ADOPTION OF BLOCKCHAIN TECHNOLOGY IN INDIAN PUBLIC DISTRIBUTION SYSTEM CHALLENGES AND SOLUTIONS

Kartik vadia[1], madhavi damle[2]

[1,2]Symbiosis Institute of Digital and Telecom Management,

Symbiosis International (Deemed University), Pune, India

Email: [2]mdamle@sidtm.edu.in

ABSTRACT

Indian public distribution system is a process to ensure food security in the country and provide basic food grains at subsidized rates with involvement of food corporation of India, an organization set up, and run by the government of India under Food Corporations Act 1964 & National food security bill of 2013. For increased efficiencies a proposed adoption of blockchain technology in the Indian public distribution systems which can foster transparency and monitoring systems.

The paper is a suggestion of solution structure for secured and transparent systems using blockchain technology.

It is a concept paper and we propose a solution to manage and track efficiently the process public distribution along with the supply chain solutions, within the Indian Public Distribution System with technology enhancement using Blockchain. The Findings in the supply chain structure of the public distribution system in terms of tracking in transportation and trade booking with robust solutions for of verification and traceability. Losses and malpractices of false bookings to avoid corrupted practices with be more effective in cost-saving, with efficient delivery and reach.

1. Introduction

The Indian Public Distribution System is under the purview of the ministry of consumer affairs, food & public distribution under the government of India which is responsible for procurement of the grains and other commodities part of distribution systems such as rice, wheat, sugar, and kerosene and allocates the goods to state government as the population in the state below poverty line (BPL) and selected families above poverty line (APL) depending on the income levels. The distribution of the commodities is based on the number of members in the family. The cost of commodities for the government is as described as below

Total cost of commodities = Allocation per person x No of beneficiaries

Where, Allocation per person = (MSP of goods – CIP of goods) x No of KG allocated per person

However, it has been noted that the cost of transportation and storage of goods incurs a larger share of expenditure as compared to the actual cost of goods, which forces the system to adopt smart management systems to enable efficiency and management at the source with secured and reliable solutions to achieve cost-effectivity and serviceability to the financially backward families.

The current process of Public distribution system includes various parties invovled in the determination of the selected unprivileged families near and below the poverty line seeking aid to procure the basic necessity of food at subsidised price. Post determination of target population the FCI procures the goods from farmers across the country by paying MSP (Minimum Support Price) and supplies it to the states as per pro-rata basis of the target population. The state then manages the process by supplying it to district and zonal offices to make sure the commodities reach fair price shops to benefit the target population.

Blockchain is a network decentralised in nature where peers are connected to each other, and the process is managed and governed by an organisation. The network shares a ledger for all the transactions recorded and does not have any central storage which works according to consensus protocol having a shared responsibility.

With the adoption of blockchain technology for maintaining records of the transaction from the procurement of goods up to the last chain in the channel being ration shop/ fair price shop will create a structured accounting and monitoring structure for the government to track activities. The paper also proposes the use of technology such as Internet of things and LORAWAN during transportation for tracking and monitoring for any theft or compromise in the quality of the goods.

In the paper we are suggesting blockchain system to be adopted for addressing the issues as it is majorly depended on manual documentation and approval formalities by filing paper forms for dispatch and allocation of commodities from every stop, the transporters need to file pick up slips and delivery notes at every pickup and drop which takes many days for approval by hierarchy and system updates and verification as digital systems are available are selected

nodes due to present semi-electronic system which requires the regular filing of transactions for future dispatch.

The paper also identifies various issues pertaining to logistics & transportation, accountability, traceability, monitoring challenges and tries to suggest solutions regarding tracking of goods during transit, auditability of the transactions and electronic record of the transactions to reduce cost and conduct the process in an efficient and time-saving measures.

