International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7625
***Article Received**: 01 June 2023 **Revised**: 27 July 2023 **Accepted**: 11 August 2023*

AgriBlock: A Blockchain based Framework for Agricultural Supply Chain Management

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Abstract—To facilitate complex interactions between regional players and the agricultural environment, modern agriculture supply chains have arisen. Supply chain processes that include several parties, such as production, processing, and delivery, interacting with one another. Lack of transparency in the agricultural supply chain is a major contributor to the incidence of fraud in this industry. A lack of openness on the part of organisations leads to worries about potential financial losses, diminishing customer trust, and dwindling brand value. Several fundamental changes to the existing supply chain architecture are required to foster the development of an effective and reliable trade environment. It is widely recognised that blockchain technology has the potential to increase visibility across agricultural and food supply chains. Businesses are using blockchain and IoT to implement more egalitarian, sustainable, and consumer-friendly methods of food production. Based on what we learned, blockchain technology may be useful in the push for a more transparent and responsible food supply chain. The primary goal of this study is to create a decentralised application framework called AgriBlock that can be used for managing the supply chains of agricultural products using blockchain technology. The developed work AgriBlock will aid in making the supply chain process more open and clear to every participant involved.

Keywords-Agriculture, Supply Chain Management, Blockchain Technology, decentralized application, AgriBlock.

I. INTRODUCTION

The popularity of cryptocurrency has grown rapidly over the last several years. Cryptocurrencies provide a novel and secure method of online payment that eliminates the need for centralized institutions like banks and credit card firms. There is a rising tide of interest in bitcoin at the moment [1]. "Blockchain" refers to the decentralized ledger that keeps track of cryptocurrency transactions. Blockchain technology allows for the decentralized storing of ever-growing transaction lists. Before being uploaded to the blockchain, these transaction listings are packaged together into blocks. All nodes in a blockchain network must agree on the contents of a block before it can be added to the distributed ledger. It is difficult to alter the data once it has been recorded without impacting earlier blocks as well. When it comes to recording transactions between two parties, the blockchain is "an open, distributed ledger that can do so in a way that can be checked and is permanent." [2].

Now that blockchain technology is gaining traction, researchers are looking at its potential uses in a variety of industries, including the agriculture industry, with the goal of improving supply chain transparency and traceability. The processes involved in the agri-food supply chain are best summed up by the expression, "bring agricultural or horticultural products from the farm to the table." Today's consumers care about where their food comes from and how it is prepared [3, 4].

However, the traditional supply chain, in which a single organization is in charge of data maintenance, was unable to provide timely access to relevant data for interested clients. Blockchain applications are being explored as a possible solution to difficulties that have typically been experienced in conventional agri-food supply chains [4] because all parties involved can access and verify digitalized information.

Agriculture is one of the most important industries because of the profound impact it has on every part of human existence. The capacity of a country to generate agricultural commodities

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is crucial to its economy and national security. Risk assessment and avoidance are integral parts of agricultural practice [5]. The daily fluctuations in the market are like the daily fluctuations in the weather. Agriculture fails to provide nourishment that can be grown without exhausting the earth. Hence the latter is degrading. Pests and weeds may ruin an otherwise good harvest. The world's climate is shifting, too. Machine learning (ML) and big data might improve agriculture's SCM framework by being used for activities such as predicting soil quality, weather, storage availability, etc. It might also be used for other defined reasons, such as gauging consumer behavior or keeping track of inventory [6]. This gives us the opportunity to use the data in accordance with scientific procedures and to arrive at appropriate conclusions at the appropriate times. Agricultural machine learning applications need a comprehensive strategy that incorporates data and tools from a wide variety of industries. Agricultural big data may be used for a wide range of purposes, including but not limited to research, policymaking, decision-making, and crop management by researchers, lawmakers, farmers, and other stakeholders [7].

