

SEMINAR REPORT
Blockchain technology and its applications

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CERTIFICATE

This is to certify that the seminar report entitled “**Blockchain technology and its applications**” has been solely prepared by Apeksha K. Rai(2018-11-124) under my guidance and has not been copied from seminar reports of any seniors, juniors or fellow students.

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1.Introduction

Twenty first century is all about technology. With the increasing need for modernization in our day-to-day lives, people are open to accepting new technologies. Throughout history, humanity has tried different ways to exchange values and protect buyers and sellers. Credit card system, the internet and mobile technologies were all important innovations, that improved the convenience, speed and efficiency of transaction. But, they had their own limitations like limited transaction size, the need for third party validation, increasing transaction cost and a weak trust based model. Besides, fraud and cyber-attacks are unavoidable.

To address these challenges, the world needed a new type of payment system or rather a network, that could establish trust, remove intermediary institutions, eliminate fraud and provide secure and efficient transaction mechanisms to protect payers and payee. So, Blockchain technology is one such important technology.

Blockchain, is one of the emerging technologies currently in the market attracting a lot of attention from enterprises, start-ups and media. Financial players are the first driving force to capitalize on this technology even though it is still in an emerging stage. A study by the World Economic Forum envisages banks and regulators around the world are poised to experiment multiple Blockchain models in 2017. With 90+ central banks involved in Blockchain discussion globally, 2500+ patents filed over the last three years and 80 per cent of the banks predicted to initiate Blockchain and distributed ledger technology (DLT) projects by 2017, the Blockchain technology is on its way to become the new normal in the world of financial services. Since the advent of steam engines, electricity and information technology, blockchain has been seen as part of the fourth industrial revolution (Chung and Kim, 2016). Blockchain technology could not draw much attention during the initial stages of its existence and Bitcoin continues to run safely and steadily over the years, the world has since become aware of the massive potential of this invention's underlying technology in applying it not only to cryptocurrencies but also to many other fields (Collins, 2016).

2. Blockchain

2.1 Definition:

A blockchain is “a type of distributed ledger of digital records that is comprised of unchangeable data in packages called blocks, where each block is then chained to the next block, using a cryptographic function called hash function”(FAO,2019).“Distributed ledger is a type of database or system of records, that is shared, replicated and synchronized among the members of a network.”

Each block is linked to its previous block using the cryptographic hash of the previous block, hence, the process is named as blockchain. A blockchain is a historical record of all the transactions that have taken place in the network from the beginning of the blockchain to the end. The blockchain serves as a single source of genuineness for the network.

2.2 Blockchain terms

Block: Each block contains data, its own hash and the hash of the previous block.

Data: A unit of data stored inside a block may be represented by any value depending on the type of blockchain. A block can store an amount of money, a share in a company, a digital certificate of ownership, a vote during an election or any other value.

Hash: Each block also has a hash. This hash is a value generated from a string of text using a mathematical function. A hash can be compared to a fingerprint, as each hash is unique. Its role is to identify a block and the block’s contents. Any changes inside the block causes the hash to change. If anyone changes the data in a single block, hash of that particular block changes, it also makes the whole chain invalid.

Hash of previous block: Each block contains a hash of the previous block. For instance, if there are three blocks in a blockchain, block three will contain the hash of block two, and block two will contain the hash of block one.

Node: A device that works on the blockchain network. Are individual computers that take input and performs a function on them and gives an output.

Wallet: All the transactions take place on the internet. So no banks and no bankers are involved in the process. Transactions are stored in a virtual account called wallet. Money can be transferred from one wallet to another. Single person can hold more than one account.

Public and private key: The generation of a Bitcoin address begins with the generation of a private key. Corresponding public key can be derived using a known algorithm. Public keys are publicly known and essential for identification. Private keys are kept secret and used for authentication and encryption. It is impossible to derive the private key from the public key.

Anyone can send a transaction using a public key to the address of a receiver. But only the owner of that address, who has the private key, can access the value of that transaction.

3. How blockchain works?

The working of a blockchain, be public or private, is as described below:

Let us consider five participants in our blockchain; A, B, C, D, E who are on a decentralized, distributed network. This blockchain example will implement the blockchain technology in the bitcoin system.