1.1 Objectives:

1)   To create a monitoring system for end to end flow of commodities from central government to ration shop/customer.
2)   Develop a structure to include all transactions, records and inventory among the supply chain and end customers.
3)   Create a corruption free system to disable malpractices like hoarding, false trading by ration shop owner, and duplicate purchasing by customers.
4)   To create a transparent system to supply optimum quantities in areas with tracking systems for hassle free distribution

The system will aid to structure all transactions, orders, and inventory along the supply chain and assist smooth and error-free transportation system. The system will lead to optimum utilisation of resources and smart tracking system along the supply chain.

It can reduce losses occurring due to unstructured management and malpractices in current systems. The solutions will support tracking of the process to enable constant supply to avoid unavailability of grains at fair price shops.

2.   Literature Review

The area and implication of the National Food Security Act (NFSA) 2013, and the structural process of the distribution service currently followed in India along with challenges regarding the leakage of food grains during transit and malpractices of selling food grains from ration shop to open market are discussed. The duties of FCI with respect to procurement, storage, and transportation to states as per allocation in terms of FIFO to avoid storage complexities (Balani, 2013). The process related to the objective to ensure adequate food supply across the nation at a subsidised rate by creating substantial food and nutritional security, involving various procedures involved by organisations and government bodies involved in management and supply chain of the process at multiple disbursals points post verification and paper documentation are explained in the paper (Chhabra et al., 2018). The paper discusses the process of public distribution system in India and describes the categorization of beneficiaries and the benefits available as per the family size and areas of leakages in the systems due to inefficient functioning of the systems and low monitoring or audits at fair price shop (Luvisotto et al., 2018). The paper discusses the current ongoing structure of allocation and distribution of goods in the distribution system over a web-based applications updated only at distribution centres as allocated by the government which involves major document-based to be submitted to the centres by the shops and zonal office to book trades and demand grain for stock and report the sales and involves a

paper trail in transportation orders and storage facilities. The challenges of semi-electronic systems involve a time-consuming process in distribution. It also describes the functions of the PDS with roles and responsibilities of the parties involved in the process namely FCI, state government, fair price shops, and consumers (Report, 2009). The paper states the loopholes in the pricing and earning capabilities of ration shop owners leading to corruption and malpractices along the process in the transportation and limited verification process leading to adulteration and robbery. The process is paper backed and involves regular reporting and filing of details with the authorities for further approval and logistical support (Gupta & Singh, 2016). The paper discusses the challenges pertaining to labour and skilled workforce in the process employed with the intermediaries and the challenges of the e-governance. It also identified areas for improvement as per the priority which will help the governing bodies to implement e-governance at a faster pace with ease of adoption and application (Zheng et al., 2017).

Blockchain technology aids in the auditability of the transactions through its unique network composition and decentralised operations among all the nodes (peers). The transactions and transfers are based on the consensus of the network post the approval by forming a block of a transaction to be entered into the network. The paper also describes the consensus algorithm for various architecture of blockchain (Ghabru et al., 2017). The paper states the applications of the technology have been made across various businesses and operations in the financial and non-financial areas and the rights of the public key and private key also defines the conditions of the network architecture, where zero-knowledge proof of work is implemented and does not need the miners to validate a transaction. The data stored in the network is virtual so can be accessed in any point of time and also be used to create an estimation (Food & Act, 2017).

The paper describes the acceptability and applicability of the blockchain technology in the public service delivery in the government areas to create a block of a recordable asset in a digital medium to form a continuous chain flow of commodity with aid to transparency and verification through hash created in every transaction looped with previous the hash to maintain the chain of flow. Also, suggests the prototype for blockchain in public distribution service and MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme (Prabhu, 2018). The paper aids in developing a structure to enable transparent systems with proof of work for every transaction booked at nodes for verification in a central ledger with an unalterable transaction system with a flow to track commodities and payments. The lack of nodes in the current semi-electronic system is posing a challenge for the central government to monitor the transaction at the end node of the ration shop which is expected to exploit the power of goods distribution and involve in the manipulation of the transactions, providing smart blockchain solutions to block and fill the loopholes of the system (Famnaz & Kumari, 2019)

