Land Record Management in India
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LAND RECORD MANAGEMENT IN INDIA AND ADOPTION OF DLTs

Land administration, also referred to as land record management, is a complex and vital process overseeing the ownership, use, and value of land. It serves as the intricate map and compass guiding our interactions with this fundamental resource, ensuring fairness and smooth operations.

The key aspects of land administration encompass determining and recording land rights, involving the identification of landowners, delineation of ownership extents, and documentation of encumbrances through vital processes like land surveying. Maintaining land records plays a crucial role, acting as the official narrative of a piece of land, chronicling its ownership history, value, and legal documents, typically stored in centralised databases and made accessible to the public. (Deininger & Feder, 2009)

The meticulous recording of land transfers serves pivotal roles in ensuring individual rights and societal well-being. It establishes certainty of ownership, protecting landowners from fraud and supporting confident investment and land use. Detailed records deter fraudulent transfers, reducing legal conflicts and fostering trust. Moreover, they aid accurate taxation, contribute to government revenue, and provide crucial data for informed urban planning. Meticulous record-keeping supports environmental protection by identifying unsustainable practices. Additionally, it fosters public trust and transparency and protects land rights, especially for vulnerable populations. Maintaining updated and comprehensive land records aligns with De Soto's theory, asserting that secure property rights, evidenced by such records, incentivise property owners to make long-term capital investments. This can manifest through utilising the land as collateral to secure loans and other financial investments. In essence, meticulous land records contribute to a stable and equitable land system, benefiting society as a whole. (Enemark 2006; Sonar & Patel, 2018)

Distributed Ledger Technologies (DLTs), especially Blockchain technology, emerged as an alternative to traditional financial systems in response to the 2008 financial crisis. While the future of cryptocurrencies remains uncertain due to the state's control over money, the underlying technologies itself is considered promising for redesigning governance processes. There has been observed a preference for exploring DLTs' potential beyond cryptocurrencies, viewing it as a tool for creating tamper-resistant and transparent records in various sectors.

With respect to land administration, DLT offers several potential benefits for coordinating land administration, including improved data validation and distribution, which enhances data recoverability and reduces manipulation of land records. Legacy systems for property transactions are slow and expensive due to numerous intermediaries, but blockchain promises to eliminate many of these by automating processes through smart contracts. It could facilitate the unbundling of property rights and bring land into the era of big data, enabling large-scale formalisation reforms.

However, challenges exist, including the need for a legal and administrative framework, the potential to hamper customary tenure norms, and concerns about the reliability and cost of transferring centralised databases to blockchain systems. While blockchain-based land administration software is mostly developed by private parties, collaboration with governments presents challenges such as government support and quality control. Smart contracts, a central aspect of blockchain property transactions, offer benefits but also pose risks, including less

privacy and rigidity in contract terms. Overall, DLT holds promise for transforming land administration, but there are significant challenges and implications to consider.

I. Land Records in India

A. Constitutional View of Land Records

The importance of land reform in India is enshrined in the Constitution. Article 39(b), which forms part of the Directive Principles of State Policy (DPSP) of the Indian Constitution, emphasises the state's responsibility to ensure the equitable distribution of material resources for the common good. Part IV of the Constitution underscores the importance of providing all citizens with a means of livelihood and a decent standard of living. To expedite the implementation of land reform laws, they are included in the ninth schedule. Land and rights over land fall under the jurisdiction of State Legislatures as per Entry 18 of List II of the Constitution. (Sonar & Patel, 2018)

Consequently, the statutory framework for land reform in India is diverse but aims to achieve objectives such as redistributing surplus land to the landless, ensuring tenancy security, and abolishing intermediaries. (Digital India Land Records Modernization Programme (DILRMP), n.d.)

B. Evolution of Land Records in India

The Land Record system in India has undergone a dynamic evolution across different historical eras. During the reign of Sher Shah Suri and Mughal Emperor Akbar, notable efforts were made with the introduction of categorisation and measurement of land, laying the foundation for systematic land records (Thakur et al.; Venkatesh, 2005). However, it was during the British Raj that various land Acts were introduced across princely states, leading to inconsistency in the maintenance of land records. Pre-independence, landlords held concentrated land, utilising the record system primarily for revenue assessment. Post-independence, India retained the British land records system, initially centred on revenue collection.

Subsequent to independence, significant reforms were implemented, emphasising detailed maintenance of land resources data and introducing measures like ceiling surplus land acquisition (Bal, 2017). Since the late 1980s, the Indian government has invested significantly in a comprehensive computerisation project, aiming to enhance land management, prevent manipulation, ensure transparency, and facilitate the instant issuance of Record of Right (RoR) land ownership certificates (Mishra & Suhag, 2017).

India currently operates on a presumptive land titling system where possession details from past transactions determine ownership. Registration involving deeds such as sale deeds and inheritance records (record of rights, property tax receipts, and survey documents) does not guarantee ownership title. In other words, land records are correct until proven otherwise (in courts, for example). (Mishra & Suhag, 2018)

The ambiguity in titling has far-reaching consequences, contributing to land disputes that impede infrastructure development and housing construction and lead to inefficiencies. Nearly two-thirds of all pending court cases in India are made up of land-related issues and disputes, according to a study by the World Bank in 2007 (India - Land Policies for Growth and Poverty Reduction, n.d.). ULBs face challenges in property tax collection due to unclear ownership, fostering a black market for land transactions. In rural areas, the lack of a clear title impedes small farmers' ability to use land as collateral, preventing access to formal credit. This situation

leaves them vulnerable to unscrupulous moneylenders and ensnared in debt (Mishra & Suhag, 2017).

In addition to being part of the state list, Land records management systems in India vary among states also due to historical evolution and local traditions. Land ownership is established through documents such as the Record of Rights (RoR), registered sale deeds, survey documents, and property tax receipts. The RoR, also known as 7/12 Abstract in Gujarat and Maharashtra, includes details about owners, limits, tenure type, land class, assessment, rights, remarks, and information about loans and government rights (Sonar & Patel, 2018). Changes in land ownership are reflected through mutations in the RoR. Spatial records, supported by sketches and larger maps, provide additional property details, including revenue boundaries, road connectivity, water bodies, land use, and topology. However, high error margins and discrepancies with RoRs make spatial records less relevant in disputes. Transaction records involve signing a non-judicial stamp paper known as a sale deed during property purchases. This deed includes property details, market price, and past transaction details and is registered under the Registration Act of 1908, with levied stamp duty. The registered deed is then sent to the Taluka office for mutation procedures and replication in the RoR. (Sonar & Patel, 2018)

Table 1: Legislative Competency of Land Management		
Matter	**Arena**	**Constitutional provision**
Land rights	State Govt.	7th schedule, List 2 of Entry 18
Maintenance and survey settlement	State Govt.	7th schedule, List 2 of Entry 44
Transfer and Registration of transactions	Centre + State Govt.	7th schedule, List 3 of Entry 6
Source: (Sonar & Patel, 2018)		

C. Reforming Land Record Management

In 2009, the Committee on Financial Sector Reforms (FSRC) recommended a move for India towards a conclusive titling system, initially undertaken in Australia in 1858 under the Torrens System of land titling (Sonar et al., 2018). The Torrens System is based on four principles: (i) a single window system for all land-related documents, (ii) the cadastral land records replicate all factual details of property titles, (iii) after registrations, mutations follow automatically without cross-checking of past transactions, and (iv) the government will minimise losses arising from defects by endorsing title insurance (Sonar et al., 2018).