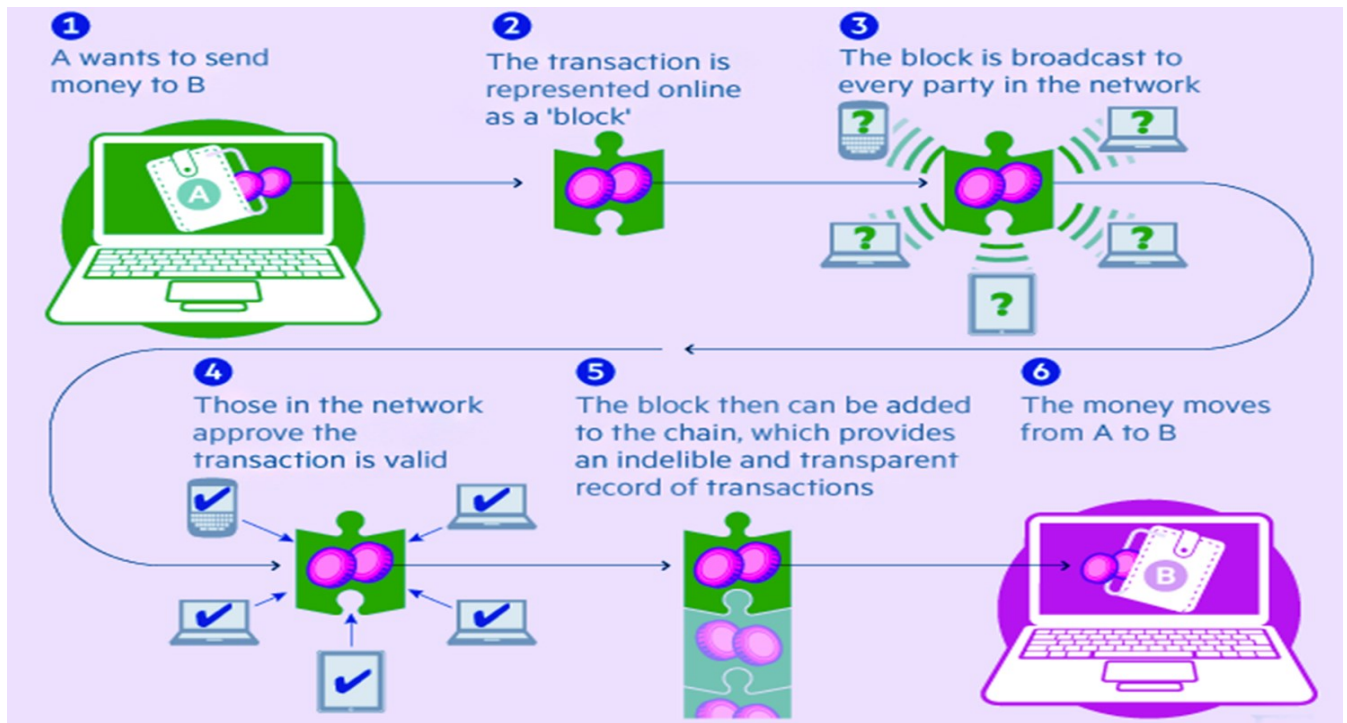


Fig. 1: Steps in working of blockchain

- (1) A wants to send 50 bitcoins to B.
- (2) This transaction of 50 bitcoins is represented online as a block.
- (3) This block is then broadcasted to each and every participant in the network [C, D and E].
- (4) In this example, C, D and E will serve as the validators in the network. This approve that the transaction is valid.
- (5) This block containing the transaction then is added to the blockchain.
- (6) The 50 bitcoins are transferred from A to B.

In Step (4), the validator, C, D and E execute cryptographic algorithms and conduct an evaluation and verification of the history of the individual blockchain under consideration. If the evaluation proves that history and the hash values are all valid, then the transaction is accepted. This is known as distributed consensus. If C, D and E for some reason cannot validate the information in the blockchain, then the data is rejected and entry for the block is denied and it is not added into the blockchain.

4. History

Blockchain history dates back to the early 1990's. Stuart Haber and Scott Stornetta work on the first Blockchain. But being into use only with the introduction of first cryptocurrency, Bitcoin. Blockchain technology was first introduced in a whitepaper entitled: "Bitcoin: A Peer-to-Peer Electronic Cash System," by Satoshi Nakamoto in 2008. Blockchain technology made its public debut in 2009 with cryptocurrency.

Bitcoin: A Peer-to-Peer Electronic Cash System

Satoshi Nakamoto
satoshin@gmx.com
www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main

5. Global scenario

According to STATISTA (2019), global market for blockchain technology,

- The Global Blockchain market size which was \$708 million in 2017 and is expected to grow to \$20 billion by 2024
- Major players like IBM, Microsoft, Facebook, Amazon, Google and many more are now exploring blockchain
- 42 per cent of world's top Universities including Stanford, Yale, Harvard and Princeton offering courses on blockchain and cryptocurrencies
- 90 per cent of American and European banks, now adopted blockchain technology in their financial activities
- The World Economic Forum anticipated that 10 per cent of world's GDP will be stored in blockchain by 2025
- Since 2017, there has been increase in jobs related to blockchain and cryptocurrencies

6. Types of blockchain

There are two types of blockchain

6.1 Private /Permissioned blockchains: This is controlled by a centralized entity. Only people with specific authentication and permission can be part of this network and thereby can verify and add records to the ledger.

