Research Article

# Blockchain based Public Distribution  System

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## Abstract

A country's Public Distribution System PDS plays a critical role in eradicating malnutrition and maintaining food quality. However non-uniform transaction records and lack of integration among stakeholders are hindering the effectiveness in this kind of method. The project proposes a computational model to investigate the feasibility of using blockchain to remove inefficiencies and trust in the method. We try to develop a blockchain-based approach that leverages smart contracts and a public blockchain network that will add transparency to the PDS system.

*Keywords*— blockchain, transaction, stakeholders, smart contracts

## I.    INTRODUCTION

Even though India produces more food than its population consumes, approximately 200 million people are still undernourished, which is around 24% of the world's hunger (FAO, 2018) [2]. India supplies grain and other products at subsidized prices to the needy sections through the Public Distribution System (PDS). However, PDS has several issues such as inefficiencies in identifying targeted beneficiaries, pilferage, and other operations. PDS is the largest distribution network of its kind in the world (Balani, 2013) [3]. The blockchain implementation of the existing PDS system will help reduce pilferage and improve the transparency of the whole system. As blockchain is a publicly hosted network, any entity or stakeholder can view the records corresponding to their role in the system. The immutable nature of the records stored in the blockchain ensure that the data once recorded cannot be altered later. This ensures the legitimacy of the data stored on the blockchain.

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## II. LITERATURE REVIEW

The application of Information and Communication Technologies (ICTs) such as the Artificial Intelligence (AI), big data, and Internet of Things (IoT), in the supply chain can lead to an improvement in the quality-of-service delivery, accountability, anti- corruption, and decision-making process. There are several case studies on the use of blockchain applications in the supply chain. Examples include tracking of shipping containers by Maersk in collaboration with IBM (Groenfeldt, 2017) [4], tracking a fish from sea to restaurant by Provenance (Hannam, 2016) [5], preventing the distribution of counterfeit food in the global supply chain.
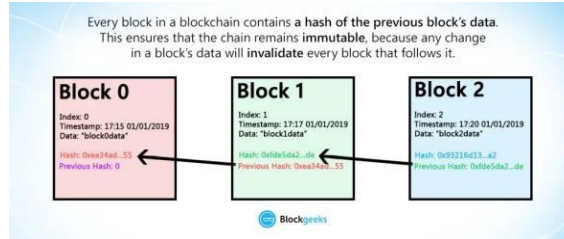


**Fig.1. Structure of blockchain**
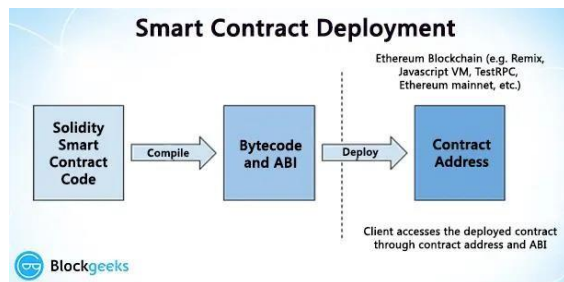


**Fig.2. Smart contract deployment**

## III. OVERVIEW OF INDIAN PDS

The Indian PDS is the largest distribution network of its kind in the world with approximately

5.35 hundred thousand Fair Price Shops (FPS) serving more than 231 million households. The Government of India (GoI) has introduced various targeted beneficiaries' schemes to improve the intensity of subsidy benefits through the National Food Security Act 2013 (NFSA). The scheme such as Targeted PDS (TPDS) covers population belonging to Below Poverty Line (BPL) and Above Poverty Line (APL).

The Food Corporation of India (FCI) is a central agency that manages all activities such as procurement, movement, storage and distribution on behalf of the Government of India (GoI). The FCI purchases grain directly from farmers or through Mandis government agencies. The grain is stored in the stocks of the FCI. To meet the demand of a deficient country / region, the FCI sends grain based on the demand and consumption of the period prior to the state / region of

depletion.

## IV.        SOCIAL CHALLENGES AND GOVERNMENT INITIATIVES

Some of the issues of the system includes (i) Lack of authentic identification of beneficiaries, (ii) Issues of ghost ration cards, (iii) Leakage of foodgrains during the process, (iv) Lack of real-time monitoring system,
(v) Lack of decentralized database to store data, but more importantly (vi) Issue of trust and single source of truth.

The major technical initiatives taken by the Government of India (GoI) with the help of state governments are (i) End-to-End computerization of the supply chain, (ii) online allocation of foodgrains to FPS, (iii) global positioning system (GPS) technology for doorstep delivery of foodgrains to the FPS, and (iv) digitization of the ration card database.

## V.        BLOCKCHAIN

Blockchain is a growing list of records called blocks that are linked by cryptography. As shown in figure 1, each block contains the cryptographic hash of the previous block, a timestamp and transaction data (usually represented as a Merkle tree). blockchain is resistant to changes in its data because the data of a particular block cannot be changed again after it has been saved without changing all subsequent blocks.