Thus, Conclusive land titling represents a fundamental shift from the current presumptive system. Key features of this approach include (Mishra & Suhag, 2017):

- Actual ownership designation through government-granted titles.

- The government is taking responsibility for accuracy and settling disputes with claimants.

- Provision of compensation to claimants, ensuring title holders are not at risk of losing ownership.

However, achieving a conclusive titling system requires land records to be updated, be free of any encumbrances, and have registered property titles as the main ownership proof (*Analytical Reports*, n.d.-b). NITI Aayog drafted a Model Act and Rules for Conclusive Land Titling in India in 2019. The draft act mentioned support for any person who has riled an entry in the Record of Titles; they can object to the Title Registration Officer within three years of such notification (Indian Express, ENS Economic Bureau, 2020). However, the draft Act failed to gain traction (Cominciolli, n.d.).

D. Lacunas in Land Record Management in India

Another study by NITI Aayog suggested that, on average, land-related disputes take about 20 years to be resolved in India (Debroy & Jain, n.d.). For small and marginal farmers, obtaining institutionalised credit becomes challenging when dealing with disputed or unclear land titles. Discrepancies between recorded land measurements and actual cultivated lands result in losses during insurance claims. The absence of updated land records for encumbered land poses obstacles and delays in infrastructure projects. Additionally, unclear land titles contribute to ownership disputes in housing projects, hindering urbanisation (*Analytical Reports*, n.d.-b). Moreover, issues like minimal transparency, accountability, disjointed datasets of the same piece of land with different government departments, delays in the processes, etc., are prevalent in India's land records management process (Thakur et al., 2020).

TABLE 2: Departments within states responsible for land Administration			
Department	**Functions**	**Documents maintained**	**Officers**
Revenue	- Collection of land revenue - Updating and maintaining revenue records	- Record of Rights (RoR) - Mutation register	- District – Collector - Block-Tehsildar - Village - Patwari
Survey and Settlement	Maintaining spatial land records	- Village map - City survey maps	- District - Deputy inspector Block - Town surveyor - Village - Village Administrative Officer
Registration and Stamp Revenue	- Registration of property documents and deeds - Evaluation and collection of stamp duty	- Encumbrance certificate - Sale deed	- District – Registrar - Block - Sub-registrar
Source: (Sonar & Patel, 2018); (Mishra & Suhag, 2017)			

To move to a conclusive system awaits another set of challenges. The information on land is not available on a single platform but dispersed amongst different departments. This information is also regulated across the centre and states. Before reforming the recording and management system, not only do the encumbrances need to be addressed, but there is also a massive data backlog that needs clearing and uploading on a digital interface along with updating new data in real time.

E. Digitisation of Land Records

The National Land Records Modernization Programme (NLRMP) was established in 2008. Since then, it has been renamed Digital India Land Records Modernization Programme (DILRMP) in 2016 and brought under a central Sector Scheme. It is a merger of two schemes, Strengthening of Revenue and Administration & Updating of Land Records (SRA&ULR) and Computerization of Land Records (CLR). (*Digital India Land Records Modernization Programme (DILRMP)*, n.d.)

DILRMP seeks to facilitate the Computerization of land records, survey/re-survey and updating of survey and settlement records, computerisation of registration, modern record rooms in tehsils, taluk, circle and block level, training and capacity building for officer and staff implementing the programme. It is a comprehensive program that aims to improve the quality of land records, increase their accessibility, and, over time, move towards a system of conclusive land titling with government-guaranteed titles.

Key Components of DILRMP:
- Computerization of Land Records: This involves digitising existing land records, including details like ownership, location, dimensions, and encumbrances.
- Survey/Re-survey: Many areas lack proper surveys or outdated maps, so this component focuses on conducting accurate surveys and creating digital maps for all properties.
- Computerization of Registration: This streamlines the registration process for land transactions and integrates it with the digitised land record system.
- Setting Up Modern Record Rooms and Centres at Tehsil, Taluk, Circle and Block level
- PMU and DILRMP cell for Capacity Building: Training and Capacity building of officers and staff implementing the programme

Benefits of DILRMP:

- Increased Efficiency and Transparency: Digital records reduce delays, human errors, and fraud, promoting efficient land administration and public trust.
- Improved Land Use Planning: Accurate and accessible land records facilitate better planning and management of land resources.
- Enhanced Property Rights: Secure and readily verifiable records strengthen property rights and protect them from disputes.
- Reduced Transaction Costs: Streamlined registration procedures and online access decrease transaction costs associated with land deals.
- Empowerment of Landowners: Easier access to land records enables better awareness and management of property by landowners.

Within DILRMP, several projects have been initiated. One such step is the Bhu-Aadhaar or the Unique Land Parcel Identification Number (ULPIN) project, which seeks to assign a 14-digit alpha-numeric number to land parcels in India based on the geo-coordinates of the land parcel.

The Indian government, in March 2023, organised a conference called the National Conference on 'Bhumi Samvaad IV', focused on implementing Unique Land Parcel Identification Number (ULPIN) or Bhu-Aadhaar. This was the fourth such conference, which brought together leaders from various states, Union Territories, ministries, and departments, as well as other stakeholders like the geospatial community, startups, and academia. The objective of the conference was to discuss the digitisation and geo-referencing of India with Bhu-Aadhaar (or ULPIN). The computerisation of Land Registrations is 94% complete, and 9 crore land parcels now have Bhu-Aadhaar. Transliteration of Land Records will be available in 22 languages in the near future, facilitating the citizens of the country. The Bhu-Aadhaar will be a move towards the Government's agenda of Citizen-Centric Governance, which will help achieve the target of India being a $5 Trillion economy.

Bhu-Aadhaar has been rolled out in 26 states and is in the implementation process in the remaining 9 states, barring Meghalaya, due to its tradition of community ownership of land parcels. By March 2024 the Department targets to achieve 100% of land records under Bhu-Aadhaar.

The Unique Land Parcel Identification Number (ULPIN), often referred to as "Bhu-Aadhaar," is a revolutionary initiative by the Department of Land Resources (DLR) under the Ministry of Rural Development, Government of India. It aims to create a unique 14-digit identification number for every land parcel in the country, akin to Aadhaar for individuals.

Core Objectives of Bhu-Aadhar are:

- Eliminate Duplicates and Conflicts: By assigning unique IDs, Bhu-Aadhar aims to eliminate disputes arising from duplicate land records and unclear boundaries.
- Enhance Transparency and Accuracy: Precise geospatial coordinates and digital maps linked to ULPINs ensure higher accuracy and improve trust in land records.
- Streamline Land Transactions: ULPIN-based records enable faster and more secure property transactions, including online access and reduced paperwork.
- Efficient Land-Use Planning: Comprehensive land data facilitates better planning for infrastructure development, agriculture, and environmental conservation.
- Empower Landowners: Easier access to land records strengthens property rights and empowers landowners to manage their assets effectively.