The paper states the concept of IOT which is interconnected with the use of RFID tags for unique identification. The LoRa WAN which stands for low

power wide area network which is introduced for industrial application to keep a monitoring check on the devices to achieve long range communication over an interval of time, the data is communicated through a unlicensed spectrum over long ranges and major applications are in the area of outdoor monitoring applications where continuous monitoring is not required only timely updates can solve challenges easily (Luvisotto et al., 2018)

3. Existing System

The existing system in the Indian public distribution is semi electronic and involves major paper documentation and reporting for the entries to be entered into the systems for further monitoring. The exact transactions details cannot be entered precisely and collective entries for the day/week are entered into the system which creates a room for manipulation and corruption in the process leading to frauds and malpractices.

The process and approvals in the system indulge of various parties such as FCI, States government, Fair price shops, as the part of primary process for allocation and distribution of the benefits to the target population. Apart from these players the process includes vendors who are appointed for jobs of transportation, storage of grains, and procurement parties which needs to be monitored to avoid issues of adulteration and theft which leads to sale of grains in to open market (Singhal et al., 2016).

The central government does not have access to the transactions and the current process has its own limitation due to involvement of middleman and false trade booking by the fair price shop owner into fake ration cards or exploitation of services from consumers regarding updates in the members of family to attain higher amount of goods.

The existing system is time consuming in terms of process as the approvals, allocation, procurement and sales usually involve 5-15 days in approvals at each level from various players and officers from disbursement to receipt of commodities and involves major manual updates of transactions in the system on the basis of documents.

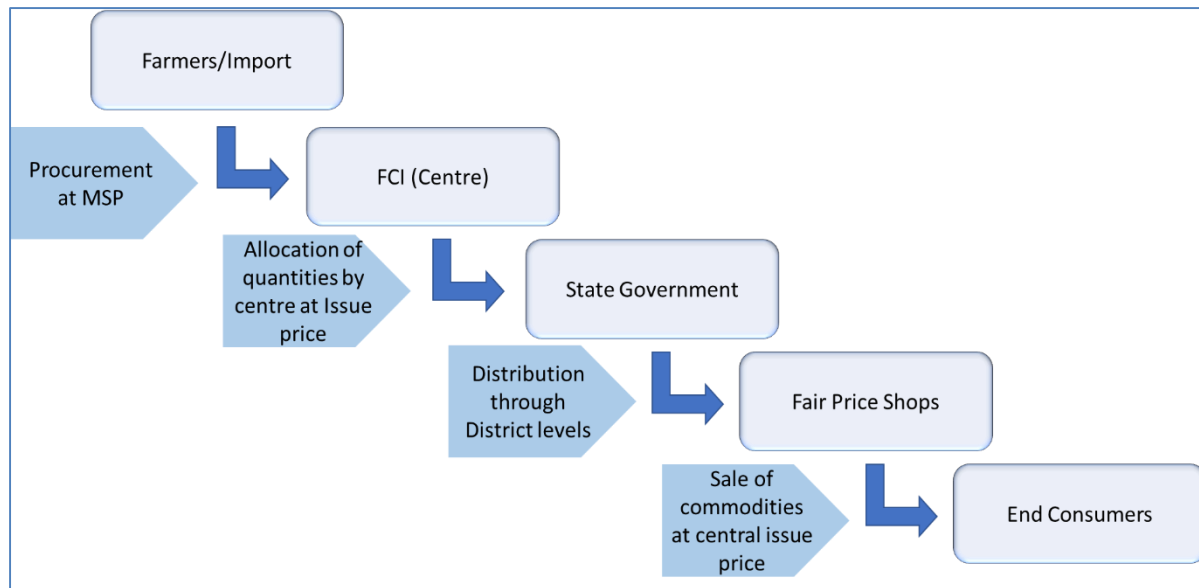The usual flow of commodities in a process is as shown below

Figure 1: Flow chart of commodities in the process of Public Distribution, Adapted from "(Balani, 2013)"

4. Proposed System

The blockchain technology implemented in Indian Public Distribution System brings changes in operation and advances the management structure of the process by standard procedures and entry systems to keep track and create secured & reliable architecture with permissions to all nodes to transact and review the updates.

