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Blockchain-Based Land Governance in Indonesia: Comparative Lessons for Regulatory Adaptation and Legal Culture

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Abstract

Indonesia's land governance system continues to face persistent challenges, including fraudulent transactions, fragmented regulation, limited transparency, and declining public trust. Although digitalization initiatives have been introduced, institutional practices and legal culture have not fully adapted to digital governance, while centralized data management and limited legal protection for digital records continue to undermine legal certainty. This study examines the potential of blockchain technology to strengthen Indonesia's land administration through a comparative legal approach. It compares blockchain implementation in land registration in Georgia, Sweden, and India, while also examining broader blockchain governance frameworks developed in Estonia, the United Arab Emirates, and the European Union to formulate regulatory directions for Indonesia. Using doctrinal and comparative legal analysis supported by interviews with officials from the ATR/BPN, the study finds that blockchain has considerable potential to enhance data integrity, transparency, administrative efficiency, fraud prevention, and legal certainty. However, successful implementation depends not only on technological capability but also on coherent legal reform, institutional readiness, interoperable digital infrastructure, personal data protection, and a supportive legal culture. This study recommends regulatory reforms, including the legal recognition of blockchain-based land records, the creation of a blockchain regulatory sandbox, and alignment with existing land and personal data protection laws. Theoretically, it contributes to the literature by framing blockchain adoption as a legal governance issue influenced by legal culture and institutional readiness, rather than solely by technological capability. In practical terms, it offers a comparative regulatory framework to support Indonesia's transition to transparent, accountable, and legally certain blockchain-based land governance.

1. INTRODUCTION

Effective and sustainable land administration is essential for ensuring legal certainty, protecting property rights, and supporting economic development.[1] Land administration encompasses the systematic recording and dissemination of information concerning land ownership, value, and use, and depends on transparent and reliable land registration systems.[2] However, limited accessibility and reliability of land records continue to generate land disputes and legal uncertainty.[3]

Indonesia's land administration continues to face systemic problems, including fraudulent land transactions. During the land mafia eradication operation in Indonesia, fraud accounted for 15.9% out of 305 cases found, making it the second highest after document forgery.[4] Interrelated systemic and institutional weaknesses had enabled fraudulent land transactions to occur in Indonesia.

This systemic weakness is evident in Indonesian judicial practice. Numerous court decisions addressing overlapping land certificates, conflicting ownership claims, and procedural irregularities in land registration consistently reaffirm that duplicate certificates and administrative errors are significant sources of legal uncertainty.[5] These issues undermine public trust in Indonesia's land administration system.

Although the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) is responsible for land registration, applicants must still complete procedures involving multiple institutions.[6] This fragmented process reduces transparency and creates additional opportunities for fraudulent practices.[7] Efforts to modernize land administration is also conducted through the *Sistem Informasi dan Manajemen Pertanahan Nasional* (SIMTANAS), which digitises cadastral records, spatial information, and land registration services.[8]

Nevertheless, official assessments have identified limited public access, inadequate monitoring mechanisms, and centralized data

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[1] Anthony Francis Burns, Abbas Rajabifard, and Davood Shojaei, "Undertaking Land Administration Reform: Is There a Better Way?," *Land Use Policy* 132 (2023): 3.

[2] Rahmat Febria Yuris and Amad Sudiro, "Responsibility of the Head of the National Land Agency for the Issuance of Land Ownership Certificates with Administrative Legal Defects," *Policy, Law, Notary and Regulatory* 2, no. 4 (2023): 439.

[3] *Ibid.*

[4] Husen Alting et al., "Land Disputes and the Land Mafia Phenomenon in Indonesia: A Critical Analysis," *Journal of Lifestyle and SDGs Review* 5, no. 3 (2025): 8–9.

[5] See, Decision No. 309 PK/PDT/2021 (Supreme Court of the Republic of Indonesia May 27, 2021), 11; Decision No. 217/PDT/2021/PT KPG (Kupang High Court February 9, 2021), 4, 27–28; Decision No. 80/PDT/2021/PT PLK (Palangkaraya High Court September 23, 2021), 9.

[6] Shafira Cendra Arini, "BPN Selesaikan 90 Kasus Mafia Tanah, Selamatkan Rp 23,38 T," Detik Finance, December 3, 2025, https://finance.detik.com/infrastruktur/d-8240985/bpn-selesaikan-90-kasus-mafia-tanah-selamatkan-rp-23-38-t#google_vignette accessed 10 March 2026.

[7] Dianto Bachriadi and Edward Aspinall, "Land Mafias in Indonesia," *Critical Asian Studies* 55, no. 3 (2023): 337.

[8] Presidential Decree No. 34 of 2003, Art. 1(b).

management as persistent sources of corruption, data manipulation, and legal uncertainty.[9] Consequently, Indonesia's current digitalization initiatives remain insufficient to strengthen transparency and public trust.[10]

These shortcomings also reflect broader issues of legal culture.[11] Recurring cases of overlapping certificates, land fraud, and ownership disputes have weakened public confidence in official land records.[12] Accordingly, modernizing land administration requires not only technological advancement but also the readiness of legal institutions and society to embrace digital governance mechanisms that promote transparency, traceability, and data integrity.

Against these prevailing issues , blockchain has emerged as a promising solution for strengthening land administration.[13] As a distributed ledger, it secures synchronized records across multiple network nodes, enhancing transparency, traceability, data integrity, and resistance to unauthorized alteration.[14] These features reduce data manipulation,[15] improve administrative efficiency,[16] and strengthen the reliability of land records.[17]

Despite these promising developments, Indonesia still lacks a coherent legal and institutional framework for blockchain-based land governance, limiting blockchain's ability to deliver legal certainty, institutional accountability, and public trust. Legal certainty, one of Gustav Radbruch's three fundamental legal values, requires clear and predictable rules that ensure consistent legal application.[18]

This regulatory gap motivates the present study, which adopts two complementary comparative perspectives. The first examines blockchain implementation in land registration in Georgia, Sweden, and India to

[9] "Kajian Identifikasi Korupsi Pada Layanan Pertanahan Di Kementerian ATR/BPN (Lanjutan)," Indonesian Commission of Corruption Eradication, 2022, 5–8.

[10] Risky Andes Syaputra, "Legal Aspects of Digitalization in Land Registration," *Journal Indonesia Law and Policy Review* 3, no. 3 (2022): 130.

[11] Wesley Thysse, *Decentralized Law: The Power of Blockchain to Transform the Broken Legal System* (Thysse Publishing, 2025), 229.

[12] Prita Miranti Suyudi, "Blockchain as a Tool for Land Access Redistribution in Indonesia," *Jurnal Magister Hukum Udayana (Udayana Master Law Journal)* 14, no. 3 (2025): 636–637.

[13] *Ibid.*

[14] Siful Islam, "Decentralized vs. Centralized Database Solutions in Blockchain: Advantages, Challenges, and Use Cases," *Global Mainstream Journal of Innovation, Engineering & Emerging Technology* 3, no. 4 (2024): 60.

