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Usage of Blockchain Mechanism in Indian Public Administration

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A B S T R A C T

Blockchain is an advanced mechanism that allows transparent information for a business network. Normally databases in this technology are stored in blocks that are linked together in a chain. It is used as a facilitator for the process of recording transactions and tracking assets of a business network. It will help share data for a collective group. With blockchain, cloud service and transactional data from multiple sources can be easily collected, integrated, and shared. This technology concerning India presently is used by government banking institutions as well as the government storing and sharing data for a wider group. Blockchain is popular in finance, especially money and time. Recently India has made efforts to become a society with digitalized setup by building a large citizen-scale digital public infrastructure, which is a positive push for the government. The basic motive for introducing a high ended technology like blockchain is for maintaining transparency, and to increase the speed of interactions with individuals. This paper has made attempted to study the mechanism adopted by the Indian government under a blockchain and how well it has been utilized. It has also attempted to give a clear picture, of what all developments have made with blockchain and what sectors are much concentrated with blockchain

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INTRODUCTION

Blockchains are a new data structure that is secured, cryptographically, and distributed across a network. These are nodded by the technologies which are supporting cryptocurrencies such as bitcoins and the transfer of any data or digital assets. This technology leads a chain that will be in blocks with digital information in a public database, which is distributed database existing on multiple computers at the same time which grows and grows without and end as new sets of recording grow and blocks of information or data are added to the existing blocks.

Ministry of Electronic and Information Technology, the center of excellence in blockchain technology is a coordinated blockchain ecosystem around the nation. It will focus on advancing blockchain technologies, platforms, assets, and systems to develop industry understanding and implement blockchain chain technologies. This will be a platform for innovative new solutions and a gateway to test and develop solutions for projects by NIC - National Informatics Centre at the central and state level. So, the NIC and Center for Excellence team will collaborate with global experts to develop and implement innovative blockchain solutions as proof of concept of production.

The platform created by the government wants to promote the use of blockchain technologies and facilitates the rapid adaption of blockchain-based solutions, which brings stronger collaboration. It ensures government, public private, and corporate that the latest technologies and standards are made available safe and trust manner. The exposure of blockchain technology has the assurance that the government has trust and greater transparency about activities and provides tireless transactions to the citizens. But it is a critical factor to accelerate the right application of the technology. It is just that government solutions should provide strong evidence and investments that will save money and improve services. Currently, the CoE-BCT is located in Kendriya Sadan, Koramangala, Bangalore, Karnataka.

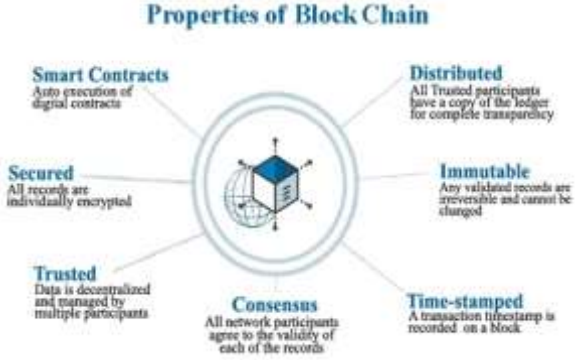

Figure 1. Properties of Block Chain

Features of Blockchain

Here are some main features of blockchain technology

- Decentralized: the network is decentralized, the group of nodes that is making the network decentralized. It gives the users a straightforward position, as this system doesn't need any governing authority we can directly access the web and have track of the assets.

- Immutability: this means that a thing which can't be changed or altered. The technology ensures that it will remain permanent and unaltered. As it is a decentralized system every nide of the system has its copy of the digital ledger. So, every mode checks its validity when a new transaction is added. It promotes transparency and makes it corruption free. So, if the majority feels it has valid then only it is added to the ledger, without a majority consent from the nodes no one can add transaction blocks to the ledger. Once a transaction block is added to the ledger then no one can change the blocks.
- Enhanced security: No one can simply change any characteristics of the network for their benefit. Encryption ensures another layer of the security system. Every information in the blocks has been hashed cryptographically. So, if someone tries to tamper with the data means to change the hash IDs entirely. There could be millions of people with the same copy of the ledger, so a person who wants to corrupt must alter every data at every node.
- Distributed Ledgers: A public ledger will provide all the information related to the transaction. Since the ledger system is maintained by other users so many people can see what exactly is on in the ledger. The distributed ledger responds well to suspicious activity or tampering. Nodes act as verifies of the ledger. If a user wants to add a new block, then it needs to be verified by others and then only a green signal is given. To keep a blockchain feature working properly it needs to maintain the ledger and participation for validation.
- Consensus: because of the consensus algorithm every blockchain, every blockchain has a consensus to help the network to make transactions. So here is simple, the consensus is a decision-making process for the group of nodes active in the network. Here the nodes can agree relatively quickly and fast. When a million nodes are validating, we need the consensus necessary for a system to run smoothly.

Statement of the Problem

Blockchain technology recently India has made several efforts to become a digital society by building a large citizen-scale digital public infrastructure with a significant push from the government. Indian Government has made an effort for the Reserve Bank of India to promote simplification and transparency to increase the speed of interaction between individuals, markets, and government. In accordance with this the Government of India, Ministry of Electronics and Information Technology has taken steps and developed in adopting blockchain technology along with various sectors in Indian Public Administration, the government has made changes in the process and procedure of various important platforms which are related to societal importance such as blood bank, Central Board of Secondary Education, Election Commission, Public Distribution system and lot more. Even then making changes in various platforms for the purpose of societal changes, still, people are not aware of the technology that is adopted and carried by our government in upgrading technological development. This study has made an attempt to

make a details study of the functioning and clear picture of how our government has made changes in the process and procedure of activities using blockchain technology and how well they are effective and useful in Indian Public Administration.

The above problem is discussed with the help of research questions:

- How well the blockchain technology working in the public administration of the Indian Government?
- What are the sectors which have been using the technology and how far it has been successful?

Objectives of the Study

- To study the technological adoption of the Indian Government in Public Administration.
- To examine the various developments made under the blockchain mechanism with respect to societal expansion.

LITERATURE REVIEW

The government, National Informatics Centre (NIC) under the Ministry of Electronics and information technology is the partner of the Government of India, which was established in the year 1976 with the objective of technology-driven solutions to central as well as state governments with a mandate.

They are the technology partner of the government, design and develop IT systems for the Government, and also provide ICT infrastructure to explore and advise on the use of emerging technologies. Blockchain is an immutable ledger that facilities the process of recording transactions and tracking assets across the business network. So, anything with a value can be traded or tracked under this technology network. Since the information in the blockchain is electronically stored this makes the transaction secure. And this technology is a distributed ledger technology, anything can be converted into digital format and stored in. It is an exchange process that is what the data blocks. Were one block connected to another block these blocks cannot be hacked. Even we can take google docs as an example of blockchain technology. Blockchain helps in a decentralized system of sharing data with a wider group of people.

