# Block Chain Technology for Revolutionizing Indian Agriculture Value Chain

Priyanka Maity\* and Swati Sharma\*\*

## ABSTRACT

India is an agrarian economy with 55 per cent of population directly or indirectly dependent on agriculture sector for livelihood. At present Indian agriculture sector is facing many challenges like low price realization by farmers, low productivity, lack of infrastructure etc. In this regard to overcome the issues Blockchain technology can be great solution in strengthening the value chain of coffee leading to transparency, low cost production and profitability to different stakeholders. As Blockchain technology allows immediate transfer of digital assets and reduces or eliminates the need for intermediaries in value chain. As of now, in terms of agricultural output, India is ranked second in the world. And currently India is the third-largest producer and exporter of coffee in Asia, the country accounts for 3.30 per cent (2017-18) of the global coffee production. India has emerged as the seventh largest coffee producer globally; after Brazil, Vietnam, Columbia, Indonesia, Ethiopia and Honduras. Coffee accounted for 3.3 per cent of production and 5.4 per cent of global exports in 2017-18. But at present the Indian coffee Industry is facing many issues in value chain management of coffee which need to be addressed. In this concern the Coffee Board of India has launched a pilot Blockchain based e-marketplace in order to integrate coffee farmers with markets. The present paper discusses the present scenario of Indian coffee industry and issues faced in effective coffee value chain management. The paper throws light on importance, benefits and applications of Blockchain technology in effective agricultural value chain. The paper addresses the role of Blockchain in strengthening coffee value chain enabling trustworthy provenance and traceability from farmer to consumer.

Keywords: Agriculture; Blockchain, Benefits, Applications, Challenges.

#### **1.0 Introduction**

India is an agrarian economy with 55 per cent of population directly or indirectly dependent on agriculture sector for livelihood. At present India is ranked second in the world in terms of agricultural production. But presently, Indian Agriculture is witnessing a phase of diversification. The current value chain of agriculture is afflicted by visible distortions. On the value side, farmers are not getting adequate remuneration for their produce. On the demand side inflationary food prices makes it difficult for the consumers to afford healthy food for consumption. In this regard there is urgent need to implement some technology to overcome the value and demand side issues.

The Block chain technology could be the technology that would allow the farmers to negotiate better prices while at the same time allowing the consumers to develop confidence in the quality of the product they consume.

<sup>\*</sup>Corresponding author; Research Scholar, Navsari Agricultural University, Navsari, Gujarat, India (E-mail: priyankamaity601@gmail.com)

<sup>\*\*</sup>Assistant Professor, Navsari Agricultural University, Navsari, Gujarat, India

The primary advantage of block chain technology is to directly connect farmer with the retailer or consumer situated at the last stage of the value chain. This would not only allow the farmers to maximize their profits by bypassing middlemen, but will also help normalize the inflationary tendencies for the consumer. As the block chain can act as a connecting treat for farmers across the globe. The real-time information would allow the farmers to gauge the right prices for their produce based on global trends.

This would also harmonize negotiation between farmers and the consumers and reduce the burden on the pockets of the consumers who face skewed prices of necessary agricultural consumables due to distortionary value chains. Block chain, thus, could give a big-push to the agricultural growth across the world and more importantly in developing countries like India which are even today largely dependent on agriculture for their economic growth.

# 2.0 What is Blockchain Technology?

The blockchain is a technology that allows the users to transfer value or assets between each other without trusted intermediary. It is analogous to triple entry accounting. It reduces the cost of verification by eliminating the trusted intermediary. Also it reduces the cost of networking by being accessible. It is a method of documenting data via a digital ledger that records and verifies transactions, agreements and contracts. The technology allows immediate transfer of digital assets and reduces or completely eliminates the need for intermediaries, like banks and other financial service providers. With this decentralised approach, Blockchain helps stakeholders involved in a value chain network from the farmer, the wholesaler, the financial service provider, to the supermarket to trade more quickly and in a more transparent manner leading to more prize realization by the stakeholders. In India several Blockchain applications in the agri-food sector include value chain management, food safety, trade finance, agricultural financial services, market information, land registries and international agreements related to agriculture etc.