[15] Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," Bitcoin.org, n.d., https://bitcoin.org/en/bitcoin-paper.

[16] Primavera De Filippi and Aaron Wright, *Blockchain and the Law: The Rule of Code* (Harvard University Press, 2018), 5, 45, 207; See also, Robert Herian, *Regulating Blockchain: Critical Perspectives in Law and Technology* (Routledge, 2019), 17.

[17] Nakamoto, *loc.cit.*

[18] Gustav Radbruch, "Statutory Lawlessness and Supra-Statutory Law (1946)," *Oxford Journal of Legal Studies* 26, no. 1 (2006): 3, 7. See also, Gümüş Öner, "Radbruch Formula and Justice in Tax Law: A Normative Evaluation on ECtHR Judgments," *Ankara Hacı Bayram Veli Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 27, no. 2 (2005): 623–624.

identify operational and institutional lessons, while the second analyzes broader blockchain governance frameworks in Estonia, the United Arab Emirates (UAE), and the European Union (EU) to derive regulatory principles for public governance. Together, these comparative perspectives provide the analytical basis for formulating regulatory recommendations for blockchain-based land governance in Indonesia.

Existing scholarship on blockchain in land administration has largely focused on technological implementation, with comparatively limited attention to the legal and regulatory reforms required for adoption. The literature comprises three principal strands. The first examines governance and institutional reform in land administration (e.g., Burns *et al.*,[19] Alting *et al.*,[20] Bachriadi & Aspinall[21]), highlighting political economy, institutional fragmentation, and land mafia practices as persistent obstacles to effective reform. The second focuses on the legal framework governing land administration (e.g., Syaputra[22]), emphasizing regulatory fragmentation, inconsistencies between conventional and digital systems, and inadequate legal protection for digital land services. The third explores blockchain applications in land registration (e.g., Pratama *et al.*,[23] Shang & Price,[24] Kaczorowska,[25] Syawaludin & Munir,[26] Thakur *et al.*,[27] Yadav & Kushwaha,[28] Paavo & Puentes,[29] Kshetri[30]), demonstrating blockchain's potential to improve transparency, data integrity, and fraud prevention while identifying continuing challenges relating to data quality, infrastructure, legal adaptation, and stakeholder readiness. Collectively, these studies indicate

[19] Burns, *et al.*, *op.cit.,* 1.

[20] Alting *et al.*, *op.cit.,* 01.

[21] Bachriadi and Aspinall, *op.cit.,* 331.

[22] Syaputra, *op.cit.,* 123.

[23] Faisal Surya Pratama, Adi Sulistiyono, and Hari Purwadi, "Prevention of Double Certificate by Implementing Blockchain," *International Journal of Business, Economics and Law* 30, no. 2 (2023): 44.

[24] Qiuyun Shang and Allison Price, "A Blockchain-Based Land Titling Project in the Republic of Georgia," *Innovations: Technology, Governance, Globalization* 12, nos. 3–4 (2019): 72.

[25] Maria Kaczorowska, "Blockchain-Based Land Registration: Possibilities and Challenges," *Masaryk University Journal of Law and Technology* 13, no. 2 (2019): 360.

[26] Aidil Rezjki Suljztan Syawaludin and Rinaldi Munir, "Registration of Land and Building Certificate Ownership Using Blockchain Technology," *2021 International Conference on ICT for Smart Society (ICISS), Bandung, Indonesia (IEEE)*, 2021, 1.

[27] Vinay Thakur et al., "Land Records on Blockchain for Implementation of Land Titling in India," *International Journal of Information Management* 52 (2020): 1.

[28] Amrendra Singh Yadav and Dharmender Singh Kushwaha, "Blockchain-Based Digitization of Land Record through Trust Value-Based Consensus Algorithm," *Peer-to-Peer Networking & Applications* 14, no. 6 (2021): 3540.

[29] Johannes Paavo and Rafael Rodríguez-Puentes, "A Systematic Literature Review on Blockchain-Based Titles Registries for Transparent Land Administration," *International Science and Technology Journal of Namibia* 17, no. 1 (2025): 67.

[30] Nir Kshetri, "Blockchain as a Tool to Facilitate Property Rights Protection in the Global South: Lessons from India's Andhra Pradesh State," *Third World Quarterly* 43, no. 2 (2022): 377.

that blockchain implementation requires institutional reform as well as technological innovation.

Nevertheless, three important gaps remain. First, existing studies examine blockchain in land administration predominantly from technical and administrative perspectives, with limited attention to the legal reforms required for its implementation. Second, they devote insufficient attention to the role of legal culture and public trust in shaping blockchain adoption. Third, they rarely integrate comparative experiences from blockchain-based land registration and broader blockchain governance into a coherent regulatory framework for Indonesia. These gaps underscore the need for a more comprehensive comparative legal analysis.

This article addresses these gaps through three principal contributions. First, it reconceptualizes blockchain adoption as a legal governance issue rather than merely a technological innovation. Second, it integrates comparative lessons from blockchain-based land registration and broader blockchain governance. Third, it incorporates Lawrence M. Friedman's concept of legal culture, which refers to the social attitudes, values, and behavioural patterns that shape how law is accepted and implemented within society,[31] to formulate regulatory directions for blockchain-based land governance in Indonesia, thereby contributing to broader discussions on regulatory adaptation within civil law jurisdictions.

Accordingly, this study employs doctrinal and comparative legal approach to assess Indonesia's legal framework and formulate regulatory recommendations. The doctrinal analysis examines legislation, judicial decisions, legal doctrines, and other authoritative legal materials, while the comparative analysis draws on the experience of Georgia, Sweden, India, Estonia, the UAE, and the EU. The analysis is then complemented by interviews with ATR/BPN officials, providing practical insights into Indonesia's institutional readiness for blockchain-based land governance.

2. RESULT AND ANALYSIS

2.1. Fraud Prevention in Land Governance: Lessons from Global Case Studies

2.1.1. Lessons from Blockchain Adoption in Land Registration: Georgia, Sweden, and India

Land registration refers to the continuous process of collecting, recording, maintaining, and updating physical and juridical information relating to land and the rights attached to it.[32] Within Indonesia's legal

[31] Istaniah Zainal Asyiqin, M. Fabian Akbar, and Muhammad Daffa Auliarizky Onielda, "The Principle of Self-Submission in Sharia Economic Dispute Resolution: A Critical Examination through Friedman's Legal System Theory," *Jambura Law Review* 7, no. 02 (2025): 401. See also, Yamani Naufal and Dian May Syifa, "Responsive Reformulation of Consumer Protection Law in the Digital Era: A Perspective of Lawrence M. Friedman's Legal System Theory," *Jurisprudensi Jurnal Ilmu Syari'ah, Perundang-Undangan Dan Ekonomi Islam* 18, no. 1 (2026): 247–248.

