ISSN: 2348-2079

International Journal of Intellectual Advancements and Research in Engineering Computations (IJIAREC)

IJIAREC |Vol.12 | Issue 2 | Apr - June -2024

www.ijiarec.com

DOI : https://doi.org/10.61096/ijiarec.v12.iss2.2024.28-37

Review

Vegetable supply chain using smart contracts

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Published on: 3 May 2024

Published by:
DrSriram Publications

Abstract

Today's Vegetable Supply and transplantation systems pose different requirements and challenges in terms of registration, donor-recipient matching, Vegetable removal, Vegetable delivery, and transplantation with legal, clinical, ethical, and technical constraints. Therefore, an end-to-end Vegetable Supply and transplantation system is required to guarantee a fair and efficient process to enhance patient experience and trust. In this paper, we propose a private sha256 blockchain-based solution to enable Vegetable Supply and transplantation Buyerin a manner that is fully decentralized, secure, traceable, auditable, private, and trustworthy. We develop smart contracts and present six algorithms along with their implementation, testing, and validation details. We evaluate the performance of the proposed solution by performing privacy, security, and confidentiality analyses as well as comparing our solution with the existing solutions.

Keywords: Block chain, Hash, Machine Learning, LASSO.

INTRODUCTION

Vegetable agricultural products have excellent production advantages in China, a predominantly agricultural country with excellent climate conditions and abundant species resources. Fruit and vegetable agricultural products have the characteristics of green, healthy and high nutritional value, which people deeply love. However, the short storage time and the low storage temperature of storage requirements for fruit and vegetable agricultural products lead to food safety incidents, which are incredibly prone to occur.

In recent years, domestic and international safety incidents of fruit and vegetable agricultural products have occurred frequently. As a result, the state attaches great importance to the traceability of the food supply chain, and countries strengthen the management of traceability by issuing relevant laws and regulations. Traceable" has become a challenge for all food and food-related companies, and the traceability system has become an effective means of quality management in the agricultural product supply chain. The traceability of

fruit and vegetable agricultural products involves many subjects. Following the business relationship, it can be divided into internal and external entities of the supply chain.

In practical applications, data in traditional traceability systems are centralized, and authoritative agencies manage the central database of the traceability system. Since the traceability data of each supply chain node are collected by the enterprise, the data are easy to tamper with. Therefore, the reliability of information transmission among different roles in the agricultural supply chain needs to be increased. Blockchain is a distributed database that is decentralized, tamper-proof, traceable, and maintained by multiple parties. It uses a cryptographic algorithm to form a chain structure composed of data blocks in chronological order. Any party must receive the consent of all other parties in advance according to agreed rules to realize information sharing and information supervision among different parties. Moreover, blockchain integrates many technologies, such as Peer to Peer (P2P) networks, cryptographic technologies, smart contracts, consensus mechanisms, timestamps, blockchain structure, etc.

Thus, it can achieve the self-verification and management of data without relying on a third party. The use of blockchain technology for the tracing of agricultural products can solve the problems with the current traditional traceability system. Blockchain is divided into three categories: Public, Consortium, and Private. Consortium chains refer to the blockchain, which several Vegetableizations participate in and manage together. In terms of privacy, Consortium chains are intermediate between Public chains and Private chains, with their data only being accessible.[1-3]

Block chain technology

Block chain, sometimes referred to as distributed ledger technology (DLT), and makes the history of any digital asset unalterable and transparent with a decentralized network and cryptographic hashing. A simple analogy for how block chain technology operates can be compared to how a Google Docs document works. When you create a Google Doc and share it with a group of people, the document is simply distributed instead of copied or transferred. This creates a decentralized distribution chain that gives everyone access to the base document at the same time.

No one is locked out awaiting changes from another party, while all modifications to the document are being recorded in real-time, making changes completely transparent. A significant gap to note however is that unlike Google Docs, original content and data on the block chain cannot be modified once written, adding to its level of security. Block chain is an especially promising and revolutionary technology because it helps reduce security risks, stamp out fraud and bring transparency in a scalable way. Popularized by its association with cryptocurrency and NFTs, block chain technology has since evolved to become a Buyersolution for all types of global industries. Today, you can find block chain technology providing transparency for the food supply chain, securing healthcare data, innovating gamingand overall changing how we handle data and ownership on a large scale. How Does Block chain Work? For proof-of-work block chains, this technology consists of three important concepts: blocks, nodes and miners. What Is a Block? Every chain consists of multiple blocks and each block has three basic elements:

