

Blockchain in Agriculture

Raghav Nagpal¹, Aryaan Shaikh², Vedant Mhasde³, Abhijeet More⁴, Prathamesh Chandekar⁵ and Mrs. Priya Shelke⁶

¹⁻⁶Vishwakarma Institute of Information technology, Pune, Maharashtra

Email: raghav.21910039@viit.ac.in, aryaan.21910912@viit.ac.in, vedant.21910320@viit.ac.in, abhijeet.21910532@viit.ac.in, prathamesh.21910530@viit.ac.in, priya.shelke@viit.ac.in

Abstract—Beyond the traditional use cases in banking, this research investigates blockchain possibilities across the agricultural sector. We examine blockchain initiatives to increase security, effectiveness, and accountability at every stage of the industry by viewing agriculture as a shackle, a matrix that extends from the beginning to the end. Food safety is guaranteed for both direct consumers and the entire global community, which is susceptible to epidemics brought on by contaminated food, by origin tracking and checking throughout the various stages of the food supplied all over the world.

Food fraud can be reduced by using smart contracts and shackles of all the records, which can also be used to spot dishonest middlemen and unethical business practices that take advantage of cooperatives and independent farmers alike. To the point where the community runs its entire GDP with unique cryptocurrency and traced changes, continuous agriculture and internal economy cooperatives, like AgriLedger with their several pilot programmes in several countries like Kenya, Myanmar, and Papua New Guinea, which might generate financial activity and retain their local value. A large, complex, and decentralised food market can be transformed into an internal one with high privacy and quality using imitate exchanging of capital and responsible start and travel monitoring of items, like Provenance's blockchain for the Grass Roots Farmers' Cooperative in Arkansas. Agriculture economic projects include transparent and effective future contract financial gateways, smart contract backing against crop problems, and micro financing situations for underserved communities which can grow from a particular level of loans into investments in agriculture. These innovations, especially for farmers in developing countries, with new businesses.

Index Terms— Introduction, Blockchain Architecture, Literature Survey, Potential Use Cases, Future Trends, Conclusion, References.

I. INTRODUCTION

In order to build an overtly open and responsible environment in agriculture, new methods and innovations are required by current agricultural development and reform. Blockchain technology is one of the new instruments. Blockchain offers a decentralised data structure for storing and retrieving data which is sent to numerous untrustworthy parties, in contrast to conventional centralised and monopolistic agriculture management systems. This might address a number of significant issues in present systems brought about by the following causes: A supply shackle managing system is overly dependent on the centralised databases as a result of the 2008 introduction of Bitcoin. Hackers can easily attack/conquer the centralised system to access the data integrity. Insider changing of the centralised database could undermine data integrity and availability.

Moreover, using a third party to verify and keep track of transactions comes at a considerable expense. In recent years, distributed databases strengthened by high-level cryptography have been offered as a solution to these problems. One of these most popular new approaches to address trust-related problems is blockchain. In order to create a digital system which is trustable in an environment which is not, numerous cutting-edge computational and cryptographic ways are combined into dispensed data structures in blockchain technology. The fundamental component for data authentication is specifically the hash function, which is utilized as an algorithmic method to create distinct IDs. To protect data integrity, the hash values might be added into a format of registered chain to check whether the data might have been altered. The people who send and receive the data in stored transactions can have their true identities verified using a digital signature. Additionally, because the consensus procedure involves.

Applications of blockchain to agriculture improve a variety of features of agricultural systems, particularly those based on the Internet of Things (IoT) and supply chains. These applications include those for food security, traceability for waste reduction, food quality monitoring and control, accurate operational data analysis, and cost-effective contract exchanges and transactions to help small-scale farmers. To enable simple and speedy development, these operations can happen using the existing blockchain formats. Varied computational and cryptographic mechanisms can be plugged based on different deployment conditions of these applications to enable flexibility to suit frantic user expectations. All computer nodes, there is less chance of data being modified by a small number of adversaries.