[32] Indonesian Law No. 5 of 1960 concerning Basic Agrarian Law, Art. 19(2), in conjunction with Indonesian Government Regulation No. 18 of 2021 concerning Management Rights, Land Rights, Apartment Units, and Land Registration, Art. 1(9), which

framework, it is intended to ensure legal certainty through the registration of land rights and the issuance of land certificates as 'lawful' evidence of ownership.[33] Land registration also promotes transparency, prevents overlapping claims, and facilitates efficient land transactions.[34] Since land registration depends on accurate and continuously maintained records, it is well suited to blockchain technology, which enhances data integrity, traceability, and resistance to unauthorized alteration.

Weaknesses in land registration—inaccurate records, document forgery, overlapping certificates, and administrative inefficiencies—remain major sources of land disputes and legal uncertainty. This subsection examines Georgia, Sweden, and India, which represent different models of blockchain adoption and provide comparative insights into its integration within diverse legal and institutional contexts.

2.1.1.1. Georgia

Georgia, a civil law tradition[35] with a negative land-registration publication system[36] similar to that of Indonesia, administers land registration through the National Agency of Public Registry (NAPR).[37] Because both countries rely on documentary evidence while allowing contrary proof, Georgia provides a relevant comparative case for examining how blockchain can strengthen transparency, reduce fraud, and improve legal certainty in land registration. Georgia became the first country[38] to implement blockchain in land registration in 2016.[39] The reform responded to longstanding problems, including corruption, cumbersome administrative procedures, high transaction costs, and bureaucratic inefficiency,[40] which had weakened public confidence in the land administration system.[41]

Prior to blockchain implementation, NAPR had digitized cadastral records to improve administrative efficiency.[42] However, centralized electronic databases remained vulnerable to cybersecurity risks and

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amended Indonesian Government Regulation No. 24 of 1997 concerning Land Registration, Art. 1(1).

[33] Indonesian Law No. 5 of 1960 concerning Basic Agrarian Law, Art. 19(1).

[34] Indonesian Government Regulation No. 24 of 1997 concerning Land Registration, Art. 3.

[35] The Constitution of Georgia No. 2071 (2018), Art. 4(4).

[36] See, Georgian Law on Public Registry No. 5565 (2011), Art. 9(1).

[37] Shang and Price, *op.cit.*, 74.

[38] Kaczorowska, *op.cit.*, 351.

[39] Nino Lazuashvili, Alex Norta, and Dirk Draheim, "Integration of Blockchain Technology into a Land Registration System for Immutable Traceability: A Casestudy of Georgia," *Lecture Notes in Business Information Processing* 361 (2019): 226.

[40] Arturo Castellanos and Raquel Benbunan-Fich, "Digitalization of Land Records: From Paper to Blockchain," *Thirty Ninth International Conference on Information System* (San Fransisco), 2018, 3.

[41] Per Aarvik, "Anti-Corruption Reforms Have Been Successful in Georgia, but Blockchain Is Stealing the Limelight," The U4 Anti-Corruption Recource Centre, October 24, 2022, https://www.u4.no/blog/anti-corruption-reforms-successful-in-georgia-blockchain-stealing-limelight accessed 14 February 2025.

[42] Lazuashvili, *et al.*, *op.cit.*, 227; See also, Aarvik, *loc.cit.*

unauthorized alteration, indicating that digitalization alone was insufficient to restore public confidence.[43] To support blockchain implementation, Georgia partnered with Bitfury Group as its technology provider[44] under NAPR supervision[45] and enacted the Law on the Improvement of Cadastral Data and the Procedure for Systematic and Sporadic Registration of Rights to Plots of Land.

This framework standardized cadastral data and provided the legal foundation necessary for blockchain-based land registration.[46] The reform significantly improved administrative performance, with more than 1.3 million land records registered through the blockchain platform[47] and international recognition for the efficiency of Georgia's property registration system.[48] Nevertheless, several challenges remain including technological infrastructure,[49] institutional capacity,[50] and implementation costs.[51]

Georgia demonstrates three important lessons for Indonesia. First, blockchain's transparency and immutability can strengthen public trust[52] while reducing fraud and administrative costs. Second, technological adoption should be preceded by regulatory reform and standardized cadastral data to ensure legal certainty and interoperability.[53] Third, successful implementation requires strong public-private collaboration supported by clear institutional responsibilities and technical expertise.[54]

2.1.1.2. Sweden

Sweden, a civil law tradition[55] with a positive land-registration publication precedent,[56] regulates land registration primarily through the Land Code and the Real Property Registration Act under the authority of

[43] Aarvik, *loc.cit.*

[44] Lazuashvili, *et al.*, *op.cit.*, 226.

[45] *Ibid.* See also, Kaczorowska, *loc.cit.*

[46] Law of Georgia on the Improvement of Cadastral Data and the Procedure for Systematic and Sporadic Registration of Rights to Plots of Land within the Framework of the State Project No. 1168 (2021), Art. 2.

[47] Castellanos and Benbunan-Fich, *op.cit.*, 7.

[48] "Doing Business 2016: Measuring Regulatory Quality and Efficiency 13th Edition," World Bank, 2016, 203.

[49] Castellanos and Benbunan-Fich, *op.cit, 8.*

[50] Shang and Price, *op.cit.*, 77-78.

[51] Mohammed Shuaib et al., "Blockchain-Based Framework for Secure and Reliable Land Registry System," *Telkomnika (Telecommunication Computing Electronics and Control)* 18, no. 5 (2020): 2565.

[52] Lazuashvili, *et al.*, *op.cit.*, 15.

[53] *Ibid.*

[54] *Ibid.*

[55] Bernadetha Aurelia Oktavira, "Mengenal Perbedaan Civil Law Dan Common Law," Hukum Online, October 6, 2023, https://www.hukumonline.com/klinik/a/perbedaan-civil-law-dan-common-law-lt58f8174750e97/ accessed 5 February 2025.

[56] Heraclitos Muhire, Enrico Giansanti, and Isabel Schoultz, "Access to Justice in Sweden," Global Access to Justice Project, 2020, 77.

Lantmäteriet.[57] Unlike Indonesia's negative publication system,[58] Sweden's land register enjoys strong legal presumption of accuracy[59] making it a useful comparative case for examining blockchain implementation within an advanced cadastral system.

Despite having one of the world's most efficient land registration systems in the 2020,[60] Sweden's pre-blockchain system continued to face administrative inefficiency[61] caused by fragmented procedures, manual verification, and lengthy transaction processes.[62] To address these limitations, Lantmäteriet partnered with Kairos Future, Telia, and ChromaWay in 2016[63] to pilot blockchain-based land registration.[64]

The project was implemented through phased pilot testing involving financial institutions, including *Statens Bostadsfinansieringsaktiebolag* (SBAB) and Landshypotek Bank,[65] before deployment on a unified digital platform managed by Lantmäteriet.[66] The platform enables secure end-to-end processing[67] while improving coordination among participating stakeholders.[68] Blockchain streamlined property transactions by integrating all parties into a single digital platform, reducing processing time, administrative costs, and manual verification while improving transparency and legal certainty.[69] *Lantmäteriet* retained supervisory authority,[70] ensuring that blockchain complemented rather than replaced the existing institutional framework.[71]

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[57] "About Lantmäteriet: Our Organization," Lantmäteriet, https://www.lantmateriet.se/en/about-lantmateriet/our-organization/ accessed 15 February 2025.