The benefits of proposed systems are

- Multiple active nodes transacting at the same time

- Secured and complex network architecture to prevent from frauds, hacks, and thefts

- Cost-effective and time-saving management system

- Proof of work

- Decentralised network immune to system failures and network breakdown

The blockchain technology contains the block of transactions managed by computer nodes in the network as there is no central server to store the data or controls the process. The blocks are sequenced and aligned using a cryptographic algorithm to create immutable data leading to its one of the major properties of transparency in the network. Any transaction mined into the system cannot be deleted and will reflect the details mentioned. However, the transactions can be disabled in the chain in case of errors but still be reflected in the disabled details while viewing the version updates into the chain. The main property of the block is to create a chronology of the transactions along the process which helps in efficient management and tracking.

The block of transactions will contain the following details:

i. Hash of the current block
ii. Hash of the previous block

iii.   Timestamp
iv.   Proof of work
 v.   Data of transactions

The proof of work relates to the creation of the block including the various transactions. The node broadcast the block across the network and other node tries to create a logical chain using the hash by solving a mathematical puzzle which is termed as mining in the blockchain. If the block is valid it is added into the chain and this qualifies for the proof of work which is approved by other nodes.

The blockchain technology will provide a solution to keep records of all the transactions since the procurement of commodities to the sale transactions including the logistic transactions with tracking facilities with help of IoT or LORAWAN technology.

The goods procured from farmers are packed in a sack of 25kgs or 30 kgs. Once then sacks are procured by FCI the process of verification, transaction booking, and installation of barcodes and devices of LORAWAN. The barcodes contain the details of the content of the sack such as Quality of grain, the weight of sack, and unique identification details for the sack. The LORAWAN devices are expected to provide details of the sack on a timely basis and the devices can only be removed by authorized personal which will be updated in the blockchain network, to avoid theft and unwanted adulteration of quality. The IOT devices will be used in trucks and logistics for real-time updates and estimated time of arrival to the upcoming node.

The below diagram will explain the flow of commodities from Procurement to end node of the ration shop and its transaction. As we know the blockchain architecture follows the peer-to-peer network architecture, where every node is connected to the other node. The diagram will also explain the naming convention of the nodes to better understand the transaction of the block in the blockchain architecture.

The process will follow a logical chain of transactions as per its structured flow, the names suggested will aid to avoid hassle free communication and process.

From the diagram shown as above, the district named "Hdr1234" will be only enter transactions related to its lower header "Hdr12" & "Hdr34" and report the details to it higher node of its respective state. This allows a secondary check for the transaction level in case of any discrepancies. Since blockchain technology is created to validate the transactions and create a block with approval from 51% of the total nodes, the hierarchical structure of naming and inclusion of previous hash in transactions will make the process easy and efficient.

The below table suggest the advancements and upgrades with implementation of the blockchain technology in the Indian Public Distribution System.

The count of target consumer is carried through census and later through the updates in the ration card, the updates need to be digitized as the ration card is updated immediately at the time of birth in the family to procure higher amount of grains but the death in the family is not updated and causing major

