

Agro-Food Supply Chain using Blockchain Technology

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Abstract - This paper proposes a standard food procurement tracking system based on blockchain technology using the farm Inspector to Retailer model. This project demonstrates a blockchain food journey. Agro-Food chain is a sequence of activities and the process of bringing raw food farms to the markets. Blockchain can transform transactions by providing better transparency, accountability and responsiveness to the supply chain. Any product can be fully tracked using blockchain supply chain management. Each movement, as well as the status of the product, can be recorded on the blockchain. Blockverify and Provenance is a blockchain based supply chain Management System. Blockchain is an emerging digital technology that allows for widespread financial transactions between unallocated groups, without the need for intermediaries such as banks. This article examines the impact of blockchain technology on agriculture and food security, outlines ongoing projects and programs, and discusses the overall outcomes, challenges and strengths, with a critical perspective on the maturity of these systems. Our findings show that the blockchain is a promising technology focused on transparent food marketing, with many ongoing programs on various food products and food related issues, but many barriers and challenges still exist, hindering its widespread popularity among farmers and programs. These challenges include technical, educational, policy and regulatory frameworks.

Keywords — blockchain, smart Contract, Ethereum, Metamask, supply chain

1. INTRODUCTION

Imagine visiting a grocery store to buy vegetables. The vegetables in the store look fresh so, buy it. But do you know if the food you buy is safe to eat or not? Whether it's a veggie or some other food item, everyone of us wants to make sure that item is not contaminated. What if you could see where the food was created, purified, stored, and tested? At present, it is not possible for buyers or sellers to obtain information regarding food departures.

The current procurement process does not work well enough to ensure food security at all stages. Due to the inefficiency of the food supply system, the food industry faces many challenges. But with ledger technology, blockchain can improve food security by connecting multiple stakeholders such as Inspector, Harvester, Exorter, Distributor, processor and vendors. Everyone within the network can access the transparent and unchanging view of transaction history. Now imagine if a website is available to thousands or millions of users worldwide, all those CPU power systems used by the attacker to his advantage without the user even seeing what is happening.

In Agricultural food marketing, food from the producer or farmer to the consumer through other processes. It includes production, processing, distribution, use and disposal. Food usually goes from the farmer to the consumer in a clever way. In the provision of food supply the production of agricultural products and food management is very important and important to ensure product safety. Growing concerns about food safety and pollution risks have revived the focus on improved tracking across the supply chain. Agricultural products are sold all over the world. It requires strict adherence to certain national laws.

Traceability is very important in the provision of food, ensuring that food is followed and followed throughout the supply chain. The type of dynamic energy found in agriculture / food supply where products are produced, processed and shipped through a number of intermediaries makes it difficult to track and trace. Tracking refers to activities that monitor food movement during periods of production, pressure and distribution. Accordingly, it is possible to find a product in any food category within a supply chain. Recent technological advances through blockchain technology can provide a sound and effective solution to ensure the sustainability of agricultural production and eliminate the need for reliable independent authority. Blockchain technology has gained greater popularity between the supply and

purchase of public goods apparently due to the flexibility of transactions, increasing trust among participating stakeholders. The ability of Blockchains to track patent records and counter-arguments can be used to resolve urgent issues such as food fraud, security remembering, procurement inefficiencies and food tracking in the current food system.

Read further to know the existing problems and how blockchain could offer a better solution.

2. LITERATURE REVIEW

The Author [1] Proposed a Supply chain Procurement Management (SCM) is an integrated concept to manage the overall flow of a distribution channel (Hello & Szekely, 2005). The chain is complex because it includes distributed operations from the top, dealing with people, physical resources and production processes, downstream, involving the entire marketing process, i.e. contracts, customer sales, distribution and disposal (Tian, 2016). The purpose of the procurement is to establish an environment of multi-stakeholder interaction, remove barriers to communication, and ensure that various companies are connected to follow the integration of the entire supply chain (Korpela, Hallikas, and Dahlberg, 2017; Tuominen, Kitaygorodskaya, and Hello, 2009). Ultimately, procurement-related stakeholders can improve overall performance, and bring greater value and benefits to their business.