Furthermore, the present picture of agricultural SCM relies on centralized structures based on the Internet of Things (IoT). This illustrates the data security, single point of failure, and other problems that have yet to be resolved. Unanswered questions and pressing concerns, such as the safety of the data, remain. Assembling trustworthy information for the SCM may be challenging due to the number of people engaged in the process. This is owing to the fact that trust between parties can only be established when a sufficient amount of verified, publicly available information has been produced [8]. Despite the fact that scholars and professionals in the field agree that a third party should be included in the chain to ensure the integrity and safety of the data [9]. Blockchain might therefore operate as a decentralized certificate authority, verifying transactions and delivering unchangeable cryptographic data to any node in the network that wants it. This would make it possible for blockchain to verify the legitimacy of financial transactions and safeguard sensitive cryptographic data. Several of the most recognizable food companies on the planet have begun working together in an effort to speed up the adoption of blockchain-based DLT in agricultural-based supply chain management (SCM), and prototype models are only now making an appearance. New architectural ideas for this kind of instrument have been developed because of the research done on similar systems [10]. Some of the largest food firms in the world have already begun working to incorporate DLT into agricultural-based SCM in order to improve the system's efficiency, and the first prototypes of this technology are just now appearing. The goal is to hasten the procedure by doing this. New architectural ideas for this kind of instrument have been developed because to the research done on similar systems. In this context, researchers have started developing blockchain-based product traceability models for application in the supply chain [11]. Preliminary data is only available for three metrics: latency, network traffic, and CPU use. New innovations at Tian have made it possible to include HACCP-based real-time monitoring of food safety in the first application [12]. However, there are several obstacles that might prevent the broad use of blockchain technology in the food processing industry and supply chain [13]. Some examples are Costco, Walmart, Cargill, and Albert Heijn, but there are many more. Some instances of such sequences are as follows: Consumers prefer these features since their incorporation into an agri-food supply chain guarantees an improvement in the food's quality and safety. Researchers from a wide range of sectors, including agriculture, industry, and academia, have reported progress in enhancing SCM's agricultural foundation [14]. New technologies like the Internet of Things and blockchain are being used to ensure the safety and transparency of data at every step of production. This is being done to make it easier to provide food to those who need it. This step is being made to make food more secure for human consumption [15].

A. Contribution

The main objective of this work is to develop a blockchain-based decentralized application for agriculture-based supply chain management. However, the contributions of this work are summarized as follows:

- To do a detailed examination of the state-of-the-art of blockchain and Internet of Things (IoT) technologies in the agricultural-based SCM and to identify their potential future applications.
- To develop AgriBlock: a decentralized application (dApp) for agriculture supply chain management.

B. Paper Structure

The rest of the paper is organized as follows. Section II shows the literature survey done for the research work. Section III represents the role of Blockchain in agriculture. Use cases of Blockchain in agriculture is represented in Section IV. Section V shows the proposed work. Finally, the overall conclusion of this research work is represented in Section VI.

II. LITERATURE SURVEY

In December 2016, the Agri Digital Company successfully settled a pioneer transaction involving the sale of 23.46 tons of grain by making use of blockchain technology. This serves as a powerful demonstration of this point. Following that time period, a cloud-based solution was used to facilitate the trading of an additional 1.6 million tons of grain and more than 1,300

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distinct consumers. There was a total of 360 million dollars' worth of compensation paid out to the growers [16-18]. This accomplishment provided as impetus for the development of a practicable and important use of this technology within the context of the agricultural supply chain. In an environment marked by high levels of rivalry, it is of the utmost importance to make the most of the opportunities presented by the realm of digitalization, which has opened up a vast amount of room for an online market platform. According to [19], the services that are provided by e-marketing include a wide variety of activities that are oriented towards offering assistance to clients. E-commerce, often known as "direct selling," supply chain management, and customer relationship management are some examples of these operations. Apps dedicated to providing customer support may be found on either side of the interactive, dynamic, and internet-dependent e-marketplace services [20, 21]. An interactive interface that serves as a liaison and links different levels of the supply chain may be created via the utilization of websites and social application platforms.

Numerous studies, like the ones carried out by the author in [22], and [23] have led researchers to the conclusion that the electronic market place for business-to-business transactions has developed into an ideal platform for both purchasers and vendors. E-marketing methods, when put into practice, may be of tremendous assistance to the expansion of existing enterprises. The results of a number of studies indicate that enhancing electronic customer relationship management has the potential to be more effective.

The vast majority of blockchain solutions for traceability management that are now on the market were developed on the basis of a single-chain architecture, such as the Fish supply chain. This was done in order to maximize efficiency and minimize costs. This is the case since such an architecture provides a number of advantageous options for users. This has been done in order to lower the prices of transactions, raise the capacities of transactions, make the system auditable, and give product certifications [24].

