International Journal of Modern Agriculture, Volume 9, No.3, 2020
ISSN: 2305-7246

Agriculture and Food Supply Blockchain Technology

Shikha Gupta[1], Bhagaban, Mahapatra[2], H.N. Attibudhi[3]
[1,2,3]Department of Agriculture, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha
Email - [2]bhagabanmahapatra@oa.ac.in

Abstract

Blockchain is a new digital technology allowing ubiquitous financial transactions between distributors without intermediaries like banks. This Paper examines the impact on agriculture and the supply chain of blockchain technologies, presents current projects, initiatives and the general consequences, challenges and potential of the blockchain technology. The findings show that blockchain is a technology that promises a transparent food supply chain with numerous ongoing initiatives on different food products and food-related issues, but there are still many barriers and challenges which hamper the popularity of farmers and systems. The technical aspects, curriculum and legislation and regulatory frameworks are the challenges. Software from Blockchain allows highly secured record keeping and automated transaction. Blockchain provides a secure, open and usable blockchain network for all parties in the supply chain. Blockchain technology can be prosecuted in agriculture and its goods to encourage food safety prevent food theft and check the source and quality of agricultural products and inputs. In fact, Blockchain technology can be used to provide fair rates and payment choices, to track land registration and for open subsidy disbursements for farmers..

Key words: Agriculture, Bitcoin, Blockchain Technology, Cryptocurrency, Food Supply Chain

Introduction

A decade is passed by since the publication by the pseudonymous author of the whitepaper "Bitcoin: A Peer-to-Peer Electronic Cash System." This work lays the foundation for Bitcoin's growth, the first blockchain to enable secure financial transactions without the need of a central and trustworthy entity such as banks and financial institutions[1], [2]. With the development of blockchain technology, Blockchain fixes a double-dollar dilemma (i.e. the digital coins vulnerability, since computer files can simply be falsified or replicated). A blockchain is a distributed transaction leader managed by a multiple computer network that does not rely on a trusted third party. The data files (blocks) of individual transactions are handled using specific software platforms which allow data transmission, processing, storage and presentation in human reading formats[3], [4]. Each block contains a time-stamp header, transaction data and a link in the previous block in its original Bitcoin configuration. A hash is generated based on the contents of each block and is then referred to in the next block heading. Some modification of a particular block thus results in a disparity of the hashing of all the blocks. Each transaction is disseminated via the blockchain protocol system network, and all device nodes must be authenticated[5]–[8]. The essential characteristic of a blockchain is its ability to maintain a consistent view of the participants and agreement (i.e.

consensus), even if certain participants are not honest. Scholars have thoroughly studied the issue of consensus in the past but its use in the field of blockchain has provided new inspiration and stimulation, leading to innovative ideas for blockchain structures[9], [10]. The most famous one used in Bitcoin is called Proof of Work (PoW), and requires computer nodes called miners to solve computer problems before validating transactions and be able to add them into the blockchain. The most commonly used computer. The first mine operator to solve puzzle bundles the chain block and validates it with a small transaction fee, plus a freshly mined coins. PoW is often criticized as constantly investing in computer power, leading to higher hardware and energy costs and the resulting possibility of centralization and high environmental footprint. An alternative approach to a consensus which builds traction is called Proof of Stake (PoS) and the goal is to enable individuals with coins within the system to make decisions that they are interested in acceptance of transactions. Consequently, the same effect is achieved by PoS of mining without the need to use large quantities of computing energy and power (distributed consensus). Hundreds of digital alternative tokens were introduced following this trend, aimed at addressing some special weaknesses of predominant cryptocurrencies or targeting certain fields, such as health care, gambling, insurance, farmers and many others. The traditional banking system frequently discusses (and adopts) Blockchain and almost 15% of financial institutions actually use this platform for their transactions. After 2014, it has been increasingly clear that blockchain can be used much more than bitcoin and financial transfers to test a number of new applications: Administrative data processing and storage, computer identification, and signature processes, assurance and monitoring of ownership of intellectual property rights and patent schemes, allowing smart contracts, patient health information tracking, greater transparency of charity organizations, frozen real-estate exchanges, electronic voting, local distribution and tracking in general These developments are already revolutionizing certain facets of industry, government and society as a whole, but they may also present new and unexpected problems and threads.