Author [2] proposed a built-in blockchain solution for LoRaWAN network servers to create an open, reliable, enabled and disruptive system, providing an irreplaceable way to ensure that specific activity data was available at a specific time on the network. They think it's the first project that combines blockchain technology with LoRaWAN IoT technology, and utilizes both benefits. The authors aim conceptual evidence to enable IoT to store low-power, access to blockchain-based infrastructure. To achieve this goal, they designed the IoT port as a blockchain node and propose a messaging system based on the low-power IoT devices. The demonstration of such a system was initiated using LoRa nodes and a gateway to the private ethereum network. In this paper the authors discuss blockchain integration with IoT by highlighting the benefits and challenges of integration. They think that moving an IoT system to a down-to-earth path would be the right decision. Blockchain is a powerful technology that can undermine accounting and management processes that can solve many IoT issues, especially security.

The Author [3] Explain the Blockchain technology used in smart agriculture. Even the UN FAO also recommended that the ICT (Information and Communications Technology) components of e-agricultural infrastructure are a combination of ICT requirements and blockchain technology. They speculate that when ICIC agricultural systems have a stable blockchain infrastructure and are

distributed by records management ledger systems, the integrity of natural agricultural data is protected by those involved in transparent data management. The authors reviewed blockchain-based concepts based on ICT-based technology. In addition, they have proposed an agricultural eCT program with blockchain infrastructure that will be used on a local and regional scale. Some papermakers have suggested a simple blockchain-based design for green greenhouse farms to provide security and privacy. IoT devices in kindergartens that act as a blockchain are centralized and make the most of the power-efficient use of stand-alone independent books. In addition, they have introduced a security framework that integrates blockchain technology with IoT devices to provide a secure communication platform for Smart Greenhouse farming.

Author [4] describe the RFID-enabled live tracking system for live fish supply. The design of the system is designed according to a specific requirement collected in the use of live fish. Similarly, it is flexible for small and medium-sized businesses. The RFID tag is applied to each live fish and is considered as a mediator linking the live fish feed center, restaurants for sale and consumers for identification. PLC-controlled sensors are used to collect data on farming and automated travel processes. Tracking data is designed to be exchanged and used in a web-based system for farmers and consumers. The system was used and distributed to the live fish facility for testing, and the results are important for effective targeting.

The Author [5] designed for intermediate or integrated tracking system that connects all parties across the supply chain. In this program all procurement members are connected to a single server and manage the same integrated information. Some features of this type of structure are:

- The recording and retrieval process possibly done immediately because the data is integrated.
- Supply chain members have to use the same system so that they can be interrelated and must agree on the data standards used.
- System users must entrust their data to the same entity and incur additional costs.
- Dependence on third parties as service providers potentially raises trust issues and concerns about sustainability which can lead to setbacks and losses to system user.
- Centralize authentication has the potential to be a single point of failure and a bottleneck of the system.

These five case studies used blockchain to record product mobility. While in the food chain, without movement, there are changes (joining, splitting, and inserting) important

processes to be recorded. This study uses a blockchain of supply chains that record transmission (movement) and product modification for use in the supply of processed food.

3. APPLICATION WORKFLOW DESIGN

In this Application we have Seven Stages are followings.

- Admin
- Farm-Inspector
- Harvester
- Exporter
- Distributor
- Processor
- Retailer

ADMIN

Admin creates new batch which is initial stage of food batch

FARM-INSPECTOR

Farm-inspectors are responsible for inspecting food farms and updating the information like food family, type of seed and fertilizers used for growing food.

HARVESTOR

Harvesters conducting plucking, hulling , polishing , grading and sorting activities, further updating the information of crop svariety, temperature used and humidity maintained during the process.

EXPORTER

Exporters are the organization who exports food throughout the world. Exporter adds quantity, destination address, ship name, ship number , estimated date and time and exporter id.

DISTRIBUTOR

Distributor imports the food from food suppliers and updates Quantity, Warehouse Name, Warehouse Address, Storage Temperature, Storage Humidity, Packaging Details.

PROCESSOR

Processors are the organizations who processes row food and makes it ready for packaging and to sale into markets. Processor adds the information like Processor Name, Temperature, Internal Batch No, Package Name, Package Address and Processing Date & Time.

RETAILER

Retailer are the responsible for distribute actual product into market, and they update information blockchain like Package ID, Expiry Date and Temperature.

4. IMPLEMENTATION DETAILS

In this proposed system Blockchain technology is used for Agrofood Supply chain. Blockchain is a specific type of database. Stores data in blocks that are chained together. Different types of information can be stored on a Blockchain but the most common use so far has been as a ledger for transaction. In food supply chain Blockchain is one of the most promising technological advancements in food fraud suppression. Includes digital secure transactions in all sales locations, which are directly visible to those who have access to the Blockchain store.