6.2 Public /Permissionlessblockchains: Public or permissionlessblockchain are decentralized and are visible to the public, anyone can join or leave the blockchain and anyone can verify and append transactions to the blockchain. This type of blockchain facilitates the dynamic collection of participants who may not know each other.

7. Primary features of blockchain

7.1 Decentralization: The network is decentralized, meaning it doesn't have any governing authority or a single person looking after the framework rather a group of nodes maintains the network making it decentralized.

7.2 Immutability : Immutability means something that can't be changed or altered. This is one of the blockchain features that help to ensure that the technology will remain as it is a permanent, unalterable network.

7.3 Improved security: As it gets rid of the need for central authority, no one can just simply change any characteristics of the network for their benefit. Using encryption ensures another layer of security for the system.

7.4 Distributed ledger: A blockchain is a public ledger that provides information of all the participants and all digital transactions that have ever been executed. A block is the "prevailing" part of a blockchain which is supposed to keep the record of the recent transactions and once they are completed, it goes into the blockchain.

7.5 Consensus:In simple terms, the consensus is a decision-making process for the group of nodes active on the network. Here, the nodes can come to an agreement quickly and relatively faster. When millions of nodes are validating a transaction, a consensus is absolutely necessary for a system to run smoothly.

7.6 Faster settlement:Blockchain offers a faster settlement compared to traditional banking systems. This way a user can transfer money relatively faster, which saves a lot of time in the long run.

8. Applications of Blockchain technology

8.1 Cryptocurrency

A cryptocurrency is a digital currency that uses cryptography for security. It is also called as virtual currency. Cryptocurrency is associated with the internet that uses cryptography. Cryptography is the process of converting legible information into an almost uncrackable code,

to track purchases and transfers. Cryptocurrency is a way to secure communications, information and money online. It has evolved in the digital era with elements of mathematical theory and computer science.

8.1.1 Key features of Cryptocurrency

- **Decentralized/No Central Authority:** No central authority is needed to control the transaction. Transactions are verified by a network nodes through cryptography and recorded in a public distributed ledger called a blockchain. The transaction is propagated across the peer-to-peer network and is replicated by every node, reaching a large percentage of the nodes within a few seconds.
- **Intangible:** Exists only on the internet, only in virtual form.
- **Anonymous:** Since there is no need for a central authority, users do not need to identify themselves when transacting with cryptocurrency.
- **Irreversible and Immutable:** Which means that, it is impossible for anyone, but the owner of the respective private key to move their digital assets and that transactions cannot be changed once it is recorded on the blockchain.
- **Limited Supply and Scarcity:** Unlike fiat currency there is no central banks to manipulate the value of the cryptocurrencies as part of its economic policies. On the other hand, most cryptocurrencies have a limited and pre-determined supply of the cryptocurrency that is coded into its underlying algorithm when it is created.
- **Generated by algorithm:** Crpto coins are generated by mathematical computation.
- **Highly volatile:** Value of the cryptocurrency has large fluctuation more or less daily.

8.1.2 Scope

- Useful in making purchases via mobile, recharges and even in paying bills, online shopping etc.
- Transfer of funds: Inter-border money transactions can be made safely, quickly and cheaply.

- No transaction limit: There is no maximum and minimum limit for the transaction.
- High returns: From single transaction lump sum amount can be gained.

1 bitcoin = 6,19,327.74 Indian Rupee (as on 15 November 2019)

According to CoinMarketCap(2019), at present, there are over 2500 cryptocurrencies are exist, with a total market capitalization of \$ 244,539,412,448. Bitcoin is the most successful and most widely circulated cryptocurrency with a market capitalization of nearly \$ 159,973,658,317.

Major Cryptocurrencies in circulation are Bitcoin, Ethereum, Rippel, Stellar, Bitcoin cash, Litecoin etc. Among all cryptocurrencies, bitcoin holds maximum share of about 58 percent.

8.1.3 Indian scenario

The Finance Minister in the country has labelled cryptocurrencies are not being legal tender. In recent time a debate has emerged within the country as to whether profits from crypto transaction should be taxed or not. In India it is neither legal nor illegal.

India's Department of Economic Affairs in its Ministry of Finance met to discuss how Bitcoin could be regulated. The committee suggested the following, that cryptocurrencies should be governed by the Reserve Bank of India Act of 1934, Bitcoin investors should be taxed, guidelines for buying and investing in cryptocurrencies should be drafted. According to the Indian government, people using these types of currencies should take certain caution because there is no lawful protection for these currencies. And no help can be provided to the people from the government side if some fraud is faced by the people (Kumar and Singh, 2018).