METHODOLOGY

The Study is Conceptual in Nature

Source of Data

The data and information are secondary sources of information collected from the Ministry of Electronics and Information Technology and the Center for Excellence in Block Chain Technology.

Types of Blockchain Under CoE-BCT

There are many features of blockchain, following are a few important types:

- Public blockchain: it is a nonrestrictive, permission-less distributed ledger system. A node or user is a part of the public blockchain. It is authorized to access current records that verify transactions or do proof of work for an incoming block and do mining.

- Private blockchain: it is a restrictive or permission blockchain operative only in a closed network. They are usually used in a private organization or enterprise, where there will only selected members of the blockchain network to be handled. So here the level of security, authorization, permission, and accessibility is only handled by the organization.
- Consortium Blockchain: is semi-decentralized and can be managed by more than one organization that manages a network. Here more than one organization acts as a node in this and exchanges their information.
- Hybrid blockchain: it is a combination of public and private blockchain. They use both the feature of blockchain which has private permission and as well a public permissionless system. With the help of this system, users can control who gets access to which data is stored in the blockchain. A part of only selected sections of data or records from the blockchain to the public and the rest is confidential to the private. The system is set to be flexible so that they can easily join a private block with multiple public blockchains.

RESULT AND DISCUSSION

Platforms of Blockchain in CoE-BCT

For an industry there are many platforms available through blockchain, some are proprietary and some are open source. Based on the nature and requirements of the application the platform can be decided. NIC the national informatic center, uses the following platforms for their products under Coe-BCT.

- Hyperledger Fabric: it is a platform of modular architecture. It can enable a network of networks. A fabric network can together perform this platform a Hyperledger fabric provides a secure and scalable platform to keep confidential contracts and private transactions. These have some feature with highly modular and has a low latency of finality platform that can support solidity and multi-language intelligent contracts and has pluggable consensus.
- Hyperledger Sawtooth: is another open-source blockchain project co-founded by Hyperledger and Linux Foundation. It does have a consensus mechanism known as proof of elapsed time. A sawtooth library is being developed, which allows programmers of customized distributed ledgers to select and choose parts of sawtooth to employ their applications. This allows users to sawtooth library while coding and provide splinter for networks.
- Ethereum: which is also known as ETH, this platform is to nullify the third party who can access data for further financial instrument tracking. This gives a work-based system the advantage of rapid deployment and has smart contracts functionality and Turing completeness that provides the tokenization it is proof to the work-based system.

Products of Centre for Excellence in Block Chain:

- Certificate Chain: in the system of certificates and documentation, the current system has an issue and use of certificates amongst the stakeholders which include rampant use of fake documents for exploiting government benefits that enhanced paperwork for document verification, and which is a delay in the process of service delivery, etc., to overcome the issues with paper-based documents, NIC has adopted blockchain technology to build certificate chain for high secured storage and retrieval of records., the major benefit of this certificate chain is system is that any authorized person can access the documents online and genuinely is assured and they are not tampered that too without any intermediary. Certificate chains are mainly used for admission purposes in professional colleges, beneficiaries, and recruitments in Karnataka for verification of eligibility. Central Board of secondary education documents are stored in blockchain. And Karnataka secondary examination board and Karnataka pre-university education examination board are storing SSLC and PUC mark cards.

Figure 2. Products of Centre for Excellence in Block Chain

- Document Chain: it is a single platform that provides a standard procedure for the authorities and consumer entities for storage and retrieval of documents issued by the government such as caste, income, driving license, and birth and death certificates. It provides a mechanism for any agency to verify the details of the applicants. It helps educational institutions, job providers, and financial institutions to get their documents verified without third-party involvement. Currently, the birth and death certificates of the Directorate of Economics and Statistics Karnataka, are recording it from April 2022. But caste and income certificates of the revenue department Karnataka have been recorded from 2018. Around 62 lakhs of certificates were available as on May 2022.
- Property Chain (PC): property management system enables the availability of a common ledger of the property facilitating a single source of truth. All the transactions such as (pledge, the release of pledge, inheritance mutation, sale, gift, acquisition initiation, alienation, etc. of property details would be stored in blockchain so that the process mutation can be executed on land records can be reflected on property transactions. So that stakeholders be able to see the complete

history before taking a decision. So the buyer will get benefitted in ascertaining ownership with rights. Bhoomi, E-asthi, and e-swath applications of Karnataka are getting integrated with the property chain for recording the transaction and state of the property.

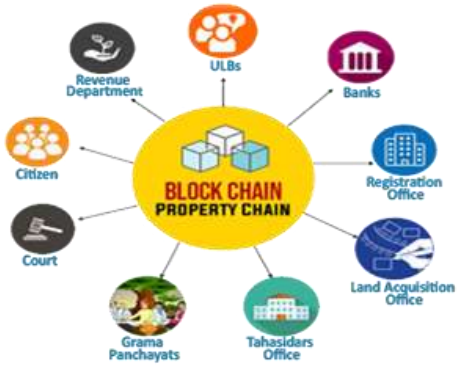

Figure 3. Property Chain (PC)

- Logistics chain (LC): Online supply chain management system for medicine now uses high-powered blockchain technology in Karnataka. The Aushada system uses blockchain to record the transactions related to the movement of drugs from the manufacturer to the supplier to the warehouse and the two hospitals with high-quality checks. This ensures that unstandardized drugs are not moved toward the supply chain. Details of the manufacturer, expiry details, and quantity of medicine are now available for the check of patients before consumption. It gives transparency and traceability of transactions to reduce the changes in spurious drugs, which enhances precision and transparency. An efficient call system can also be implemented if there is a variation in the quality of drugs. This system of integrated supply chain system will bring stakeholders to a common platform. As of Karnataka government is using this system past three years.

Current Users of Blockchain in Administration

Central Board of Secondary Education:

Academic {Blockchain} Documents (ABCD)" was established to link and record CBSE academic documents like a chain using blockchain technology. This chain captures scholarly documents in multiple locations. Academic documents in this chain are protected, tamper-proof, and immutable. Any attempt to tamper with the data is impossible and all distributed sites must be updated to synchronize data between them. Blockchain technology records data on a distributed ledger with all associated nodes. Data is simultaneously captured at all locations within the distributed network of blockchain nodes based on consensus among the nodes. This removes the dependency on third parties for verification. Data is linked, encrypted, and stored securely so it can be changed and tracked. Block tampering is prevented by linking blocks in a blockchain.

Data is reliable because it can be validated across participating nodes. Academic documents of CBSE are stored in blockchain. ABCD – Academic (Block Chain) Documents platform with blockchain mechanism details with

academic documents of students which are the great assets of the students and they are needed to be stored safely and produced on demand to higher education institutions/Employers. This ABCD platform help in storing and accessing the tamper-proof sheet for all stakeholders such as students, higher educational institutions, employers, and government department. The documents stored here are secured, tamper proof and transparent.