[58] Nur Susilowati, Mulyani Djakaria, and Ida Nurlinda, "Analisis Prospek Pemberlakuan Sistem Pendaftaran Tanah Publikasi Positif Dan Aspek Kepastian Hukum Pemegang Hak Atas Tanah," *ACTA DIURNAL Jurnal Ilmu Hukum Kenotariatan* 4, no. 1 (2020): 54.

[59] Dang Anh Quan, "Two Land Registration Systems. The Land Law of Vietnam and of Sweden" (PhD Dissertation, Lund University, 2011), 178.

[60] "Ease of Doing Business Score and Ease of Doing Business Ranking 2020," World Bank, 2020, https://openknowledge.worldbank.org/server/api/core/bitstreams/2db10c90-db63-5746-a4e3-1bfe264dda7c/content.

[61] Juliet McMurren, Andrew Young, and Stefaan Verhulst, "Case Study: Addressing Transaction Costs Through Blockchain and Identity in Swedish Land Transfers," GovLab, 2018, 3.

[62] *Ibid.*

[63] *Ibid.*, 4.

[64] Anetta Proskurovska and Sabine Dörry, "The Blockchain Challenge for Sweden's Housing and Mortgage Markets," *Environment and Planning A: Economy and Space* 54, no. 8 (2022): 1573.

[65] *Ibid.*, 1574.

[66] Kaczorowska, *op.cit.*, 352.

[67] Proskurovska and Dörry, *op.cit.*, 1577.

[68] *Ibid.*

[69] Paavo and Rodríguez-Puentes, *op.cit.*, 72.

[70] McMurren, *et al.*, *op.cit.*, 6.

[71] *Ibid.*, 3.

Sweden offers three principal lessons for Indonesia. First, blockchain should complement existing land administration institutions by improving coordination among government agencies, financial institutions, and private actors.[72] Second, successful implementation requires legal recognition of electronic signatures and digital transactions alongside clear governance arrangements for public-private collaboration.[73] Third, long-term sustainability depends on continuous system maintenance, standardized data governance, and effective institutional oversight.[74]

2.1.1.3. India

India's experience offers a valuable point of comparison for Indonesia, as both countries have historically faced complex and error-prone land administration systems.[75] To address these challenges, India undertook a gradual modernization process[76] through the National Land Records Modernisation Programme (NLRMP)[77] and its successor, the Digital India Land Records Modernisation Programme (DILRMP),[78] aimed at establishing an integrated and transparent land information system.[79] As part of this broader agenda, Andhra Pradesh pioneered the adoption of blockchain technology by incorporating approximately 100,000 land records in Amaravati into a blockchain-based platform developed in cooperation with Chromaway.[80] The system integrates geographical information system (GIS)[81] and land registration data within a private blockchain network involving multiple institutional stakeholders.[82]

The Andhra Pradesh initiative demonstrates blockchain's potential to improve transparency, security, and efficiency in land administration by

[72] *Ibid.*, 7.

[73] "Land Registry in Sweden," Blockchain, 2017, https://blockchain.machetemag.com/sweden/land-registry-sweden/ accessed 20 February 2025.

[74] Paavo and Rodríguez-Puentes, *op.cit.*, 79.

[75] Yadav and Kushwaha, *op.cit.*, 3540-3541.

[76] Vrinda Bhardwaj and Trisha Pande, "Land Rights and Digital Revolution in India: Potential and Pitfalls," *SSRN Electronic Journal*, January 14 (2022): 1.

[77] Thakur et al., *op.cit.*, 101940.

[78] Swaroopa Royadu, "Self-Guide For Purchasing the Land – The Digital India Land Modernization Program [DILRMP]," *Jus Corpus Law Journal* 3, no. 1 (2022): 1134.

[79] *Ibid.*, 1135-1136. See also, Sandip Chowdhury, "Without Addressing Legacy Issues, Can Digitising Land Records in India Be a Game Changer?", The Wire, May 18, 2021, https://thewire.in/rights/land-digitisation-ulpin-land-records-legacy-digital-india and Bhardwaj and Pande, "Land Rights and Digital Revolution in India: Potential and Pitfalls," 4.

[80] Anjali Kaushik, "New Technology Interventions Including Blockchain Technology in Land Record and Registry Management in India," *ICEGOV '20: Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, (2020): 149.

[81] Amit Kapoor, Mark Esposito, and Mukul Anand, "Land Record Management in India," *SSRN Electronic Journal*, February (2024): 13-14.

[82] Luca Mario Comincioli, "The Role of Blockchain in Improving Land-Users' Rights (Can Blockchain Solve Corruption Problems in Land Administration in Developing Countries? -The Case of India)" (Master's Thesis, Luiss School of Government, 2021), 36.

facilitating faster ownership transfers and reducing fraud.[83] However, its effectiveness depends on accurate land records,[84] adequate institutional and human capacity, and supporting technological infrastructure.[85] India's experience therefore suggests that blockchain-based land governance can enhance trust and transparency only when supported by accurate land records, adequate institutional and human capacity, and sufficient technological infrastructure.

To facilitate comparison, the principal lessons from blockchain adoption in land registration across Georgia, Sweden, and India are summarized in the table below.

Table 1. Comparative Lessons from Blockchain Adoption in Land Registration

Jurisdiction	**Main Challenge Before Blockchain**	**Key Reform**	**Main Lesson for Indonesia**
Georgia	Fraud, weak bureaucracy, fragmented cadastral records.	National blockchain registry supported by legal reform and public-private partnership	Standardize cadastral data before blockchain adoption, supported by a clear legal framework and institutional collaboration.
Sweden	Inefficient property transactions despite digitalization.	Blockchain integrated into property transactions through multi-stakeholder collaboration	Blockchain improves efficiency when supported by interoperable infrastructure and legal recognition of electronic transactions.
India	Fragmented land records and decentralized administration.	Phased blockchain implementation through pilot projects	Adopt blockchain gradually with institutional readiness, capacity building, and data validation.

[83] Kshetri, *op.cit.*, 376-377.

[84] Venkatesh Panchapagesan, "Can Blockchain Solve Land Record Problems?," Mint E-Paper, April 12, 2018, https://www.livemint.com/Opinion/t60KeJCjKuEkzU9hEC01GI/Can-blockchain-solve-land-record-problems.html accessed 17 March 2025.

[85] Umamaheswara Rao, "Andhra Pradesh's Literacy Rate Goes Up But Gender Divide A Concern," The Times of India, December 19, 2020, https://timesofindia.indiatimes.com/city/visakhapatnam/states-literacy-rate-goes-up-but-gender-divide-a-concern/articleshow/79802446.cms accessed 17 March 2025; See also, V. Kamalakara Rao, "AP Internet Penetration Lower than National Average," The Times of India, January 12, 2021, https://timesofindia.indiatimes.com/city/visakhapatnam/ap-internet-penetration-lower-than-natl-average/articleshow/80219473.cms accessed 17 March 2025.