Blockchain beyond Cryptocurrencies:

According to The National Association of Software and Services Companies (NASSCOM) [which is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry], Banking Finance Services and Insurance (BFSI) holds maximum share of 60 per cent in adoption of blockchain in India.

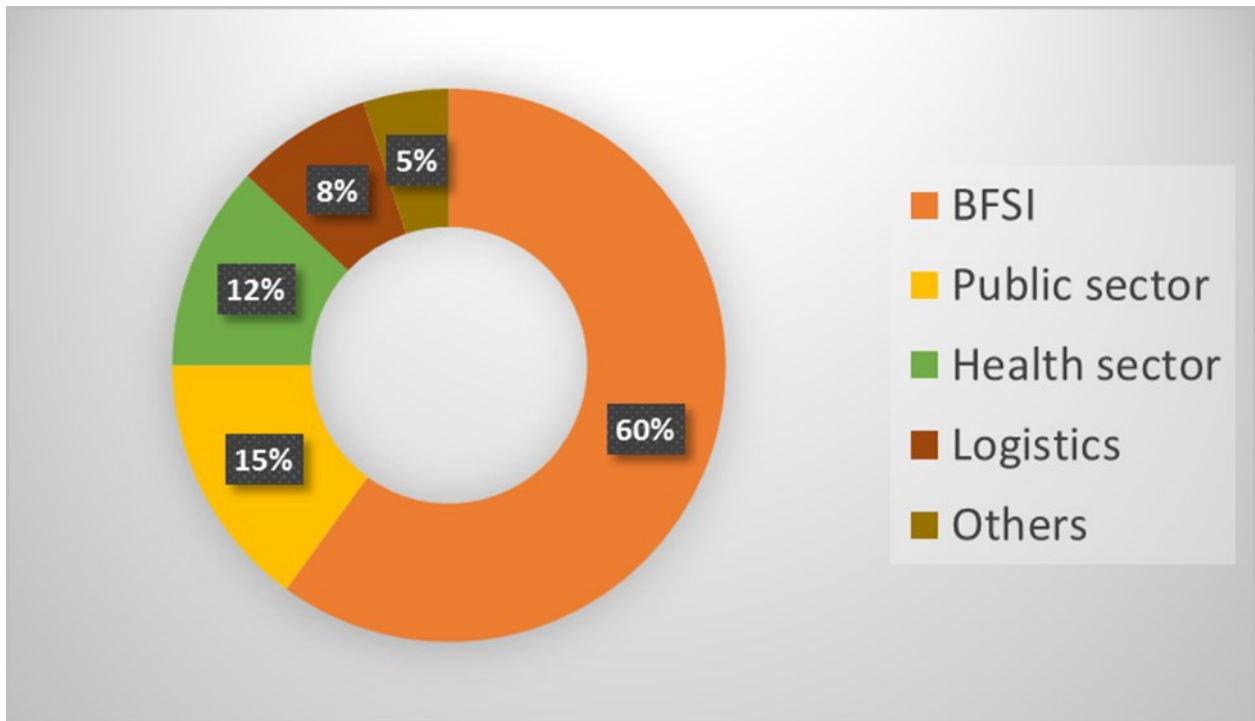


Fig.2 : Sector-wise adoption of blockchain in India

8.2 Agriculture food supply chain:

Supply chain is a system of organizations, people, activities, information and resources, involved in moving a product or services from supplier to customer.

Traditional food supply chain, which involves complex interconnected process between producers, processor, inspection and insurance agency, logistics and shipping, manufacturers, banks, importers and finally consumers. However in this long process, there exist quiet challenges like,

- Consumers may find it difficult to understand the place of origin and quality of produce
- As a produce move between multiple stakeholders , the ownership custodian information becomes difficult to trace
- Centralized parties, especially private agencies certify crop produces which may not be trusted by international importers
- Information flow between stakeholders is sequential, leading to potential delay in decision taking

- Overall, it loses transparency in the process

All these challenges can be tackled by **Blockchain** supply chain.

When people buy goods locally, they are not aware of the origins of these goods, or the environmental footprint of production. Consumers can use their smart phones to scan the QR code on the front of the bottle and they are then taken to a website, where they can find relevant information, from bottling to the raw ingredients. Thus it helps in,

- Getting information beyond the label
- Maintain Complete records from farm to retail and thus increases trust
- Paper work completely converted into digital records
- Helps consumer in tracing-
 - Where ingredients come from?
 - How they are produced?
 - How they're incorporated into finished products?