Various IT Systems Have Been Developed with the Focus on the Following:-

1. Minimum Govt. maximum governance
2. Ease of Doing Business (EoDB)
3. Ease of Living (EoL)
4. Reduce compliances
5. Data-driven decisions
6. Light but tight framework.
7. Transparency
8. Accountability
9. No data redundancy
10. Integrated systems
11. Quick Disposal

The National Informatics Center (NIC) and the Ministry of Electronics and Information Technology (MeitY), Government of India provided the best possible technical support to CBSE when required. A CBSE academic record chain has also been developed in technical collaboration with NIC.

After the declaration of results, there are two challenges: (i) immediate availability of digital academic documents and (ii) authentication of these documents for higher education in India and abroad and selection of candidates for posts. To address this issue, CBSE developed its first-of-its-kind digital academic repository called "Parinam Manjusha" and launched it in 2016. This repository is integrated with NEGD (National E-Governance Division) digital locking platform. Currently, the results data of X and XII classes for eighteen (18) years or 2004-2021 are available online for students to download their digital study documents and for employers and colleges to review. About 12 billion digital real-time generated, digitally signed and PKI-based QR-coded academic documents such as mark sheets, migration certificates, and passport certificates are available in this repository. Digitization of old records of class X and XII since 1975 is in progress and will be added to the archive as soon as it is completed. After that, the archive becomes one of the largest digital academic archives in the world.

One of the challenges in applying and selecting candidates for positions in Indian and foreign institutions of higher education is to verify the academic records produced by the candidates. Checking the correctness and authenticity of these documents with the respective universities or councils requires considerable work and time. Therefore, institutions and companies often require applicants to send original documents. To implement another secure authentication of digital academic documents based on network technology, the Government of India, in technical collaboration with CBSE, Ministry of Electronics and Information Technology (MeitY), and National Informatics Center, proposed a solution using Blockchain technology called "Academic {Blockchain} Documents (ABCD)". This blockchain ensures secure and tamper-proof storage of academic records. Everyone can access these academic documents online in a reliable and verifiable manner. Initially, digital academic exam papers for 2019, 2020, and 2021 will be placed under this Blockchain.

Usage of Academic Block Chain Documents

This blockchain provides a trustworthy, immutable, and traceable scholarly document. It can be used for admission to various educational institutions and for corporate recruitment. It can also be used for online advice for laboratories. Financial institutions can also use this system to approve loans such as education loans based on the applicant's eligibility. It is transparent, tamper-proof, paperless, and independent from third parties.

There are two ways to verify academic documents –

(i) Access the portal and enter basic student information such as student ID number to view academic documents;
(ii) Institutions can register with her CBSE and use bulk verification tools and API-based verification modes;

Users of Academic {Blockchain} Documents

Academic {Blockchain} Documents (ABCD) provides a mechanism for educational institutions and businesses to verify the eligibility details of applicants seeking higher education and employment online. It also helps in the consulting process by integrating the system with a plugin interface. The main users of this chain are:

- Student
- Educational institution
- Employer
- Financial institution

Table 1. Users of Academic

Class	Academic Year	Number of Certificates
CLASS-X	2018-2019	1821257
CLASS-X	2019-2020	1919179
CLASS-X	2020-2021	2110001
CLASS-XII	2018-2019	1282850
CLASS-XII	2019-2020	1260490
CLASS-XII	2020-2021	1366926

Karnataka State Government

Karnataka State Drugs Logistic and Warehousing Society

The entire drug delivery transaction is kept in each participant's register (main ledger). Every time someone supplies, purchases, or dispenses a drug, all other parties involved are notified and recorded in a register. Blockchain ensures complete oversight as there is no central authority to falsify records. The supply of medicines to government hospitals includes procuring medicines from manufacturers/suppliers, ensuring transportation of medicines to designated warehouses in various districts, and providing medicines to hospitals regularly. will be Patients receive receiving drugs with a doctor's prescription. In particular, the Karnataka government has procured and provided free medicines to patients across the state to ensure timely treatment without drug shortages. About 2,911 hospitals are covered by the system, and more than $300 million in pharmaceuticals are procured and delivered to these hospitals through 26 warehouses each year.

Challenges in this System

- Poor Visibility: Consumers have no way of verifying the authenticity, origin, quality, and expiry date of medicines as counterfeit medicines can enter the system. As a result, lack of transparency leads to problems such as counterfeiting and drug shortages. Patients, retailers, and regulators don't know where their medicines come from.
- Difficulty in Tracking and Tracing: Actors in the supply chain maintain their registers that other users cannot access. This makes it difficult to track and trace medicines throughout the supply chain. Gathering the data necessary to create a history of all transactions to date to the manufacturer is a cumbersome process.

Drug Logistic Chain

A drug Logistics Chain is a pharmaceutical supply chain built using blockchain technology. All drug delivery transactions are stored in each participant's register (main ledger). Every time someone supplies, buys, or dispenses a drug, everyone involved is notified and added to the registry. Blockchain ensures complete oversight as there is no central authority to falsify records. So, if one ledger is hacked/compromised, the other ledgers are intact and can be easily verified. Therefore, transactions within this chain are protected, tamper-proof, and immutable.

Features of Drug Logistics Chain

The drug Logistics Chain captures all transactions that occur in the government drug purchase and distribution supply chain. These transactions are stored in a shared/distributed manner with all stakeholders involved in consensus between them. This removes the dependency on third parties. Certificates are linked and stored with encrypted security, making them immutable and traceable. Block tampering is prevented by linking blocks in a blockchain. Certificates are trustworthy because they can be validated across the relevant stakeholders.

- Reserved
- Reliable
- Immutable
- Traceable
- Verifiable

Benefits of Drug Logistics Chain

Drug Logistics Chain provides trustworthy, immutable, and traceable transactions. It can be used by various hospitals and citizens to verify the original supplier of medicines and the quality inspection of medicines.

- Transparency - Patients can see the manufacturer, expiry date, and standard of pharmaceutical batches before consumption.
- Tracking - Facilitates tracking of drug movement from manufacturer to patient. Not only does it guarantee timely delivery, but it also eliminates the risk of counterfeiting.
- Traceable - Not only does it provide integrated supply chain information; but an o maintains a traceable record of medicines distributed.
- Tamper-proof – Ensures that transactions cannot be tampered with and can be easily verified.
- No 3rd Party Dependence - No need to rely on institutions or suppliers to check the quality of your medicines.

Users of Drug Logistics Chain

The drug logistics chain provides a mechanism for citizens and hospitals to verify the quality of delivered or dispensed medicines. It also helps track and trace the delivery of medicines. This eliminates the need to rely on third-party quality verification. It also saves a lot of verification time and facilitates paperless verification.