The data in the block. The nonce — "number used only once." A nonce in block chain is a whole number that is randomly generated when a block is created, which then generates a block header hash. The hash — a hash in block chain is a number permanently attached to the nonce. For Bitcoin hashes, these values must start with a huge number of zeroes (i.e., be extremely small). When the first block of a chain is created, a nonce generates the cryptographic hash. The data in the block is considered signed and forever tied to the nonce and hash unless it is mined.[4,5]

System Framework Development

The blockchain-based fruit and veg traceability project aims to improve the traceability of agricultural products. The project uses the technology to ensure the authenticity and transparency of traceability information of farming products' traceability systems and achieves effective and reliable traceability. Using a traceability system, detailed information about agricultural products can be displayed to consumers, and trust regarding such products' safety can be enhanced. The blockchain traceability system was mainly divided into a storage layer, service layer, interface and application layer. The local database stores the public information of each link. The service layer includes data analysis, reputation-based smart contracts, key management, consensus mechanism, etc. The application layer includes uploading data from enterprises, querying traceability information by consumers, and supervision by government departments.[6]

Chain Generation

The existing storage mode of the blockchain traceability system involves directly writing traceability information of each node of agricultural products into the blockchain. With increasing numbers of nodes, an increasing amount of transaction data is obtained, and the storage load pressure of the blockchain consequently increases. Due to the unique chain-type structure of blockchain, the query efficiency is very low; members of the

same blockchain network access all the data on the chain ledger. To overcome these shortcomings, this paper improved the storage mode of a blockchain traceability system for agricultural products and designed a method involving the double storage of traceability information under the chain of 'database+block- chain".After traceability data is uploaded to the system, the system classifies the data. The product's public information is stored in the local database. The encrypted ciphertext and the hash value of public information are uploaded to the blockchain. Considering the issue of storage space, the SHA256 algorithm with higher security is used in the encryption of public information. The block structure of the traceability information data structure stored on the blockchain includes the block head and block body. The parameter "Value" is the value written to the blockchain, including Type, ID, Private Data and Info Hash. The parameter "Type" is the name of the structure body that is defined by the "Value" parameter. The parameter "ID" is the unique identification field of the source message record, which corresponds to the unique identification field of the source traceability information 30 stored in the local database. The parameter "Private Data" is the cypher text of private information encrypted by the CBC algorithm. The parameter "Info Hash" is the value of source traceability information after this information has been hashed.[7]

Encryption and Traceability

The data involved in the entire supply chain is not only product traceability information but also contains private data that only relevant companies can view, such as transaction information. For competing enterprises, data privacy is an important issue; private information, such as transaction data, is encrypted by the AES encryption algorithm's Cipher Block Chaining(CBC) mode.TherequiredKey1 is randomly selected by the smart contract to generate and upload encrypted ciphertext to the blockchain. To ensure the security of the Key1, this paper used Elliptic Curves Cryptography (ECC) to encrypt the Key1. The encrypted Public Key authorized the viewing node. The Public Key of the assigned viewing node and the Encrypted Key1 form a key- value pair, stored in the world state of the smart contract and written to the blockchain. When the relevant enterprise nodes view the private data on the blockchain, the current node private key is used to decrypt the Encrypted Key1 on the blockchain to obtain the original Key1 and the Key1 is used to solve the private information and view the confidential information. The conceptual model that defines a system's structure, actions, and viewpoints is known as a system design or systems architecture. An architecture description is a formal account and depiction of the designs and behaviour of a system Vegetableized for facilitating reasoning[8].

System components, the features of those components which are externally visible, and the relationships (e.g. the behaviour) between them. It can offer a blueprint from which systems and products that will collaborate to implement the whole system can be developed. Architecture description languages (ADLs) collectively indicate efforts to formalize languages which define system architecture. A physical element assignment provides a design solution for a consumer product or life cycle process that aims to satisfy the functional architecture and the requirements baseline requires[9].

Smart Contract for System

Smart contracts are time-driven, stately computer programs deployed on shared distributed databases. It can be automatically executed when trigger conditions are met, and node behaviour can be transmitted and verified in an informationized manner. Smart contracts are called Chain-code in Hyper ledger Fabric, which greatly reduces the degree of manual participation and ensures the decentralization of blockchain and the tamper- proof of data. Alliance members in the Consortium chains negotiate to participate in bookkeeping and define incentive methods based on business needs. The agricultural products traceability system based on blockchain designed in this paper records traceability data of fruit and vegetable products from production, processing, transportation, and sales. In order to encourage alliance members to upload traceability data, this paper designs a reputation-based smart contract. After the node uploads the traceability data that meets the requirements, the contract logic will be triggered to increase the reputation value of the node[10].