ULPIN holds immense potential to revolutionise land record management in India. By ensuring efficient, transparent, and secure land governance, ULPIN can ultimately contribute to equitable land ownership, sustainable development, and economic growth.

Additionally, in 2021 Department of Land Resources bought out the new guidelines on the Digital India Land Records Modernization Programme (DILRMP). These guidelines have been prepared to keep in view the needs of the States/UTs towards implementation of various components of DILRMP approved by the Government of India, extending the programme for a further period of five years, i.e., 2021-22 to 2025-26, with newly added components:

(i)   Linkage of Aadhaar number with land records database and

(ii)   Computerization of Revenue Courts and their integration with land records.

These Guidelines will help States/UTs to achieve completion of 100% basic and primary computerisation and digitisation work of all land records of the country by 31.03.2023 and completion of all other components of DILRMP by 31.03.2026 so as to provide the citizens ease of living and ease of doing business to stakeholders. Further, the Department is responsible for managing important legislative acts such as the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act of 2013 and the Registration Act of 1908. These acts are closely linked to land records and their maintenance.

Other initiatives like the National Generic Document Registration System (NGDRS) and Multilingual Land Records which is being developed to break the linguistic barriers across states and provide a common sharing protocol, and coming up very soon.

Table 3 shows the progress achieved under the DILRMP. The table shows that most states have achieved a significant level of computerisation of land records and their integration with spatial data. (Ahmed & Sengupta, 2023)

S.No.	State/UT	Cadastral Maps/FMBs/Tippans Digitized (%)	Cadastral Maps Geo-refrenced (%)	Cadastral Maps linked to RoR (%)
1	ANDAMAN & NICOBAR ISLANDS	13.01%	0.49%	43.90%
2	ANDHRA PRADESH	95.34%	95.18%	94.36%
3	ARUNACHAL PRADESH	NA	NA	NA
4	ASSAM	80.83%	10.60%	63.66%
5	BIHAR	100.00%	99.04%	97.88%
6	CHANDIGARH	100.00%	100.00%	100.00%
7	CHATTISGARH	99.84%	0.07%	95.79%
8	GOA	79.05%	100.00%	73.65%
9	GUJARAT	99.85%	98.69%	65.18%
10	HARYANA	91.87%	5.40%	5.45%
11	HIMACHAL PRADESH	89.85%	4.58%	44.98%
12	JAMMU & KASHMIR	76.79%	74.48%	32.74%
13	JHARKHAND	99.44%	98.41%	96.39%

Table 3: Status of Map Digitisation under DILRMP 2.0

14	KARNATAKA	52.58%	100.00%	50.48%
15	KERALA	99.99%	19.78%	0.00%
16	LADAKH	12.42%	0.81%	0.40%
17	LAKSHADWEEP	82.38%	33.33%	37.50%
18	MADHYA PRADESH	99.91%	99.90%	99.90%
19	MAHARASTRA	29.18%	58.81%	18.74%
20	MANIPUR	100.00%	6.30%	0.04%
21	MEGHALAYA	NA	NA	NA
22	MIZORAM	100.00%	46.54%	46.06%
23	NAGALAND	100.00%	32.12%	32.12%
24	NCT OF DELHI	100.00%	32.37%	32.37%
25	ODISHA	100.00%	0.59%	99.87%
26	PUDUCHERRY	100.00%	0.77%	100.00%
27	PUNJAB	69.10%	0.00%	0.01%
28	RAJASTHAN	71.07%	7.17%	57.25%
29	SIKKIM	100.00%	88.63%	0.23%
30	TAMILNADU	100.00%	25.72%	99.86%
31	TELANGANA	86.48%	53.95%	0.79%
32	THE DADRA AND NAGAR HAVELI AND DAMAN AND DIU	100.00%	35.00%	35.00%
33	TRIPURA	100.00%	100.00%	100.00%
34	UTTARAKHAND	33.91%	0.61%	13.55%
35	UTTAR PRADESH	91.32%	66.18%	83.34%
36	WEST BENGAL	96.04%	5.51%	98.03%
	Total	**68.27%**	**49.77%**	**70.97%**
	Source: Department of Land Resources			

F. Problems Still Persist Despite Digitisation Efforts

While DILRMP so far has looked at the digitisation of land records, it has not addressed issues around land ownership. It is well known that land records in India are unclear and do not guarantee ownership. Such unclear land titles are there for various reasons, some of which are discussed below.

In India, the legal framework is centred around registered sale deeds rather than land titles. The Transfer of Property Act of 1882 mandates transferring or selling the right to immovable property through registered documents governed by the Registration Act of 1908. Consequently, transactions are registered, not the land title itself, creating a situation where ownership is not always guaranteed, and previous transactions may face challenges. Moreover, certain property transactions are not mandatory to register under the Registration Act, leading to unrecorded divisions and potential disputes over property ownership. (Sonar & Patel, 2018)

Also, land ownership is still established through multiple documents maintained by different departments, making it cumbersome to access them. (Mishra & Suhag, 2017)

Even after implementing the Digital India Land Records Modernization program, India's current land registration process involves several steps. The buyer and seller finalise the 'Agreement to Sale,' which is notarised, and the buyer often pays a token amount. If the buyer seeks a loan, the seller obtains a 'No Encumbrance Certificate' from the Land Registration Office. The buyer pays stamp duty online or through bank deposits, and the final sale deed is drafted on stamp papers. The full payment is made, and both parties and witnesses sign the deed. The deed is registered at the Sub-Divisional Registrar Office, where property details are verified, and the buyer collects the original registered deed. The buyer then applies for mutation at the Patwari's land revenue office, providing necessary documents. The Patwari verifies statements and issues a certificate, granting mutation if no objections are received; otherwise, the case is transferred for resolution. (Thakur et al., 2020)

Thus, we see that departments still work in silos and do not coordinate the updation of the data themselves, which risks discrepancies appearing later. For example, sale deeds are stored in the registration department, maps in the survey department, and property tax receipts in the revenue department. A person will have to go back to several years of documentation to find any ownership claims on a piece of property, which causes delays.

Moreover, the cost of registering property is high, so people avoid registering transactions. While registering a sale deed, the buyer must pay a stamp duty and the registration fee. In India, stamp duty rates across states vary between 4% and 10%, compared to 1% and 4% in other countries. Further, the registration fee is an additional 0.5% to 2%, on average. (Mishra & Suhag, 2017)

The computerised land records, a vital aspect of the DILRMP, aim to enhance transparency and efficiency in land administration. While many States/UTs have made these records available online for free, concerns arise regarding privacy (Mishra & Suhag, 2017). Land records typically include owners' personal details, property location, type, and assessed value, posing privacy risks when accessible on the Internet. The freely available data may be combined with other datasets for unintended purposes, such as by real estate entities without owners' consent. Although India does have personal data protection laws, they are new, and their interaction with legacy public records, such as land records, is yet to be seen.