In this paper, we provide a thorough analysis of blockchain-based agricultural applications as well as the most recent innovations to support blockchain technologies. In order to implement the proposed applications, we first explain the fundamental principles of blockchain techniques, describe the current data storing environment, and examine already existing, widely used formats. Then, we offer a thorough analysis of several blockchain applications in projects that are related to agriculture. After the poll, we continue to talk about the future of developing technology and how to overcome current obstacles to system deployment. Additionally, an example is provided to show how blockchain might be enhanced in the future to provide a more dependable and effective supply chain for food.

Traditional difficulties still plague blockchain using applications, including the lack of or insufficient infrastructure, internal operations problems, and all other technical problems. Despite the current trend toward trying to adapt standard procedures using blockchain technology, doing so usually results in extra costs and no real benefits. It does, however, promise to create a safe, decentralized, and transparent transaction procedure and might perhaps lower transaction costs. All the processes in the agriculture industry without transparency, it would be beneficial for decentralization, and are currently impacted by insecure transactional ways? Which brings us to our main question.

The first step in determining whether a problem you are encountering could be solved using a solution which is blockchain based to identify the use case. Next, developing the key principles (including all the regulatory need and requirements, stakeholders, legal work, internal operations with existing system, scale, and other requirements), and finally decide what application or format would help state the problems of that specific case. Typically, a far more straightforward digital application might be the best option. Self-implementing smart contracts and automated transactions would revolutionize the agriculture sector. Smart contracts may play a particularly useful part in traceability, green bonds, and agricultural backing.

A blockchain-based agricultural insurance system with very important weather incidents and associated payouts written in a smart contract, connected to the different type of wallets, and using regular weather data provided by sensors in that particular field and checking it with our data from the close weather stations which would enable quick payout in case of a drought or flooding in the field. To achieve the maximum efficiency of smart contracts, the structure to enable such innovations, such as high valued data, allowing legislation, and rules, should be addressed first and foremost.

Because there are a very small number of pilot implementations to provide proof-of-concept, the entire process of designing, checking, applying, and enforcing smart contracts in conventional agricultural value group is still under development.

Existing literature is the foundation for our study. We conducted a thorough review of the literature. We begin by compiling all pertinent survey articles by using a methodical procedure and searching for relevant terms in Open Athens, IEEE Xplore, and numerous electronic databases, such as ScienceDirect, IEEE Xplore, and Google Scholar. Blockchain technology used for agricultural applications, for managing supply chain, for the IoT, data originality, trackability, origin, and IPFS with the technology were the search phrases used to gather the pertinent papers. On the successful accomplishment of data collection, all of the terms are employed in several combinations for searching such as:

1. What are the blockchain applications in project site relating to agriculture?
2. What are the blockchain applications in projects relating to food security?
3. What are the primary difficulties these blockchain apps run into when they are deployed?
4. How might blockchain be enhanced to create a future food supply system that is more dependable and effective?

All of our work contributed can be summarised as follows: If we attempt in-depth check of blockchain technology currently used in agriculture and enlighten promising applications for the applications, By illustrating the informational details of the important parts in blockchain technology, we I suggest appropriate blockchain schemes for the agricultural sector; Additionally, we can see the key challenges in many agricultural applications and discuss other solutions,

In today's post-COVID-19 pandemic world, we can use blockchain-based supply systems to improve the allocation of resources when dealing with unexpected emergencies. Despite the fact that there have been numerous new surveys on blockchain articles released in the past few years, our work offers a thorough analysis with the reference of agriculture. In order to use our insights to recommend appropriate technologies and formats for individual applications in their respective agricultural situations, both technical information and application-related aspects are mentioned in the work. In order to leverage our insights to recommend appropriate approaches and formats for individual drills in their respective agricultural contexts, both technical details and application-related issues are mentioned in the work.

II. BLOCKCHAIN ARCHITECTURE

Its a multi-layer layout, that is the motive why it'll be easier to govern. The net of factors (IoT) layer is the primary. It consists of important sensors like humidity, temperature, stress, acceleration, and different variables connected to ARDUINO boards.

Bluetooth or a wi-fi community is used to talk among the gadgets. The Arduino functions will provide us with information, a good way to be exploited inside the next layers. the primary layer can deliver us with reliable environmental information.