The implementation of Agrofood supply chain by using Ethereum. Ethereum is a Blockchain technology that can run smart contracts. Ethereum is used for addressing the issue of storing critical data which is necessary at different stages of supply chain. Smart contract is type of Ethereum. This means they have a balance and they can send transaction over the network. In Ethereum, the smart contracts are defined using language called Solidity.

The website is created for food supply chain. It is developed by HTML. The front end of website is generally created by using HTML, CSS and JavaScript. For Ethereum the API is JSON-RPC layer called Ethereum web3 API On our website web3.js is also used for a collection of libraries that allow you to interact with the local or remote Ethereum node using HTTP or IPC connections. This library interact with Ethereum Blockchain.

Truffle suite framework is used in this website. Also Ganache is used in the website. It is personal Blockchain for rapid Ethereum and Corda distributed application development. Metamask Ethereum browser extension is used for allows users to store and manage account keys,

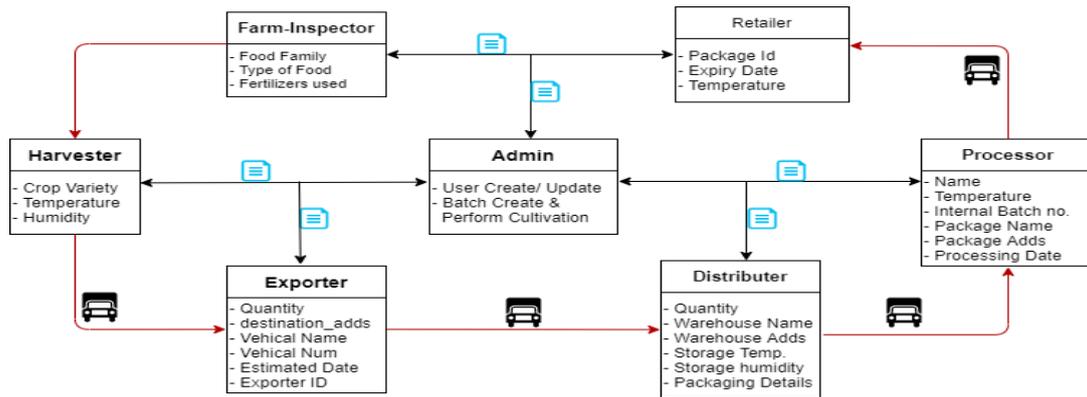


Fig. 1 Application Workflow Diagram

broadcast transaction, send and receive Ethereum based cryptocurrencies and tokens and securely connect to decentralised application. For Back-End we used python and PHP

4.1 ETHEREUM BASED AGROFOOD SUPPLY CHAIN

Implementation of Agrofood supplychain using Ethereum Smart contract addressing the issue of storing critical data Necessary at different stages of supplychain and making it verifiable by all stakeholders in supplychain.

- This project showcases the journey of any food on blockchain.
- The food supply chain is the sequence of activities and process to bring seeds from food farm to processed food in markets.
- We have implemented smart contract addressing the issue of storing critical data necessary at different stages of supplychain and making it verifiable by all stakeholders in supplychain.

4.2 ADMIN DASHBOARD

- In admin dashboard you will be able to find out total users registered, total number of roles and total food batches created.
- Total number of Userd, Total Batches, Batch Overview, Total roles, List of Users Role and All the Contract Addresses.
- In batch overview section you will be able to find out the progress of each batch.
- Using create user button you can add new user into food supply chain.
- Using clicking on button Create Batch, Admin will be able to create new Batch of Food Batch.

4.3 ADMIN ACTIVITIES

- In the Add User form admin have to provide basic information of user like User Wallet Address, User

name, User Contact Nunber, Role of User, User Status means the User is Activated or Deactivated.

- Admin also can provide profile image of user.
- Only Admin can add new user in food supply chain.

CREATE NEW BATCH

- To add new food batch, you can use create batch button in batches overview section in admin dashboard.
- You have to provide basic information of batch like Farmer Registration Number, Name, Address, Exporter Name etc.
- .By submitting Add Batch form you create new batch which can be updated by other roles later.

BATCH OVERVIEW

- Get all food batch information in batch overview. We get the in at what stage the batch is processing. You can find out progress of batch.
- Similarly admin can also scan QR-code to find out the transaction details of batch.
- Food Batch States
- --- Processing : when the stage is in process
- --- completed : when the stage is completed by respective roles
- --- Not Available : Batch is not reached upto this stage
- Admin will be able to see the progressive information of food batch.