G. Way Ahead

It has been abundantly clear that digitisation alone cannot improve land management in India; it needs legal and regulatory remedies. However, the spread of information and responsibilities over multiple departments recording information on land is vast. Thus, along with an administrative overhaul backed legally, there is a need for a system which connects and helps collaborate with the multitude of government departments and, of course, citizens. One such system is the Distributed Ledger Technology of DLT.

DLT is a superset of technologies that makes it possible to register and record, share and transfer valuable information securely and tamper-proof to only the intended recipients. The contemporary need for data and information sharing, which effectively enables cross-government collaboration, demands that public services be reimagined with technology as the centrepiece. This paper establishes DLT as a possible future for governance and public service mechanisms, especially land record management. Although it is not without its weaknesses, DLT is still evolving, and its usefulness has been acknowledged by national governments worldwide. India, too, needs to start now since scaling it up nationwide would need time, effort and financial resources.

II. Understanding Distributed Ledger Technology (DLT)

Introduction to DLT: Introduce the concept of Distributed Ledger Technology.

Distributed Ledger Technology (DLT) is a term that describes a system of storing and updating data across multiple nodes or devices without relying on a central authority or intermediary. Unlike centralised ledgers, distributed ledgers enable the creation of decentralised networks where participants can share and verify information securely and transparently.

The importance of DLTs, of which one application is Bitcoin, which in turn is built upon Blockchain (which is ultimately a sort of DLT), rests in their ability to store data in a distributed manner, using a ledger format within an immutable protocol that records all transactions. Consequently, any transaction and its corresponding information and any related asset can be easily traced and attributed to a specific entity at any given moment.

DLT can be used for various applications, such as digital currencies, smart contracts, supply chain management, identity verification, etc. DLT can potentially improve efficiency, reduce costs, enhance trust, and empower users in different domains and industries.

Underlying Principles of DLT

DLT, or distributed ledger technology, serves as a system for recording and updating information across multiple nodes in a network. The core principles of DLT encompass decentralisation, immutability, transparency, and cryptography.

Traditional IT architectures rely on stringent access controls, firewalls, and specialised network connections to maintain security and prevent data tampering. In contrast, DLTs, even when operating on permissioned networks, enable a broader range of actors to verify records without compromising the security of original documents.

In a decentralised framework, no central authority controls the ledger or validates transactions. Instead, each network node possesses an independent ledger copy, facilitating transaction

verification through a consensus mechanism. Immutability ensures that once a transaction is recorded, it cannot be altered or deleted, preserving data integrity and preventing fraud.

Transparency is achieved by making the ledger open and accessible to authorised parties, fostering trust and accountability while minimising information asymmetry. Cryptographic techniques, such as hashing, digital signatures, and encryption, play a crucial role in safeguarding data within the distributed ledger system, ensuring both authenticity and confidentiality.

Applications in Various Sectors

Distributed Ledger Technology (DLT) functions as a decentralised system for recording and distributing data among multiple network nodes, removing the necessity for a central authority. Its versatility spans across finance, supply chain, healthcare, energy, and government sectors, offering advantages like improved transparency, security, efficiency, and innovation. In finance, DLT can expedite cross-border payments, introduce digital assets, and enhance regulatory compliance. In supply chains, it bolsters traceability and quality assurance, reducing costs and fraud. In healthcare, DLT facilitates secure data sharing and patient empowerment. In energy, it facilitates peer-to-peer trading and grid stability. For governments, DLT fosters transparent governance and streamlines service delivery.

DLT in Land Record Management

Distributed ledger technology (DLT) is a system of recording and storing shared and synchronised data among multiple participants. DLT can enable more transparent, secure, and efficient land record management by reducing the need for intermediaries, enhancing data quality, and facilitating transactions.

Some of the potential applications of DLT in land records are:

- Digitizing land titles and deeds: DLT can provide a tamper-proof and immutable record of land ownership and transfer history, as well as reduce the risk of fraud, corruption, and disputes. DLT can also enable the verification of land rights and claims using cryptographic signatures and smart contracts.

- Streamlining land registration and transfer processes: DLT can automate and simplify the processes of registering and transferring land rights and reduce the costs and time involved. DLT can also enable real-time updates and notifications of land transactions and improve coordination and communication among different stakeholders.

- Enhancing land data management and analysis: DLT can enable the collection, storage, and sharing of various types of land data, such as spatial, environmental, social, and economic data. DLT can also facilitate the analysis and visualisation of land data for better decision-making and planning.

- Promoting land access and inclusion: DLT can empower marginalised and vulnerable groups, such as women, indigenous people, and refugees, to access and claim their land rights. DLT can also enable the participation and collaboration of different actors in land governance and development, such as governments, civil society, the private sector, and communities.

The transition from presumptive to conclusive titling in India's land records modernisation trajectory commenced in 1989 when Mr. D.C. Wadhwa recommended reforms as part of the One-Man Committee on Records of Rights in Land.

This shift, aligned with the Torrens system and its fundamental principles - the mirror, curtain, and indemnity principles - aims to accurately reflect land assets, eliminate the need for an ownership trail of documents, and provide compensation for state errors, respectively.

- Mirror principle: the land records register reflects (mirrors) accurately the details of all registered land assets

- Curtain principle: The recorded facts about the asset are sufficient; they do not require an ownership trail of documents

- Indemnity principle: The State provides compensation in case of an error made by the state in recording the land records

Leveraging DLTs for land registry aligns seamlessly with these principles. DLT inherently ensures accurate reflection of land assets and transaction details, thus fulfilling the mirror and curtain principles. Implementation of the indemnity principle by the State becomes feasible once the system gains confidence in data integrity. The envisioned benefits of scaling up this system encompass enhanced certainty of ownership, reduced litigation, stimulated land transactions, and heightened transparency through real-time audit capabilities and digitally signed records. DLT emerges as the optimal technology for this endeavour, given its ability to maintain transparent ownership records, track transaction history, and facilitate secure transactions among multiple stakeholders. A DLT-based land titling and transaction system can track various land transactions and services, collaborating with financial institutions to update registries and enable smart transactions. Notable stakeholders identified to hold access to private information on such a DLT-enabled platform include title holders, purchasers, government offices, financial institutions, regulatory authorities, real estate companies, appraisers, and insurance providers.

IV. Case Studies from India and around the World

Case Studies of India States

ANDHRA PRADESH

The Andhra Pradesh Land Records Department, in collaboration with the transport branch of the authorities of Andhra Pradesh, conducted a blockchain pilot that began in October 2017. This initiative marked Andhra Pradesh as the first Indian state to implement blockchain technology. The pilot's results were encouraging, leading to plans for its extension across all departments in the future. The idea to employ blockchain for land records arose from a genuine need among landowners to prevent tampering, as property disputes constituted 66% of civil court cases, primarily due to fraudulent or manipulated land records.

After the successful implementation of the Land Pooling Scheme (LPS) in Amaravati, the capital city of Andhra Pradesh, it became a key government initiative to allocate returnable plots to farmers who contributed their lands for the construction of the capital city. To address the substantial land registration requirements, the Andhra Pradesh Capital Area Development Authority (APCRDA) decided to leverage existing geospatial technology and incorporate recent technological advancements for transparent and real-time data dissemination to the public.

