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Grain Traceability in Supply chain of Agricultural based on Blockchain Technology

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Abstract:
The transport and the mobilized age of agricultural product buildup an energized focus on the quality, security, and approval of low significant principles in food and agricultural supply chain. The creating issues identified with food safety and security. Pollution dangers have built up a huge requirement that goes about as a basic quality managing security of items in the farming production network. Blockchain is a problematic development that can offer an inventive response for build traceability in food and agricultural supply chain. In this paper, we planned a methodology that uses the Ethereumblockchain and smart contract effectively operate business exchanges for grain traceability and tracking over the supply chain. Our planed arrangement with the requirement for a trusted authority in the center, given tread record, an intermediator, productivity and profitability are upgrading and safety with high integration, security, and reliability. The proposed plan revolves around the performance of smart understanding to regulation and control all affiliations and trade among all of the individuals required inside the store arrange natural framework. All trades are recorded and set away in the blockchain's unchanging record with connected to a decentralized document framework and in this manner providing to each of the an elevated level of straight for wardens and recognizabelity into the production network environment in a protected, trusted, strong way capable.

Keywords: *Blockchain, Ethereum smart contract, traceability, Agricultural supply chain, Food safety.*

I. INTRODUCTION

In the growth of farming production and effective logistic management in foods and farming supply chain is critical to product surety. The increasing concerns with food safety and impurity risks have revived the focus for upgrade traceability across all the domains of the supply chain [1] [2]. Observing the development of agricultural products, efficient planning management in farming and the food supply chain is tough to predict product safety. Increasingly agricultural products are dealing with the number of countries that require exact tracking and conformance to countries specific rules and regulations [3] [4]. Traceability of products in the farming supply chain needs assembling, communicating and management of critical information by exactly recognizing the origin and the multiple information interchange in the supply chain. Because of the dynamic nature of information in the agricultural food supply chain, it is not possible to trace everything. Here products are firstly produced with several raw materials into finished products. It get processed and then sent to several intermediaries that are vendor's merchants and from there it goes to number of dealers. Product impurity and its implications to general public health strongly emphasize traceability as it is a necessary policy tool towards observing food quality and its safety [5]. Dabbene and Gay [6] have contended the utilization of careful information assortment with the assistance of data specialized technique, for example, by utilizing BARCODES and RFID which empowers the information increase and better discernibility in horticulture and nourishment production network. In the case of defilement explaining the mode and

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quickly segregating the item from production, the network needs close coordination among the number of partners in the cultivating store network. Specific organizes in the nourishment inventory network basically have great discernibility yet the exchange of data demonstrates to be troublesome and tedious [7]. Blockchain innovation has increased colossal ubiquity over the inventory network which gives important and handy arrangements guaranteeing discernibility of agrarian produce and evacuates the necessity for a confided in brought together authority [8] and this arranging network because of straightforwardness and solidness of exchanges, improves trust among partaking partners. Blockchain can be moved viably to the farming production network because of its trust, secure, following and discernible nature. The general working and structure of nourishment supply chains are intricate and tremendous including various partners going from inhabitants, vendors, processors, and purchasers or buyers from the examination network the nourishment inventory network is getting a parcel of consideration. There are other significant issues that are to be tackled in the store network cycle that incorporates provenance, convention guidelines over various sellers, processors, and shippers [9]. Without focal recordkeeping, the blockchain enables members to monitor exchanges through a mutual open record of transactions [10]-[12]. it is a mutual conveyed record made out of extra squares that incorporate subtleties of all exchanges information, execution results and is discernible [13],[14]. Each square is connected to the following square making it a safe chain of stable confirmation records. Ethereum is a programmable blockchain stage that can administer business rationale including associations, the arrangement of occasions and access control to uphold the necessary work process and execute conceded to business rationale among store network members. The Ethereum virtual machine [evm] is the runtime condition for Ethereum calculations on which the client programs are executed. The general goal of this paper is to show how blockchain and Ethereum brilliant agreements can proficiently follow and the consistent coordination of business exchanges and work processes in the agrarian store.