- Citizen/Patient
- Hospital
- Government

Contents in Drug Logistics Chain

The pharmaceutical logistics chain involves transactions in the supply of pharmaceuticals from procurement to citizens. Once the transactions are made, the stakeholders send signed transactions to the Drug Logistics Chain, which links those transactions into a chain and stores them securely in the Drug Logistics Chain. The drug logistics chain system will be integrated with the Karnataka (Aushada) government's existing online supply chain management system and record transactions on the blockchain. The movement of pharmaceuticals from one entity in the supply chain to another entity is recorded in the Pharmaceutical Logistics Chain. The drug logistics chain network also executes business logic called smart contracts to ensure consensus among stakeholders. Events such as the recording of quality check results can cause medications to be "frozen" and recalled to prevent out-of-spec medications from being administered to patients. There are built-in checks and balances to ensure that incorrect entries are not made.

The following transactions are recorded in the pharmaceutical distribution chain.

- Procurement
- Warehouse receipt
- Out of the warehouse
- Quality check
- In the hospital
- Hospital use

While the Aushada system implements the business logic of the pharmaceutical supply system, the pharmaceutical logistics chain provides the Ausdhada system with a platform that provides immutability, provenance, and finality of data stored on the blockchain.

Stakeholders

- Karnataka State Drugs Logistics and Warehousing Society
- 32 Warehouses
- Quality Testing Laboratories
- 2924 Hospitals/Institutes

Karnataka Secondary Education Examination Board and Karnataka Pre-University Education Examination Board

Karnataka Secondary Education Examination Board and Karnataka Pre-University Education Examination Board will store SSLC and PUC branded cards on blockchain from 2020. This allows students, citizens, and other departments to review mark cards for any purpose. One of the challenges in the admission process

of higher education in India and abroad and the selection of candidates for posts is the verification of the certificates presented by the candidates.

Verification of the accuracy and authenticity of a certificate at a responsible university or committee not only takes months but also effort and processing time. So, in most cases, institutions and companies follow the original made by the candidate. Even if the candidate is issued a fake certificate, the candidate must accept it and continue. This challenge has been solved for many years without an adequate solution. To overcome this challenge, the National Informatics Center has developed a solution using blockchain technology. This solution is called Certificate Chain. This certificate chain ensures that certificates are securely recorded, tamper-proof, and traceable. And those certificates can be accessed online by anyone in a trusted and verifiable way.

Certificate Chain

A chain of certificates is set up using blockchain technology to link and record educational certificates from different institutions like a chain. A certificate chain records certificates distributed in multiple places. Certificates in this chain are protected, tamper-proof, and immutable. Any attempt to tamper with the data is impossible and all distributed sites must be updated to synchronize data between them.

Features of Certificate Chain

A certificate chain records certificates in a shared/distributed manner with all involved stakeholders. Certificates are added to the chain based on consensus among the parties. This removes the dependency on third parties. Certificates are linked and stored with encrypted security, making them immutable and traceable. Block tampering is prevented by linking blocks in a blockchain. Certificates are trustworthy because they can be validated across the relevant stakeholders.

- Reserved
- Reliable
- Immutable
- Traceable
- Verifiable

Benefits of Certificate Chain

A certificate chain provides a trusted, immutable, and traceable certificate. It can be used for admission to various educational institutions and for corporate recruitment. It can also be used for online advice for laboratories. Financial institutions can also use this system to authorize loans such as education loans based on the applicant's eligibility.

- Transparent
- Anti-tampering
- Paperless
- No 3rd party dependencies

Users of Certificate Chain

Certificate chains provide a mechanism for educational institutions and businesses to verify the eligibility details of applicants applying for higher education and jobs online. It also helps in the consulting process by integrating the system with a plugin interface. This series of certificates aims to provide details of educational certificates from various commissions and universities in the coming

days. This eliminates the need to rely on a third party for verification. It also saves a lot of verification time and facilitates paperless verification.

- Student
- Educational institution
- Job provider
- Financial institution

Contents in Certificate Chain

As mentioned above, the suite of certificates includes certificates from various universities and institutions. When new certificates are issued by these universities or institutions, the signed certificates are submitted to the certificate chain, which links these certificates to build a chain, and links them to the certificate chain. safely stored in Karnataka's SSLC and PUE boards are now on the chain and will start storing certificates in 2020, gradually returning to previous years. Other committees and universities have also expressed interest in joining the chain.

Board	Logo
Karnataka Secondary Education Examination Board	
Karnataka Pre-University Education Examination Board	KARNATAKA PUC

Directorate of Economics and Statistics

Birth and death certificates from the Karnataka Department of Economic Statistics dated April 2022 were collected.

Certificate Chain

A series of certificates is created using blockchain technology to record data in digital form. The system can store certificates and their changes, and encrypt and link them. A certificate chain records information in a way that can be distributed to multiple sites. Certificates in this chain are protected, tamper-proof, and immutable. Manipulation of information residing on the chain is not possible as the distributed ledger must be updated. This requires consensus from all peers to synchronize data between peers. This ensures the tamper-proof properties of the certificate chain. Therefore, the actual authentic certificate is retained.

Benefits of Certificate Chain

Common certificate chain systems are developed using blockchain technology to provide trusted, immutable, and traceable certificates. Various organizations and government agencies can use it to store and retrieve records. The system can store various certificates such as birth certificates, death certificates, and caste certificates. Various departments can use these certificates to authorize welfare payments to affected individuals after verifying the certificates. The recorded information may be used by other organizations, such as insurance companies, to validate customer claims, which avoids fraud. Changes to certificates are also sent down the certificate

chain by the issuing authority. The certificate chain system links these new updates to certificates and integrates them into a chain for safe storage.

The system provides fast, reliable access for verification and eliminates storage facilities for storing certificates in previous paper-based formats. This paperless system saves review time and facilitates digital e-paper-based formats. This system can be used by different departments and organizations

Developed generic certificate chain improves the following capabilities:

a. Transparency
b. anti-tampering
c. Paperless
d. free from interference by third parties;
e. see traces of certificates issued to persons;
f. a single platform that allows the storage and retrieval of different certificates;

Certificates Proposed to be Stored in Certificate Chain

The generic Certificate Chain developed enhances the following features.