disbursement issue and the lack of integration of directories posing a higher challenge [9]. The integration with Aadhar Card will aid in creating updated family details and also aid in providing the base to migration of process from semi-manual to completely electronic management.
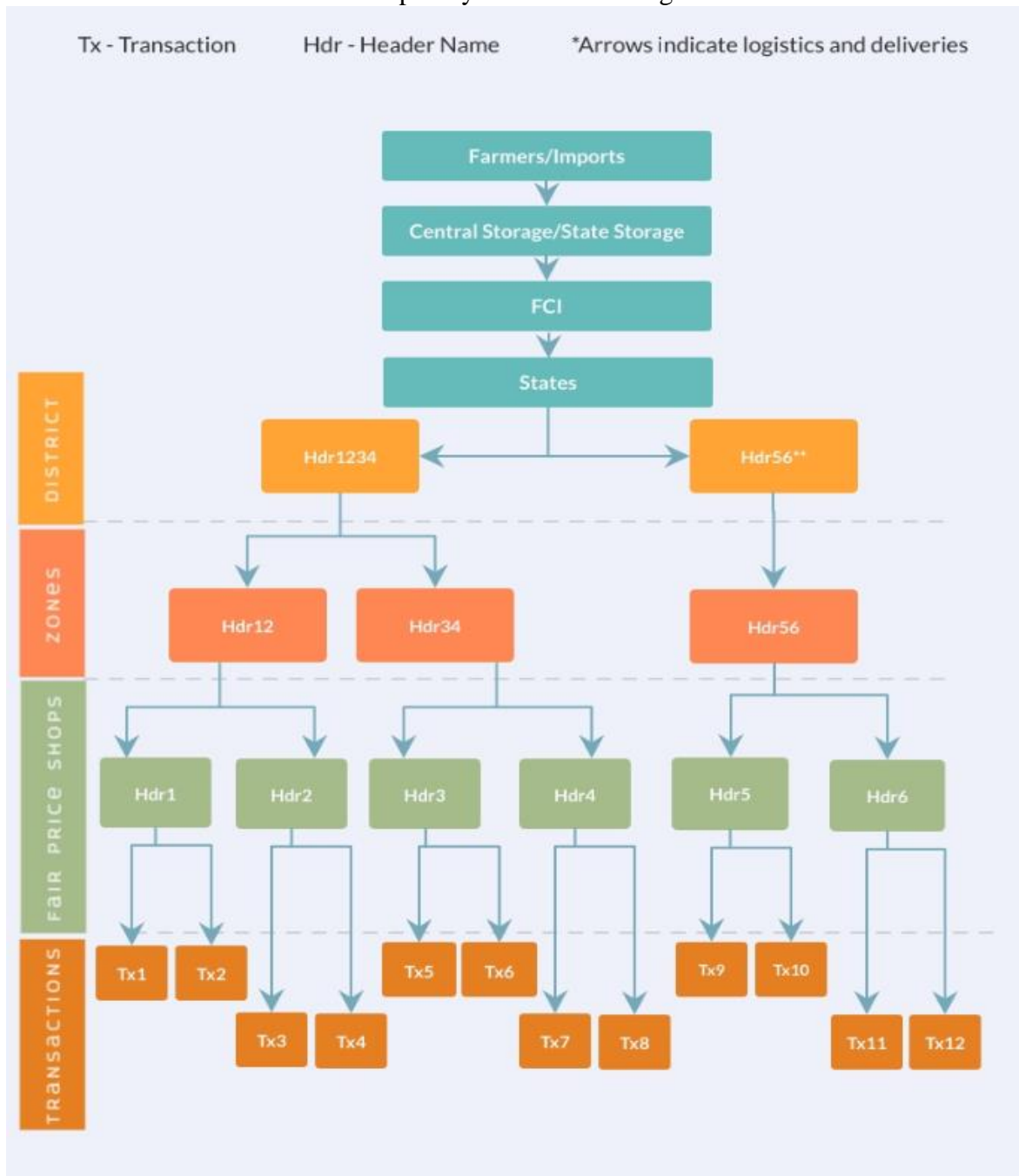

Figure 2: Distribution Channel with proposed naming convention for better traceability

The process with FCI is very complex and has to go through multiple stages before sending it out to the states for distribution. The process starts from the procurement where the FCI needs to setup various purchase centres or *mandis* which can support technological support as the farmers sell their produce

against the MSP, these grains need to be reviewed for their quality and hygienically stored in the godown as the grains need to be preserved throughout the year where a RFID tag will help to manage the commodities efficiently and keep an auditable check on the inventory. The FCI is a governed body by the central government hence the major contribution and management structure is required in this stage as the disbursement of the commodities and estimated time of delivery will be performed with a robust procedure of blockchain and tracking devices as the major physical approval and paperwork will be eliminated with technological implementation. The vendor management can be done efficiently with external nodes given to vendors to assist in storage, transportation, imports, and exports.