It is required to apply a variety of modern technologies in order to boost performance, revenue, accountability, and safety in the wine supply chain , as well as to accept more secure and secure international transactions. Additionally, it is vital to embrace the more secure and secure international transactions. It has been stated that the wine supply chain in [25,26] improves the performance of the performance in addition to the security of the agricultural-based SCM system. Along the supply chain, the work that is described inaims to provide accurate data about the production, processing, distribution, and retail operations, among other things; describes the distribution routes for pork [27]. Large companies are currently working on a food supply chain monitoring project [28] that will link their existing information systems with blockchain technology, which will be used by a variety of parties. The goal of this project is to increase customer trust by preserving the reputation of the product and ensuring its safety through openness. This project's objective is to maintain the consumers' faith in the product by maintaining the product's reputation and assuring the product's safety via transparency. Integrating sensor data with the data from the fresh food supply chain reveals the origins of products, so making possible the transmission of transparent data from the farm to the consumer's plate. The manufacture and sale of food products that have a short shelf life.

III. ROLE OF BLOCKCHAIN IN AGRICULTURE SUPPLY CHAIN MANAGEMENT

A supply chain is "the operations from production through distribution that get agricultural or horticulture goods from the farm to the table [2]," which is what agricultural food supply chain management is all about. The supply chain for agri-food goods is substantially more complex and difficult to manage than other supply chains due to the presence of a broad range of stakeholders and external influences. The agricultural and food industries produce perishable goods. Both the weather and the method of transport may have a significant impact on how long food keeps and whether or not it has any harmful bacteria.

Contamination might happen at any stage of the process. Food recalls, and the investigation of foodborne infections are made more complicated by the lengthening of food chains brought about by globalization [17]. This level of complexity calls for higher levels of efficiency and closer partner coordination. Centralized information management in conventional food supply chains has the potential to undermine openness and trust. A corporation, for instance, can choose to provide just the data that is most useful to it. A lot of the restaurants' claimed gastronomic benefits could be impossible for customers to verify. There is a possibility for information imbalance between the public and food producers during food safety emergencies to affect consumer decisions, which might lead to a drop in sales [18].

Traceability systems provide a method for addressing problems that occur in food distribution networks. In ISO 22005:2007 [19], the International Organization for Standardization (ISO) defined traceability as "the ability to follow the movement of a feed or food through specified stage(s) of production, processing, and distribution." However, the actual definition of traceability differs depending on the type of food [20]. Knowing the movements and processes in the manufacturing process might make it easier to recall tainted goods, which would improve the safety of customers

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and their faith in the system. This is true despite the fact that the definitions varied somewhat.

Traceability may be broken down into different categories according to the various parties involved and the criteria for traceability. The traceability might include just one stakeholder (i.e., on an intra-company or internal level) or all stakeholders (i.e., on an external level or supply chain level) [21], [22]. Traceability on the market for the European Community is divided into two categories: mandated traceability and optional traceability [21], [23]. The primary goals of mandatory food traceability are pecuniary, whereas the primary goals of voluntary food traceability are to ensure the quality and safety of the food. A combination of mandated and voluntary traceability mechanisms is required in order to achieve trustworthy and comprehensive tracking. However, due to the fact that each stakeholder has their own unique standards and monitoring techniques, the voluntary system is rather complicated and contains a large number of different types of data [24].

With the use of blockchain technology, people may deal with one another in a secure and private manner, cutting eliminating the need for intermediaries like banks (in the case of crypto currencies) or middlemen (in the case of agriculture). The elimination of the need for a single authoritative source has caused a shift in how confidence is extended; rather than putting faith in a single entity, users may instead put their faith in the security provided by encryption and decentralized networks. Therefore, it helps restore trust between producers and consumers, which might contribute to lower transaction costs in the agri-food sector.

Transactions involving people who choose to remain anonymous may be reliably tracked thanks to blockchain technology. This facilitates the speedy identification of both fraud and malfunctions. In addition, smart contracts allow for the immediate reporting of issues. It may be challenging to maintain track of products as they make their way through the broad supply chain in the agri-food industry. This is a good solution to the problem.

This technology addresses the concerns of consumers, governments, and other organizations by ensuring that the food people consume is of a high quality and is safe to consume. All of these parties have a strong interest in ensuring that the food people consume is of a high quality and is safe to consume. The use of blockchain technology not only ensures transparency amongst all parties involved but also makes the acquisition of trustworthy data more simpler. The blockchain technology has the ability to record every step of the value chain for a product, from the moment of production all the way to the point of destruction. It is essential to collect accurate data throughout the agricultural production process [26], as this will allow for the development of data-driven infrastructure and insurance solutions, both of which will make farming more efficient and less prone to risk.