# 3.0 Importance of Blockchain Technology in Agriculture

- **Improve transparency in the value chain and Traceability for consumers**: The Blockchain technology can provide certification and regulations for clean food. The open and shared ledger system will trace product origin with immutable provenance data from farm to table. Also retailers can verify easily that the product they are receiving is exactly what they demanded.
- Expand financial options for farmers: Farmers, particularly in developing economies, have limited access to financial resources in this regard lending institutions perceive agricultural industry as risky and are hesitant to provide funding to small farmers as they cannot prove their ability to repay debt. In this regards Blockchain technology provides farmers with the ability to show what they have harvested, farmers could use the verification for funding or purchasing crop insurance. It provides quicker access to funding resources and makes farmers financially inclusive
- **Provide immediate payment on delivery:** Blockchain technology enable real-time payment on delivery and improve settlement process for farmers. The farmers get paid immediately without delay and Blockchain adds transparency, trust, and inefficiency to settlement which can decrease risk and unlock new financing mechanisms for financial institutions.
- **Provides direct access of suppliers and transparent transaction information to the farmers**. The blockchain provides farmers with access to information on transactions, stock price of goods, and complete information of buyers etc.
- **Farmers has direct access to suppliers and market information** Farmers are able to determine what their harvest is currently worth and sell at a price that reflects global market conditions. The

information sharing will increase industrial competition, and price will become higher and increased price realization by farmers.

# 4.0 Benefits of Implementation of Blockchain in Agriculture Sector

- **Cost-effectiveness**: The Blockchain provides a way of combining many processes and systems together. The blockchain technology increases the efficiency through distributed processing and leads to reduction in long-term costs, such as a reduction in manpower of the concerned department etc.
- **Increased Efficiency**-The use of smartphones will significantly reduce the inefficiency of the current system. It will drastically cut down the number of intermediaries that surge the current title regime. The Blockchain also helps in reducing the level of corruption at different levels of value chain.
- **Increased Transparency**: Registration on the Blockchain would mean that the information is completely available to the public domain. The tampering of information at any point is not at all possible.
- **Simplification of administrative burden**: The blockchain technology will lead to robust land title system which will lead to a decrease in the number of land-related disputes in the country.

# 5.0 Application of Blockchain in Strengthening Indian Agriculture Value Chain

- **Food safety:** Consumers have grown suspicious of the food they are consuming. Food fraud costs the global food industry an estimated US\$ 30-40 billion annually. So, big food chains will have no choice but to use Blockchain for ensuring accountability, traceability and quality of the food. Blockchain will become a competitive edge for brands competing in the competitive FMCG space.
- **Food value chain:** Farmers and all members of the value chain can access all the information throughout the chain. This will make the entire value chain more democratic and efficient resulting in lesser food wastage and higher remuneration being paid to the stakeholder adding the greater amount of value.
- Agri inputs: Blockchain application will solve the problem of fake inputs and huge losses of companies by increasing the traceability of each product sold from manufacturer to end buyer. Retailers and farmers can simply scan the Blockchain barcode on each product via their smartphone and get to know about the authenticity and source of the products they are buying.
- Land title registration: The Government of Andhra Pradesh was the first mover in this space and have partnered with Swedish Startup Chroma Way to build Blockchain solution for land registration and recordkeeping.
- **Disbursement of subsidies:** Across the globe, farm sector is heavily dependent on government subsidies. For example in India 2017-18 budget, US\$ 4.9billionwas allocated for agri-related subsidies to farmers. The major issue is that how much of this amount actually reaches the farmers. The Blockchain will lead to efficient distribution and delivery of subsidies in more transparent manner resulting in targeted disbursement of subsidies avoiding leakages in the existing system.
- **Procurement Tracking:** The involvement of multiple agents adds high costs to the system and makes the entire process time-consuming. With the Blockchain, the whole process can be simplified to a single distributed ledger. It will reduce the need of intermediaries as with the features like traceability and auditability, farmers can directly sell crops or food to the restaurant or individuals.

- **Crop and Food Production:** With the help of smart farming, IoT sensors could fetch important information like the temperature of the soil, water level, fertilizer details and more and send it to the Blockchain. The blockchain will help in enhancing the quality of the farming process as well as produced crops.
- Weather crisis control: Due to excessive rains, it becomes difficult for grown crops to tolerate flooding. But with blockchain technology it will be possible to trace the weather, also farmers can quickly request and receive insurance claim through smart contracts.
- **Managing agricultural finance:** With Blockchain, the agricultural finance process becomes more transparent and fair. The agriculture industry needs to do a lot of work to maintain and build consumer trust when it comes to the food quality check.