Table 3. Departments Onboarded Under the Certificate Chain:

State	Department onboard	Certificates Registered
CHHATTISGARH	Agriculture Department	5
	SUBTOTAL	5
JHARKHAND	Higher Education-Collegiate Education	1
	SUBTOTAL	1
KARNATAKA	Directorate of Economics and Statistics	2
	Revenue Department	45
	SUBTOTAL	47
MANIPUR	Pre-University Board	1
	SUBTOTAL	1

Table 4. States and Departments Under Various Certificate Chain

State	Department	Certificates	Available Since
CHHATTISGARH	Agriculture Department	Transfer Certificate	
	Agriculture Department	Provisional Certificate	1/1/2013
	Agriculture Department	Degree Certificate	1/1/2000
	Agriculture Department	Migration Certificate	
	Agriculture Department	Cumulative Markscard	
JHARKHAND	Higher Education-Collegiate Education	Provisional Certificate	
KARNATAKA	Directorate of Economics and Statistics	Karnataka Birth Certificate	1/4/2022
	Directorate of Economics and Statistics	Karnataka Death Certificate	1/4/2022
	Revenue Department	Caste Certificate (Cat-A)	1/1/2018

	Revenue Department	Caste And Income Certificate	1/1/2018
	Revenue Department	Agri Certificate	1/2/2018
	Revenue Department	Population Certificate	
	Revenue Department	Income Certificate	1/2/2018
	Revenue Department	Caste Certificate (SC-ST)	1/2/2018
	Revenue Department	OBC Certificate (Central)	
	Revenue Department	Residence Certificate	1/2/2018
	Revenue Department	Non-Tenancy Certificate	
	Revenue Department	Widow Certificate	
	Revenue Department	Living Certificate	
	Revenue Department	Agricultural Family Member Certificate	1/2/2018
	Revenue Department	No Re-Marriage Certificate	
	Revenue Department	Land less Certificate	
	Revenue Department	Surviving Family Members Certificate	1/2/2018
	Revenue Department	Unemployment Certificate	
	Revenue Department	No Govt. Job Certificate	
	Revenue Department	Agriculturist Certificate	1/2/2018
	Revenue Department	Small / Marginal Farmer Certificate	
	Revenue Department	Agricultural Labour Certificate	
	Revenue Department	Noncreamy layer Certificate	1/2/2018
	Revenue Department	Landholding Certificate	
	Revenue Department	Bonafide Certificate	
	Revenue Department	Solvency Certificate	
	Revenue Department	Domicile Certificate	1/2/2018
	Revenue Department	Income Certificate for a Compass for Employment	
	Revenue Department	Attestation of Family Tree	
	Revenue Department	HK Region Residence and Eligibility	
	Revenue Department	Crop Certificate	
	Revenue Department	Minority Certificate	1/2/2018
	Revenue Department	General Certificate (AryaVaishya)	
	Revenue Department	Income and Asset Certificate (EWS)	
	Revenue Department	Physically Handicapped Pension	
	Revenue Department	Widow Pension	
	Revenue Department	Sandhya Suraksha Yojana	
	Revenue Department	National Family Benefit Scheme	1/2/2018
	Revenue Department	Indira Gandhi National Old Age Pension	1/2/2018

	Revenue Department	Mythiri	1/2/2018
	Revenue Department	Manaswini	1/2/2018
	Revenue Department	Anthya Samskara Yojane	1/2/2018
	Revenue Department	Acid Victim Pension	1/2/2018
	Revenue Department	Farmer Widow Pension	1/2/2018
	Revenue Department	Endosalphan Victim Pension	1/2/2018
	Revenue Department	Birth Certificate	29/03/2022
	Revenue Department	Death Certificate	
MANIPUR	Pre-University Board	Higher Secondary Examination Mark Statement	8/9/2022

Table 5. Certificates Proposed to be Stored in Certificate Chain

Blockchain Portal	Centre of Excellence in Blockchain Technology
Document Chain	Directorate of Economics and Statistics, Karnataka
	Revenue Department, Karnataka
Property Chain	Property Chain
Logistics Chain	Karnataka State Drugs Logistic and Warehousing Society

Revenue Department, Gok

A caste and Income Certificate from Karnataka State Finance Ministry dated January 2018 will be collected. About Rs 6.2 crore allowance will be available in May 2022.

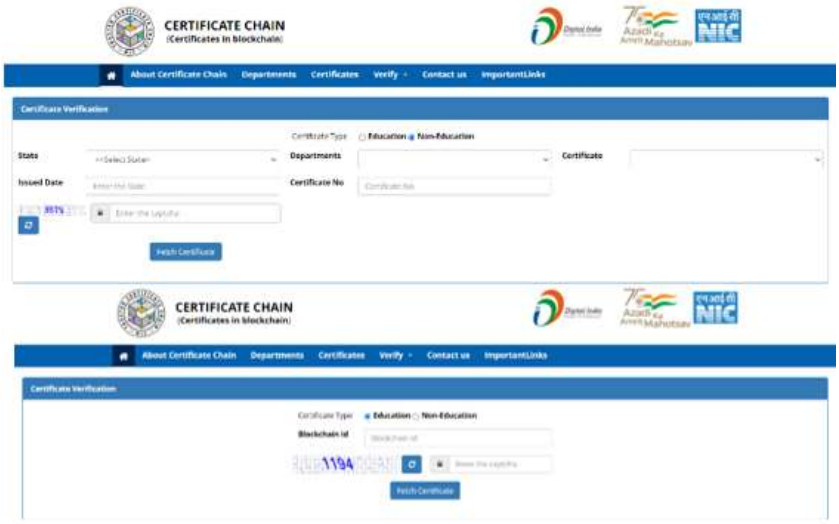

Figure 4. Revenue Departement, Gok

Table 6. Facilitation

Serial No.	Date	Event Name
1	3/9/2022	Half-day workshop on Blockchain and Certificate Chain use cases for NIC Karnataka
2	23-03-2022	National Workshop on Certificate Chain
3	29-11-2021	Induction training program on Blockchain Technology and its Applications
4	22-09-2021	Workshop on Unified Blockchain Framework
5	18-01-2020	Inauguration of CoeBCT
6	11/9/2020	Inauguration of Karnataka SSLC and PUC certain
7	07-12-2020 To 11-12-2020	Theme-based webinar Blockchain Technology
8	-	Hyper Ledger and BCT Frameworks, HyperledgerSawtooth
9	-	BCT Framework (Hyperledger Fabric)
10	-	Use case-1: Certificate Chain
11	-	Use case-2: Drug Logistics
12	16-10-2019	Training program on Blockchain Technology
13	30-07-2021	Theme based webinar

Blockchain and cases in the use of Blockchain

Land Records

In India, property ownership is now evidenced by a series of documents proving ownership from person to person, down to the current owner. Registration is recognized only as an agreement between the two parties regarding the transfer of ownership. It is important to note that the Sub-Registration Office (SRO) only registers deeds under the Central Registration Act of 1908 and does not confirm title to the land, so any of these intermediate transactions cannot be challenged. It means you can. Property fraud is also prevalent in our country in many forms. The State Treasury/Revenue and Panchayati Raj Department are administrators of the Land Registry. You have the authority to maintain the land register details. Various other transactions related to changes in ownership due to sales, loans, mortgages, mortgage releases, and crop renewals initiated by other departments are approved by Treasury officials and RoRs are renewed. Land registers are subject to state law.

The land record system used in various states facilitates land mutation. Title to land, farmers, crops grown, sources of irrigation, rights, and obligations are to be preserved and maintained. A title record document is necessary for farmers to benefit from the government in the form of subsidies for seed, fertilizer, and other purposes such as securing and selling loans. The National Registry Office uses software that is independent of the Land Registry System. Full documentation of properties to be registered is uploaded by citizens along with metadata. After going through an approval process, the final step is to collect the biometric data of the parties. The bill of sale is then printed, and signatures are obtained from the buyer and seller and re-uploaded into the system for future issuance of certified copies.