A blockchain is usually managed by a peer-to-peer network that follows a protocol for communication between nodes and validates new blocks.

## VI.        SMART CONTRACTS

A smart contract is a computer program or transaction log that aims to automatically execute, control, or document legally relevant events and actions in accordance with the terms of a contract or agreement. Smart contracts aim to reduce the need for reliable intermediaries, arbitration and execution costs, fraud losses, and the reduction of malicious and accidental exceptions. Since Ethereum, various cryptocurrencies have supported scripting languages that enable more advanced intelligent contracts between untrustworthy parties. Smart contracts need to be distinguished from legal contracts that are legally binding agreement in natural language. A smart contract goes through a series of steps to be deployed on the blockchain as shown in the figure 2.

## VII. PROPOSED SYSTEM

We propose to provide the ledger write access only to known participants such as GoI, FCI, central and state warehousing corporation, and verified ration shop dealers. It may be noted that PDS proposes four processes to represent various activities. The processes are: Procurement, Movement, Storage and Distribution. It may be noted that though quality control is not shown specifically, it is carried out when the items move from one entity to the other. Indian PDS follows a hierarchical structure for distribution, when we consider the physical movement of

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food grains starting from the centrally owned warehouses till the beneficiary.

Stakeholders in each level in PDS supply chain such as FCI Head Quarter, Transporters, Warehouse Manager, Fair Price Shop In-charge, etc. have a peer node that can reside on the cloud, data centers or local machines owned by that entity. Each peer in the network has a unique identity provided by a certificate authority. We assume FCI to be the certificate authority in our proposed model. The system architecture of the proposed model is shown in figure 3.

### A.  *Direct Purchase Centers*

Direct Purchase Centres are opened to procure paddy from the farmers. Normally a Direct Purchase Centre will have an area of about 33 cents and storage facility of 100 MT, drying platform, winnowing machine, electronic weighing scale and moisture meter. Direct Purchase Centres are opened every year, generally throughout the state and in the Delta Districts in particular, depending upon extent of paddy cultivation. Government is committed to provide permanent infrastructure to the Direct Purchase Centres as they play a crucial role in procurement. Therefore, Construction of own buildings for Direct Purchase Centres is being taken up in a phased manner.

### B.  *Warehouse*

For the movement plan of food grains in the PDS supply chain, deficit state warehouses send a request for food grains to surplus state warehouses. This request targets all the peer's representative of the stakeholders involved in this channel. After that, a transaction proposal is constructed and used to invoke a smart contract with specific input parameters in order to read and update the ledger. Great care is taken to ensure that the rice is stocked properly through the maturing stage. The rice is stored in the warehouses of the company, which are spacious and well ventilated. A vigilant staff ensures hygienic conditions in the warehouse. Further on, regular inspection and fumigation is carried out to prevent any kind of infestation against various microorganisms. The crop is allowed to stay in the warehouses for a long time to ensure complete maturity of rice.

### C.  *Consumer*

Consumer or beneficiary is the end user who gets benefited from the subsidized food-grains. Every household is provided with a unique identity called Ration Cards. The beneficiary is also provided with special schemes based on the geographical conditions and interests. Based on the type of the card the consumer possesses, they are provided with appropriate quantities of food grains.

### D.  *Fair price shop*

The public distribution store, also known as the Fair Price Store (FPS), is part of the Indian public system set up by the Indian government that sells mediocrity at subsidized prices. Locally these are known as ration shops and public distribution shops, and chiefly sell wheat, rice and sugar at a price lower than the market price called Issue Price. Other essential commodities may also be sold. To buy items one must have a ration card. These shops are operated throughout the country by joint assistance of the central and state government. The items from these shops are much cheaper but are of average quality. Ration shops are now present in most localities, villages, towns and cities. India has more than 5.5 lakh - 0.55 million) shops, constituting the largest distribution network in the world.
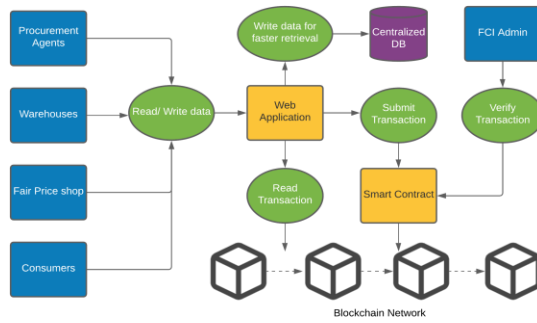
**Fig. 3. System architecture**