The implementation of blockchain technology for registration maps became a landmark step for APCRDA to enhance transparency in transactions, update spatial and non-spatial data in real time, and share information for public access. The entire workflow involved introducing Geographical Information System (GIS) data, organising and integrating non-spatial information

from the sales department, and ultimately creating an integrated database. The GIS database maintained spatial plot data, including dimensions and on-ground GPS locations, and integrated this information with adjacent plots, roads, and public places. Land registration data flowed into the GIS database from the AP online platform and was subsequently sent to the blockchain.

The successful integration of GIS and blockchain technology was implemented and tested in real time, showing promising prospects for future applications. A public ledger of land records, developed in collaboration with ChromaWay, a Swedish startup, is currently being constructed, allowing easy access to property details for individuals. The distributed ledger serves as protection against ransomware attacks, exemplified by incidents like WannaCry, highlighting the vulnerability of India.

Zebi Records, a blockchain-based solution for hosting land data, is actively being used in Amaravati, the capital region of Andhra Pradesh. Approximately one lakh land records with the Capital Regional Development Authority (CRDA) are now on the blockchain. The implementation process involves the blockchain solution integrating seamlessly with existing department systems through API calls, using HTTP API calls to integrate with GIS systems on different technical platforms. APCRDA's GIS system data is stored in the blockchain through Geo-JSON format. Modifications or alterations of land records follow a specific process, with options available only for authenticated users. Upon user request, the GIS system generates parcel images, and the blockchain server generates blockchain certificates with embedded QR codes for property information. The existing systems encompass all transaction validation business logic and call APIs of the blockchain for relevant data, offering flexibility and option-based functionalities.

TELANGANA

In July 2017, the state of Telangana announced its plan to sign Memorandums of Understanding (MoUs) with various blockchain agencies, expressing a keen interest in leveraging the technology to enhance government services (Press Trust of India, 2018). Telangana initiated a pilot project for a land registry in the capital city of Hyderabad. It was reported in September 2017 that a complete rollout of the system in Hyderabad and nearby areas would occur within a year (Blockchain News, 2017).

The Telangana government outlined that the migration of land records to a blockchain platform would be conducted in phases, with only confirmed transactions being moved to the blockchain (The Hindu, 2018). For instance, lands serving as collateral for loans and other types of mortgages could be seamlessly transitioned to the blockchain. Banks and financial institutions typically conduct a thorough appraisal of such properties (Panchapakesan, 2018).

Public-Private Partnership (PPP) projects were also initiated. Telangana state collaborated with Tech Mahindra, signing an MoU to establish a Blockchain District in the capital city of Hyderabad. The objective is to create a conducive blockchain environment, with the government providing an appropriate regulatory and legal framework (Krishnakumar, 2018). Tech Mahindra, in turn, would contribute the technology and platform for the incubators within the Blockchain District (Anupam, 2018). The success of Telangana's blockchain-based property registration platform was recognised with a gold SKOCH award.

Case Studies of other countries:

GEORGIA

Georgia's blockchain-based land registry initiative showcases technology adoption in post-socialist economies. Similar to Ghana, it's part of ongoing land governance reforms but with different outcomes. Georgia, a former Soviet republic, transitioned from collective farms to private land ownership starting in 1992. The land was redistributed to rural households, aiming for both subsistence and commercial farming. However, challenges persist, including limited land privatisation and underdeveloped rural credit markets.

Georgia's adoption of digital technology, particularly blockchain, was facilitated by the presence of Bitfury Group, which established Bitcoin mining centres in the country in 2014. Bitfury's operations, fuelled by cheap electricity, spurred widespread interest in cryptocurrency mining among individuals, with up to 5% of households estimated to be involved by 2018. This surge in mining activity made Georgia a net exporter of electricity and potentially boosted incomes.

Georgia's reformed land registry has been a resounding success in securing property rights and preventing fraud. Georgia's land registration began in 1999, but local officials sometimes favoured elites over ordinary landholders, leading to perceptions of corruption. To address this, private land surveyors were provided, and farmers were educated about their rights. Reforms in the mid-2000s aimed to combat corruption and modernise land management, with support from international organisations and governments. A digital database called NAPReg was created, but concerns remained about external influence on land transactions. Georgia then pioneered the use of blockchain for land titling, building on a decade-long effort to digitise property registries. By 2018, 1.5 million land titles had been recorded on the blockchain in Georgia.

GHANA

Ghana faces an unstable political climate combined with the fact that 90% of the land lies unregistered by the government. It turned towards DLT-based solutions to combat corruption and lack of state capacity records tampering and large information asymmetries. It operates a public blockchain-based platform called OpenLedger in partnership with private entities like IBM and Bitland while more such companies are expected to join. Ghana is pushing to modernise its land records by making them immutable. Local startups and organisations have also been putting efforts into understanding the legal and ground realities.

Nevertheless, the current land recordation procedures in Ghana are influenced by two conflicting factors: the government's efforts to consolidate and formalise land rights through bureaucratic means, and the fragmentation caused by local and regional authorities vying for political support by allocating land (Miscione et al., 2020). Significant proportions of land transfers are still administered using traditional methods and are not officially identified in range. These sales frequently occur through sharecropping and other temporary land use agreements, with payments to local chiefs being disguised as "drink money."

The manner in which the blockchain registry will interface with the conventional land allocation method, which continues to be a significant means of land distribution in certain regions of the country, remains unclear. The process of digitising the land administration system has the potential to result in the establishment of additional layers of parallel institutions and clandestine governance.

SWEDEN

In June 2016, the Lantmäteriet, Sweden's property regulator, collaborated with Telia, ChromaWay, and Kairos Future to release a groundbreaking report titled 'The Land Registry in the Blockchain.' The study aimed to assess the potential of blockchain technology in revolutionising real estate transactions by addressing critical challenges in land record management.

The report highlighted key impediments in Sweden's land record management, such as information asymmetry between sellers and buyers, lack of transparency, and a prolonged registration process. These challenges forced various stakeholders to establish complex processes, leading to bureaucratic delays and red-tapism in real estate transactions.

In response, the Swedish government embarked on a project to establish a blockchain-based land registration system, aiming to grant equal privileges to all transaction parties. The project focused on streamlining the contracting procedure, introducing digital signatures, and identification to enhance efficiency.

The first phase of the initiative showcased the potential of blockchain technology, while the second phase, concluded on March 31 2019, involved testing smart contracts to automate transactions. This phase successfully eliminated the need for physical signatures in the buyer-seller interaction.

In 2021, the third phase of the blockchain pilot was completed with the active participation of banks, businesses, and startups. The live demonstration emphasised client-side verification of digital signatures and the export of legal contracts, ensuring compliance with EU laws, including GDPR privacy rules.

The Swedish system operates on a private blockchain, with the land authority and banks holding copies of records. This ensures a highly secure and transparent verification and storage service for property transactions, aligning with the project's goal of enhancing legal efficiency. Despite the substantial progress, the Swedish blockchain initiative stops short of creating a full-blown cryptocurrency for buying and selling land, opting instead for a secure and controlled approach to property transactions.