When an outbreak of a food-borne disease happens, it can take days, if not weeks, to find its source. Better traceability could help save lives by allowing companies to act faster and protect the livelihoods of farmers by only discarding produce from the affected farms.

We can see from the **Fig. 3** and **Fig. 4** that, traditional food supply chain is sequential which takes more time for the information dissemination whereas, blockchain based supply chain is connected between different stakeholders involved in the food supply chain and it ensures information security and it provides information/data to all the participants on the chain.

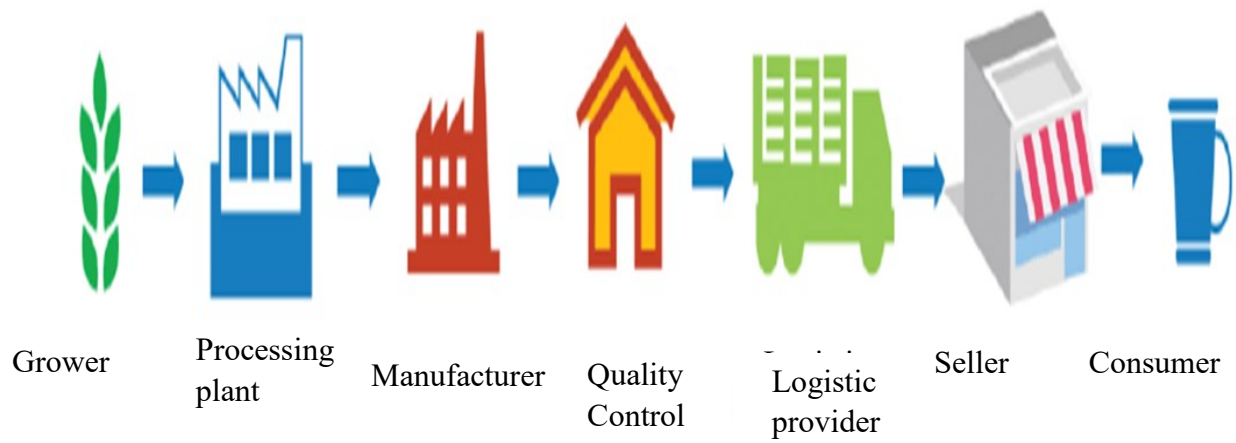


Fig. 3 : Traditional food supply chain

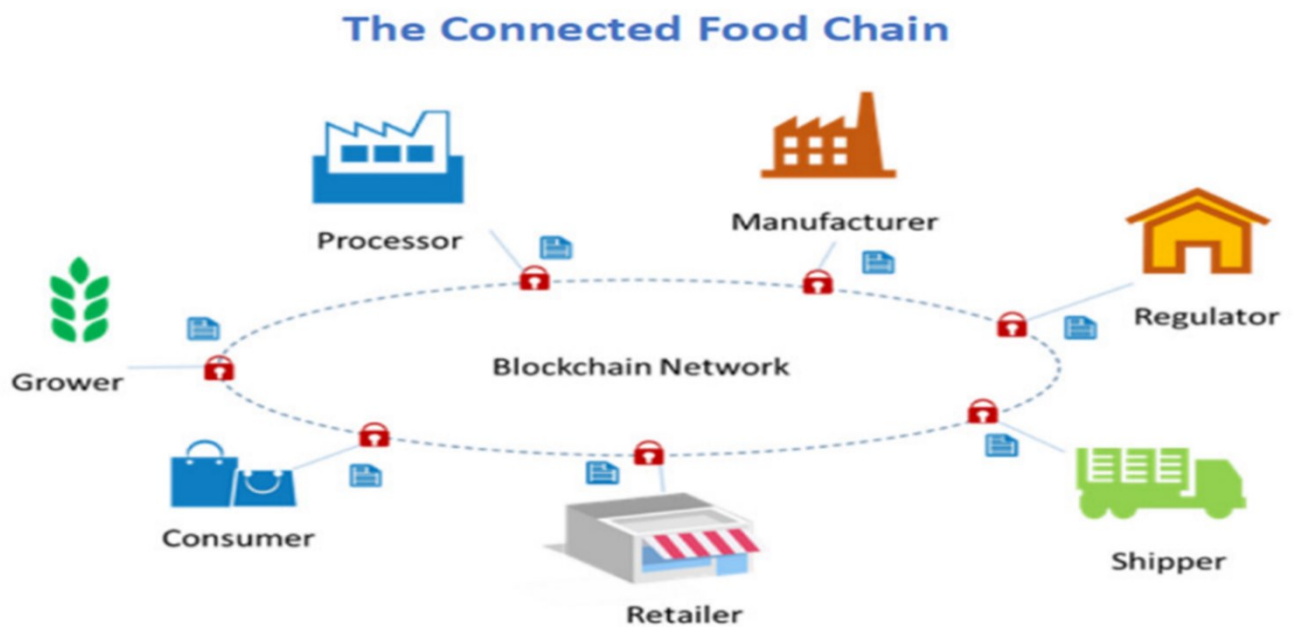


Fig.4 :Blockchain based food supply chain



Fig. 5 :Tracing of produce

8.3 Land registration:

Land registrations are normally functioned by the state and therefore, their performance level depends on the level of corruption, organisation and overall functioning of national institutions. In addition, land registration systems are low-tech, largely inefficient, depend on paper documents, handwritten signatures and manual labour to register land titles. Errors and fraud can be common practice, which result in costly disputes. All these limitations in traditional land registries are overcome by blockchain technology.

Blockchain-based implementations could provide an incorruptible ledger of land records. Especially in the case of the rural poor, if this is linked effectively to sovereign ID/digital ID then the safekeeping of land records even in times of natural disasters or wars would not be an issue. This provides a safe and secure way to have digital originals and it could reduce millions of dollars of expenditures for the government (FAO, 2019).

8.4 Healthcare:

To improve the communication and association with the healthcare sector, blockchain technology could play a vital role, empowering and securing a convenient sharing mechanism of electronic health data.

- Digitization of medical data enables easy retrieval, sharing on need basis for better decision making based on historic cases and is also very crucial for legal purpose record keeping
- A blockchain based Healthcare Data Gateway (HDG) is proposed by Yueet *al.* They propose the use of a private blockchain cloud to guarantee that the medical data cannot be changed by anybody including the patient himself and/or the physicians
- Medical data is diverse in kind, i.e. it could be numeric, textual, image data (scans, x-rays, photos, *etc.*), video data (transcripts, recordings, *etc.*), *etc.* To remove the complexity of storing varied data types, Yueet *al.* proposed an Indicator Centric Schema (ICS), a blockchainbased data model. In this model, a single table shall be used to organize all data for a given patient and would include simple relevant fields like timestamp, indicator, type, value and category

8.5 Finance:

Financial service industry is currently the leader in experimenting with the technology. The shift from a centralized technical infrastructure to distributed, ecosystem-enabling platforms is laying the foundations for new business models in payments, digital banking and financial transaction technologies.