# VIII.    IMPLEMENTATION

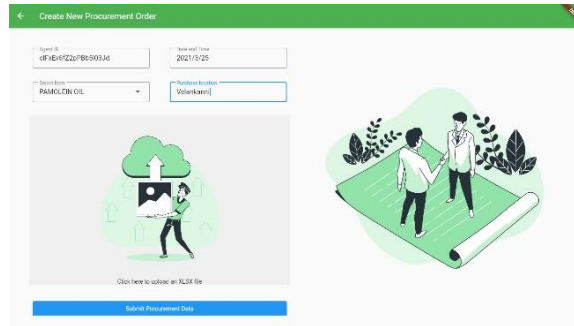A.    Procurement data Submission



**Fig. 4. Upload procurement data as excel**

This page records the purchases done by procurement agents from farmers. For every purchase made, details like procurement location, agent id and farmer id are specified as shown in the figure 4. Items and their quantity are also mentioned here. All the details filled in the form is retrieved in the form of a JSON string. The retrieved JSON is used to brain a sha256 hash digest which is recorded in the blockchain against its corresponding transaction ID.

B.    Transaction password

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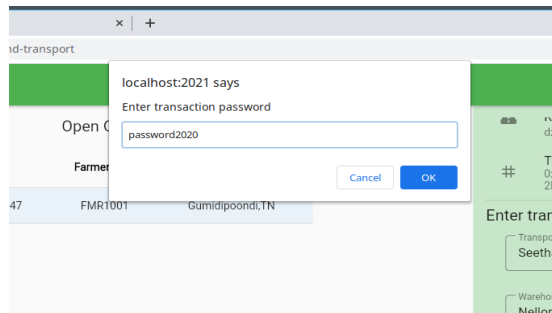
**Fig.5. Transaction password prompt**

Every transaction made by the respective stakeholders like agents, managers, dealers are also secured by a second level of authorization by requiring them to enter a transaction password as shown in the figure 5 before recording it on the blockchain. This password serves a dual purpose in a way by providing a second level authorization as well as the password for decrypting the wallet stored in the database for signing the transactions before sending them to the blockchain.

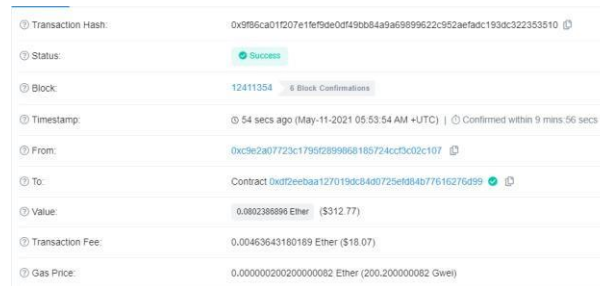C.    Etherscan transaction reference



**Fig. 6. Etherscan transaction reference**

Figure 6 is a snapshot from the etherscan.io website    showing the details of a sample transaction. The  etherscan.io website can be used as the block explorer for the public networks of ethereum. The above snapshot displays details of a sample transaction like the timestamp, Transaction status, included block number, gas used and the participating address. This page can be considered as a proof of the transactions made using the web application

## IX.    CONCLUSION

Through this paper, we have proposed a blockchain  based solution for Indian PDS using ration cards in Indian Public distribution system use ration card to get subsidized food grains. The proposed framework provides a thorough investigation into the complicated structure of the supply chain and conceptualizes how the technology can be effectively used. It helps in providing a structured solution to the issues faced by Indian PDS such as poor beneficiary identification and data inconsistency due to unorganized and poorly maintained electronic records. We have also identified the list of possible data analytics for different stakeholders to take appropriate decisions. To decide which kind of supply chain transaction data go where, we presented the framework for storage and analysis of data across on- chain and off-chain to enhance the performance of proposed blockchain framework. Employing a unique identification system for beneficiaries in Indian PDS, we have demonstrated a consortium blockchain based solution to prevent the use of ghost ration cards and leakage of food grains and so on. The work can also be further extended to investigate and alleviate the technical issues that may come up during implementation while handling huge amount of data generated in the PDS supply chain.

# REFERENCES

[1] Blockgeeks Infographics

[2] FAO. (2018). The state of food security and nutrition in the world 2018. In Global food insecurity report. https://doi.org/10. 1093/cjres/rst006.

[3] Balani, S. (2013). Functioning of the public distribution system-an analytical report. In PRS legislative research (Issue December).

[4] Groenfeldt, T. (2017). IBM and Maersk apply blockchain to container shipping. Forbes. https://www.forbes.com/sites/ tomgroenfeldt/2017/ 03/05/ibm-and-maersk-apply-blockchain-to- container-shipping/

[5] Hannam, K. (2016). This emerging tech company has put Asia's tuna on the blockchain. Forbes. https://www.forbes.com/ sites/keshiahannam/2016/ 09/30/this-emerging-tech-company-has-put-asias- tuna-on-the-blockchain/