Lessons Learned

DLT provides a compelling solution to the issue of trusting other parties, offering genuine digital trust through, for example, Blockchain technology. Despite its potential to replace paper, which has been a staple for thousands of years, the adoption of this technology is a gradual process. DLTs stands out as the important solution capable of managing digital originals, validating legal actions and processes, and ensuring transparency. However, there are legal challenges, such as the validity of digital signatures, that need resolution.

In her examination of blockchain's role in formalising land rights in developing countries, Rodima-Taylor (2021) asserts that although there is a shift to digital registries in land recordkeeping, blockchain's ability to create virtual spaces for property and governance is constrained. The technology still depends on interfaces and intermediaries for transactions and legal standing rather than directly facilitating contractual claims.

The promise of enhanced interoperability and synchronisation through DLT raises a critical question: Can digitalisation truly make a difference in the absence of broader legitimacy and

legibility of land rights in the real world, or does it risk perpetuating false promises that mask exclusion and inequality on the ground?

Existing legacy infrastructures for real property transactions are sluggish and costly due to reliance on numerous intermediaries such as brokers, government databases, title companies, and legal entities. DLT-based applications in land record management present significant potential advantages for coordinating land administration by ensuring transaction validation on multiple nodes, enabling data recovery in case of node destruction. By enhancing public access to information and allowing real-time verification of land ownership, DLTs have the potential to mitigate the manipulation of land records.

V. Problematising Digitisation of Land Records in India

This document primarily discusses the impact of DLTs on land records. However, in the context of India, it is crucial to first comprehend the process of digitisation concerning land records. The reason is that the integration of DLT in Land Records management is dependent on the level of digitalisation of land records (which in India is largely happening within the ambit of DILRMP.

The Neo-liberal influence on economic policy leading to a decline of state intervention and efforts towards redistributive policies with regards to land reforms backed by policy advocacy of the World Bank and several other donor agencies lie behind the collective efforts to find apolitical solutions (such as bringing DLTs in land record management) to legacy problems related to Land and its management at least in Global South. This push is also helped by the demographic changes and rising pressures of urbanisation.

Now, where does the need to formalise land records lie?

According to Bromley (2008), the drive to formalise tenure in housing and land assets stems from the belief that having official titles is crucial for poverty alleviation and development in poorer regions. Formalisation involves registering and issuing titles to individuals or families who currently possess housing and land assets without secure ownership. This lack of security is thought to deter investment in these assets. Formalisation aims to transform possession into ownership, allowing individuals to use their titles as collateral for loans from banks and other financial institutions. These loans could be used to start businesses, improve housing, or invest in agriculture, with the ultimate goal of reducing poverty. Tenure security is seen as essential for this process, and formal titles are seen as providing that security.

Gurumurthy et al. (2022) highlighted concerns about DILRMP's impact on marginalised farmers. They criticise the program for neglecting the customary tenure rights of marginal farmers, tribal groups, and indigenous peoples, potentially leading to their exclusion from common property resources. Bromley (2008) further accentuates this by refusing to accept that formalisation of Land Records can create 'development' without accounting for several other factors such as jobs, planned urbanisation, supporting agricultural asset creation, etc, which affect the ability of people to buy and sell land and houses which in fact constitutes the land records in the first place

The DILRMP has faced significant criticism and is perceived to be failing or has failed due to several key reasons. The following sections highlight the same.

Legitimisation of Erroneous Land Records and related issues

The DILRMP has resulted in the recording of inaccurate land records, particularly in areas where marginalised populations lack the resources to update their land titles. This has led to revenue

records remaining outdated for many years, exacerbating exclusions from land rights. In many cases, public (or collective) investment in land can actually enhance tenure security, contradicting the common belief that security is a prerequisite for investment. Investments like trees, irrigation systems, or buildings can strengthen a landholder's legal position in disputes (Sjaastad & Bromley, 1997). Thus, while tenure insecurity may deter investment, it can also incentivise investment as a means to bolster security. This challenges the notion that insecurity hampers investment, especially in indigenous or tribal tenure systems where investments can legitimise land claims and provide recourse even in cases of land loss (Sjaastad & Bromley, 1997).

The process of digitising land records, as initiated by DILRMP, has created a foundation of data that can potentially be used to develop a DLT-based land record management platform. However, this data faces certain challenges that need to be addressed. In 2022, Haryana Police expressed concerns about the digitisation of revenue records on the government website *(jamabandi.nic.in),* citing a case where an accused used a copied thumb impression from the website to withdraw money fraudulently. The police have recommended that thumb impressions should not be visible to the public on the website and that the website should be audited for other security loopholes. This raises privacy and data security issues. ("Haryana Cops See Red in Digitisation of Revenue Records," 2022)

Additionally, there is sizable data heterogeneity across states in terms of recorded land data. The National Council of Applied Economic Research (NCAER)'s Land Policy Initiative ranks states based on the extent of digitisation of land records and has documented how this process improved the quality of land records on the Land Records and Services Index 2021 (N-LRSI). Assam, Chandigarh, Sikkim, Jammu and Kashmir, and Ladakh have scored the lowest on N-LRSI 2020-21. The study recognises the fact that each state faces unique social and political challenges in the digitisation process, and their particular contexts can inhibit them from performing well on the index.

There are concerns about the quality of data when integrating DLTs with digitised land records. For example, in August 2018, the Gujarat Government halted across the state the creation of new records under the DILRMP after it received several complaints as citizens sought resurveys and correction of records (Rupavath, 2022). By that time two-thirds of all villages in the state were created. Weighed down by a substantial volume of grievances, the district authorities had encountered difficulties in resolving these disputes—each rectification necessitates a new survey of the land plot. A modification in one title necessitates adjustments in other titles, creating a cascade of modifications in the RoRs (Rupavath, 2022). This, in turn, raises the issue of potential data tampering before the data is put on a DLT-based land record management platform.

Exclusion and De-recognition of Land Rights

De-recognition of Traditional Common Property Resource (CPR) Regimes

The DILRMP neglects the traditional tenure rights of marginalised farmers, tribal groups, and indigenous peoples. It fails to recognise collective land claims in common lands, leading to the disenfranchisement of vulnerable communities. For example, in Meghalaya and Karnataka, local communities express dissatisfaction with the program's failure to acknowledge their collective land rights under traditional law. (Gurumurthy et al., 2022)

Conversion of Communal Rights into Individual Rights

In some areas like Coorg, under DILRMP, communal rights in *jamma* lands were recorded as individual rights during the digitisation process. This led to the enclosure of commons, land

degradation, and the fragmentation of society. Imperfect records created through the DILRMP are perpetuated in larger data exchanges, such as the AgriStack, without proper verification processes. (Gurumurthy et al., 2022).