Security, data management, and interoperability in an IoT-based supply chain may all benefit from the use of smart contracts and blockchain technology [27]. This is what we get when we combine the technologies. In lieu of digital certificates, smart contracts might be used for security management, provided they contain a list of identifiers or attributes tied to the contract owner's public key [28]. A smart contact maintained on the blockchain further increases security since only the list owner can make changes to it.

As a result, with the help of smart contracts in blockchain, there is no longer a need for a central authority to operate as a certifier. The task of maintaining user IDs in a blockchain-based smart contract is greatly simplified by the availability of a Graphical User Interface (GUI) [19]. This lessens the possibility of users' identities being exposed inadvertently. To facilitate the deployment of both traditional and cutting-edge security systems, it stores extra primitives such TLS (Transport Layer Security) public keys [20].

Customers may now verify identities independently of previously trusted certification authorities because to the immutability of public keys stored in the blockchain. Domain Name System-reliant SCM authentication mechanism DANE [21] is not as safe as this solution since it is not as transparent and distributed as blockchain. Because blockchain is decentralized and transparent, it is also more secure against tampering from authoritative sources (DNS). There are several ways in which the usage of smart contracts and blockchain technology might expedite and enhance data management. You may do this in a number of different methods, including via access control, information, scoping functionality, evidence of ownership, data authentication, and non-repudiation. The use of non-repudiation and data that cannot be disputed are two further methods.

In Table 1, the core characteristics of the blockchain concept improve the efficiency of supply chain management in the agricultural sector is represented. Distributed ledger technology (DLT), immutability, transparency, and decentralization are among the key characteristics.

TABLE I. BLOCKCHAIN CHARACTERISTICS

Decentralization	Considering that every node in the blockchain network participates in its decentralized operation, a smart contract enables autonomous execution in accordance with the provisions that were previously set. As a result, decentralizing the system eliminates the possibility of a single point of failure, cuts down on the amount of data used and the amount of time it

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	takes to process requests, and ensures accountability.
DLT	Independent devices, also known as nodes, are utilized by distributed ledger systems in order to record, share, and synchronize transactions that take place in each entity's electronic ledger (instead of keeping data centralized as in a traditional ledger). The data stored in a blockchain is organized into blocks, and the blocks are linked together using an append-only mode.
Immutable	Each node in the network has its own copy of the distributed digital ledger. Each node in the network verifies a new transaction for fraud before it is broadcast to the rest of the network. A transaction cannot be added to the network unless it is supported by the vast majority of the nodes that make up the network. This indicates that the majority of the network's nodes must agree before any new transaction blocks are added to the ledger. Once a record has been authenticated, it can no longer be changed. This prevents any of the network's users from making any changes or erasing it.
Transparency	Blockchain technology, which provides a completely auditable and valid ledger of transactions, is one of the most promising emerging technologies because it holds out the possibility of greater information transparency. Blockchain is meant to be a machine that promotes transparency by allowing anyone to join the network and, as a consequence, examine all of the information that is stored on that network.
Smart Contract	Smart contracts are blockchain-stored computer programs that activate automatically when specific conditions are met. They automate agreement execution so all parties know the outcomes instantly. This eliminates intermediaries and saves time.

IV. USE CASES OF BLOCKCHAIN IN AGRICULTURE

The early days of BCT are marked by technological investigation, and a comprehensive blockchain solution has yet to be introduced to the market. Complete BCT solutions are those that can be tokenized, have immutable data, and have no central point of failure, as defined by this group. Tracking and tracing, as well as provenance data, already have use cases and solutions based on the first three attributes. Key needs in the agri-food industry include the capacity to monitor and trace items and collect provenance information. The potential of blockchain technology has been evaluated by comparing it to other sectors. Research showed that BCT has a much greater influence in the agricultural SCN than was previously believed, particularly in the areas of food safety and provenance. Both proposals, however, were graded as somewhat practicable [21]. It has the potential to assist in the resolution of a number of issues pertaining to agriculture on a worldwide scale.

Under German law, Solino Coffee Products operates as a partnership. Solino gives buyers access to data on where their coffee beans came from. Since customers are increasingly demanding that producers make supply chain processes more transparent to them, it was a challenge for the company to provide reliable details about the coffee products moving through the supply chain. This was especially true for provenance details. Several years ago, Hamburg's Solino Coffee created the first blockchain application to display supply chain activity openly to consumers and the firm itself. The QR code on the coffee container has made it possible for consumers to learn more about the bean's background with the use of a smartphone. Thus, the whole supply chain is made clear and accessible, from farming to roasting and transportation to Hamburg, which boosts credibility and brand loyalty.