Comparative experience from Georgia, Sweden, and India demonstrate that blockchain can strengthen land governance by reducing document forgery, improving transaction efficiency,[86] and enhancing transparency through immutable and verifiable land records.[87] However, these benefits depended not only on technological capability but also on a supportive legal culture,[88] namely the willingness of public institutions, land officials,[89] legal professionals, and society to adopt new mechanisms[90] for recording, verifying, and protecting land rights. Accordingly, blockchain adoption should be understood as both a technological and legal-institutional transformation, requiring broader governance frameworks, as discussed in the following section.

2.1.2. Comparative Legal Frameworks for Blockchain in Public Governance: Insights from Estonia, the UAE, and the EU

The comparative experience discussed above demonstrate that successful blockchain-based land registration depends not only on technological capability but also on a coherent legal and institutional framework governing digital records, public administration, and data protection.[91] Accordingly, this subsection moves beyond technical implementation to examine how blockchain is regulated within broader public governance systems.

Public governance refers to the legal, institutional, and administrative arrangements through which public authorities formulate policies, exercise regulatory powers, deliver public services, and coordinate relations with private actors and society.[92] In the blockchain context, it encompasses the regulatory framework needed to ensure legal certainty, institutional accountability, interoperability, cybersecurity, and personal data protection.[93]

Against this background, Estonia, the UAE, and the EU are examined because they have developed comprehensive legal frameworks for blockchain-enabled public governance. Their experiences offer complementary approaches to digital governance, interoperability, electronic identification, regulatory innovation, and personal data protection, providing

[86] Fauzi Amri, Poltak Sihombing, and Syahril Efendi, "Blockchain in Land Registry," *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram* 11, no. 1 (2023): 222.

[87] Pratama, *et al.*, *op.cit*, 46.

[88] Thysse, *op.cit.*, 262–263.

[89] Asyiqin et.al., *loc.cit.*

[90] Naufal and Syifa, *loc.cit.*

[91] Suyudi, *loc.cit.*

[92] David H. Rosenbloom, Robert S. Kravchuk, and Richard M. Clerkin, *Public Administration: Understanding Management, Politics, and Law in the Public Sector*, 9th Edition (New York: Routledge, 2022), 40.

[93] De Filippi and Wright, *op.cit.*, 5–8. See also, Silvia Semenzin, David Rozas, and Samer Hassan, "Blockchain-Based Application at a Governmental Level: Disruption or Illusion? The Case of Estonia," *Policy and Societ* 41, no. 3 (2022): 397-398.

valuable guidance for assessing Indonesia's regulatory readiness for blockchain-based land governance.

2.1.2.1. Estonia: Digital Governance and Blockchain-enabled Public Services

Estonia has pioneered the digitalization of public services since the 1990s, supported by a robust legal framework for digital governance.[94] Central to its e-governance is X-Road, an interoperable open-source data exchange platform that enables secure collaboration among government institutions.[95] X-Road also supports blockchain-based technologies such as the Keyless Signature Infrastructure (KSI), a distributed timestamping system that safeguards the integrity of digital records across public registries, including healthcare and land databases.[96]

To support this digital ecosystem, Estonia has established an integrated legal framework comprising the Public Information Act, Population Register Act, Digital Signatures Act, Electronic Communications Act, and Personal Data Protection Act. Collectively, these laws provide the legal basis for public information management,[97] digital identity,[98] electronic communications,[99] digital authentication,[100] and personal data protection,[101] thereby enabling interoperable digital public services.

Estonia's digital governance demonstrates that blockchain adoption depends on the integration of legal regulation with interoperable digital infrastructure. The Public Information Act, for example, prohibits duplicate public databases and unnecessary requests for data already available through X-Road,[102] thereby improving administrative efficiency and institutional coordination.[103] For Indonesia, Estonia illustrates that blockchain should be supported by a coherent legal and institutional framework rather than implemented as a standalone technological solution.

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[94] Parol Jalakas, "Blockchain from Public Administration Perspective: Case of Estonia" (Master's Thesis, Tallin University of Technology, 2018), 24–25.

[95] *Ibid.*, See also, Semenzin, *et al.*, *loc.cit.*

[96] *Ibid.*

[97] Estonia Public Information Act (2000), Art. 1.

[98] Estonia Population Register Act (2000), Art. 1.

[99] Estonia Electronic Communications Act (2004) Art. 1 and 2.

[100] Estonia Digital Signatures Act (2000) Art. 3.

[101] Estonia Personal Data Protection Act (2007) Art. 1.

[102] Kristjan Vassil, "Estonian E-Government Ecosystem: Foundation, Applications, Outcomes," World Bank, 2016, 6.

[103] *Ibid.*

2.1.2.2. UAE: Government-led Blockchain Regulatory Framework

The UAE has pursued e-governance since the 1990s and has increasingly integrated blockchain into its digital transformation agenda.[104] Through the Emirates Blockchain Strategy 2021, the federal government aims to migrate 50% of government transactions onto blockchain platforms, thereby reducing paper consumption and administrative costs.[105] While the Dubai Blockchain Strategy seeks to implement blockchain across applicable public services under the coordination of the Smart Dubai City Office (SDCO).[106]

To operationalize these initiatives, the SDCO issued the Dubai Blockchain Policy, which establishes the regulatory framework for blockchain deployment across government entities.[107] The Policy regulates three principal dimensions. First, network governance (Arts. 5–8) governs ownership structures, membership models, intellectual property management, funding mechanisms, and network scalability.[108] Second, network operations (Arts. 7, 9–15) establish standards for interoperability, data formats, privacy, cybersecurity, stakeholder participation, and compliance auditing.[109] Third, foundational capabilities (Arts. 3, 6–7, and 14–17) regulate the underlying technological architecture, shared digital services, and legal and institutional support required for blockchain implementation.[110]

Unlike jurisdictions that focus primarily on technological experimentation, the UAE combines blockchain deployment with a structured governance framework that clearly allocates institutional responsibilities and establishes operational standards. For Indonesia, this demonstrates that blockchain-based land governance requires not only legal recognition of blockchain but also clear institutional authority, interoperability standards, cybersecurity safeguards, and effective regulatory oversight.

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[104] Abdelaziz Alzaabi, Noura Metawa, and Adam Marks, "The Role of Digital Transformation in Enhancing Government Service Delivery in the UAE: A Literature Review," *International Review of Management and Marketing* 15, no. 5 (2025): 103-104.

[105] "Emirates Blockchain Strategy 2021," The Uni Arab Emirates' Government Portal, 2021, https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/strategies-plans-and-visions-untill-2021/emirates-blockchain-strategy-2021 accessed 10 May 2025.

[106] *Ibid.*

[107] "Dubai Blockchain Policy," Dubai Future Councils, https://www.digitaldubai.ae/docs/default-source/publications/dubai-blockchain-policy.pdf?sfvrsn=4a4bb396_4.