Traceability Verification

The traceability information is collected by Internet of Things device or manually entered. Users upload the traceability information of production, processing, logistics and sales to the system. After classification by system, the traceability information is divided into private information and public information. The private information is uploaded to the blockchain after CBC encryption, and the public information is stored in the local database. The SHA256 algorithm is used to hash public information. The hash value obtained is stored in the blockchain system, and the block number is returned. The block number is updated to the public information record corresponding to the database[11-13]. If the agricultural product's information needs to be modified, the hash value of the public information needs to be rewritten into the blockchain to update its block number. Consumers can obtain public information and block number from the database by scanning the QR code, hash the public information obtained, and compare the consistency with the hash value stored on the blockchain through the block number to determine whether the product traceability information has been tampered with.

Philippe Bocquier et.al., has proposed in this paper This paper proposes to critically examine the United Nations projections on urbanization. Both the estimates of current trends based on national data and the method of projection are evaluated. The theory of mobility transition is used as an alternative hypothesis. Projections are proposed using a polynomial model and compared to the UN projections, which are based on a linear model. The conclusion is that UN projections may overestimate the urban population for the year 2030 by almost one billion, or 19% in relative term. The overestimation would be particularly more pronounced for developing countries and may exceed 30% in Africa, India and Oceania. The United Nations Population Division has been publishing and revising its World Urbanization Prospects since 1991 (the latest being the 2002 revision: United Nations 2002) and this has become a popular source of data and analysis of the past, current and future proportion urban in each country, region or continent of the world. As urban issues get more attention, notably in the Millennium Development Goals (MDG), it is increasingly used as an instrument for projections of some other global trends, such as poverty (UN-Habitat 2003; World Bank 2003), energy consumption, environment and resources (UNDP et al. 2003), etc. Projections and even estimations, for recent years, of other global trends cannot afford to do without urbanization projections, as they are often a key indicator of global integration. Since the UN data is largely used and referred to, analyzing the historical trends and projections from this set of data will be more useful to the interested reader and also to the planner than to refer to not yet internationally agreed alternatives. Nevertheless, and without questioning the merits of the UN database on urbanization, it is necessary to assess its limits. This has already been done through a number of publications since the inception of the UN method of projection for urban population. What about the projection method? Let alone the difficult problem of the availability of reliable data, and temporarily working with the hypothesis that national definitions capture reasonably well the proportion urban, the method of projections used by the UN since its first projections of urban population needs examination.[14]

RUI ZHANG et.al., has proposed in this paper Block chain offers an innovative approach to storing information, executing transactions, performing functions, and establishing trust in an open environment. Many consider block chain as a technology breakthrough for cryptography and cybersecurity, with use cases ranging from globally deployed cryptocurrency systems like Bitcoin, to smart contracts, smart grids over the Internet of Things, and so forth. Although block chain has received growing interests in both academia and industry in the recent years, the security and privacy of block chains continue to be at the center of the debate when deploying block chain in different applications. This article presents a comprehensive overview of the security and privacy of block chain. To facilitate the discussion, we first introduce the notion of block chains and its utility in the context of Bitcoin-like online transactions. Then, we describe the basic security properties that are supported as the essential requirements and building blocks for Bitcoin-like cryptocurrency systems, followed by presenting the additional security and privacy properties that are desired in many block chain applications. Finally, we review the security and privacy techniques for achieving these security properties in block chain-based systems, including representative consensus algorithms, hash chained storage, mixing protocols, anonymous signatures, non-interactive zero-knowledge proof, and so forth. We conjecture that this survey can help readers to gain an in-depth understanding of the security and privacy of block chain with respect to concept, attributes, techniques, and systems. Block chain technology is a recent breakthrough of secure computing without centralized authority in an open networked system. From a data Buyer perspective, a block chain is a distributed database that logs an evolving list of transaction records by Vegetableizing them into a hierarchical chain of blocks. From a security perspective, the block chain is created and maintained using a peer to peer overlay network and secured through intelligent and decentralized utilization of cryptography with crowd computing It is predicted [30] that the annual revenue of block chain-based enterprise applications worldwide will reach $19.9 billion by 2025, an annual growth rate of 26.2% from about $2.5 billion in 2016. Meanwhile, Goldman Sachs, MVegetable Stanley, Citibank, HSBC, Accenture, Microsoft, IBM, Cisco, Ten cent, Ali, and other world-renowned financial institutions, consulting firms, IT vendors, and Internet giants are accelerating laboratory research and capital layout on block chain technology. Block chain together with artificial intelligence and big data are considered as the three core computing technologies for the next generation financial industry. In addition to Bitcoin.com, several orthogonal efforts, such as the Hyper ledger project sponsored by IBM and Apache foundation, Ethereal and File Coin provide open source repositories and platforms for block chain research and development[15].