Due to the absence of central authority transaction are carried out directly from sender to receiver which helps in immediately validation and automatic settlement. No agreement is made and no discussion is involved hence no negotiation. Currently 15 per cent of Indian banks adopted blockchain technology. The concept of blockchain based KYC platform is already being implemented by IT giants like IBM. The Shared Corporate Know Your Customer (KYC) project

assures an efficient, secure and decentralized mechanism to validate, collect, store, refresh and share KYC information for customers.

9. Blockchain use-cases:

9.1 Decentralized Government Project:Bitnation (worlds first decentralized borderless voluntary nation) project for the decentralization of governance used blockchain technology to offer an emergency digital ID and a bitcoin visa card for victims of the refugee crisis (Turkey) 2016, to receive funds from family in the absence of a bank account.

9.2 AkshayaPatra Mid-day Meal Program Management Project:AkshayaPatra, the world's largest NGO-run mid-day meal program, collaborated with Accenture to use blockchain. An analysis of the project indicated that blockchain improved the efficiency by 20 percent, which increased the number of meals served by millions.. Thus blockchain has provided the required transparency to the meal chain, to help in audits and invoicing. This has also saved the manual.

9.3 Walmart brought unprecedented transparency to the food supply chain with Hyperledger Fabric:The Hyperledger Fabric is a blockchain-based food traceability system. Walmart traced the origin of over 25 products from 5 different suppliers. For mangoes in the US, the time needed to trace their provenance went from 7 days to 2.2 seconds. They also announced to start suppliers of fresh leafy greens in 2019. For pork in China, it allowed uploading certificates of authenticity to the blockchain, bringing more trust to a system where that used to be a serious issue.

10. Case study

Blockchain for Agriculture and Food

Ge-Lan, Christopher Brewster, Jacco Spek, Anton Smeenk, and Jan Top

Abstract

This report documents experiences and findings from the public private partnership (PPP) project 'Blockchain for Agrifood' that was started in March 2017. The project aims to contribute to a better understanding of the blockchain technology (BCT) and its implications for agrifood, especially how it can impact specific aspects of supply chains and what is needed to apply BCT in agrifood chains. A second aim of this project is to conceptualise and develop a proof of concept in an application based on a use case concerning table grapes from South Africa where BCT could be applied. This has been done by building a demonstrator that keeps track of different certificates involved in the table grapes supply chain. The code of this demonstrator is published at Github.¹ Furthermore, the project explored issues regarding the relevance, applicability and implications of BCT for the agrifood sector through literature study and stakeholder consultation.