[108] *Ibid.*

[109] *Ibid.*

[110] *Ibid.*

2.1.2.3. EU General Data Protection Regulation (EU GDPR): Data Protection Concerns in Blockchain Applications

Blockchain core characteristics—decentralization and immutability—create fundamental tensions with conventional data protection regimes, particularly where personal data must be modified or erased. While, EU GDPR provides one of the most comprehensive legal frameworks governing personal data protection, it therefore offers an important reference for assessing blockchain governance.[111]

The EU GDPR introduces substantial challenges for blockchain adoption by establishing the principle of data minimization, which stipulates that personal data must be collected solely for specified and legitimate purposes.[112] The EU GDPR further mandates data accuracy and outlines procedures for rectifying inaccurate personal data.[113] In addition, it grants individuals the right to access information about the processing of their personal data[114] and acknowledges the right to erasure, or the "right to be forgotten," in certain situations.[115] While these principles are fundamental to protecting individual rights, they may be at odds with the immutable ledger structure of blockchain, where information cannot be readily altered or removed.[116]

Accordingly, EU GDPR compliance in blockchain applications depends largely on system architecture and governance design rather than on blockchain technology itself.[117] Hybrid solutions, including off-chain storage of personal data, on-chain cryptographic hashes, and privacy-by-design mechanisms, have therefore been proposed to reconcile blockchain innovation with data protection requirements. For Indonesia, the EU experience demonstrates that blockchain-based land administration must be accompanied by comprehensive personal data protection standards to ensure that technological innovation remains consistent with individual rights and legal certainty.

The key features of blockchain governance in Estonia, the UAE, and the EU, and their implications for Indonesia's blockchain-based land registration framework, are summarized in the table below.

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[111] Muhammad Al-Abdullah, *et al.*, "Designing Privacy-Friendly Data Repositories: A Framework for a Blockchain That Follows GDPR," *Digital Policy, Regulation and Governance* 22, nos. 5–6 (2020): 398.

[112] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data, and Repealing Directive 95/46/EC (General Data Protection Regulation), Art. 5(1)(b).

[113] *Ibid.*, Art. 5(1)(f).

[114] *Ibid.*, Art. 15(1).

[115] *Ibid.* Art. 17.

[116] *Ibid.*

[117] Al-Abdullah *et al.*, *op.cit.*, 406.

Table 2. Comparative Legal Frameworks on Blockchain Governance and Their Relevance to Indonesia's Land Registration System

Jurisdiction	Key Legal and Institutional Framework	Governance Characteristics	Relevance for Indonesia's Blockchain-Based Land Registration
Estonia	Comprehensive e-governance laws, interoperable infrastructure, and digital identity.	Legal recognition, interoperable digital infrastructure, secure data integrity, and institutional coordination.	Develop an integrated digital land administration system with legal recognition and interoperable databases.
UAE	National blockchain strategy, regulatory standards, and coordinated implementation.	Centralized governance, regulatory coordination, standardized implementation, and digital transformation.	Establish a national blockchain roadmap, regulatory standards, and institutional coordination.
EU	Harmonized digital regulation, data protection, cybersecurity, and electronic identification.	Legal certainty, accountability, data protection, and fundamental rights.	Align blockchain governance with data protection, cybersecurity, and accountability safeguards.

The experiences of Estonia, the UAE, and the European Union demonstrate that blockchain-based land governance depends on coherent legal and institutional frameworks. These lessons provide key regulatory guidance for developing Indonesia's blockchain-based land registration system.

2.2. Regulatory and Institutional Readiness for Blockchain Integration in Indonesia

2.2.1. Challenges in Integrating Blockchain into Indonesia's Legal and Institutional Framework

Building upon the comparative findings in Section 2.1, Indonesia's regulatory readiness should be evaluated across five interrelated legal dimensions, including (i) legality of contracts and electronic evidence; (ii) personal data protection and access rights; (iii) technological responsibility; (iv) regulatory compliance; and (v) dispute resolution.[118]

Indonesia's land governance framework establishes the fundamental principles of land administration by regulating the acquisition, transfer, and registration of land rights to promote legal certainty and protect

[118] Olfriady Letunggamu and Rahma Dwi Putranto, "Implications of Blockchain Technology in Civil Transactions: A Review of Legal Aspects," *Pena Justisia* 23, no. 1 (2024): 3458.

landholders.[119] Further elaboration on land registration procedures designates the ATR/BPN as the central authority responsible for executing land administration functions.[120] Consequently, the ATR/BPN plays the central role in implementing and supervising Indonesia's land governance system.

The most significant step toward integrating blockchain technology into this system occurred in 2023 with the issuance of a ministerial regulation which introduces the use of data blocks for digital land certificates.[121] Although it introduces data blocks for electronic land certificates, it remains limited to technical implementation and does not recognize blockchain-based land records or define their legal consequences.[122] Unlike Georgia, blockchain has not yet been institutionally integrated into Indonesia's land registration system.

Blockchain-based land governance in Indonesia must comply with the existing legal framework governing electronic systems, digital transactions,[123] and electronic land registration.[124] However, this framework does not provide a comprehensive legal basis for blockchain integration, smart contracts, or the institutional coordination required for land administration. By contrast, Sweden demonstrates that blockchain implementation depends on interoperability among cadastral authorities, financial institutions, and technology providers throughout the property transaction process.[125] Indonesia has yet to establish comparable coordination mechanisms.

Recent judicial developments further indicate a growing recognition of blockchain technology within Indonesia's legal system. The Constitutional Court acknowledged blockchain as a distributed ledger technology capable of verifying transactions and ensuring the security and validity of stored information.[126] Although the decision arose in the context of digital financial assets, the Court's reasoning was technology-neutral, focusing on the functional reliability of blockchain as a distributed ledger system rather than its sector-specific application. Nevertheless, while the Constitutional Court recognized blockchain as a reliable distributed ledger technology, the

[119] Indonesian Law No. 5 of 1960 concerning Basic Agrarian Law, Art. 19.

[120] Indonesian Government Regulation No. 24 of 1997 concerning Land Registration, Art. 5.

[121] Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency No. 3 of 2023 concerning the Issuance of Electronic Documents in Land Registration Activities, Art. 1(6).

[122] Aslan Noor et al., "Electronic Land Certificates As Evidence of Ownership: An Analysis under Indonesian Civil Procedure Law," *Jurnal Ilmiah Global Education* 6, no. 4 (2025): 3177-3178.

[123] Indonesian Law No. 11 of 2008 Concerning Electronic Information and Transactions, Art. 4.

[124] Indonesian Government Regulation No. 18 of 2021 concerning Management Rights, Land Rights, Apartment Units, and Land Registration, Art. 84.

[125] McMurren, *et al.*, *loc.cit.*; See also, Paavo and Rodríguez-Puentes, *loc.cit.*

[126] Decision No. 51/PUU-XXIII/2025 (Constitutional Court of the Republic of Indonesia), 30.

decision did not establish its legal status within Indonesia's land administration system.

