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Blockchain Based Food Traceability in Agriculture Supply Chain

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Abstract -Agriculture is the primary source of livelihood for about 58 percent of India's population. Agriculture supply chain is further complicated by fragmented inbound and outbound networks. It consists of multiple agents or intermediaries tapping into the marketing channel to realize a profit and successfully pass on the losses to the producer. Agricultural producers are facing multiple obstacles; from seasonal changes to the broken supply chain also their occupation is very laborious and demanding. Most of the losses produced here are due to misinformation, miscommunication and lack of trust between the different tiers. The proposed system uses blockchain technology which facilitates the transfer of data or useful information in a decentralized and transparent manner. The proposed system can have various nodes; shares information with them in the form of blocks. Each block is associated with hash value and contains transaction information verified by each node in the supply chain. The proposed system uses smart contract i.e. agreement between different parties that executes automatically without Third-party interference, which helps to build trust and transparency between them.

Key Words: Blockchain, Supply Chain Management, Smart Contract.

1. INTRODUCTION

The Supply Chain Management (SCM) is a group of processes and sub-processes carried out for transforming raw material into a final product, maximizing customer value and achieving a maintainable competitive advantage et al [1]. It is also interpreted as a network of entities that are part of the system from production to trading. The whole supply chain network is divided into several stages. Processes involved in these stages often take months to complete et al [2]. In such situation, if the final product lacks in quality, it becomes extremely difficult to track the root cause of the problem. The demand for top quality products and interest of end consumers in the provenance of data is increasing rapidly. Therefore, it has become necessary for every supply chain system to track the movement of products from origin to the end consumer's et al [3]. To gain end consumers trust, the supply chain authorities have to be efficient and accurate in delivering information. Agriculture development is predicated by improvement in farm production and productivity, better utilization of agriculture inputs, proper marketing infrastructure and support, and also efficient food management. But currently traditional agriculture supply chain management facing many problems in terms of centralized network, lack of trust, less quality product and lack of communication by introducing blockchain in traditional agriculture supply chain will overcome the problem that it is facing today. Blockchain is secure system that plays a significant role in evolution of supply chain with its inherent properties like decentralization, transparency and immutability.

Proposed system is based on cryptographic hash. It is a Decentralized and encrypted ledger system for storing transactions. the transaction may include the data like quantity, raw materials, etc., Several crop insurance schemes like the National Agricultural Insurance Scheme, can be maintained using Blockchain Technology for tamper proof records and for periodic checking of settlement of claims during crop losses. it eliminates the need for third-party representatives as smart contracts can be used to settle transactions. This ensures that the transactions and the identity of the user can never be compromised. If such a fraud transactions occurs, the decentralized mining system will block it to enter into the encrypted chain. Bringing transparency helps us in improving the processes involved in production. Traceability is also very important that we can know the source of the item including details likethe producer details, harvested and produced time etc.

2. LITERATURE SURVEY

Today an agricultural SCM System facing many obstacles. [4]Explains how blockchain technology helpful for SCM to transfer the information in secured way. The Third-party interference in this aspect curbed using a data ledger which is reliable and incorruptible. It analyses the different ways in which blockchain technology can be incorporated in the agricultural supply chain, as a transparent and dependable transaction mechanism. The paper [5] present a fully decentralized blockchain based traceability that enables to build blocks for agriculture that continuously integrate with IoT devices from provider to consumer. To implement, we introduced Provider-Consumer Network a theoretical end to end food traceabilityapplication. The objective is to create distributed ledger that is accessible by all users in the network that in turn brings transparency. In the proposed system [6] all transactions are written to blockchain which ultimately uploads the data to Interplanetary File Storage System (IPFS). The storage system returns a hash of the data which is stored

on blockchain and ensures efficient, secure and reliable solution. System provides smart contracts along with their algorithms to show interaction of entities in the system. Furthermore, simulations and evaluation of smart contracts along with the security and vulnerability analyses are also presented in this paper. [7] Paper provides a survey to study both techniques and applications of blockchain technology used in the agricultural sector. First, the technical elements, including data structure, cryptographic methods, and consensus mechanisms are explained in detail. Secondly, the existing agricultural blockchain applications are categorized and reviewed to demonstrate the use of the blockchain techniques. In addition, the popular platforms and smart contract are provided to show how practitioners use them to develop these agricultural applications. Thirdly, identify the key challenges in many prospective agricultural systems, and discuss the efforts and potential solutions to tackle these problems. Further, we conduct an improved food supply chain in the post COVID- 19 pandemic economy as an illustration to demonstrate an effective use of blockchain technology.

3. IMPLEMENTATION:

The smart contracts are created by the farmer. In the initial state of establishing the smart contracts, the smart contracts will check whether the farmer is registered. The processor then issues a purchase request, at which time the contract status is buyCropFromFarmer, and two conditions need to be checked: (1) Whether the requested processor is a registered entity; (2) Whether the processor has paid the fee. If these two conditions are satisfied, the contract status changes to CropRequestAgreed, the processor status is now WaitForCropFromFarmer, the farmer status changes to SellCropToProcessor and all active entities receive information from the farmer about selling crops to the processor. If the above two conditions are not met, the contract state becomes CropRequestFailed, the processor state is Request- Failed, and the farmer state is CancelRequestOfProcessor. processor is a registered entity; (2) Whether the processor has paid the fee. If these two conditions are satisfied, the contract status changes to CropRequestAgreed, the processor status is now WaitForCropFromFarmer, the farmer status changes to SellCropToProcessor and all active entities receive information from the farmer about selling crops to the processor. If the above two conditions are not met, the contract state becomes CropRequestFailed, the processor state is Request- Failed, and the farmer state is CancelRequestOfProcessor. Algorithm 1 describes the process by which farmers sell their crops to processors.