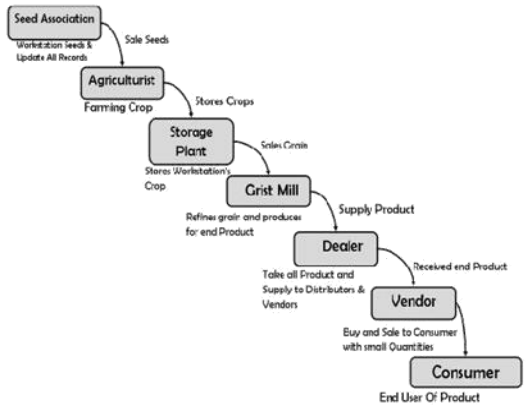

Fig. 1 Grain supply chains of product flow

II. RELATED WORK

Lastly we can conclude that DLT technology provides huge opportunities for agricultural sector as it removes the intermediaries' merchants by using smart contracts and it is necessary to keep improving in developing backward and develop DLTs coordination through public and private sector partnership will be the fastest and most efficient way to develop DLTs [15]. Through this paper we can understand that through blockchain technology the system provides a transparency and a valuable platform to monitor and manage and also to raise the supervision of traders in food supply chain. The requirements of traders are met for a better supply chain and environment [16]. Here there are various challenges and the utmost is the blockchain does not have the verification system to prove the raw data were correct and the major issue is we cannot predict the cost to implement blockchain [17]. Through this e agricultural is raises the economic efficiencies reduces uncertainties while achieving the well-being agricultural growth and development .It is safeguarded for merchants, tenants, laborers consumers etc. A too for a duo assessment of technical and social needs is presents as it is model system to implement in local areas [18]. There is still

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a major challenge of appropriate financial services in developing countries as like small scale farming in Africa; the efforts are being made to solve these challenges which provide universal access to quality financial services, affordable through which targeted market will find useful in meeting financial needs [19]. This paper determines the implementation of blockchain technology targeting grain quality assurance tracking in a real scenario. Preliminary results support a potential demand for a blockchain based certificate that would lead to an added valuation of around 15% for GM free soy in the scope of a grain exporter business network in Brazil [20]. Through blockchain it is an upcoming digital technology that allows transactions between untrusted parties, such as banks without the needs of intermediaries. Findings indicate that blockchain presents a promising technology towards the transparent supply chain of food [21].

GRAIN TRACEBILUTY ON BLOCKCHAIN-BASED APPLICATION

III. In this section, we will describe our solutions which uses and applies Ethereumblockchain and smart contracts to track, trace, and establishes the transactions in the grain supply chain. Our given solution will abolish all the needs of a trusted centralized authority and will provide the transactions and records for food supply chain management with reliability, safety and security.A.SystemovervieTheEthereum smart contracts can make and give wellbeing and security of horticultural and nourishment things into an incorporated savvy framework which guarantees the quality and amount of nourishment item that is being conveyed to the customer. Through our answers and given structure we will concentrate on the utilization of keen contracts executed independently on the overall population Ethereumblockchain stage. The execution of the keen agreements capacities will be done by a huge number of mining hubs that are dissipated around the world. So the inquiry is what is mining hubs. A mining hub is a registering machine that gathers, approve and afterward, in conclusion, actualizes the exchanges. The hubs additionally store the information and aftereffect of these exchanges in a record that is reproduced and synchronized by all mining hubs. In the blockchain, the shrewd agreements will acknowledge every one of the exchanges as capacity calls and will likewise actuate circumstances to empower the taking part elements to always watch, track, follow and take solid cautions when an infringement happens. Our answer centers around the grain inventory network in a specific case. Figure 2 clarifies a general diagram of the framework design of the proposed nourishment inventory network the executive's arrangement. As given in the figure all entities are Seed association, the agriculturist, Storage plant, Grist mill, Dealer, Vendor, the consumer and along these Blockchain which has the Ethereum Virtual Machine executing smart contract. Each and every single participant is having Ethereum Account with unique identity as an Ethereum Address (EA). The public and private keys are used to digitally sign and validate each and every transaction under specific EA or account.

