store data points of different products. Such high level of customization would require a lot of testing at many different levels.

3.4 Data Transparency

Advocates against food blockchain also raise issues about transparency of information. Blockchain would help the food supply chain on a vast scale but this also comes at a cost, especially in a place like India. India agriculture has varied farming practices which is very subjective to its native regions, since implementing blockchain would require the farmers to give up those farming techniques for the sack of technology would arise far too many disputes against the system. Recording such high level of information could cause an adverse effect on the business if things start to go wrong. Collection of such information at the primitive stages of the use of blockchain would prove to be very difficult since the farmers wouldn't voluntarily disclose the information especially if the information will affect the day to day running of their business. As discussed in the previous sub point where India account to the largest amount of land disputes, farmers wouldn't want the end consumers to know where the crop has been grown and harvested or which type of pesticide the crop has been subjected to which could adverse the sales of their produce. With such a vast array of information available to the end consumers, consumers may diminish the value of the product they're buying.

With such a vast array of information available they direct competitors can create an alternative to that product which in turn can cause a lot of disturbance within the agriculture industry. With so many factors to take into consideration, blockchain should be able to handle large amounts of data. These data can have a significant impact on the economics in Indian agriculture.

First, we see interest in deploying blockchain primarily from big organizations because they have the infrastructure — both technical systems and information already in location — to promote farm-level automation of information processing. In addition, as one of the constraints of the blockchain, the structure and scales have to be carefully planned out as each transaction added to the blockchain would increase the size of the database. Either a small ledger should be built for every region which can be combined into a large ledger or a large ledger if the company can efficiently manage it.

3.5 The Future

Currently, at this present time, blockchain has a lot of challenges and roadblocks before even implementing on a wide scale. For many participants in the food ecosystem, original attempts and obligations to implement blockchain are often obstacles. The technology should either enhance prices or reduced costs to create financial sense. Although more customers advocate transparency and food safety, if the price does not justify the cost, there is little incentive for business players to engage.

The latest transformation of the organic sector is a good case study. It has come a long way for both consumers and producers to embrace the concept of organic food. However, once the higher price for organic food is justified, the advantages for switching to organic food are recognized by producers and consumers.

Voice of consumers is enough for producers to make changes. The distinctive decentralized design of Blockchain ensures verified goods and procedures to generate a market with transparency for premium goods. Commanding a premium price would therefore provide a financial incentive. In the meantime, the incentive problem could be solved by different financing structures. A blockchain-enabled monitoring scheme would increase the capacity to acquire such loans and reduce the price of the supply chain on a larger scale.

4. REFERENCES

[1]India aims to deliver groundbreaking agricultural blockchain <https://www.finder.com.au/india-groundbreaking-agricultural-blockchain>