An article published in 2019 by IndiaSpend (and later on Scroll) revealed that in January 2016, the Jharkhand government launched a 'land bank' portal containing district-wise information about land available for industrial and non-agricultural purposes. However, many tribal groups protested, claiming that their common lands and historically cultivated farmland were included in the land bank. Verification in Khunti district found that tribal religious and burial spaces were also listed. People discovered sudden changes in land ownership, including strangers listed as heirs or reduced land ownership. Investigations, as per the articles, suggest that errors and discrepancies in online records were likely introduced by private data-entry agencies appointed by local district administrations between 2008 and 2016 to manually enter data from physical land records into digital software. (Purohit, 2019)

This has caused fear of displacement and sparked disputes, particularly during the state's five-phase election at the time. Many viewed the digitisation of land records as part of the government's land policies, which have often disregarded tribal and marginalised rights. Additionally, most tribal communities lack digital literacy, leading to widespread ignorance about digital procedures. Their recurring concern is that the digitisation program is a government attempt to take over tribal land for industrial use. (Purohit, 2019)

Exclusion of Non-Landowning Farmers

Accurate measurement and maintenance of land records can help a State to achieve its redistributive efforts in welfare policies, which can impact the most marginalised, especially those who depend on land in the form of agriculture for sustenance. However, due to neo-liberal impulses, the administrative regime, under the State's tendency of adoption of the Torrens system has treated land records from an economic and transactional view, ignoring other socio-cultural aspects associated with land. (Goswami et al., 2020)

The digitisation of land records limits the definition of farmers to landowners, excluding those who work on leased land, engage in sharecropping, or are landless agricultural labourers. This exclusion prevents non-landowning farmers, pastoralists, livestock farmers, and fisherpeople from accessing benefits and welfare programs based on land titles. (Gurumurthy et al., 2022)

Overall, the DILRMP's failure to recognise traditional land tenure systems, its creation of inaccurate land records, and its exclusion of non-landowning farmers contribute to its perceived inadequacy and failure to address the needs of marginalised communities in India.

Interpreting realities: A case study of Tamil Nadu's performance in Land Record Management against CAG's Audit

In 2022, the Comptroller and Auditor General of India conducted a Performance Audit on Land Records Management in Tamil Nadu. The objectives of the audit were to assess whether:

(i)   the Record of Rights (RoR) computerisation, digitisation of maps, survey/resurvey of lands and activities under other components were carried out to achieve a conclusive land-titling system with title guarantee

(ii)   the Revenue and Registration Departments effectively use the available data, and

(iii)   data security, required infrastructure, adequate training and capacity building for effective maintenance and sustenance of the scheme were in place and monitoring of the programme was adequate.

Prior to delving into the findings of the Comptroller and Auditor General's (CAG) Audit report, it is imperative that we take a moment to capture the state's performance on a few key indicators under the DILRMP programme. This will allow for a fair and accurate comparison to be made.

Some achievements of Tamil Nadu as per the DILRMP-MIS 2.0 portal:

- 100% Computerised Land Records in its 16810 villages
- RoR Distribution through CSC, Kiosks, Online, etc., in 99.86% of villages totalling 16,787 villages
- 100% digitisation of Cadastral Maps/FMBs/Tippans. 25.71% of Cadastral Maps Geo-referenced and 99.86% of Cadastral Maps linked to RoR
- 74.44% of completed Modern Record Rooms against a sanctioned strength of 313. Civil works were completed in 233, and equipment was procured in all 313 record rooms.

The Performance Audit (PA) covered the activities during 2016-21. The field visits included the examination of records at the offices of the Revenue and Disaster Management Department (R&DMD), Directorate of Survey and Settlement, Chennai, Assistant Directors of Survey and Land Records (ADSLR) and Taluks.

As per the audit, CAG contended that digitisation of land records in Tamil Nadu has resulted in better access and more transparency in land record management. However, the scheme's outcomes were marred by significant deficiencies in converting manual records into digital records, abnormal delays in launching online services for Natham land records and e-Adangal, and unresolved issues affecting transparency and timely delivery of online patta transfers. Moreover, there were also deficiencies in data linkage between the Registration and Revenue Departments, asset management, data security and monitoring of the scheme.

The digitisation of land records resulted in better access to these records for the public. Unfortunately, there were errors and deficiencies in the digitised land records. In 61% of the villages studied, there were significant differences in the total land area between the manual and computerised land records. Discrepancies resulted from errors in the application software, such as improper capture of old survey numbers and misassignment of subdivision numbers. About 3.22 lakh private land parcels were mistakenly classified as government land, causing hardship to landowners.

The online transfer process was slowed by issues such as multiple patta numbers for one owner and redundant patta numbers. Service delivery to citizens was affected by the incomplete computerisation of Field Measurement Sketches (FMS), leading to errors in land area records.

Despite efforts, many computerised Natham land records were not brought online, and the e-Adangal Project was not fully implemented. Delays in processing online patta transfer applications were common, with significant percentages of applications facing delays in approval and rejection.

The integration between the Registration and Revenue Departments did not prevent a high rejection rate for patta transfers, causing delays and hardship for landowners. Manual scrutiny revealed a high rate of incorrect approvals and rejections for patta transfer applications.

Since 1998, land records have been computerised through three schemes in the state. The project was supposed to be completed by March 2020, but deadlines have not been met, and timely and efficient services have not been achieved. Resurvey work is progressing slowly in three districts, and LRMCs have not been completed in 144 out of 305 taluks (47%).); thereby, the envisaged facilities were not provided to the citizens seeking land record-related services.

Resurvey work remains incomplete in several areas, delaying the finalisation of land settlement. Despite significant funding, many Land Record Management Centres lacked essential facilities. At all levels, monitoring of land record management was deficient, with some monitoring committees not meeting at all.

VI. Potential Integration of DLT in Land Record Management: A Policy Roadmap

Despite challenges faced in the land recording system in India, there's a silver lining: essential resources to support this process are available. These include formal updating procedures, institutions managing land registration, government involvement, digital land record databases, supportive legal frameworks, capacity building for staff, and mechanisms to evaluate registration effectiveness.

As DLTs gain traction in both public and private sectors in India, it has become imperative to develop a robust governance framework to ensure its safe and sustainable use. While current blockchain arrangements often rely on contractual agreements to address legal issues, the increasing deployment of blockchain-based applications necessitates a more comprehensive governance approach to address the evolving needs of stakeholders.

Key Principles for Designing a Governance Framework:

Transparency emerges as a fundamental principle in the design of a governance framework for DLTs. This entails clearly defining the rights, powers, and obligations of each participant in the blockchain network and ensuring traceability in the decision-making process. Providing access to relevant information enables participants to comprehend the functioning of the blockchain system and assess the associated risks and challenges effectively.

Legitimacy is another crucial aspect to consider when conceptualising a governance framework for DLTs. Mechanisms should be established to verify the accuracy and authenticity of the information or data stored within the blockchain. This ensures the integrity and reliability of the blockchain system, fostering trust among users and stakeholders.