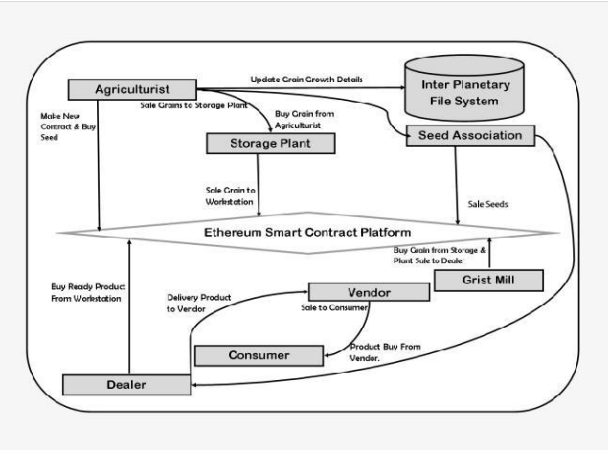

Fig. 2 Automating Grain traceability on Ethereum Smart Contract Platform system overview.

B. System design

In this system different participating entities has action, interacting and association with smart contract. Here seven participating entities are described below:

1. As the name we can say that in this company huge variety of seeds are produced and they are

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identified by EAN-UCC globally identifiers. It facilitates agriculturist's to get planting materials in the seed form and other strong nutrients that support in better agricultural production. For example: Providing fertilizers for nutrients.

2. Then agriculturist buys the seed from the Seed association and with that seed they harvests the crop, cultivates the crop and make the smart contract. The agriculturist takes the responsibility for regularly observing and store data of the growth details the crops and saving their images in the decentralized file system as images or MPEG FILES. A well, known decentralized file system is Inter Planetary File System [22].
3. It stores the cereal crops. It determines the grade quality quantity and then buys the cereals from the agriculturists. While storing the grain some factors we should keep in mind are moisture, temperature number of days of storage.
4. They buy the grain from the elevator/storage plant purifies the grain, eliminates the foreign material, converts the untreated cereals into the final product.
5. A dealer is generally a go down where they receive the final product and then ships them to vendor or merchants. It is the entity involved in the process of distributing the food product to the general public.
6. They buy the goods from the dealer or wholesaler in batches and then sell in small quantities to the buyers. We can take an example as the merchant buys the food product in bulk and then sell in the lower unit of measure to the customer.
7. The customer or the buyer is the end-user who buys and consumes the product from the vendors.

The producer of the seed or the seed company saves all the details of the seed like germination, quality, chemical composition, quantity etc. These seeds are sold by the Seed association are identified using standardized identifiers using GTIN. The agriculturist or tenant buys the seed from the Seed association and harvests the crop. The Seed association has a huge variety of seeds. From them the agriculturist buys the seeds that they want. The tenant records the growth details of the seeds and observes or monitors the seeds. It is recorded in the decentralized file system like Inter Planetary File System. In Inter Planetary File System all images, data, and records are digitally signed and attributed to a certain actor. It means that the actor for uploading the images, thus in this case tenant uploading MPEG files, is the undisputed owner and is responsible for any fraudulent or inaccuracy. Then after that agriculturist stores the grain into the elevator after checking the important factors that will cause changes in the cereal crops that is temperature, time, moisture, quality of that food product etc. Then the grain is purchased by the grist mill which refines, analyzes, and eliminates the moisture and compete prepares the finished product. Then the dealer buys the cereal crops from processor in order to ship the products to potential buyers. The dealer remains in direct contact with the prospective buyers due to a large number of products they sells in small quantities to the vendor or merchant and from there the vendors sell it to the end consumer who needs thatproduct. Blockchain via smart contracts can be applies in such a way to impose penalties on the tenants for the inaccuracy. Another option is to install the cameras in the field which cannot be hacked. It will automatically take the photos and will send to the blockchain to be data store in storage. Therefore their upload in form of images and trusted and their content can be disputed.