Indonesia's legal framework for personal data protection does not fully accommodate blockchain-based land administration. In particular, blockchain immutability creates a normative tension with the right to erasure because blockchain records cannot be modified without compromising the integrity of the distributed ledger.[127] Although the existing framework provides general safeguards for personal data, it does not resolve this structural incompatibility, leaving important legal questions concerning blockchain governance unresolved.

Despite this legal framework, significant gaps remain between regulatory design and administrative practice. Interviews with ATR/BPN officials indicate that blockchain integration is constrained not only by technology but also by fragmented institutional governance.[128] Land administration across more than 400 local offices still lacks standardized data architecture.[129] Inconsistent naming conventions, metadata, and data formats have resulted in fragmented datasets that cannot be effectively integrated at the national level.[130] India's phased implementation further illustrates that blockchain should only be introduced after substantial improvements in data quality and cadastral digitization have been achieved.[131] Indonesia therefore faces challenges comparable to those encountered during India's early implementation stages, particularly regarding inconsistent land records and heterogeneous local databases.

The absence of a unified identifier system further undermines interoperability between spatial datasets and non-spatial data, including land use classifications and national identity numbers.[132] As a result, routine data exchanges across institutions frequently fail to produce coherent and usable national cadastral datasets.[133] These institutional constraints also contrast with Estonia's interoperable X-Road infrastructure, which enables secure data exchange among government agencies through standardized data architecture.[134]

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[127] Indonesian Law No. 27 of 2022 concerning Personal Data Protection, Art. 8.

[128] Mulyadi, "Interview Conducted by the Author with the Head of Data and Information Management Division at the Center for Data and Information on Land, Spatial Planning, and Sustainable Food Agricultural Land (Pusdatin), Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), Republic of Indonesia," July 1, 2025.

[129] *Ibid*.

[130] Noor Puspita Sari, "Interview Conducted by the Author with the Head of Sub-Directorate of Maintenance of Land and Spatial Rights, Directorate General of Land Rights Determination and Land Registration, Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), Republic of Indonesia," April 6, 2026.

[131] Comincioli, *loc.cit.*; See also, Kshetri, *loc.cit.*; Kaushik, *loc.cit.*; and Kapoor, *et al.*, *loc.cit.*

[132] Sari, *loc.cit.*

[133] Virgo Eresta Jaya, "Interview Conducted by the Author with the Director General of Survey and Mapping of Land and Spatial Planning, Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), Republic of Indonesia," April 19, 2026.

[134] Jalakas, *loc.cit.*; See also, Semenzin, *et al.*, *loc.cit.*

These findings are consistent with Chehrehbargh et al., who identify fragmented institutional coordination, the absence of a coherent governance framework, limited stakeholder readiness, and inadequate institutional capacity as the principal obstacles to modernizing Indonesia's land administration system.[135] Their assessment highlights fragmented institutional coordination, the absence of a coherent legal and governance framework, limited stakeholder readiness, and insufficient institutional capacity, all of which hinder the effective integration of digital land governance technologies, including blockchain.[136]

2.2.2. Policy Recommendations for Indonesia

Indonesia's Basic Agrarian Law obliges the state to conduct land registration for legal certainty, yet this foundational statute "remains intact" with no substantive update for digital records. The other supporting regulations in the land governance system also contain no provisions regarding the use of blockchain. Indeed, reports indicated the government is already planning a blockchain roadmap for land governance through *ATR/BPN*.[137] However, clear rules on blockchain governance will encourage investment in the realization of this plan. In short, policymakers should create a permissive environment—through regulations or ministerial directives—which unequivocally enables the application of blockchain technology within land administration and affords legal certainty for its pilot implementations.

This recommendation is consistent with the comparative findings discussed above. Georgia demonstrates that blockchain-based land registration should be accompanied by explicit legal recognition within the land administration framework,[138] while the UAE illustrates the importance of adopting a dedicated governmental strategy that provides clear institutional direction for blockchain deployment.[139] These experiences suggest that Indonesia requires not only technical regulations but also a comprehensive regulatory framework that formally recognizes blockchain applications within land governance.

The new law should also empower the ATR/BPN to develop and administer a blockchain regulatory sandbox. i.e. a controlled live-testing environment where innovative land-registry applications can be trialed under official supervision. It is important to note that the regulatory sandbox model is not novel within the Indonesian context. The Financial Services Authority (OJK) has already operationalized such a framework

[135] Fatemeh Jahani Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia," *Journal of Spatial Science* 69, no. 4 (2024): 1222.

[136] *Ibid.*, 1222-1223.

[137] Nezar Patria *et al.*, *Satu Dekade Pembangunan Digital Indonesia 2014-2024* (Kementerian Komunikasi dan Informatika, 2024), 186.

[138] Castellanos and Benbunan-Fich, *loc.cit.* See also, Shang and Price, *op.cit.,* 77-78.

[139] Shafaq Khan *et al.*, "Blockchain for Governments: The Case of the Dubai Government," *Sustainability* 14, no. 11 (2022): 14.

through its Digital Financial Innovation Sandbox,[140] thereby establishing a domestic precedent for supervised experimentation with emerging technologies. These mechanisms allow authorities to "live test" new technologies and carefully monitor their opportunities and risks.[141]

In setting technical standards, Indonesia can draw on international models, particularly Estonia's X-Road, while leveraging institutional experience gained from its previous regulatory sandbox initiatives. India's phased implementation likewise demonstrates that pilot projects enable governments to evaluate technical feasibility, institutional readiness, and regulatory compatibility before nationwide deployment. A similar phased approach would reduce implementation risks within Indonesia's diverse land administration system.

Blockchain-based land governance must also be harmonized with Indonesia's existing land law. Georgia demonstrates that legal certainty is strengthened when blockchain records are formally recognized within the land registration system rather than serving merely as supporting infrastructure. This recommendation is further supported by recent Brazilian scholars , which demonstrates that even in jurisdictions with advanced digital asset regulations, blockchain cannot operate as an autonomous property registration system because rights *in rem* remain legally dependent upon the official Real Estate Registry.[142] Accordingly, Indonesia should ensure that blockchain functions as a complementary technological layer within the existing land registration framework rather than as a substitute for the statutory registration system. Consistent with this approach, although the ITE Law already recognizes electronic records as admissible evidence, Indonesia should explicitly recognize blockchain-based land records and establish evidentiary standards, including secure digital signatures and verifiable links between on-chain and off-chain records.

Drawing on the EU GDPR framework, Indonesia should ensure that blockchain implementation remains compatible with personal data protection despite the technology's immutable architecture. Compliance may be achieved through technical measures such as storing only cryptographic hashes on-chain, maintaining personal data off-chain, applying

[140] Circular Letter of the Financial Services Authority of the Republic of Indonesia No. 21/SEOJK.02/2019 on the Regulatory Sandbox Art. I(4), II, and III.

[141] Ivo Jenik and Schan Duff, "How to Build a Regulatory Sandbox: A Practical Guide for Policy Makers," CGAP, 2020, 9.