The process at a state government is a complex procedure as the state government also aids the FCI in procurement facilities, the systems are required to be robust to handle multiple transactions and approval processes as the physical custody of the commodities is with the state government for supporting storage facilities but allocation form the FCI/Central is outstanding. The RFID tags and technological advancements in this scenario will be able to provide structured and efficient management. Due to the low availability of the physical storage area, FCI outsources its activity to state or either third party vendors, hence the system nodes need to handle by these vendors or appoint manpower from FCI for the activity of approval of grains and further installation of tracking devices. This manpower will also be supervising the task handled by the vendors and facilitate continuous audits of godowns conditions and prevent theft or any other malpractices.

Area of work	Earlier Procedure	Proposed procedure through blockchain
Count of Target consumer identification	Antyodaya Anna Yojana, Planning Commission, Ministry of rural development, Central government with help of census	The identification of target consumer remains the same in addition to ration card the details should be synchronised with Aadhar card for automatization
Food Corporation of India (FCI)	Procurement of commodities from farmers and storage into Central godowns, allocation of commodities to state as per distribution requirement and population. Under certain circumstances, ad-hoc demand has to be made by the state in case of calamities and distress	The plan suggests the FCI offices will take part in procurement but the godowns for storage should be handled by State government to save costs of storage and maintenance, as limited states are involved in procurement procedures, the devices of LORAWAN transmitters and barcodes will be installed by FCI officials. The Allocations will be routed through blockchain systems and intimation to logistics for deliveries to state government. The demand can be raised through the developed blockchain tool

Logistics from Central to State Allocation	Post allotment the delivery procedures involves a lot of manual documentation in terms of third-party vendors for pickup and delivery locations as per allocation.	The third-party vendors can be allocated a node under blockchain for all communication and Payment details, the carriers (Trucks) will have installed IOT devices for live tracking and real-time updates.
Allocation from State to District	The state government allocates the districts commodities as per population and further logistics is to be handled by state government either through maintained transport infrastructure or third-party involvement as per grants and availability of funds as per budget allocation	The allocation transactions will be booked under the blockchain network with third party node (Logistics) and district offices node. The quantity of allocation procedure remains the same as per population
District to Zonal offices	The zonal offices are allocated goods as per the population and need to file records with the district office of sales every month	The transportation and other facilities can be managed as above the transactions can now be filed on a real-time basis as per transaction booking, also request can be generated for additional requirement of quantities
Zonal offices to fair price shop	The fair price shop owners need to file sale transactions every month with zonal offices to report the remaining stock and demand stock for upcoming month involving investment of time, labour and paper documentation	The transactions of the sales from fair price shops can be directly updated to the systems saving cost on energy and resources
Fair Price to consumers	The fair price owners enter details in the ration card/book for the consumer and own records as each family has its allocated ration shop in the nearest area. The duplicate manual entry is saved with the shop owner to report upwards in the process chain	The sale transactions will be recorded electronically as per Aadhar linked ration cards for transparent sales and to avoid human errors for duplicate sales

Table1: Comparative table of current and proposed process

The count of target consumer is carried through census and later through the updates in the ration card, the updates need to be digitized as the ration card is updated immediately at the time of birth in the family to procure higher amount of grains but the death in the family is not updated and causing major disbursement issue and the lack of integration of directories posing a higher challenge (Transfers, 2018). The integration with Aadhar Card will aid in creating updated family details and also aid in providing the base to migration of process from semi-manual to completely electronic management.