C. Traceable functionality

Starting with transactions of seeds that are sold in mid of Seed association and the tenant, to the next the sum-up of grain produce sold between succeeding entities is logged and all the transactions can be verified. As such we can take an example: The total amount of cereal crops sold between the entities cannot be changed. Additionally, for selling the variety of cereal crops could not be mixed in as total volume is known to the stakeholders. It is

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difficult and tough to observe the situations of the agricultural field whereas the tenant uploads images of the plants and the land situations timely. Inter Planetary File System offers the digital record which can be used to validate upon conditions of agreement. Consistently watching for quality pleasing is additionally invigorated by the utilization of discernible identifiers per part and the ability to follow every one of the exchanges between the partners. The nature of the shipment and circumstances can likewise be checked by utilizing IOT empowered holders and bundles containing sensors, cameras, 4Gcommunication, and so forth the states of the yield, item, and the sent things will persistently be recorded and tells during the shipment procedure. With blockchain these snippets of data and notices can't be adjusted or changed and quickly accessible and available by all partners.It merits saying that the partner can make or execute information and record wrong or false information. For this situation, the blockchain records the information accordingly with demonstrated characterization to the genuine partners. At later in the event that the information was gotten to be erroneous, at that point the judges and all members can with100% demonstrated credit the information to a specific partner or we can say an on-screen character. At that point for this situation, blockchain will recognize misrepresentation. To determine this kind of misrepresentation blockchain can be customized through savvy agreements to have more projects to object shipment or the entire production network procedures and put a few activities to force punishments to fake or take the option and restorative activities.

IV. IMPLEMENTING PROCES FRAMWORK

We discuss these Algorithm to define work process of proposed by Blockchain based. As examined before farmer make smart contract. The farmer's purchase grains with some terms of registered grain association.Algorithm1 is explain to vending grains to farmer's initialize entity as initial step. Established contract, these smart contract confirm to all requested farmers are registered and seed payment are done. Farmer state of convert to grain request is submitted. And farmer state change to wait for grain. And grain association is accept sale of grains. And then make a massage for notifying for sale of grain. Otherwise all states are truncation decline and error display. Algorithm 1 Grain Association Vend Grain to Farmer's Entity: farmer's registered list is F. farmer's Ethereum Address (EA) Grain Association's Ethereum Address (EA)Amount, Grain Categorize, Grain Brand Name Grain Rate

Step1. Contract state is Created.

Step2. Farmer's state in Grain Request.

Step3.Readystate of Grain Association.

Step4. Access restricted the onlyfis registered Farmer.

Step5. If farmer = registered and Grain Rate = payment is clear then Contract status converted into Grain Required Submitted. Shift State of Wait for Grain s from the farmer.

Grain Association status are accept To Sale. Storage Plant Volume's Ethereum Address (EA)date Purchased, Grain Rate

Step1. Contract state is Purchase From Storage Plant Step2. Grist Mill's state in Grain Request

Step3. Storage plant state is harvest purchased from agriculturist Step4. Access restricted the only gmis registered Grist mill

Step5. if Grain deal is acceptedand Grain Rate = payment is clear then Contract status converted into Grain Request accepted.

Shift State of wait for Grain from the storage plant from the Grist

Mill.

Storage Plant state are AgreeToSale

Make a message for notifying the stating sale of Grains.

End

Else

Decline contract status and display an error.