Furthermore, accountability plays a pivotal role in the governance of DLTs. It involves designing mechanisms to determine liability and responsibility in the event of disputes or errors within the blockchain network. By establishing clear accountability measures, stakeholders can be held accountable for their actions, promoting accountability and transparency within the blockchain ecosystem.
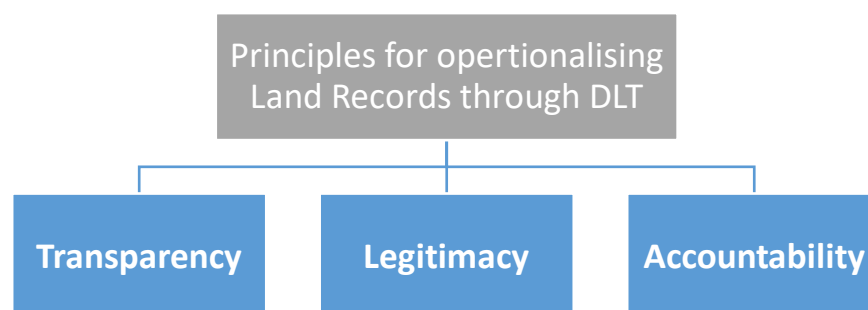
Based on this framework, certain governance standards can be operationalised and planned for.

Decentralisation

In order to improve the correctness of the records and allow equitable access to all, land registration services have to be closer to the people: The distance and the time taken to register a change in land records are reduced, and motivation to register changes in land records is increased. Thus, more so in the spirit of DLTs, it calls for decentralisation at the level of government for integration of DLT in Land Record Management.

In OLSRD and SVAMITVA, for example, while they produce results quickly, their institutional effectiveness is questionable. Despite decentralisation, true authority and autonomy are lacking, and there's a lack of proper governance structures to coordinate various actors. Decentralisation may be the goal, but centralised control still dictates the rules, highlighting the need for empowerment and resources at the local level for effective governance. (Ho et al., 2021)

Thus, in order to integrate DLT into the land record management system, it's crucial to entrust it to a dedicated agency or department with clear processes for states and UTs to collaborate together with the central government. This ensures that the process receives proper attention and expertise, rather than burdening departments like the Revenue Department with multiple responsibilities.

Hence, first of all, the existence of multiple agencies (survey and settlement department, the revenue department and the registration department) at the level of revenue administration should be done away with and should be replaced by one single agency to handle registration, mutation and survey/re-survey of land to avoid overlapping and complication of information.

To implement the integration of Land Records and DLTs, it's crucial to have a single agency responsible for uploading all electronically recorded land information onto a DLT-based platform. There are three potential options for this. Firstly, a Government Department could take on this role. The Department of Land Resources (DoLR) under the Ministry of Rural Development, currently managing the DLIRMP, can undertake this task by default. Secondly, an Independent Authority could be established. To avoid challenges like funding constraints, external influences, and bureaucratic hurdles, an independent body with specialised expertise could be created. This entity would be accountable to the legislature, ensuring efficient management of the integration process. Lastly, a Corporation under The Companies Act could be considered. Under this model, the entire task could be assigned to a company supervised by a department. This approach offers flexibility in IT development and manpower recruitment.

Conversely, a national-level authority can be put in place to undertake the work of creating a system of integrating DLT into the land record management systems throughout the country. Such an authority would require some legal backing, perhaps in the form of legislation. A provision for such an authority can be made in the new law, though it is not compulsory that it should be. The National Authority could be a multi-member authority with states as members (as in the case of NPCI) with its own budget and functionaries. It will lay down the broad parameters of the programme, its methodology and content. It will provide technical and policy support besides monitoring the implementation and utilisation of funds.

Moreover, since land administration comes under the purview of the state list as well, each state and union territory can establish a dedicated land titling authority, operating under the overall supervision of a National-Level Authority with statutory powers from the new legislation. The State Authority, comprising officers from the respective State Government on deputation, will plan, design, execute, and monitor the land titling program. This will involve outsourcing, assistance from State Government functionaries, and deputation of State Government

employees for local-level support and quality control. Following the integration of Distributed Ledger Technology (DLT) into the land record management system, the State Authority will handle subsequent maintenance, operation, and updates.

Further, a certain level of power related to land record modifications and management needs to be shared with local governing bodies such as Gram Sabhas and Panchayats, who now have a leading role in making decisions and administering rights in initiatives like FRA and SVAMITVA. Similarly, in OLRSD, Slum Dwellers Associations have been established, and Urban Land Bodies are more involved in land administration. A redistribution of power needs to be formalised through legislative and policy actions, which allocate adequate resources to support these new responsibilities.

The National Level Authority can phase out once the nationwide implementation is complete and operational responsibilities shift to designated state agencies. Alternatively, it can transform into an institute, providing ongoing technical support to State Authorities and the Government of India.

Accessibility to the Database

DLTs, by design (even in permissioned environments with certain rules governing accessibility), promote an open database to its users. This is one of the things facilitating the updating, as anyone has the possibility to check if the information registered in their names is correct or not.

Vidhi   Additionally, since transactions recorded on DLT-based systems cannot be reversed or erased, it complicates the exercise of rights such as the right to be forgotten provided under data protection laws. Similarly, permissionless blockchain systems, wherein no authorisation is required to participate, and any user may access and edit the information on the blockchain, may mask the identity of users, thereby posing challenges to the implementation of 'know your customer' norms.

This calls for balancing privacy norms and data security issues with the openness of the information systems running on DLTs. A higher resilience of a system promotes its adoption and disintermediation. (Biraro et al., 2021)

In addition to this functional approach, there is a clear need to focus on the public interactions with such systems and the role of intermediaries, as this is where the greatest risks have arisen and are likely to arise in future (with digital asset exchanges the most urgent focus of attention, so as to address the largest range of market integrity, consumer protection, and financial stability risks).

Security of the System

In land transactions, ensuring the security and integrity of the system is paramount to instil trust among participants. Participants must have confidence that they are dealing with legitimate entities and that their rights will be protected under the law. The legal validity of certificates or titles issued after registering land rights, along with the existence of backups of records used to produce land documents, are crucial for maintaining trust and confidence in the system. Moreover, establishing a robust system of categorisation and certification, in conjunction with the legal framework, is essential to ensure consumer protection, data privacy, choice of law/courts, and competition frameworks. This integrated approach to security helps safeguard the interests of all stakeholders involved in land transactions and contributes to the overall integrity of the system. (Biraro et al., 2021)

VII. Conclusion

In conclusion, the adoption of DLTs in India necessitates the development of a comprehensive governance framework to address legal, ethical, and operational considerations. About. https://www.mplanes.com/about By adhering to key principles such as transparency, legitimacy, and accountability, stakeholders can ensure the safe and sustainable use of DLT while fostering trust and confidence in its application in land record management. Moving forward, collaborative efforts between government, industry, and civil society are essential to design and implement effective governance mechanisms that support the responsible use of DLTs in India's evolving digital landscape.

The key challenge remains one of ensuring real-time accuracy, that is, up-to-date land records, accessible to the common citizen, beyond mere formalities of computerisation and digitisation. Given the systemic nature of the issues highlighted, incremental measures to ensure an updated, more comprehensive real-time land record system appear more pragmatic than instant top-down measures such as titling legislation, which do not seem to adequately account for the complexities within land tenure and land administration systems in India.

DLT holds immense potential to revolutionise land transactions by enhancing accessibility to databases and bolstering the security of the system. However, realising these benefits requires addressing associated challenges, such as data protection and identity verification, and implementing robust security measures. By navigating these challenges and leveraging the functionalities of DLT, stakeholders can create a more transparent, efficient, and secure environment for land transactions, ultimately fostering trust and confidence in the system.

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