# 6.0 Current Scenario of Coffee Industry in India

In India, coffee has a place of pride among plantation crops grown and is traditionally cultivated on the south-western hill slopes under monsoon rainfall conditions, is also termed as "Indian monsoon coffee" since 150 years. Indian coffee is said to be the finest coffee grown in the shade rather than direct sunlight anywhere in the world. The two well-known species of coffee grown are the Arabica and Robusta. India has emerged as the seventh largest coffee producer globally; after Brazil, Vietnam, Columbia, Indonesia, Ethiopia and Honduras. The Table 1 depicts the major 10 Coffee producing countries in world. It accounted for 3.3 per cent of production and 5.4 per cent of global exports in 2017-18. Arabica coffee is also well received in the international market. In short Indian coffee is well known for its quality and is much in demand in the international market.

Production (in 100060kg bags)
61700
29500
14200
10200
7500
7450
5200
4900
4500
4300

 Table 1: Major 10 Coffee Producing Countries in World

Source: Statista.com

Therefore, India exports coffee to a large number of countries including U.K., the U.S.A., Russia, Australia, Iraq and a large number of countries of continental Europe. Table 2.depicts the export of coffee from India to top ten countries. Export earnings have increased from Rs. 2070.68 crore in 2009-10 to Rs. 6210.23 crores in 2017-18. Italy was the largest export market for Indian coffee, importing 80,099 MT (20.28% of India's total exports) in 2017-18. Coffee research and development efforts are well organised in India through its Coffee Research Institute, which is considered the premier research station in South East Asia. It is under the control of the Coffee Board of India, an autonomous body, under the Ministry of Commerce and Industry, Government of India. At present there are many problems in Indian coffee production and distribution; therefore coffee industry needs more suitable government policy measures, research, development and extension activities to augment coffee cultivation.

Destination	Quantity	Unit Value in Rs/tonne
Italy	80099	141547
Germany	39233	161354
Russian Federation	26418	171756
Belgium	18126	205908
Turkey	15951	170688
Poland	13709	158771
USA	13405	104981
Indonesia	12344	137953
Jordan	11162	175108
Libya	10545	144861

#### Table 2: Export of Coffee from India to Top Ten Countries

Source: Coffee Board, 2018



PRODUCTION OF COFFEE IN INDIA (IN MT)



Source: Coffee Board, 2018

Currently India is the third-largest producer and exporter of coffee in Asia, the country accounts for 3.30 per cent (2017-18) of the global coffee production. The Fig. 1 depicts the Coffee Production in India highlighting the Production of Arabica and Robusta. The coffee production in the year 2018 stood at 316,000 MT and coffee exports from India stood at 395,014 MT valued at US\$ 963.28 million.





Coffee productivity by states in 2017-18 (kg/ha)

Source: Coffee Board, 2018

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Fig. 2 depicts the coffee productivity by states were major states with high productivity are Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odhisa, North East etc. Fig. 3 depicts the coffee production in different States in India. The top three importers of Indian coffee during 2017-18 were Italy (25.16 per cent), Germany (10.51 per cent) and Belgium (5.97 per cent). Out of the total coffee produced in India nearly 70 per cent is exported and nearly 30 per cent is consumed domestically. India's **per capita coffee consumption stands at 0.03 kg**. **Revenue** in the Coffee segment is forecast to be around US **\$423m** in 2019 with a market that is expected **to grow annually by 7.7%** (CAGR 2019-2023). In India the Coffee consumption is mostly concentrated in **the southern** states **of Tamil Nadu (60%)** and **Karnataka (25 %)**.



# Figure 3: Coffee Production in Different States in India

### The key Issues in present Value Chain Management of Coffee in India

Value Chain elements	key Issues
Social	Food Insecurity, Malnutrition
	Poor access to education and healthcare, labour rights
	Gender Inequality
	Ageing grower communities
	Migration of young growers
	Dispersed actors- poor bargaining power
Economic	Green bean Price Volatility
	Long term Decreasing Real Coffee Prices
	Lack of Market Information
	Lack of Product Information
	Rising Living costs
	Access of Finance
	Ageing Coffee Plants
	Limited access to insurance and hedging instruments
	Poor services through local, co-operative grower organisation
	Shortage of labour
Environmental	Evolving pest and disease
	Loss of diversity
	Soil erosion and degradation
	Inappropriate use of agrochemicals
	Depletion of water value
	Limited of waste water management
	Climate change and volatility
Infrastructure	Erratic power value
	Limited number of certified curers