1. Food Supply Chain and Agriculture Blockchain:

Although blockchain technology is gaining traction in many cryptocurrencies and is demonstrating its usefulness, various organizations and other institutions aim to make its toleration and openness more efficient in solving problems in contexts where multiple untrusted actors engage in the delivery of certain capital. The agriculture and food supply chain are two significant, highly relevant sectors. Food supply chains and agriculture are well interrelated, because agricultural products are almost always used as inputs for a supply chain distributed across several sectors, where the consumers are often the final customer. As a successful example, Agri-Digital carried out the first auction of 23.46 tons of grain on a blockchain worldwide in December 2016. Since then more than 1,300 customers and over 1.6 million tonnes, including $360 million in farm payments were transacted via the cloud-based system. Agri-Digital's success has encouraged the future use of this technology in agricultural supply chain. Agri-Digital aims to build trustworthy and efficient agricultural supply chains using blockchain technology. There are numerous and distributed sectors of the world's food supply chain including farmers, shipping companies, distributors and foodstuffs. This system

is slow and unstable at the moment. For instance, the origin of those products or of the environmental footprint of manufacturing is not known as people buy goods local. Several projects have been established to address real-life practical problems in the agricultural supply chain using blockchain technology. These projects can be divided into four key categories below: a) food safety, b) food integrity c) food safety and d) farmers support.

2. Food Security:

The "Food and Agriculture organization" (FAO) describes food safety as "a condition in which the people have access to adequate, secure and nutritious food, both physically, socially and economically, and which satisfy their swimming and food choice requirements for active and healthy life." This goal has proved extremely difficult for humanitarian crises in conjunction with economic, violent political and ethnic conflicts. It was also extremely difficult to achieve. In the wake of humanitarian events, Blockchain is considered an opportunity to deliver international assistance with transparency, to disinter mediate the delivery process, and to make records and property checkable and accessible and, in the final analysis, to respond more quickly and effective. For example, digital food cups were sent to Palestinian refugees in Azraq Camp Jordan through a blockchain based in Ethereum, where cups could be redeemed using biometric data. The project currently provides assistance to 100,000 refugees.

3. Food Safety:

Food safety is a condition for the sanitary treatment, management and storage of food in order to prevent disease in humans. CDC reports that food poisoning leads to 48 million Americans falling ill and 3,000 to death annually. In 2016 Oceana conducted research into marine fraud, which shows that 20% of marine products were improperly labeled. Researcher responses on the reduced trust, long shipping distances, high complexity and large processing times characterizing food supply chain. In the immediate need to enhance food traceability in terms of its protection and accessibility Blockchain could provide an efficacious alternative. Wal-Mart and Kroger are the very first blockchain firms to integrate the technology into their supply chains, based first on case studies focused on Chinese pork and Mexican mangoes. Blockchain connectivity with the internet of things (IoT) has recently been introduced in order to monitor physical data and control it in real time using the HACCP framework. This is particularly important to maintain the cold chain in the logistics of the distribution of spoilable foodstuffs. For example, ZetoChain carries out environmental monitoring based on IoT devices on each link in the cold chain. Problems are detected in real time and quick action is immediately notified to the parties involved. Smart contracts are used to improve the security of purchases and product distribution. Consumers can use mobile apps to scan labels of the Zeto products and discover the past of the drug.

4. Food Integrity:

Product credibility requires reliable food supply chain interactions. The specifics of the origin of the products should be given by every performer. This problem is a major concern in China, which has caused very serious problems of transparency due to extremely rapid growth. Food safety and security can be improved by better traceability. Food businesses can mitigate food fraud by quickly identifying and linking the outbreaks with their specific sources through blockchain. Recent research has estimated the value of $14 billion in the food traceability market. Other examples include businesses, start-ups and projects designed to improve the quality of the food supply chain through blockchain technology.