The blockchain layer incorporates three unique blockchains, and the agri product records blockchain is the primary. The user facts blockchain is the second one. It has all of the information about the community individuals. The transaction data blockchain is the ultimate one at the listing. It holds a wealth of information, together with user non-public data, intermediate statistics, transactions, logistics, and agricultural product facts. Smart contracts are used in this paradigm. those automatic contracts use the very best level of information encryption currently to be had in the security industry. As a result, it will verify the satisfactory of the decision and assure clarity and powerful verbal exchange among entities. The counseled structure concurrently distributes at ease statistics to all network individuals, it is appeared as big advantage that may boost the performance of agricultural machine.

III. LITERATURE SURVEY

The blockchain is a shared ledger where all members can write and maintain accounts and transactions [1]. It entrusts a trustworthy origin of information about the condition of farms, stock, and paperwork in the agricultural sector, when gathering such data is frequently quite expensive [2]. By tracking food's provenance, blockchain technology adds in the establishment of reliable supply chains for food and confidence between producers and those who consume. It makes it easier to apply data-driven technology to improve farming because it is a reliable method of data storage. Additionally, it enables on time payments between stakeholders which can be triggered by the changes in data which appears on blockchain when used in conjunction with smart contracts [3]. This article explores the applications in theory and practicality of blockchain technology in the supply chain for food, agricultural backpacking, intelligent farming, and agricultural product transactions. We also talk about the difficulties in capturing smallholder farmers' transactions and developing an ecosystem for applying blockchain technology to this industry [4]. Blockchain has led to multiple technologies being introduced for specific farming, in wheat production farming the farmer delivers the produced byproduct by moving it across the weighbridge and then checks the quality of the grain produced at the sample station [5]. Blockchain technology helps in planning and committing to a particular schedule to avoid wastage and help save resources, this allows for an increase in the profit and helps map out the required expenditure at the beginning of the project [6]. The economical usage of resources in blockchain helps in providing us an infrastructure which helps in the economical activities [9]. The use of blockchain varies for different agricultural sectors and it ranges

from having a sustainable business and reduction of waste to having future transactions without any frauds happening [7]. The system setup by blockchain allows for the seeking for harmonizing the processing of assessments carried out by the security profile used in the agriculture model created by blockchain technology [8]. Blockchain traceability and management functions allow flawless processing and for a great quality of product to be achieved, the supply chain management part of it allows for their to be complete control of the security and storage capabilities [10]. There is a serious amount of networking that goes into agricultural modelling using IoT, for this purpose smart agricultural technology is implemented like machine learning and qualitative tools such as robots, drones, and other sensors which help in networking, surveying, mapping and a total analysis of the project [11]. There are multiple agents which are required by the people doing blockchain based agricultural practices for accessing that technology such as mobile phones, blockchain based applications allow for an easy exchange medium between these technologies [12]. In this case smart and precision farming can be possible only by allowing multiple other technologies to combine together such as IoT, blockchain, e-agriculture, etc [13]. There have been multiple successful cases of smart blockchain based farming such as the smart rural farming practices of Uganda which allowed for a case of Communication and Information Technology for Agriculture and Rural Development.

IV. POTENTIAL USE CASES

Use Case 1:

Production of Crops and Food

The agriculture industry faces numerous obstacles to overcome while increasing profitability amid unfavorable environmental conditions, such as:

1. By using the least amount of resources possible to grow more food, we can meet the needs of the growing population.
2. Maximising consumer pleasure while minimising environmental impact
3. Promoting supply chain transparency to ensure fair compensation for farmers
4. Dealing with weather volatility

Use Case 2:

Supply Chain for Food

1. Tracking the supply chain for food is essential to determining the food's origin. It guarantees the food is safe for consumption.
2. However, given the way the supply chain for food is now run, it is difficult for food producers and retailers to verify the food's provenance.
3. With the advent of the blockchain, it is now possible to introduce openness and confidence to the ecology of the supply chain for food, ensuring everyone's access to safe food.