Among European producers of frozen foods, FRoSTA AG ranks high. They provide fish, meals, veggies, and more in the frozen state for distribution throughout Europe. Their goal is to boost confidence in their frozen fish products and, by extension, boost consumer loyalty, and they know that knowing more about where their fish was caught would help them do so. In order to provide customers with provenance data on frozen fish items, a BCT-based technology prints the information on the packaging.

Food Trust was first introduced by IBM in 2017. Food Trust, which is based on Hyperledger Fabric BCT, makes it easier for businesses involved in the food supply chain to share data with one another. Food Trust was established with the intention of providing a mechanism that, in the event that food recalls were required, could do so in a timely manner while also reducing the total amount of products that were recalled. Since 2017, IBM's Food Trust consortium blockchain has been largely responsible for providing traceability and provenance capabilities for the ecosystem of the food supply chain. It currently has more than 80 members, including Walmart, Albertsons, and Carrefour. Proof-of-concept (POC) testing was performed on the blockchain-based system for food traceability that was created with the help of Hyperledger Fabric and was then deployed. In the year 2020, the international retail giant Walmart became a member of the Hyperledger Fabric consortium in the United States. Their need was for a system that would enable product tracking in the event of an outbreak of food-borne disease. The contemporary consumer has access to data on provenance and the capacity to track the origin of food products purchased from corporations such as Nestle and Unilever. The easiest way to get things done is to force individuals to conform to a new standard or routine. For example, Walmart wants its suppliers of fresh leafy greens like salad and spinach to join

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their blockchain in order to provide transparency and provenance. This is part of IBM's Food Trust network-based Food Traceability Initiative. They are doing this as part of their commitment to enhancing the safety of food by reducing the amount of time it takes to recall items by a significant amount. As a result of this trial, Walmart has shown that it is now capable of tracing back food goods to their original source in a matter of seconds, when in the past this process would have taken days or weeks.

V. PROPOSED WORK

The main objective of this research work is to develop a blockchain-based decentralized application for agriculture. The proposed dApp has been implemented in Go Ethereum (GETH) with 10 nodes. The additional environment required for developing the proposed work is given as follows. A system having Ubuntu 21 operating system, 8 GB RAM, Intel i5 processor with 3.6GHz clock speed. The solidity v 0.8.21, along with the ganache truffle suite, is used to deploy the smart contract and the blockchain nodes. Figure 1 shows the use diagram of the proposed work. For the current work, there are 4 different types of users can register to the dApp. The users can be the Farmers, Retailer, Hotel/Restaurant Owner, and Consumers. A Farmer can produce the product. After production the farmer registers the product in the dApp. The retailer will be responsible for transporting the product from the farmer to store it in the warehouse. From the storage, the Hotel/ Restaurant Owner, and Consumer buys the product and scans the product to check the validity. Each created account is associated with the MetaMask account, from users will be paying for buying the product.

By using the provided portal, the users can register themselves by giving different credentials asked by the portal. When the user clicks on Register, the details will be stored in IPFS server available in the local device. Simultaneously, in the blockchain peer to peer network the registered user will be associated with one Blockchain account. Each created Blockchain node will be associated with one Ethereum address, private and public key. In addition, the Blockchain node is associated with a default 100ETH cryptocurrency. Figure 2 shows the registration portal available for different users. Figure 3 shows the list of nodes created in Ganache. Figure 4 shows the account information of a node.

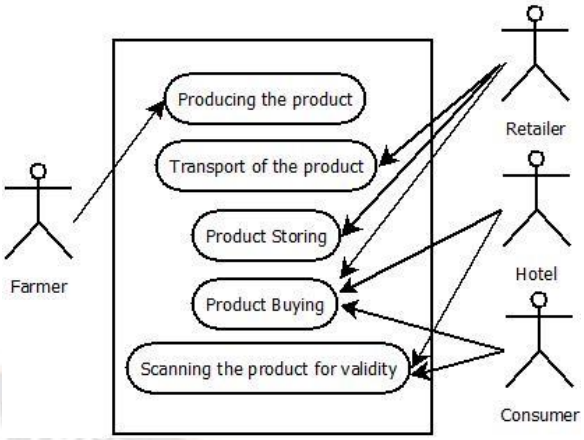

Figure 1. Use case diagram of the proposed dApp

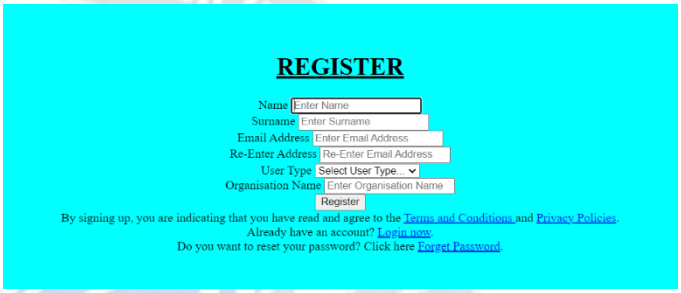

Figure 2. Registration portal for different users.