The processor then sells the processed crop to a distributor, who in turn sells it to retailer, as shown in algorithm 2. At this point, the production date, sales quantity and purchase date of the agricultural food are important parameters of the current stage. First, with respect to recognition address and the states of the distributor and retailer, due to the distributor having just finished the trade with the processor, the smart contract status is AgriFoodSoldToDistributor, and the state of the distributor is AgriFoodReceivedFromProcessor. The status of the retailer is ReadyToPurchase, which must satisfy two conditions: (1) Whether the requested retailer is a registered entity; (2) Whether to agree to the sales agreement and whether the agricultural food payment has been completed. If these two conditions are satisfied, the contract will automatically execute the transaction with the contract status changed to SaleRequestedSuccess, distributor status changed to AgriFoodSoldToRetailer, and retailer status changed to AgriFoodDeliveredSuccess. Upon completion of the transaction, the deed will send a notification of successful delivery to the retailer. If the above two conditions are not satisfied, the contract status is changed to SaleRequestDenied, the distributor status is changed to RequestFailed, the retailer status is changed to AgriFoodDeliveryFailure, and the contract sends a notification of failure to all participants. Algorithm 3 describes the algorithm for consumers to purchase agricultural food from retailers. First, the consumer's initial state is ReadyToBuy. Thanks to the successful dealings between retailers and distributors, the smart contract state is SaleRequestAgreedSuccess, while retailer status is AgriFood-DeliveredSuccess. Similarly, smart contracts restrict customers who register with retailer to make purchase requests. The important parameters at this stage are customer address, retailer address, purchase date, sales ID, and AgriFood ID. When consumers successfully pay agricultural food prices, contract status changes to AgriFoodSoldToCustomer, retailer status to SuccessfulPurchaseAgriFoodSaleSuccess, and customer status to SuccessfulPurchase. If the payment is not successful or the paid price is incorrect, the contract status will be changed to SaleOfAgriFoodDenied, the retailer status will be AgriFoodSaleFailure, and then the customer status will be changed to FailedPurchase.

Algorithm 1 Farmer Sell Crops To Processor

Input: *'rp' is the list of registered Processors*
Address of Processor,
Address of Farmer,
Quantity,DatePurchased,CropPrice

```
1  Contractstate is buyCropFromFarmer
2  State of the processor is CropRequested
3  Farmer state is WaitForSellCropToProcessor
4  Restrict access to only rp ∈ Processor
5  if CropSale is agreed and CropPrice = paid then
6      Contract state changes to CropRequestAgreed
7      Change State of the processor to
       WaitForCropFromFarmer
8      Farmer state is SellCropToProcessor
9      Send a notification of crop sale to processor
10 end
11 else
12     Contract state changes to CropRequestFailed
13     State of processor is RequestFailed
14     Farmer state is CancelRequestOfProcessor
15     Send a notification stating request failure
16 end
17 else
18     Reset contract and displays an error message.
19 end
```

Fig 1: Algorithm 1: Farmer sells crops to Processor

Algorithm 2 Distributor Sell Agri-Food To Retailer

Input: *'rr ' is the list of registered Retailer*
Address of Distributor,
Address of Retailer,
DateManufactured, Quantity,
DatePurchase

```
1 Contractstate is AgriFoodSoldToDistributor
2 State of the distributor is AgriFoodReceivedFromProcessor
3 Retailer state is ReadyToPurchase
4 Restrict access to only rr ∈ Retailer
5 if Sale is agreed and Price = paid then
6     Contract state changes to SaleRequestedSuccess
7     Change State of the distributor to
      AgriFoodSoldToRetailer
8     Reatailer state is AgriFoodDeliveredSuccess
9     Send a 'success' notification to retailer .
10 end
11 else
12    Contract state changes to SaleRequestDenied
13    State of distributor is RequestFailed
14    Retailer state is AgriFoodDeliveryFailure
15    Send a 'failure' notification to all participants.
16 end
17 else
18    Reset contract and displays an error message.
19 end
```

Fig 2: Algorithm 2: Distributer sells agri-food to Retailer

Algorithm 3 Customer Buys From Retailer

Input: *Address of Retailer,*
Address of Customer,
SalesID, AgriFoodID,
DatePurchased

```
1 Contractstate is SaleRequestAgreedSuccess
2 State of the retailer is AgriFoodDeliveredSuccess
3 Customer state is ReadyToBuy
4 Restrict access to only Customers
5 if Price = paid then
6     Contract state changes to AgriFoodSoldToCustomer
7     Change State of the retailer to
      SuccessfulPurchaseAgriFoodSaleSuccess
8     Customer state is SuccessfulPruchase
9     Send a 'purchase success' notification.
10 end
11 else
12    Contract state changes to SaleOfAgriFoodDenied
13    State of retailer is AgriFoodSaleFailure
14    Customer state is FailedPurchase
15    Send a 'purchase failure' notification.
16 end
17 else
18    Reset contract and displays an error message.
19 end
```

Fig 3: Algorithm 3: Customer buys from Retailer

3. CONCLUSIONS

By employing blockchain in different aspects of the Indian agricultural supply chain, many problems found, can be cleared up. Data collection, verification, storage and transfer will be done in a transparent and reliable manner. The use of blockchain technology in the Agri-food supply chain allows stakeholders and consumers access reliable information. It also increases the ability to track goods and reduces theneedfor a third party to monitor the network and control information.

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