Next, the agricultural scientist intends to make use of blockchain to enable shoppers to track their turkeys from the supermarket to their farms. Turkeys and animal health was taken into account at a recent blockchain test. Coca-Cola wanted to use blockchains to bite off the sugarcane industry forced labor. Blockchain is used by European grocery Carrefour for the checking and tracing of food sources in various categories, fruit, covering meat, fish, vegetables and dairy products. Downstream brewery is the first to use Blockchain technology to teach all about beer, namely the ingredients and brewing processes. Every element of this craft beer is registered in the blockchain to ensure integrity and authenticity. Customers can use their smart phones to check the QR code at the front of the bottle and then go to a page where information is available from bottling up to raw ingredients. In addition, the research project "Paddock to Plat" aims to track beef throughout the production and consumption chain and to allow Australia to improve its reputation for excellent quality. As the technical tool, the project uses Beef Ledger. The JD.com e-commerce website, for instance, tracks beef from Inner Mongolian nations, which is sold in various Chinese provinces. Details on the animals involved, their nutrition, their slaughtering, and their dates of packaging of meat can be seen through the scanning of QR codes. Gog chicken uses an ankle bracelet to show that its chickens have free access to this information, so that its customers will know that their chicks are actually free. The company's goal is to build trust by tracking the food's origin. Grass Roots Farmers Cooperative has a meat subscription box that uses blockchain technology to provide reliable information to customers about the growing livestock conditions. Additionally, Intel demonstrated how hyper ledger Saw tooth, a business platform for blockchain development and management, could make traceability of the supply chain of seafood simpler. The research employed sensory instruments to monitor fish location and storage conditions. The World Wildlife Foundation (WWF) announced in January 2018 that it is to eliminate the illegal logging through blockchains by the Blockchain Supply Chain Traceability Project. Balfego also insists on the traceability of tuna. In fact, researchers have developed the Food Blockchain, a network of food quality that tracks the path from food production through the plate. In addition, with Origin Trail, consumers can see the ingredients which they put in their soup in which garden they grew, the actual value of the poultry line etc. In addition, the "blockchain for agri-food" initiative established a blockchain proof-of-concept framework on South African table grapes. Finally, an enhanced

security framework for greenhouse farming based on blockchain technology was introduced and brought to process.

5. Small Farmers Support:

A strong method for increasing productivity in developing countries is small farmer cooperation which lets individual farmers gain a greater portion of the value of the agriculture they are cultivating. AgrLedger uses distributed crypto-driven tools to boost confidence among small cooperatives in Africa. Farm Share is committed to establishing new forms of property ownership, community cooperation and self-reliant local economies. To order to reduce overall financial costs and to increase transparency and easy access to the global markets, B2B OlivaCoin is a trading platform for olive oil that promotes the demand for olive oils. In addition, some start-ups offer help for smallholder farmers by offering traceability resources, including Provenance, Arc-Net, Bart. Digital and Bext360.The Soil Association Certification has recently joined together with Provenance to establish pilot technology to track the path of organic food. Here they note that also farmers of medium size could benefit from the above-mentioned initiatives because they constitute a category that is distinctly different than large companies. On the other hand, cooperatives could be formed by small-or medium-sized farmers and can be considerably large. Nevertheless, they are the ideal base for blockchain, since transparency of information can help to resolve disputes and conflicts between farmers more easily and fairly for all.

6. Potential Benefits:

The technology of Blockchain offers numerous advantages as it can securely deliver distributed transactions between various dismissing parties. This is a key factor in the food and agriculture supply chains where various players from raw production to the supermarket shelf are concerned. A decentralized ledger can enable the links between inputs, suppliers, producers, purchasers, and regulators which are very different under different programs, various rules (policies), and/or different applications to improve traceability in value chains. Blockchain has the power to track environmental and social responsibility, enhance the provenance of records, enable mobile payments, lending and financing, reduce transaction fees, and promote safe and trustworthy monitoring in real time of supply chain transactions. Blockchain in particular seems highly appropriate to be used in the developing world in relation to small farmer funding. Such examples could include rural farmers ' financing and insurance, as well as transaction facilitation in developing countries. Although in developing countries, small-scale farmers grow more than 80% of items, they are not assisted in most cases by resources like finance and insurance. For the developed world, the environmental / economic protection of small farms has traditionally been restricted to existing problems, such as unequal competition and the power of big business. Blockchain might help throughout the value chain at fairer prices. Finally, blockchains ' potential for transparency could facilitate the development of reputable trading systems. The credibility of the actors involved in this process is strengthened and improved by their efficiency, accountability and dedication have seen from many other networks of trading (e.g. Alibaba,eBay).