V. FUTURE TRENDS

Blockchain can improve accountability and transparency in supply chain networks, make it simpler to spot fake goods, cut down on middlemen, and improve product traceability. Such qualities might be advantageous to the agricultural industry. In fact, many of the benefits of blockchain are already present in existing methods that are now in use, and they frequently improve efficiency.

However, due to its intrinsic characteristics, blockchain is a technology that can also provide data immutability in order to foster trust between parties that are not reliable.

CONCLUSION

A technology that is quickly evolving is blockchain. Although technology has begun to change some industries, there is still much to be done. Recent years have witnessed the development and widespread availability of blockchain technology, which has the potential to change a number of industries, including the food business. In the sphere of blockchain technology, there are many inventors.

However, it is becoming more and more clear that blockchain technology in agriculture offers uses for the industry. More than one billion people are employed by the world's agriculture industry, which has a market value of more than 2.4 trillion dollars. Today, there are more opportunities than ever before for creativity. If food producers and other supply chains start focusing on, smart contracts and blockchain technology can tremendously improve agricultural supply chains.

REFERENCES

- [1] Leduc, G., Kubler, S., & Georges, J. P. (2021). Innovative blockchain-based farming marketplace and smart contract performance evaluation. *Journal of Cleaner Production*, 306, 127055.
- [2] Ge, L., Brewster, C., Spek, J., Smeenk, A., Top, J., van Diepen, F., ... & de Wildt, M. D. R. (2017). *Blockchain for agriculture and food: Findings from the pilot study* (No. 2017-112). Wageningen Economic Research.
- [3] Ge, L., Brewster, C., Spek, J., Smeenk, A., Top, J., van Diepen, F., ... & de Wildt, M. D. R. (2017). *Blockchain for agriculture and food: Findings from the pilot study* (No. 2017-112). Wageningen Economic Research.
- [4] Mengeloglu, F., & Karakus, K. (2008). Thermal degradation, mechanical properties and morphology of wheat straw flour filled recycled thermoplastic composites. *Sensors*, 8(1), 500-519.
- [5] Xiong, H., Dalhaus, T., Wang, P., & Huang, J. (2020). Blockchain technology for agriculture: applications and rationale. *frontiers in Blockchain*, 3, 7.
- [6] B. W. Akins, J. L. Chapman, and J. M. Gordon, "A whole new world: Income tax considerations of the bitcoin economy," 2013.
- [7] Brown, M. E. (2015). Satellite remote sensing in agriculture and food security assessment. *Procedia Environmental Sciences*, 29, 307.
- [8] Chod, J., Trichakis, N., Tsoukalas, G., Aspegren, H., & Weber, M. (2020). On the financing benefits of supply chain transparency and blockchain adoption. *Management Science*, 66(10), 4378-4396.
- [9] Ge, L., Brewster, C., Spek, J., Smeenk, A., Top, J., van Diepen, F., ... & de Wildt, M. D. R. (2017). *Blockchain for agriculture and food: Findings from the pilot study* (No. 2017-112). Wageningen Economic Research.
- [10] Lin, J., Shen, Z., Zhang, A., and Chai, Y. (2018). "Blockchain and IoT based Food Traceability for Smart Agriculture," in *Proceedings of the 3rd International Conference on Crowd Science and Engineering*, (New York, NY: Association for Computing Machinery), 3.
- [11] Kaske, D., Mvena, Z., and Sife, A. (2018). Mobile phone usage for accessing agricultural information in Southern Ethiopia. *J. Agric. Food Inf.* 19, 284–298. doi: 10.1080/10496505.2017.1371023
- [12] Walter, A., Finger, R., Huber, R., and Buchmann, N. (2017). Opinion: smart farming is key to developing sustainable agriculture. *Proc. Natl. Acad. Sci. U. S. A.* 114, 6148–6150. doi: 10.1073/pnas.1707462114
- [13] Kaddu, S., and Haumba, E. N. (2016). "Promoting ICT based agricultural knowledge management for increased production by smallholder rural farmers in Uganda: a case of Communication and Information Technology for Agriculture and Rural Development (CITARD), Butaleja," in *Proceedings of the 22nd Standing Conference of Eastern, Central and Southern Africa Library and Information Associations (SCECSAL XXII)*, Butaleja, 243–252.