Key words: blockchain, agriculture, food

Use case focussed on grapes supply chain:

- A South African farm produces organic grapes and the certifying authority issues certificate to the farm enabling the farm to certify the individual boxes of grapes it produces which are identified using a unique identification number
- Later, they are shipped to a reseller in Europe where they are sold to a supermarket and eventually to a customer. All the parties involved in the chain should be able to verify the validity of the issued organic certificate
- When the grapes change ownership, this should be recorded in the blockchain as well (except for the end-consumer). This would enable anyone to check the provenance of the grapes: how did they end up in the supermarket?
- When it turns out that the farm used some kind of unauthorized pesticide which is discovered during audit, the auditor should be able to revoke any certificate issued by the farm. This should be recorded on the blockchain so anybody validating the certificate will be able to see this

Findings: Stakeholders found that, it is feasible to put basic information on certificates on a blockchain with a permissioned ledger and smart contract. And ensured that, same layer of information will be shared among different parties and also it provided tamper proof certificate to all the stateholders.

(Lan Ge *et al.*, 2017)

11. Future initiatives:

11.1 High tech on ground: blockchain technology to boost small farm income: Is a three way partnership between ICRISAT, Eleven01(India's native blockchain platform) and KHETHINEXT(mobile-based agricultural solutions provider), to create a transparent market place. The objective is to increase productivity and ensure higher incomes to smallholder farmers in India (DownToEarth, 2019).

11.2 Walmart pilots blockchain tech for Shrimp from Andhra Pradesh: The move will strengthen the supply chain and reinforce customer trust. Walmart announced that it is piloting blockchain technology for end-to-end traceability of shrimp sourced in Andhra Pradesh and shipped to select Sam's Club locations in the U.S.(The Hindu, 2019).

11.3 UNICEF blockchain fund: first UN organization to accept cryptocurrency donation: The United Nation's International Children's Emergency Fund (UNICEF) has announced that it will be accepting, disbursing, and holding donations in the form of bitcoin and ether. With the setting up of its new Cryptocurrency Fund, UNICEF becomes the first UN organization to make transactions in cryptocurrency(IBT, 2019).

11.4 How India's government can build better contract with blockchain: Smart contracts powered by a decentralized ledger could transform contract enforcement in India, a way to establish trust between multiple parties, without the use of an intermediary (Shukla, 2019).

12. Challenges in blockchain:

- **High operational and maintenance cost:** The processing power and time needed to achieve encryption for all the objects included in a blockchain system. Blockchain systems have different types of devices which have very different computing capabilities

- **Matching physical to the digital:** Converting physical data to digital record is the biggest task
- **Poor connectivity:** Difficult for the rural poor to access internet, without which transactions cannot be made
- **Transactional data privacy:** Users do not want all of the details of a transaction to be made completely public
- **Lack of awareness:** There is a general lack of awareness about the blockchain and training platforms are inexistent
- **Regulation:** Cryptocurrencies indicates they are vulnerable to speculators and their price has large fluctuations almost daily. Hence, without some form of regulation, cryptocurrencies are not trustful to be used yet in food supply chains as a complete solution
- **Lack of common understandings:** Most of the population not ready to accept this technology because of trust issue

13. Conclusion:

Blockchain based transactions are gaining importance in many sectors like taxation, insurance, voting system, logistics *etc.*, and cryptocurrency can be seen as a future currency. Blockchain proved security in records and its decentralized nature provided large opportunity for going digital.

It can be considered as agriculture's next revolution. At present India accounts for only two percent of all blockchain, it is still in nascent stage. It may lead to sustainable farming practices and responsible consumption. It compares to what the internet was in the early 90s. nobody knows what the internet was going to be or what we were going to do with it. It is still in infancy, that sure to change the world a few years from now. In a nutshell, Blockchain can be a game changer.....

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15. Discussion:

15.1 Cryptocurrencies are intangible. Is it safe to use?

Not completely. In blockchain network transactions made are converted into uncrackable code using a cryptographic functions, which ensures security of the transaction.

15.2 Use of public blockchain in healthcare is considered as limitation. Why?

In public blockchain, data entered can be publicly viewable. But, all personal medical information cannot be made public. So, to avoid this problem private blockchain is developed in healthcare sector.

15.3 What happens if cryptocurrencies are banned in India?

Ban has never been a solution to any problem. Instead, a ban can result in brain-drain. If investors are not allowed to make transactions in bitcoin, they might shift to other countries like US and Canada where the use of cryptocurrencies is permissible. Also money- minded people will never mend their ways. Instead, they would find some loopholes in the system which will eventually lead to an increase in cryptocurrencies through illegal means.