7. Challenges and Open Issues:

The widespread use of blockchain technology poses various obstacles and difficulties. A case study in the Netherlands found that small and medium-sized businesses do not have the necessary size, size or know-how to invest on their own. Nevertheless, because of a great number of complexities there are convincing market scenarios still lacking. There is a general lack of awareness of the blockchain in the education sector and there are no educational programs. Farmers need to recognize it correctly before they implement blockchain. Seeing that farmers are primarily committed to farming, they do not typically have advanced technology skills. In addition, regulation is an important barrier. Existing cryptocurrencies have been experienced to suggest that they are vulnerable to speculators and their prices almost daily fluctuated. Therefore, crypto currencies are not trustworthy to be used as a complete solution in food supply chains without any sort of regulation. There is still a lack of (common) awareness of how blockchain technology and transactions dependent upon certain currencies should be used by policy makers and technical experts. In addition, numerous design decisions have an impact on the existing or developing blockchains. These are allowed (i.e. approved participants), permission-less, or closed systems, open (i.e. everyone can join) etc. Existing blockchain implementations face major challenges to scalability, as the actual processing of transactions is constrained by constraints like the transaction block's size and length. Although blockchain provides advanced encryption, there are significant risks involved with cash lose, just because the account owner may inadvertently have forgotten private keys to access and maintain the account. In addition, there seem to be a difference in technical expertise and access to blockchain technology between the developed and developing countries. Most bibliographic sources come from well-organised and affluent primary countries (i.e. Australia, USA, the Netherlands, etc.). The use of big data in agriculture also demonstrated this digital divide. In developed regions such as the US and Europe, it would appear that most continuing experiments occur.

Conclusion

The present paper shows that blockchain technology has been used by several programs and campaigns, which are intended to create an atmosphere in which the food supply chain is tested and respected and incorporate the key stakeholders into the supply chain. Many problems and challenges are still to be addressed, not just at the technical level. Blockchain must be easier. Different startups have been working towards developing the software that makes it easier for farmers to use blockchain technologies, including 1000 EcoFarms, which have combined all the key biochain food, farming and agriculture processes, and use the proposed FoodCoin ecosystem. To order to reduce obstacles of use, policymakers should spend more in research and innovation, education and training to develop and demonstrate the potential advantages of this technology. Experts analyze the potential government shift to blockchain, emphasizing that government and their respective agencies should cooperate and recognize and address the unique "pain points." Numerous measures can be taken from the political perspective, for example to encourage the development of blockchain-conscious

environments in agro-food chains, endorse innovations as part of overall priorities to improve productivity and to ensure the sustainability of the agri-food supply chain and the establishment of a consistent regulatory framework for the introduction of blockchain. Blockchain is exciting technology for a secure food supply chain, but there are still a large number of barriers and threats to its greater acceptance among producers and food systems. The near future demonstrates if and how government and private efforts to establish blockchain technology as a secure, effective and open way to ensure the health and security of foods will overcome these challenges.

References

1. K. Francisco and D. Swanson, "The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency," *Logistics*, vol. 2, no. 1, p. 2, 2018.
2. C. (Accenture) Leong, T. (Accenture) Viskin, and R. (Accenture) Stewart, "Blockchain in Food Supply Chain," *Accenture*, pp. 1–63, 2019.
3. S. Kaya and M. Turğut, "Blockchain Technology in Supply Chain," *J. Int. Sci. Res.*, pp. 121–134, 2019.
4. E. Camerinelli, "Blockchain in the Supply chain," *Finextra.com*. p. 1, 2016.
5. K. J. Petersen, "Blockchain in Supply Chain," *Cio*, no. June, pp. 0–13, 2017.
6. IBM, "The Benefits of Blockchain to Supply Chain Networks," 2016.
7. T. Dowsett, "Blockchain and the supply chain," *MHD Supply Chain Solut.*, vol. 47, no. 6, p. 42, 2017.
8. K. Sadouskaya, "Adoption of Blockchain Technology in Supply Chain and Logistics," *Reinf. Plast.*, vol. 9783745043, no. April, p. 23, 2017.
9. K. Behnke and M. F. W. H. A. Janssen, "Boundary conditions for traceability in food supply chains using blockchain technology," *Int. J. Inf. Manage.*, 2019.
10. O. Bermeo-Almeida, M. Cardenas-Rodriguez, T. Samaniego-Cobo, E. Ferruzola-Gómez, R. Cabezas-Cabezas, and W. Bazán-Vera, "Blockchain in agriculture: A systematic literature review," in *Communications in Computer and Information Science*, 2018.