[142] Under the Civil Code of Brazil Art. 1.245, ownership of immovable property is acquired only upon registration before the official Real Estate Registry. Accordingly, blockchain should complement rather than replace the existing registration system, thereby enhancing administrative efficiency while preserving the legal structure governing real property rights. See, Renato Guimarães Pantoja, "Registro de Imóveis Em Blockchain à Brasileira: Uma Forma de Implementar a Blockchain Seguindo a Lei de Registros Públicos" (Undergraduate Thesis, Universidade Federal do Rio de Janeiro, 2024), 8, 11–12; See also, Felipe Saraiva Andrade, André Bruno Façanha De Negreiros, and Maria Darlene Braga Araújo Monteiro, "Automatização Dos Cartórios de Registros de Imóveis Na Era Da Democracia Digital: A Atuação Do Registrador de Imóveis Como Garantidor de Direitos Em Tempos de Certificação Digital, Metadados e Blockchain," *Brazilian Journal of Development* 8, no. 11 (2022): 74962, 74965, 74973.

pseudonymization and encryption, and establishing institutional oversight for data protection. Estonia further demonstrates that interoperable digital infrastructure is essential to enable secure data exchange while minimizing unnecessary duplication of personal data across government agencies.

Sweden further illustrates that blockchain implementation is an institutional, rather than merely technological, reform requiring close collaboration among public authorities and relevant stakeholders. Accordingly, Indonesia should strengthen coordination among the stakeholders such as ATR/BPN, Land Deed Officials (PPAT), licensed cadastral surveyors, the Ministry of Communication and Digital Affairs of the Republic of Indonesia (Komdigi), the National Cyber and Crypto Agency (BSSN), local governments, and technology providers to ensure interoperability, consistent data governance, and effective implementation of blockchain-based land registration.

2.2.3. Prospects and Future Challenges in Implementing Blockchain for Land Administration in Indonesia

Building upon the comparative analysis and policy recommendations discussed above, the future implementation of blockchain-based land governance in Indonesia presents both significant opportunities and substantial challenges. The experiences of Georgia, Sweden, India, Estonia, the UAE, and the EU as discussed in Section 2.1.1 and 2.1.2 are not solely on technological innovation, but also on legal certainty, institutional coordination, interoperable digital infrastructure, personal data protection, and public acceptance. Accordingly, Indonesia's long-term prospects should be assessed through these interrelated legal, institutional, technological, and socio-cultural dimensions.

First, blockchain can strengthen legal certainty, data integrity, and administrative efficiency in Indonesia's land registration system. Georgia demonstrates that immutable distributed ledgers reduce opportunities for document forgery, overlapping certificates, corruption, and unauthorized alteration by creating reliable and auditable land records.[143] In the long term, blockchain may strengthen Indonesia's land publication system while improving the resilience of cadastral data against physical loss, system failures, and cyberattacks through distributed storage.

Second, blockchain can improve institutional coordination and interoperability across Indonesia's land administration system. Estonia shows that blockchain should operate within an interoperable digital ecosystem,[144] while Sweden highlights the importance of coordination among cadastral authorities, financial institutions, legal professionals, and technology providers.[145] A permissioned blockchain platform, could therefore

[143] Lazuashvili, *et al.*, *op.cit.*, 226-227. See also, Aarvik, *loc.cit.*; Castellanos and Benbunan-Fich, *op.cit.*, 3.

[144] Vassil, *loc.cit.* See also, Jalakas, *op.cit.*, 25.

[145] Proskurovska and Dörry, *loc.cit.* See also, McMurren, *et al.*, *op.cit.*, 7; Paavo and Rodríguez-Puentes, *loc.cit.*

facilitate secure data sharing[146] among ATR/BPN, PPAT, licensed cadastral surveyors, local governments, and other relevant institutions while supporting smart contracts to automate verification and reduce transaction costs.

Third, blockchain offers important opportunities to strengthen transparency, institutional accountability, and public trust.[147] Distributed recordkeeping and consensus-based validation make every authorized transaction traceable, thereby improving accountability while increasing confidence in land administration. These benefits, however, can only be realized when supported by an adequate legal framework and institutional readiness.

Despite these prospects, blockchain implementation continues to face significant challenges. Regulatory reform[148] remains necessary to recognize blockchain-based land records, clarify the legal status of smart contracts, harmonize evidentiary rules, and ensure compatibility with Indonesia's PDP Law. Institutionally,[149] successful implementation depends on sustained coordination among ATR/BPN, PPAT, licensed cadastral surveyors, Komdigi, BSSN, local governments, and technology providers. Indonesia must also improve cadastral data quality, digital infrastructure, cybersecurity, and internet connectivity before nationwide implementation becomes feasible. India's phased implementation illustrates[150] that pilot projects provide a more realistic pathway toward gradual adoption.

Beyond legal and technical considerations, the long-term success of blockchain depends on public trust and a supportive legal culture.[151] Comparative experience shows that technological innovation alone cannot transform land administration without institutional acceptance and societal confidence. Indonesia should therefore strengthen digital literacy, public participation, and institutional transparency to encourage acceptance of blockchain-based land registration while reducing resistance to change. Ultimately, blockchain adoption should be understood as a long-term legal and institutional reform rather than merely a technological upgrade. Its successful implementation in Indonesia depends on integrating legal, institutional, technological, and socio-cultural dimensions within a coherent governance framework.

3. CONCLUSION

This study demonstrates that Indonesia’s ongoing digitalization of land administration has not sufficiently addressed persistent challenges, such as fraudulent transactions, overlapping land records, institutional fragmentation, regulatory gaps, and declining public trust. A comparative

[146] Herny Christine *et al.*, “A Study of Permissioned Blockchain-Based Framework for Land Ownership Tracking in Indonesia,” *Jurnal Interkom: Jurnal Publikasi Ilmiah Bidang Teknologi Informasi dan Komunikasi* 17, no. 3 (2022): 124–125.

[147] *Ibid.*, 125. See also, Amri, *loc.cit.*; Pratama, *et al.*, *loc.cit.*

[148] Lazuashvili, *et al.*, *op.cit.*, 227.

[149] Muhire, *op.cit.,* 78.

[150] Kshetri, *op.cit.,* 377. See also, Kapoor, *et al.*, *op.cit.*, 14; Comincioli, *loc.cit.*

[151] Thysse, *op.cit.,* 263.

legal analysis of blockchain implementation in land registration (Georgia, Sweden, and India) and broader blockchain governance frameworks (Estonia, the UAE, and the EU) reveals that successful integration of blockchain into land administration depends not only on technological capability but also on the presence of a coherent legal and institutional ecosystem. The comparative findings suggest that effective blockchain-based land governance requires reliable cadastral data, interoperable digital infrastructure, comprehensive regulatory frameworks, robust personal data protection, institutional coordination, and phased implementation strategies. Therefore, Indonesia should pursue regulatory reforms that recognize blockchain-based land records, establish an ATR/BPN regulatory sandbox, harmonize blockchain governance with existing land and personal data protection laws, and develop interoperable technical standards. Blockchain should ultimately be viewed as a governance reform that necessitates coherent legal, institutional, technological, and socio-cultural support to enhance transparency, prevent fraud, and restore public trust in land administration.

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