The process with FCI is very complex and has to go through multiple stages before sending it out to the states for distribution. The process starts from the procurement where the FCI needs to setup various purchase centres or *mandis* which can support technological support as the farmers sell their produce against the MSP, these grains need to be reviewed for their quality and hygienically stored in the godown as the grains need to be preserved throughout the year where a RFID tag will help to manage the commodities efficiently and keep an auditable check on the inventory. The FCI is a governed body by the central government hence the major contribution and management structure is required in this stage as the disbursement of the commodities and estimated time of delivery will be performed with a robust procedure of blockchain and tracking devices as the major physical approval and paperwork will be eliminated with technological implementation. The vendor management can be done efficiently with external nodes given to vendors to assist in storage, transportation, imports, and exports.

The process at a state government is a complex procedure as the state government also aids the FCI in procurement facilities, the systems are required to be robust to handle multiple transactions and approval processes as the physical custody of the commodities is with the state government for supporting storage facilities but allocation form the FCI/Central is outstanding. The RFID tags and technological advancements in this scenario will be able to provide structured and efficient management. Due to the low availability of the physical storage area, FCI outsources its activity to state or either third party vendors, hence the system nodes need to handle by these vendors or appoint manpower from FCI for the activity of approval of grains and further installation of tracking devices. This manpower will also be supervising the task handled by the vendors and facilitate continuous audits of godown conditions and prevent theft or any other malpractices.

The district and zonal levels need to be majorly involved in the management and timely distribution of the commodities where the trackers and analytics systems will aid them to avail information regarding the estimated time of arrival and prepare organised flow of receipt and dispatch of commodities as per the demands generated from the fair price shops as per the sales record and the available inventory with them. The systems will also take into consideration the special requests due to natural calamities to generate specific demands and supply ad-hoc commodities in times of distress throughout the supply channel.

The tracker devices installed on the sack of grains will be removed by the fair price shop owners by inputs of the owner details and the device to be returned to the FCI for reuse. The devices will help in monitoring any unwanted opening and tearing of sack, it will monitor location to avoid unwanted pitstop for adulteration or exchange of sack information with low-quality grains.

The sales procedure at fair price shop are as followed:

* Scanning of Aadhar card of the registered head of the family.
* Verification of records and eligibility in the month (As poor households may purchase grains as per daily/weekly basis as per availability of funds)

- Scanning of the sack barcode to determine the quality of grain sold and for price determination.
- Scanning on similar terms for all items and bill generation

5. Benefits of the System

- Eradication of black-market sales in fair price shop due to electronic sales
- Eradication of false sales booking into dormant ration card, as all details of birth and death will be updated electronically through Aadhar.
- Updates to zonal offices for stock availability in the fair price shops and sales records
- Transparency at customer end through an SMS update of the bill or paper bill as feasible.
- Eradication of waiting time for approvals and verification of stocks which usually take 7-15 days at state and district offices for approval and dispatch.
- Transparency for central and state governments to monitor the process on real-time basis.
- Avoids adulteration and manipulation in quality of goods, theft of goods during transportation
- Request of automated ad-hoc supplies to the upper hierarchical stage in case of shortages.

6. Discussion

Building Web-based portal for electronic records at the time of sale and automated EOD updating of records into the blockchain as per the required format by the portal will be efficient way to manage records and allow couple of hours to handle errors before it gets updated to blockchain ledger. Special surprise audits at fair price shops to maintain integrity and accountability. Ratings of the fair price shops to be generated via reviews of the audit committee and customers through regular verification and survey to maintain the risk of losing the rights to operations as per review and audit reports. The system will help to cut costs significantly in a time-saving manner due to digitization of the process with utmost transparency and auditability. The government can keep a track of consumers using the facilities frequently and also determine the income levels through linking Aadhar card (Assuming Aadhar card already linked to PAN card) helping the government to update the income levels which are not revised since many years and target a specific population, thus supplying optimum quantities and prevent black market trading at the fair price shop.

7. Conclusion

The process of Distribution is expected to be followed in a streamlined manner. The process will cater to areas of application, allocation, approval, tracking, and selling of commodities. It will enable a well organised channel of communication and updates. The electronic database will help in the analysis of the consumption and challenges at various levels to be addressed as per priorities. It will require maximum investment in capital expenditure to develop blockchain network, IoT, and LORAWAN devices which will be recovered

soon due to the systematic and efficient cost-saving methods as compared to current systems. The current malpractices will be eradicated and lead to a better rationalized process of operations. The proposed system will disrupt the manual processing and middleman present in the current system.