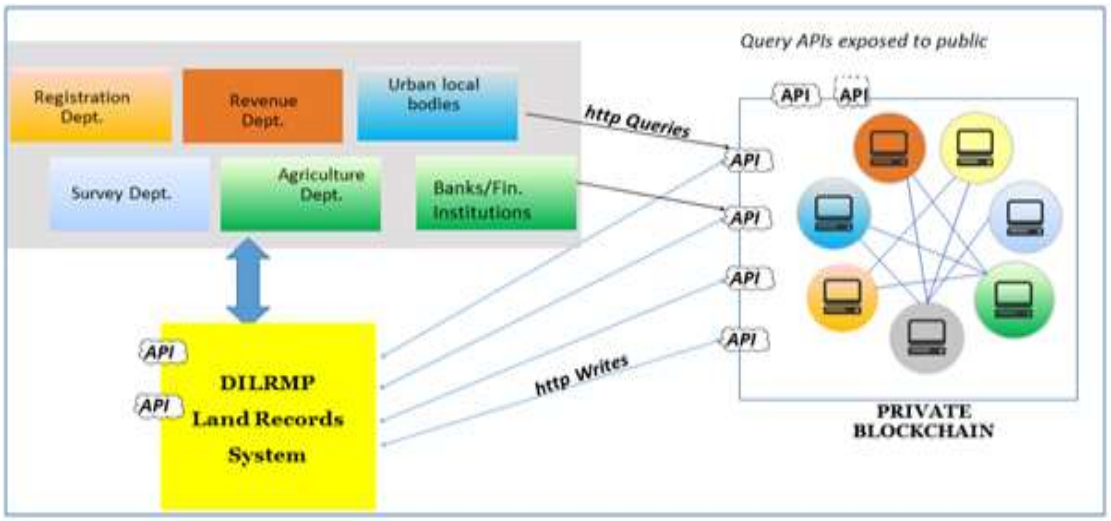

Figure 5. Land Records

Challenges

The major challenges in this area include the increasing number of land-related lawsuits, the difficulty of tracking duplicate sales of the same land or property, the lack of clear or golden proof of ownership, and the lack of systems to facilitate included. Citizens check land registers, and many documents to get loans from banks with land as collateral, financial institutions rely heavily on real estate as collateral, so they are getting real photos of properties for loans. not. Financial institutions, etc. Farmers have to spend time and money to collect all documents such as RoR, Mutant Extracts, Crop Certificates, etc. needed to secure loans, subsidies, and other government benefits.

Data in the land registry system, registration system, etc. must be tamper-proof as each of these departments relies entirely on the integrity of the other departments to initiate transactions. Therefore, to avoid problems, trust is required to perform authorization for different activities using a common data source. History has proven that the original was falsified to create a certified copy of the registry, and the property was sold based on the falsified document. Also, properties are sold to multiple buyers by keeping each other secret.

Proposed System

Compared to other data, land registry data must be stored accurately on the blockchain. The existing transaction history of the land must first be inserted into the blockchain after approval by the state tax authorities. Approved data is digitally signed and stored. This will be the starting point for any mutation. Certificates issued by tax authorities are stored on the blockchain and can be used by other authorities, such as banks, for verification processes during real estate/farm transactions. Transactions related to changes in ownership due to sales, loans, mortgages, mortgage releases, and crop renewals are initiated by other departments. At the beginning of the above transaction, a detailed verification must be done on the blockchain data. After the transaction has been approved in the respective database. Completion of Deed Registration/Loan Approval by Bank.

Transaction details are stored on the blockchain. In particular, the registry department obtains survey number details from the blockchain to ensure that property ownership belongs to the prospective seller before the sale begins. After receiving the signatures of the buyer and seller on the contract of sale, the scanned documents must be moved to the blockchain network to create blocks. Once a block

is created, it cannot be edited or manipulated. Similarly, whenever ownership changes from person to person, a lock is created. Through the implementation of smart contracts, certain events such as land registration automatically initiate mutation requests in the land register, bank credit approvals update rights and liabilities, and crop details updates are triggered to update. RTC farmer and crop details. Smart contracts also facilitate the payment of subsidies to farmers in case of crop failure. If eligibility applies only to certain types of farmers, eligibility can be determined from the blockchain.

Benefits of the Proposed System

- Placing data in a central location that all departments can access allows for permissions, mutations,
- Trusted bodies such as notaries are not required to provide certified copies of documents.
- Farmers are confident that the land they own will not be altered by the wrong people.
- Farmers can get credit quickly. Updating information about liability on the title register can be done after the farmer has repaid the loan. This makes it easier for farmers to access other benefits/services.
- The facilities available to farmers by the agriculture/horticulture/animal sector when captured on the blockchain make it easy for these sectors to ensure that the same benefit/multiple benefits do not reach the same farmer multiple times. Set each time a contract is received.
- Property registration blockchain data will be made available in the registration software workflow system and open to the public for verification. This provides complete details of the real estate chain from first to last purchaser. The Buyer does not need to rely on untrusted personnel/agents to verify the authenticity of documents provided by the Seller.
- A transparent, trustworthy, and tamper-proof repository of property registration documents will be made available to citizens and registration departments.
- Citizens can see ownership details and complete property history before purchasing a property
- Fake registrations will be eliminated once a set of documents is available.

Blood Bank

The purpose of using blockchain technology (BCT) in blood bank systems is to ensure that patients receive safe blood. Check the blood quality/expiration date from the blockchain that provides the necessary trust factor. Donor data may also be checked by collection centers to ensure that unsafe donors are excluded. As a result, all involved parties are informed of blood availability at various blood banks.

Benefits of Blockchain in Blood Banks:

Blood quality can be determined at each segment of the chain

- You can know the history of donors in each node
- See blood details including blood flow at each stage
- Sample integrity to the recipient is preserved
- Availability of blood for blood banks

In India, 90% of blood donations take place in camps set up by various organizations. All donated blood goes through a testing stage to separate safe blood, but unsafe blood can also seep into this testing and reach infected patients. This problem is often overlooked, but the consequences are fatal. The biggest challenge in setting up a blood bank is donor authentication and identification, and more importantly, filtering donors based on their previous credentials. Therefore, it is important to have a central platform for blood donors.

The National AIDS Control Organization (NACO) recently reported that 2,234 patients acquired HIV from poor blood transfusions in the past 16 months. Even though modern testing methods have shortened the time window for these deadly diseases, the problem is still increasing. One of the main reasons is the absence of centralized blood donation records, responders to previous donations at a particular blood bank donate blood again to multiple blood collection centers. Many quarantined donors are also donating again.

Most blood donations are event or time driven and have little to do with the actual demand at the time. What is needed is a single platform that brings together all the blood ecosystem stakeholders, tailoring the drive to the needs of the real world, and designing solutions that help address these challenges with the latest technological advances.