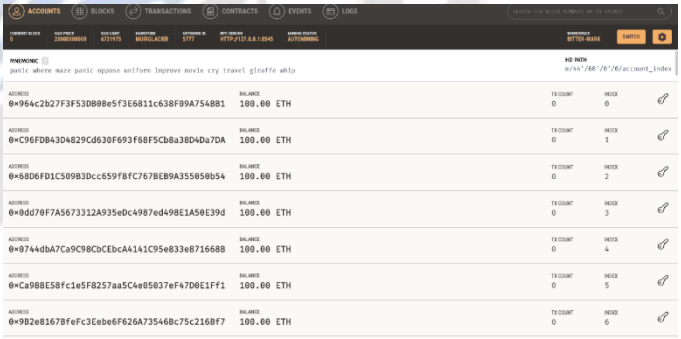

Figure 3. Configured nodes in Ganache environment

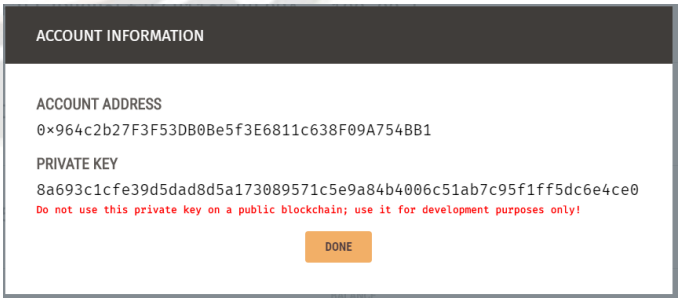

Figure 4. Account Information of Account 1 in Ganache

Every registered user has to pay in terms of ETH to the retailer. During the payment, a smart contract written in Solidity v0.8.21 will be invoked. A smart contract is a key feature of Blockchain technology that enables the network to auto-trigger upon arriving a predefined condition [29]. In this

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dApp, when a user wants to buy s product, then it has to pay for it by using the MetaMask account. When this event is initiated, the smart contract will be invoked for sending the defined amount to the farmer. The objective of this functionality is to make the process of buying and selling more transparent. Figure 5 shows the MetaMask details of a Blockchain node. Figure 6 shows the different transaction details for the developed dApp.