References

Balani, S. (2013). Functioning of the Public Distribution System. *PRS Legislative Research*, *December*, 1–21.

Chhabra, V., Chopra, S., & Rajan, P. (2018). Challenges in technology adoption in Indian public distribution system: A quality management approach. *International Journal of Productivity and Quality Management*, *23*(3), 328–348. https://doi.org/10.1504/IJPQM.2018.089804

Famnaz, A. F., & Kumari, D. S. (2019). Implementing Blockchain in Public Distribution System. *Ijarcce*, *8*(6), 120–125. https://doi.org/10.17148/ijarcce.2019.8624

Food, N., & Act, S. (2017). *National Food Security Act 2013 and Reforms in Public Distribution System;* Natio*nal Consultation on Sustainable Development Goals SDG 2-Zero Hunger ('End hunger, achieve food security and improved nutrition and promote sustainable agriculture)*. https://niti.gov.in/writereaddata/files/Nilambuj-Final Presentation.pdf

Ghabru, M. G., Devi, G., & Rathod, N. (2017). Public Distribution System in India: Key Issues and Challenges. *Indian Journal of Economics and Development*, *13*(4), 747. https://doi.org/10.5958/2322-0430.2017.00240.2

Gupta, P., & Singh, U. (2016). Efficiency of Public Distribution System Insights and Challenges. In *Delhi Business Review* (Vol. 17, Issue 1). http://www.delhibusinessreview.org/V17n1/dbr_v17n1g.pdf

Luvisotto, M., Tramarin, F., Vangelista, L., & Vitturi, S. (2018). On the Use of LoRaWAN for Indoor Industrial IoT Applications. *Wireless Communications and Mobile Computing*, *2018*. https://doi.org/10.1155/2018/3982646

Prabhu, S. (2018). *Blockchain Prototype for E-Governance CHAPTER-1. June*. https://doi.org/10.13140/RG.2.2.10710.14408

Report, A. (2009). Department of Food and Public Distribution (Ministry of Consumer Affairs and Public Distribution), Government of India. *Annual Report*, *1*(1), 114–157.

Singhal, P., Agrawal, R., & Sharma, V. (2016). Significance of Supply Chain Management in Public Distribution System. *Journal of Supply Chain Management Systems*, *5*(1). https://doi.org/10.21863/jscms/2016.5.1.024

Transfers, D. B. (2018). *Improving Public Service Delivery through Blockchain Technology Applying blockchain technology to achieve data security and simplify Direct Benefit Transfers 1*. 1–10. https://www.semanticscholar.org/paper/Improving-Public-Service-Delivery-through-Applying/58bbc60a328bca404d5a03356f852297df279ddc

Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends. *Proceedings - 2017 IEEE 6th International Congress on Big Data, BigData Congress 2017*, *June*, 557–564. https://doi.org/10.1109/BigDataCongress.2017.85

Kamilaris, A., Fonts, A., & Prenafeta-Boldύ, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. *Trends in Food Science and Technology*, *91*(September), 640–652. https://doi.org/10.1016/j.tifs.2019.07.034

Niti aayog. (n.d.). https://niti.gov.in/planningcommission.gov.in/docs/plans/mta/mta-9702/mta-ch8.pdf

Odisha State Civil Supplies Corporation Limited. (n.d.). http://oscsc.in/pds.html

Sharma, N., & Shankar, P. R. (2016). Supply chain challenges in public distribution system. *Journal of Supply Chain Management Systems*, *5*(1), 27–32.

Singh, C. (n.d.). *WORKING PAPER NO : 481 Expenditure Management in the Public Distribution System*. *February 2015*, 1–30.

World Bank. (n.d.). https://www.worldbank.org/en/news/feature/2019/02/21/schemes-to-systems-public-distribution-system