Blood Chain brings together all key stakeholders in blood circuit management, blood banks, donors, blood collection facilities, laboratory centers, hospitals, and patients in one platform. Blockchain provides a shared ledger technology that can be used to record the history of business transactions that cannot be changed by participants in the business network. Blockchain provides a single point of truth: a shared, tamper-proof ledger. Blockchains use consensus to commit transactions to the ledger. Since each member has a copy of the same ledger, the provenance and traceability of assets are transparent and reliable.

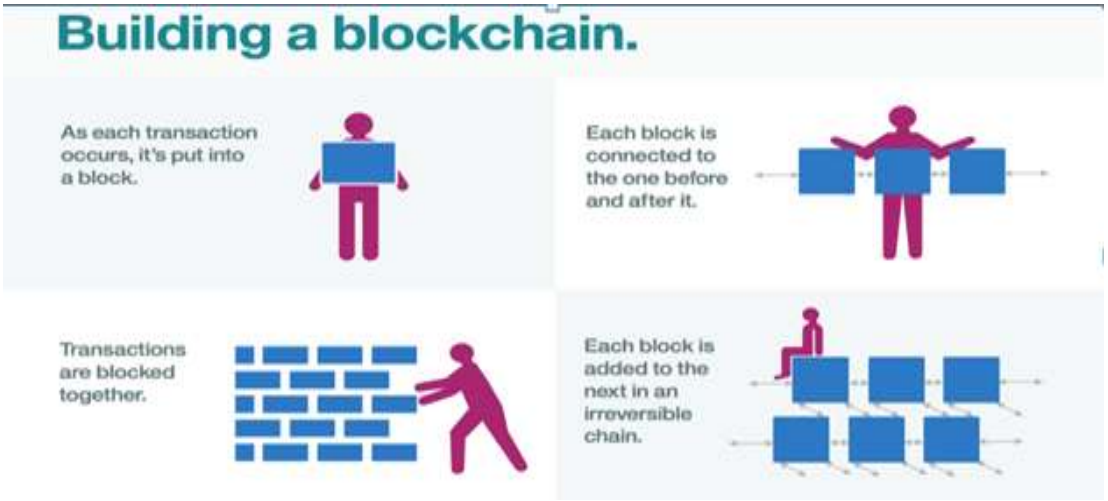

Figure 6. Blood Bank

Hyperledger Sawtooth is an enterprise blockchain platform for building, deploying, and running distributed ledgers. The smart contract abstraction provided by Sawtooth allows application developers to code in the language of their choice. The platform facilitates the development of blockchain solutions by separating the core system from the application domain.

Programmers can specify the appropriate business rules for their application in the language of their choice without needing to understand the design of the underlying core system. Sawtooth's core design allows applications to choose transaction rules, permissions, and consensus algorithms that support their unique business needs. A blood bank use case is to directly record donor registration-to-hospital transactions and other important properties of blood such as groups, test approvals, expiry dates, and blockchain-maintained temperature. (Blood condition, availability, assurance of availability quality).

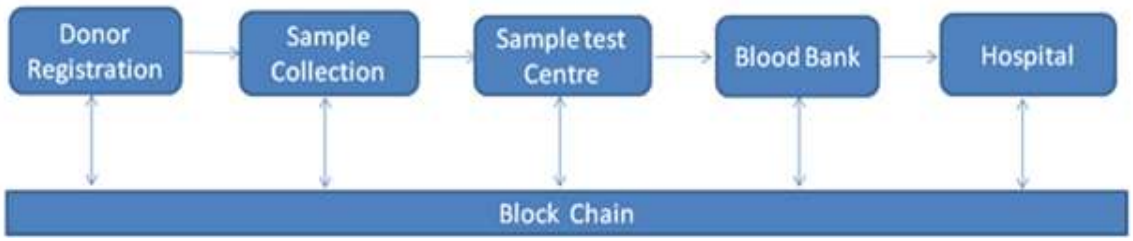

Figure 7. Benefits of Blockchain in Blood Banks

Entities involved

- Donor
- Collection Centre
- Testing Centre
- Blood bank
- Hospital
- Dept of Health and family welfare, DCD, Citizen

Supply Chain Management through Block Chain

1. Spirits producer imports raw materials (spirits/alcohol) with a blockchain-certified permit. Information on raw materials and quantities is provided on the permit
2. Liquor/alcohol/packaged liquor transactions are recorded on the blockchain at various levels
    - Transportation of raw materials from truck to warehouse
    - Stores data for applying raw material requirements at the start of shuffling
    - Bottling is based on the mixture produced
    - Storage of sake cups

Warehouse shipment of packaged spirits under blockchain certification permit.

All Production Warehouses are Integrated Into the Blockchain Network

Distributed Ledger:

Traditionally, stakeholder transactions were provided through trusted third parties in the spirits industry. A major risk of relying on third parties in the spirits industry is that the issuer may control its stakeholders, who may jeopardize the issuer's inefficient services. They are expensive, prone to abuse and manipulation, lack transparency, and are vulnerable to corruption and fraud. These uncertainties lead to disputes between the parties involved. As a result, dispute resolution, reverse transactions, or transaction refunds can be costly. In addition, current systems lag in reconciling the ledger records of various stakeholders, leading to

erroneous business decisions and omissions. These risks and hazards may result in missed business opportunities.

When using blockchain technology in a distributed ledger system, each record in the distributed ledger has a timestamp and a unique cryptographic signature, permanently recording all transactions of participants in the blockchain network. Additionally, the record is initiated on the blockchain and anyone else involved in the transaction can see this information once uploaded.

Benefits for B2B & B2C:

- Manufacturing sector: The entire manufacturing supply chain is captured on a blockchain network.
- Consumers: Consumers can verify directly via blockchain without trusting a third party. Consumers can also check the quality of the spirits directly from the blockchain network using the batch number and the QR code printed on each bottle label.
- Buyers: Buyers can verify authorization through the blockchain network without having to trust a third party.