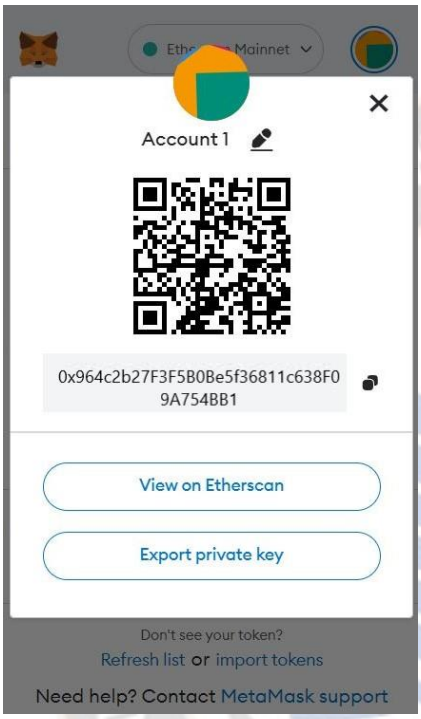

Figure 5. Linked MetaMask account of Account 1 of Ganache

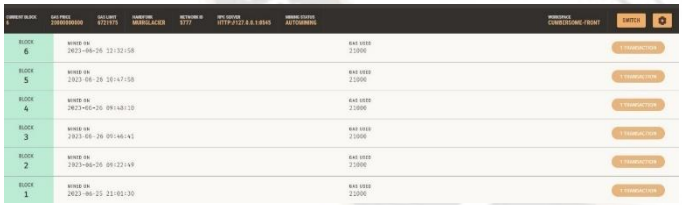

Figure 6. List of transactions executed in the proposed dApp

VI. CONCLUSION

Inaccuracy in the process is exacerbated by concerns about information security and privacy. Because of this lack of security and confidentiality, stakeholders like farmers are wary about entrusting their data to other systems throughout the transfer process. Many data security and privacy approaches, such as ring signatures, have been used in blockchain-based farms, but none of them can conceal transaction amounts or the identities of the sender and the recipient. rings. Information control and assurance are essential for blockchain-based agriculture and the internet of things. Information about transactions involving several parties should be kept secret throughout any hypothetical review or rollout phases of future research. It is also important to investigate the reasons and responsibilities played by governments in fostering technological innovation. Information assurance may be strengthened, and worries about information sharing can be removed, in blockchain-based farming by analyzing user behavior. The main objective of this research is to develop a Blockchain based decentralized application for agriculture. This developed application enables the users including the farmer, retailer, hotel or restaurant owner, and general consumer can buy and sell the food products produces by the farmer in a transparent manner. This developed application also provides a secure way of payment through the MetaMask account. In addition the farmer also comes to know about the actual value of the sold product so that he or she will be more interested in farming which can also help in increasing the rate of agricultural production rate.

REFERENCES

[1] A. Panigrahi, A. K. Nayak, and R. Paul, “Smart contract assisted blockchain based public key infrastructure system,” Transactions on Emerging Telecommunications Technologies, Oct. 2022, doi: https://doi.org/10.1002/ett.4655.

[2] N.Y. Harun, M.T. Afzal, Combustion behavior and thermal analysis of agricultural and woody biomass blends, Adv. Environ. Biol. 9 (15) (2015) 34–40.

[3] M.A. Hossain, M. Quaddus, N. Islam, Developing and validating a model explaining the assimilation process of RFID: An empirical study, Inf. Syst. Front.18 (4) (2016) 645–663.

[4] A. Panigrahi, A. K. Nayak, R. Paul, B. Sahu and S. Kant, "CTB-PKI: Clustering and Trust Enabled Blockchain Based PKI System for Efficient Communication in P2P Network," in IEEE Access, vol. 10, pp. 124277-124290, 2022, doi: 10.1109/ACCESS.2022.3222807.

[5] M. Yuan, P. Chahal, E.C. Alocilja, et al., Wireless biosensing using silverenhancement based self-assembled antennas in passive Radio FrequencyIdentification, RFID tags, IEEE Sens. J. 15 (8) (2015) 4442–4450.

[6] A. Panigrahi, A. K. Nayak and R. Paul, "Impact of Clustering technique in enhancing the Blockchain network performance," 2022 International Conference on Machine Learning, Computer Systems and Security (MLCSS), Bhubaneswar, India, 2022, pp. 363-367, doi: 10.1109/MLCSS57186.2022.00072.

[7] S.S. Ibrahim, A. Ibrahim, A.N. Allah, et al., Building of a community cattle ranchand Radio Frequency Identification, RFID technology as alternative methods ofcurtailing cattle rustling in Katsina state, Pastoralism 6 (1) (2016) 1–9.

[8] B. Yan, S. Shi, B. Ye, et al., Sustainable development of the fresh agriculturalproducts supply chain through the application of RFID technology, Inf. Technol.Manag. 16 (1) (2015) 67–78.

[9] X. Dong, W. Jianbo, J. Tong, et al., Locating logistics locations of suspiciousagricultural production food safety emergencies, Adv. J. Food Sci. Technol. 8 (6)(2015) 452–455.

[10] R. Zayou, M.A. Besbe, H. Hamam, et al., Agricultural and environmental applications of RFID technology, Int. J. Agric. Environ. Inf. Syst. 5 (29) (2017) 50–65.

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 10s
DOI: https://doi.org/10.17762/ijritcc.v11i10s.7625
***Article Received**: 01 June 2023 **Revised**: 27 July 2023 **Accepted**: 11 August 2023*

[11] C. Chen, X. Xu, Design and application of traceability and supervision platformfor broiler based on internet of things, Nongye Gongcheng Xuebao/Trans. Chin.Soc. Agric. Eng. 33 (5) (2017) 224–231.

[12] A. Panigrahi, A. K. Nayak, and R. Paul, "A Blockchain Based PKI System for Peer to Peer Network," Lecture Notes in Networks and Systems, pp. 81–88, 2022, doi: https://doi.org/10.1007/978-981-16-4807-6_9.