Existing system

Blockchain-based systems developed for Vegetable Supply have mostly focused on agricultural Vegetable of smart cities. Existing blockchain-based projects for Vegetable Supply have implemented several types of services related to Vegetable Supply, assets tracking, shipment monitoring, tokens transferring, Vegetable sorting, and auditability of Vegetable handler's actions. The existing studies have followed **Ethereum and Hyperledger Fabric platforms** to issue rewards and penalties for the Vegetable Supply participants and ensure the compliance of user's action with Vegetable Supply laws. The opportunities for blockchain technology in Vegetable Supply of smart cities are many, and technical, social, and Vegetablization challenges in implementing

such opportunities are unclear to researchers and practitioners. To the best of our knowledge, none of the existing studies have explored or reviewed the opportunities offered by blockchain in terms of Vegetable Supply of smart cities. More specifically, we conduct this study to explore the role of blockchain in Vegetable Supply, present several blockchain-based research projects and case studies, and discuss the challenges which need further research to improve Vegetable Supply services in smart cities[16].

Drawbacks

- Less accuracy.
- Poor clarity result and Vegetable Supply scheme.
- non-problematic concept and can cover an
- array of policy aims, such as the circular economy. There are,
- Not able to support relation to what Vegetable Buyer operations are considered “sustainable.” These may relate to the emphasis

Proposed system

In this paper, we present a way to improve the situation of Vegetable Supply in india. Our technique is based on smart contracts, developed using block chain technology. Block chain will enable proper book-keeping of the Vegetable Supply s introduced in the market by different producers and retailers. This will enable smart contracts to clearly specify collection targets and penalize the appropriate retail buyer whenever required[17]. providing incentives to customers when they channelize their Vegetable to the formal sector, can serve as the first step in reducing the dominance of the Vegetable sector in Vegetable Supply.

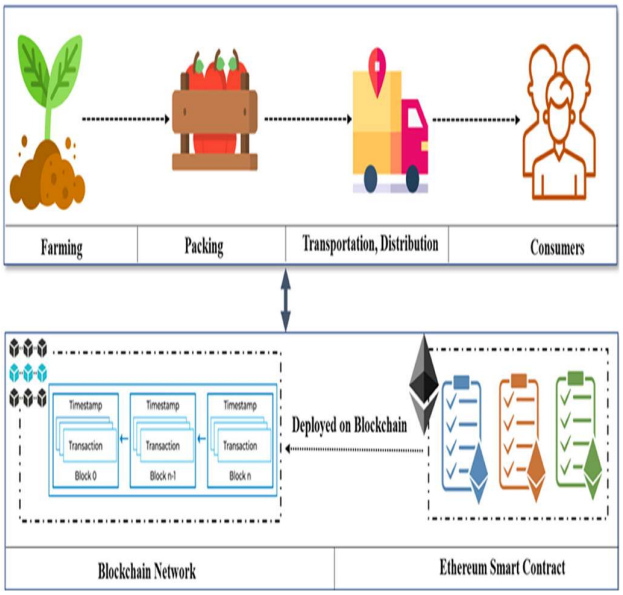

Fig 1: Interaction between Vegetable collectors and the retailer using a blockchain-based smart contract.

Advantages

- Offering clarity in property rights of products and Vegetables.
- supporting law and policy goals by incentivizing sustainable Vegetable Supply.
- maintaining anonymity and privacy for institutions and individuals.
- Reliable data analysis provide better Vegetable Supply .
- Clear accuracy on location identity.

Modules

Authorization module

This module of the smart contract will be used exclusively by GAs to provide a digital e-Vegetable license to any PR, RT and owner of CC or RU, allowing them to start their operation in India. This license will state each stakeholder’s responsibilities in terms of their e-Vegetable collection targets for upcoming years and the penalty for not meeting the specified target. If the stakeholders fail to meet these targets, the penalty amount, as calculated by the smart contract, will be automatically deducted from the stakeholder’s account and transferred to appropriate government account.

Producer module

Each pr must maintain a record of the amount of vegetable supply s that they plan to supply (supply amount) in the indian market. They must also specify the rts to which they will supply vegetable supply s, the amount of e-vegetable they have gathered so far, its source and the ccs on the vegetable supply b to which they will supply the gathered vegetable. These records must be provided to the producer module. This module will call the collection module to verify the contribution of e-vegetable made by prs[18].