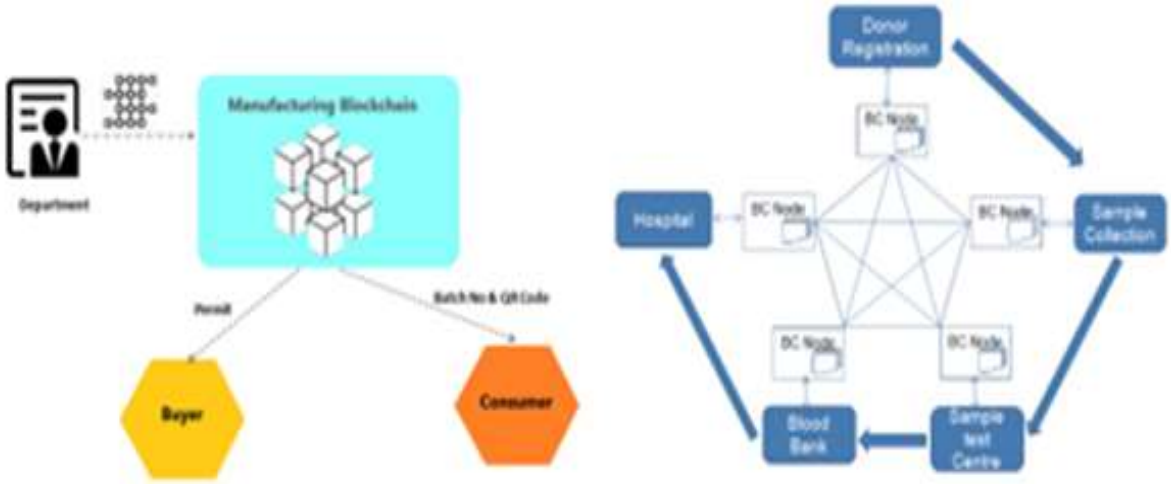

Figure 8. Benefits for B2B & B2C

A proof of concept (POC) is in progress. Export licensing has been integrated into the blockchain network and more work is underway. Blockchain technology can have a major impact on reducing HIV prevalence in developing countries and help protect the future of the population.

Public Distribution System:

Subsidized distributions are made monthly and distributed to cardholders statewide under the Public Distribution System. PDS includes procurement from farmers to the distribution of ration cards to beneficiaries. This includes various entities. To Central and State Authorities, Millers, Shipping Companies, Shop Owners, and Ultimately Beneficiaries.

A key feature of PDS is the general lack of accountability throughout the supply chain, with complete disregard for leaks occurring at various points. Blockchain technology helps to effectively manage supply chains using distributed ledger technology. The entire supply chain from sourcing to payment can be part of the blockchain.

Farmers grow grains and the government sources them at the Minimum Support Price (MSP). Government-appointed millers first collect the grain and it is then moved to the state's godown and distributed to another block's godown. From Block Godown, these goods are distributed to various Fair Price Shops (FPS) for distribution to beneficiaries.

Government agencies identify and allow the registration of millers for this purpose. Farmers register with millers to deposit their produce and receive payments under the MSP. A farmer is paid under his MSP based on supply. Miller then processes these goods for further distribution in storage. Miller is paid to handle these items. Miller is also paid to transport them to the nearest government facility. At these storage locations, fair value shopkeepers collect quotas that are distributed to beneficiaries.

Role of Blockchain in the Public Distribution System

Blockchain could at least eliminate delays in payments to farmers due to miller procurement. Since the main body of collection and stockpiling is the miller, the miller cannot register the amount of collection unless the farmer approves the transaction. This makes all transactions non-negotiable. Since calculations and payments need to be made based on this initial data, blockchain technology can be used to seal the origin of the data (data history record).

A distributed ledger allows all stakeholders to see a local copy of the ledger to make decisions and act accordingly. Certain activities, such as paying farmers, can be done without waiting for the miller to shell. Since the procurement period is set for each product, payment can be started immediately without waiting for processing by other actors. This makes them suitable as part of blockchain technology as each transaction is time-insensitive. Farmers only interact with government-identified millers, so transporters don't have to be part of the public chain to join the network.

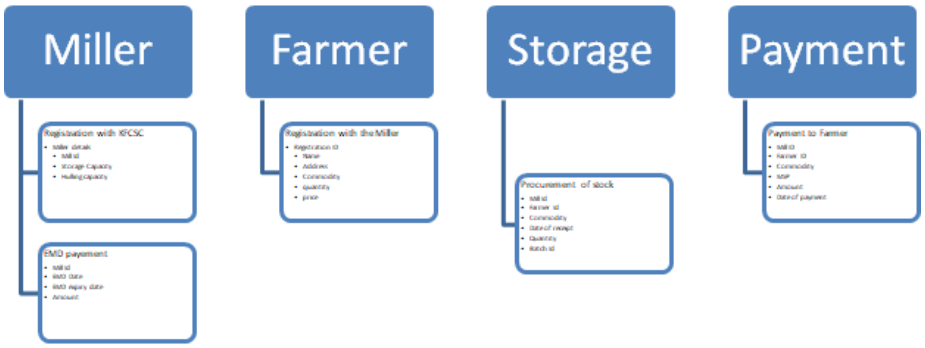

Figure 9. Role of Blockchain in the Public Distribution System

Remote Voting Chain

Remote voting systems are blockchain-based and designed to allow dispersed immigrants and other on-the-job voters to vote from their place of work (the host constituency) without having to commute to their parent constituency. It is a decentralized system that saves time and money. Allows for higher voter turnout. A Proof of Concept (PoC) was developed and demonstrated under the direction of the Indian Electoral Commission.

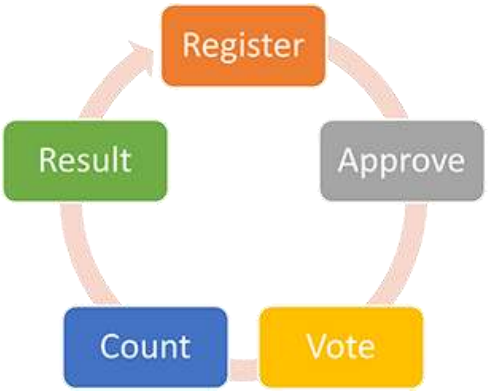

Figure 10. Remote Voting Chain

The system allows remote voting, voting, and encrypted voting details to be securely stored on the blockchain. Only election officials in the parent district are authorized to download and decrypt all encrypted ballots from the blockchain for vote counting.

GST Chain

The GST Chain was set up using blockchain technology to record the GST transactions of the various stakeholders involved in the GST administration by linking them like a chain. The GST Chain stores all of the taxpayer's transactions and maintains the taxpayer's ongoing tax liability.

Blockchain as (BaaS)

Blockchain as a Service (BaaS) enables government agencies to build, host, and use their blockchain apps, smart contracts, and functions on the blockchain using blockchain services, and the CoE. NIC handles the complex backend of the department and keeps all important blockchain-related artifacts and infrastructure running. It also includes supporting activities such as bandwidth management, proper resource allocation, and hosting requirements and provides security features.

CONCLUSION AND RECOMMENDATION

The need for the hour technological development has as many changes worldwide. One such technology development has been adopted by Indian Government too. The blockchain mechanism was initially developed for the financial transaction but now it has created an opportunity for various sectors to use this technology in their own way to store and retrieve information. The data are stored in blocks that are highly authenticated with high encryption. The data are safe and transparent enough to avoid fraudulent activities. Blockchain as the name suggests looks difficult, but the right and proper application adopted will help run the platform smoothly. Indian governments Centre for Excellence is one such platform that has included blockchain in all such important areas of public development, that is Education, Supply chain, and election commission. This platform is found beneficial to almost all the areas in which it has been equipped. And it has been evident that it will be a game changer in other sectors in the upcoming years apart from the sectors they have been in use.

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