[13] Robert Roberts, Daniel Taylor, Juan Herrera, Juan Castro, Mette Christensen. Integrating Virtual Reality and Machine Learning in Education. Kuwait Journal of Machine Learning, 2(1). Retrieved from http://kuwaitjournals.com/index.php/kjml/article/view/175

[14] T. Ojha, S. Misra, N.S. Raghuwanshi, Wireless sensor networks for agriculture:The state-of-the-art in practice and future challenges, Comput. Electron. Agric.118 (3) (2015) 66–84.

[15] T. Chi, M. Chen, A frequency hopping method for spatial RFID/WIFI/Bluetoothscheduling in agricultural IoT, Wirel. Netw. (10) (2017) 1–13.

[16] L. Olinde, J.P.L. Johnson, Using RFID and accelerometer-embedded tracers tomeasure probabilities of bed load transport, step lengths, and rest times in amountain stream, Water Resour. Res. 51 (9) (2015) 7572–7589.

[17] D. Dujak and D. Sajter, "Blockchain Applications in Supply Chain," SMART Supply Network, pp. 21–46, Jun. 2018, doi: https://doi.org/10.1007/978-3-319-91668-2_2.

[18] Y. Chang, E. Iakovou, and W. Shi, "Blockchain in global supply chains and cross border trade: a critical synthesis of the state-of-the-art, challenges and opportunities," International Journal of Production Research, vol. 58, no. 7, pp. 1–18, Aug. 2019, doi: https://doi.org/10.1080/00207543.2019.1651946.

[19] Carter, C.R.; Rogers, D.S. A Framework of Sustainable Supply Chain Management: Moving toward New Theory. Int. J. Phys.Distrib. Logist. Manag. 2008, 38, 360–387.

[20] T. Pizzuti and G. Mirabelli, "The Global Track&Trace System for food: General framework and functioning principles," Journal of Food Engineering, vol. 159, pp. 16–35, Aug. 2015, doi: https://doi.org/10.1016/j.jfoodeng.2015.03.001.

[21] Lakhani, K.R.; Iansiti, M. The truth about blockchain. Harv. Bus. Rev. 2017, 95, 119–127.

[22] "Traceability (Product Tracing) in Food Systems: An IFT Report Submitted to the FDA, Volume 1: Technical Aspects and Recommendations," Comprehensive Reviews in Food Science and Food Safety, vol. 9, no. 1, pp. 92–158, Jan. 2010, doi: https://doi.org/10.1111/j.1541-4337.2009.00097.x.

[23] Bozarth, C.C.; Handfield, R.B.; Weiss, H.J. Introduction to Operations and Supply Chain Management; Pearson Prentice Hall: UpperSaddle River, NJ, USA, 2008.

[24] M. M. Aung and Y. S. Chang, "Traceability in a food supply chain: Safety and quality perspectives," Food Control, vol. 39, pp. 172–184, May 2014, doi: https://doi.org/10.1016/j.foodcont.2013.11.007.

[25] Baker, J.; Steiner, J. Provenance Blockchain: The Solution for Transparency in Product Supply Chains. Provenance. 2015. Availableonline: https://www.provenance.org/whitepaper (accessed on 10 September 2021).

[26] The Farm Management Software for Agriculture Industry | AgriOpenData," www.agriopendata.it. https://www.agriopendata.it/

[27] F. Tian, "An agri-food supply chain traceability system for China based on RFID & blockchain technology," 2016 13th International Conference on Service Systems and Service Management (ICSSSM), Kunming, 2016, pp. 1-6, doi: 10.1109/ICSSSM.2016.7538424.

[28] Sayel M. Fayyad, Mohammad Abuzalatah, Mohannad Rawashdeh, A. M. Maqableh, Zaid Abulghanam. (2023). Control, Design and Analysis of Delta 3D Printer . International Journal of Intelligent Systems and Applications in Engineering, 11(4s), 444–457. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/2702

[29] "Arc-net - Brand Protection and Security through Transparency. Trace. Verify. Trust," arc-net.io. http://arc-net.io/ (accessed Jul. 24, 2023).

[30] R. Hackett, "Walmart and 9 Food Giants Team Up on IBM Blockchain Plans," Fortune, Aug. 22, 2017. https://fortune.com/2017/08/22/walmart-blockchain-ibm-food-nestle-unilever-tyson-dole/

[31] A. Panigrahi, A. K. Nayak, and R. Paul, "HealthCare EHR," International Journal of Information Systems and Supply Chain Management, vol. 15, no. 3, pp. 1–15, Jul. 2022, doi: https://doi.org/10.4018/ijisscm.290017.