Retailer module

Each rt must record the amount of vegetable supply s that have been purchased by them (purchase amount). This amount will be verified through the exchangepr_rt module. Rts must also specify the amount of e-vegetable they have gathered so far, its source and the prs on the vegetable supply b from whom they will purchase. The retailer module will call the producer module to verify the contribution of e-vegetable made by rts and whether the prs specified by rts match with the list provided by the prs.

Consumer module

CSs who wish to join the VEGETABLE SUPPLY B, must call this module to register themselves through their unique identification number like Aadhar.

Ethereum based agrofood supply chain

Implementation of Agrofood supplychain using Ethereum Smart contract addressing the issue of storing critical dataNecessary 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[19].

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.[20]

Admin activities

In the Add User form admin have to provide basic information of user like User Wallet Address, User name, User Contact Number, 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.

User activites

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 cannot edit this information.

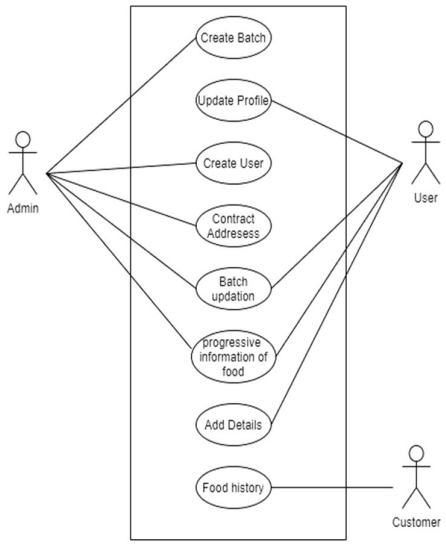

Fig 2: Use case diagram

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 od 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. 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 tthen Distributor update the information like Quantity, Warehouse Name, Warehouse Address, Storage Temp., Storage Humidity and Packaging Detailes 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 Quamtity, temperature, tiem 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. Afterv complete all the stages information finally customer see the Food History or Progress using QR code so that customer can eat the food safely.

Hardware & software requirement

- **Hardware Requirement**
  - 4 GB RAM.
  - 200 GB HDD.
  - Intel 1.66 GHz Processor Pentium.
- **Software Requirement**
  - Apache and JAVA

- NETbeans

Working

A blockchain is a shared, distributed leadership, and frequently public digital ledger made up of papers known as blocks that are used to record transactions across multiple devices in such a way that any connected block cannot be altered retrospectively without affecting all future blocks. This allows participants to independently check and audit transactions at a cheap cost. To operate a blockchain database on its own, a peer-to-peer network and a distributed time-stamping server are used. They have been verified by popular collaboration encouraged by collective self-interest. A design like this supports strong workflow in situations where participants' uncertainty about data security is low. The use of a blockchain removes a digital asset's ability to be endlessly reproduced. It verifies that each unit of value was transmitted just once, so resolving the long- standing issue of double spending. A blockchain has been described as a protocol for exchanging value. When properly set up to explain the agreement on trade, a blockchain may maintain title rights since it provides a record that demands an offer and acceptance. When correctly set up to explain the trade agreement, a blockchain can retain ownership rights since it offers a record that demands offer and acceptance.

The decentralized blockchain may use ad hoc message passing and distributed networking. One risk of a lack of decentralization is a so-called "51% attack", where a central entity can gain control of more than half of a network and can manipulate that specific blockchain record at will, allowing double-spending. peer-to-peer blockchain networks lack centralized points of vulnerability that computer crackers can exploit; likewise, it has no central point of failure

RESULTS AND DISCUSSION

Present a blockchain-based solution to track the origin of medicine using fruit and vegetable agricultural products query. This process involves interaction from many different members governed by smart contracts. Consumers could ensure the reliability of fruit and vegetable agricultural product information with the help of blockchain-based data storage.

Fig 3: output Window

This system helps track unused fruit and vegetable agricultural products, and validating their condition typically requires a centralized server to trace each product as it is transferred between different stakeholders.

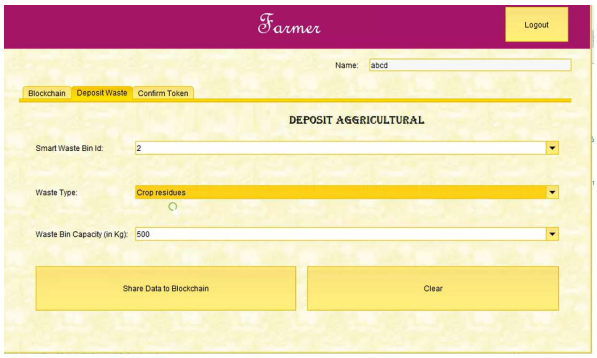

Fig 4: output Window

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