15.4 Name some cybercrime cases in cryptocurrency?

Cyber criminals have netted \$4.3 billion from digital currency exchanges, investors and users in 2019. There are lot of notable cryptocurrency thefts with the latest cybercrime cases being the Coincheck hack (with \$400 million worth of NEM tokens stolen in 2018). In 2013, Australian police arrested a Cocaine dealer operating on Silk Road and being paid in Bitcoins.

15.5 What is the status of cryptocurrency in India?

In India cryptocurrency transactions is restricted, since there is no regulatory body to look after it. During the Union budget of 2018, GOI declared that, cryptocurrencies are not a legal tender and no government support will be provide to those who are involved in cryptocurrency transaction.

15.6 Name the countries where cryptocurrency are used. What measures they have taken to overcome these challenges?

Canada and US completely adopted cryptocurrency transactions. Few countries such as Japan and South Korea are adopted crptocurrency with certain regulations and with government involvement. Thailand completely banned the use of cryptocurrencies, due to increased cyberattack cases.

15.7 Is RFID (Radio Frequency Identification) and cryptocurrency are same?

No. Blockchain technology is an improved version of RFID. Adoption of RFID restricted to only tracing of food supply chain, but blockchain technology adopted in various areas like finance, healthcare, voting system, land registration *etc.*, where it provides immutable records.

15.8 Cryptocurrencies are scarce and limited in supply. Why?

For example, in case of bitcoin, only 21 million bitcoins were developed during the introduction of bitcoin. Out of them, 85 per cent of bitcoins are already mined. So it is not safe to invest in bitcoins, because one who introduced (Satoshi Nakamoto) bitcoin himself is unknown to the users and he doesn't know what is next.

15.9 With several challenges, how blockchain can be considered as game changer?

Though there exist several challenges in blockchain, it is gaining importance because of its decentralized nature, which avoids the third party intervention, which is a major issue in food supply system and banking activities.

15.10 Why blockchain network cannot be hacked?

In this system data entered are converted into uncrackable code, which means they are highly encrypted. No such improvised technologies developed as of now

**KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA**

Department of Agricultural Economics

Ag Econ 591: Masters Seminar

Name	: Apeksha K.Rai	Venue	: Seminar hall
Admission number	: 2018-11-124	Date	: 01-11-2019
Major Advisor	: Dr. Chitra Parayil	Time	: 10.00 am

Blockchain technology and its applications

Abstract

A new disruptive force of digital technology is changing the business models and gradually becoming a more important element around the world. The need for digitization throughout the

globe is the necessary step towards future technology advancement. Blockchain is an incredible technology that has immensely taken by storm in the recent days. Blockchain technology is being used collaboratively with digital money (cryptocurrency) to modernize all the peer to peer transactions secure, decentralized, transparent and accountable (Priyanka and Nagaratnam, 2018).

A blockchain is a type of distributed ledger of digital records that is comprised of unchangeable data in packages called blocks, where each block is then chained to the next block, using a cryptographic function called hash function (FAO, 2019). Blockchain technology was first introduced in a whitepaper entitled: “Bitcoin: A Peer-to-Peer Electronic Cash System”, by a pseudonym author in 2008 (Nakamoto, 2008).

Blockchain offers a secure system of recording transactions in a digital database that removes third-party intermediaries, reduces transaction costs, enables faster and even real-time transactions, assures immutable data entries and provides access to the record for all participants in the network (FAO, 2019). Initially blockchain was born out with cryptocurrencies, for a more decentralized financial system. Currently this technology is finding innovative uses in a wide range of applications.

Blockchain based transactions are being piloted in many sectors including finance and banking, agri-food supply chains, land registrations, digital IDs, public services like healthcare, voting system *etc.* It has also been adopted in decentralized government projects, AkshayaPatra Mid-day Meal Program, Walmart with IBM in vegetable retail and many more.

Blockchain’s unique feature of decentralization is reflected both in positive and negative ways. Areas like agriculture value chain, taxation, education and insurance are yet to see a major renovation via blockchain adoption and these can be the focus areas of future research in blockchain (Knezevic, 2018). Decentralized nature of blockchain provides immense opportunity for different sectors like banking, agriculture supply chains and land registrations to go digital.

India has potential to adopt blockchain, which can be accomplished by providing digital infrastructure, better internet facilities and by conducting awareness programmes in rural areas. For this purpose, Nucleus Vision along with NITI Aayog and Government of Telangana and

Goa, hosted India's first ever International Blockchain Congress (IBC) in Hyderabad. The idea was to make India become the next big player in the blockchain space (The Hindu, 2018).

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