4.4 USER ACTIVITIES

UPDATE USER PROFILE

- To update , user profile you can use Update Profile form where you have to fill the information of user like full name of user, his / her contact number and profile image of user

- Role of user and user status can only be modified by admin, user can not edit this information

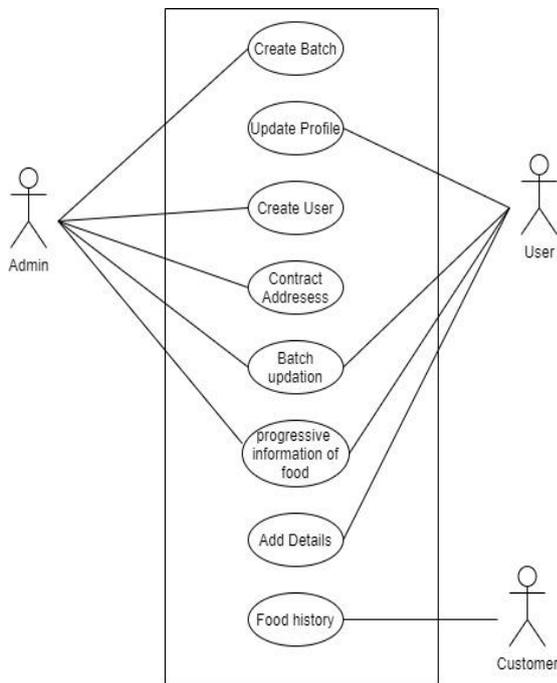


Fig.2 Use case diagram

- Exporting information gets stored on blockchain and batch progress to next step which is Distributor.

BATCH UPDATION BY DISTRIBUTOR

- Once the batch received from the Exportor then Distributor update the information like Quantity, Warehouse Name, Warehouse Address, Storage Temp., Storage Humidity and Packaging Details etc.
- Distributor information stored on blockchain and Batch progress to next step which is Processor.

BATCH UPDATION BY PROCESSOR

- Processors have to update the processing information like Quantity, temperature, time for roasting, internal batch number, packaging date, processor name and address of processor.
- Processor stored the information on blockchain and Batch progress to last step which is Retailer.

BATCH UPDATION BY RETAILER

- When the batch updated from processor then batch received to Retailer.
- Retailer have to update the information like packaging id, expiry date and temperature etc.

After complete all the stages information finally customer see the Food History or Progress using QR code so that customer can eat the food safely.

BATCH UPDATION BY FARM-INSPECTOR

- User's having role of Farm inspector will be able to see the update button in batch overview.
- Farm inspector can update information by providing Type of Seed, Food Family and Fertilizer Used.
- After successful submit of farm inspector information batch progress to next step which is harvesting.

BATCH UPDATION BY HARVESTER

- Harvester grows food crops and after complete nourishing of food crops harvester makes the crop ready to export by updating Food Variety, Temperature and humidity to blockchain

BATCH UPDATION BY EXPORTER

- Exporters sends the food crops for further process on crops as per demands and they update their own information to blockchain.
- Once the food batch are ready to export, Users having role of exporters updates the information of Exporting.
- It includes Quantity, Destination Address, Vehicle Name, Vehicle number, Estimated datetime and Exporter id.

5. HARDWARE & SOFTWARE REQUIREMENT

- **Hardware Requirement**
 - 4 GB RAM.
 - 200 GB HDD.
 - Intel 1.66 GHz Processor Pentium.
- **Software Requirement**
 - Solidity (Ethereum)
 - Metamask (Ethereum Wallet)
 - IPFS
 - Web3JS
 - Apache and PHP
 - Truffle

6. CONCLUSION

In this paper, The Ethereum based blockchain technologies integrated. On every stage the respected stockholders update the data and store in blockchain. The customer can get information of how the food is processed and supplied to them and customer can ensure that food is safe for them to ingest. The major problems like Food frauds, Foodborne illness, illegal Production etc can be solved with help of blockchain.

7. FUTURE SCOPE

With the help of blockchain technology, it is possible to record transactions on a regular basis, and to monitor transactions securely and transparently. This also helps reduce human error and time delays. It is also used to monitor costs, hiring, and outsourcing at each point of sale. But this has a huge impact on understanding and monitoring the real environmental impacts of products. Not only can a medium-sized ladder be used to check the legitimacy or legitimacy of a product by following it and creating its own resources. This type of robot has a bright future because it is very useful in agriculture and reduces workload.

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