Source: Modified based on Sampel et al (2017)

Source: Coffee Board, 2018

### 7.0 Role of Blockchain Technology in Strengthening Coffee Value chain

Indian coffee is highly valued and famous in the world market and sold as premium coffees. The share of farmers in the final returns from coffee is very exiguous. A pilot Blochchain based emarketplace has been launched by the Coffee Board of India which aims to integrate coffee farmers with markets. The development was announced by Indian Ministry of Commerce and Industry on March 28, 2019. The Coffee Board is an organization backed by the Indian Ministry of Commerce and Industry which promotes coffee production in India and has also rolled out an e-marketplace for coffee producers in order to reduce the number of intermediaries between coffee growers and buyers. The product will reportedly be delivered in the form of an application and aims to improve transparency and traceability of coffee produced in India. To implement the project, the Coffee Board collaborated with M/s Eka Plus, a digital commodity management platforms for agriculture development. By creating "bean to cup" traceability, the Blockchain marketplace promises to reduce the middlemen in coffee trading, thereby increasing profitability for the farmers. As information on the Blockchain is immutable, use of the marketplace can build trust between suppliers and traders. The Figure 5 depicts the Implementation Model of Blockchain Technology in Indian Coffee Industry. The Blockchain application was initially launched in a pilot phase with a limited number of growers. After the pilot phase it will be expanded to all growers in the country, as there are over 350,000 coffee growers in India. This initiative taken by the board will help in creating a brand image for Indian Coffee through traceability by reducing growers dependency and intermediaries by having a direct access to buyers for a fair price for their produce, in finding right coffee suppliers for the exporters and within the given stipulated time for meeting the growing demands and for building a better trust and long term relationship which is due to increased visibility towards the traceability and transparency of the produce.



#### Figure 5: Implementation Model of Blockchain Technology in Indian Coffee Industry

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# 8.0 Challenges in Implementation of Blockchain Technology in Indian Agriculture Sector

- The major issue is lack of regulation and compliance. Once the Indian government implements the clearly defined regulation on Blockchain and distributed Ledger Technology, the adoption will become faster.
- The testing and adoption of Blockchain applications are still restricted to cryptocurrency. For successful execution at large scale, the banks need to hire Blockchain experts and the cost of hiring such experts are much higher making its adoption costly.
- Many public Blockchainbased applications is still not clear who incurs the cost of network maintenance as well as validation of transactions.
- There is restriction in creation of enough opportunity for Blockchain developers due to lack of robust regulatory framework in India.
- Many vendors in the value chain not being ready to adopt the new technology because of the trust issues and lack of awareness about the technology is also a major issue. Therefore for the accelerated adoption of Blockchain more digitization and awareness is required.
- Blockchain in agriculture is also a challenge which comes from the number of operations that needs to be connected and the lack of funds available to implement this advanced technology.
- The global agriculture value chain is long and complicated. It is difficult to connect millions of small and medium-sized farms to provide the traceability and safety.
- For the small and marginal farmers it is difficult to afford the costs of adopting this technology, even if the technology brings benefits to them.
- The biggest challenge inBlockchain adoption is that the regulatory treatment is not clear for many uses with Blockchain and about virtual currency technology.

# 9.0 Conclusion

The Indian coffee sector is at an important point of transition, wedged between quality and value segments of the market. Traditional means of marketing and production are increasingly under threat from market pressures and there is need for new strategies for effective value chain management. So, Blockchain technology can be great solution in strengthening the value chain of Indian agriculture sector. The major benefits of block chain to agriculture are cost-effectiveness in production and processing, efficiency in management, transparency and easing administrative burden etc. At present the India coffee industry is facing many challenges like green bean price volatility, long term decreasing real coffee prices, lack of market information, lack of product information, rising living costs, ageing coffee plants, limited access to insurance and hedging instruments, evolving pest and disease, lack of infrastructure etc. So in order to address the challenges of coffee industry in India the Coffee Board of India has launched a pilot Blockchain based e-marketplace in order to integrate coffee farmers with markets. The major benefits of block chain to agriculture are costeffectiveness in production and processing, efficiency in management, transparency and easing administrative burden etc. So in this regard the Blockchain technology can be used to increase transparency, reduce complexity and cost in food-based value chains by enabling trustworthy provenance and traceability from farmer to consumer.

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