End

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In algorithm 2 Explain to grain mill purchase grain from storage plant in a large amount of grain. Main things is considered. In this step grist mill are request grain if grain deal and grain payment are accepted then grain request accepted and storage plant is agree to sale. Make a message for notifying the state sale to grain to demanding otherwise grain request failed from grain request contract state and work station demand is failure storage plant unaccepted demand from workstation. Then make a message to notifying state demand unaccepted otherwise decline contract stats and display error message.

Algorithm 2 Grist Mill Purchase Grain from Storage plant Entity: Registered Grist Mill list is'gm'

Grist Mill's Ethereum Address (EA) Make a message for notifying the stating sale of Grains to demanding Workstation.

End

Else

Contract state converted to Grain Request Failed. Status of Grain Workstation is Demanding Failure Storage Plant state is unaccepted Demand of Workstation. Make a message for notifying the stating Demand unaccepted.

Else

Decline contract status and display an error.

End

In algorithm 3 we proposed to deliver product vendors from dealers. Product sold to dealer and receive product from workstation and vendor are ready to purchase product. Paid product payment then contract state are convert vendingdemand accepted. Dealer's status is product sold to vendor.Vendors status is product delivered and send a message progress done to dealer. Otherwise contract status is convert in to unaccepted vending demand. Dealers status is demand failed and vendors fail to delivery product then send a message progress are failed. Otherwise decline contract status and send notification message error.

Algorithm 3 Dealer Delivery Product to Vendors Entity: Registered Vendor list is'v' Dealer's Ethereum Address (EA)

Vendor's Ethereum Address (EA)

Date Purchased

Step1. Contract state is Product Sol to Dealer

Step2.Dealer'sstateisProductTakingFromWorkStation

Step3. iVendor state is Prepare To Purchase

Step4. Access restricted the onlyvis registered Vendor.

Step5. If Vending is accepted and Product payment = Paid then Contract status converted into Vend Demand accepted progress. Dealer's status converted into Produst Sold to Vendors.

Vendor's status is Product Delavery Progress Make a message for notifying 'Progress done'.

End

Else

Contract status converted into Vend Demand Unaccepted.

Dealer's status converted into Demand Failed.

Vendor's status is Product Delivery Failure.

Make a message for notifying 'Progress are Failure'.

Else

Decline contract status and display an error.

End

In algorithm 4 are proposed consumer purchase product from vendors contract state is vending demand accepted, vendor supply effective and consumer are ready to prepare to purchasing product. If payment are paid then contract status convert into sold by consumer, vendor's status vending product and consumer status ready to purchase. Send notification message purchasing complete. Otherwise contract status convert into product vending rejected, vendors status vending failed and consumers status purchasing fail then send notification message purchasing failure. Otherwise decline contract status and display message error.

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Algorithm 4 Consumer Purchase From Vendors
Entity: Consumer's Ethereum Address (EA)
Vendor's Ethereum Address (EA)date Purchased, Product ID, Vend ID.

Step1. Contract state isVend Demand Accepet Progress.

Step2. Vendor's state is Product Supply Effective.

Step3. Consumer state is Prepare To Purchase.
Step4. Access restricted the only Consumer.

Step5. If Product payment = Paid then

Contract status converted into Product Sold To Consumer.
Vendor's status is Product Vending Progress.
Consumer's status is Progress Purchasing.
Make a message for notifying 'Purchasing Complete'.
end
else
Contract status converted to Vend of Product Rejected.
Vendor's status is Product Vend Failed. Consumer's status is Purchasing Failure. Make a message for notifying 'Purchasing Failure'.
else
Decline contract status and display an error.
end

CONCLUSION

In this paper, we give a simple way and process by using Smart contract and Blockchain Technology for tracking product, tracing product quality and remove middleman in business operation. We give a single point to processing grain traceability of agricultural supply chain. We are having details of the related system design, production flow architecture and Implemented algorithms. We explain every process how to tracing and tracking grain traceability and supply chain by our solution. We can be applied to any type of grains in agricultural supply chain. Provide automatic generate payment after checking delivery of product is complete. In automatic payment is crypto currency and this currency are convert to currency.

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