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Digital Transformation of Land Administration: Strengthening Good Land Governance and Legal Certainty in Indonesia

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ABSTRACT

Land administration in Indonesia continues to face persistent problems, including overlapping ownership claims, land disputes, document forgery, and inconsistencies between physical and juridical data, conditions that underscore the importance of legal certainty in the governance of land rights. In response, the Government of Indonesia has pursued the digital transformation of land services, including electronic certificates and integrated land databases, as part of its broader bureaucratic reform agenda. This study aims to analyze how the digital transformation of land administration strengthens the application of Good Land Governance principles and enhances legal certainty over land rights, while identifying the challenges that continue to constrain its implementation. The study employs normative legal research using statutory, conceptual, and analytical approaches, examining primary legal materials, including the 1945 Constitution, the Basic Agrarian Law, Government Regulation Number 18 of 2021, and the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021, alongside secondary legal literature. The findings show that digital transformation strengthens transparency, accountability, effectiveness, efficiency, and legal certainty in land administration, while reducing opportunities for maladministration and document fraud. However, its success remains constrained by uneven technological infrastructure, cybersecurity risks, personal-data-protection requirements, limited inter-agency interoperability, and uneven human-resource readiness, all of which require continued regulatory and institutional strengthening.

Keywords: *Digital Transformation, Electronic Land Certificate, Good Land Governance, Land Administration, Legal Certainty, Personal Data Protection*

INTRODUCTION

Land constitutes a strategic natural resource in the life of Indonesian society, encompassing economic, social, cultural, and legal dimensions.¹ As an agrarian nation with a continually expanding population, Indonesia faces escalating demand for land, which generates persistent problems, including overlapping ownership claims, land disputes, forgery of land documents, boundary conflicts between parcels, and inconsistencies between physical and juridical data.²³ These conditions demonstrate that land administration constitutes a critical function in securing legal certainty and protecting land rights.⁴

The constitutional foundation governing the control and management of land in Indonesia is set out in Article 33, paragraph (3) of the 1945 Constitution of the Republic of Indonesia, which provides that the earth, water, and the natural resources contained therein are controlled by the state and are to be used for the greatest prosperity of the people. This provision is further elaborated in Law Number 5 of 1960 concerning Basic Agrarian Principles (hereinafter UUPA), which affirms that the state possesses the authority to regulate the allocation, use, supply, and preservation of land in order to guarantee legal certainty within the legal relationship between society and land.⁵

In line with the advancement of information and communication technology, the Government of Indonesia has pursued digital transformation across various public service sectors, including land administration, as part of the broader bureaucratic reform agenda and the development of the Electronic-Based Government System (Sistem Pemerintahan Berbasis Elektronik, SPBE).⁶ Within the land sector, this transformation materializes through the digitalization of land services, the development of an integrated national land database, the introduction of electronic services, the use of electronic signatures, digital archiving, and the implementation of electronic certificates as a form of modernized land administration.⁷

¹ Firman Muntaqo et al., "The Transformation of Land Law in Indonesia: From Commodification to Maqāsid and Social Justice," *Al-Ahkam* 35, no. 2 (October 1, 2025): 287–312, <https://doi.org/10.21580/ahkam.2025.35.2.25605>.

² Fatemeh Jahani Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia," *Journal of Spatial Science* 69, no. 4 (October 6, 2024): 1097–1129, <https://doi.org/10.1080/14498596.2024.2360531>.

³ Ben White and Marcus Taylor, "Labour and Land in Indonesia: An Introduction," *Journal of Agrarian Change* 25, no. 4 (October 18, 2025), <https://doi.org/10.1111/joac.70034>.

⁴ Kusuma Firdaus, Yos Johan Utama, and Aju Putrijanti, "Legal Protection and Certainty of Land Rights through PTSL: A Review of Indonesian State Administrative Law," *Journal of Posthumanism* 5, no. 6 (May 27, 2025): 931–51, <https://doi.org/10.63332/joph.v5i6.2161>.

⁵ Ganjar Kurnia et al., "Local Wisdom for Ensuring Agriculture Sustainability: A Case from Indonesia," *Sustainability* 14, no. 14 (July 19, 2022): 8823, <https://doi.org/10.3390/su14148823>.

⁶ Kusmiarto Kusmiarto et al., "Digital Transformation of Land Services in Indonesia: A Readiness Assessment," *Land* 10, no. 2 (January 27, 2021): 120, <https://doi.org/10.3390/land10020120>.

⁷ Rohan Mark Bennett et al., "Digital Transformation in Indonesian Land Administration," in *Geospatial Science for Smart Land Management* (Boca Raton: CRC Press, 2023), 43–67, <https://doi.org/10.1201/9781003349518-7>.

Land digitalization is expected to address the weaknesses inherent in the conventional administrative system, which has long relied on physical documentation.⁸ The manual system entails limitations, including protracted service processes, elevated administrative costs, the risk of document loss or damage, and heightened opportunities for certificate forgery and maladministration; comparable risks of document falsification and the corresponding value of digital authentication have similarly been documented in adjacent areas of Indonesian administrative practice.⁹ With the establishment of an integrated digital system, processes such as land registration, database maintenance, certificate verification, rights registration, and the delivery of land information services can be conducted more rapidly, transparently, efficiently, and accountably.

One of the principal policies within the digital transformation of land administration is the introduction of the electronic certificate, regulated under the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021 concerning Electronic Certificates. This policy constitutes a strategic measure to strengthen the security of land documents through an electronic system equipped with digital authentication mechanisms, electronic recording, and integrated data management.¹⁰ The electronic certificate is expected to minimize the risk of document forgery, accelerate land services, and enhance the effectiveness of national land data management.

The digital transformation of land administration is also closely connected to the concept of Good Land Governance, an extension of the broader principle of good governance applied specifically to the management of land resources. Good Land Governance emphasizes transparency, accountability, public participation, legal certainty, effectiveness, efficiency, fairness, and integrity in the conduct of land administration.¹¹ The application of digital technology offers considerable opportunity to realize these principles through the provision of easily accessible

⁸ Daivi Rodima-Taylor, "Digitalizing Land Administration: The Geographies and Temporalities of Infrastructural Promise," *Geoforum* 122 (June 2021): 140–51, <https://doi.org/10.1016/j.geoforum.2021.04.003>.

⁹ Rissa Dwi Novita and Muhammad Abdul Razak, "PERSONAL DATA PROTECTION IN FALSIFICATION OF COVID-19 VACCINATION CERTIFICATES: A JURIDICAL VIEW," *Journal of Court and Justice*, August 11, 2022, 25–37, <https://doi.org/10.56943/jcj.v1i3.145>.

¹⁰ Damianus Krismanoro, "The Urgency of Electronic Land Certificates in the Land Registration Legal System in Indonesia," *Journal of Law and Sustainable Development* 11, no. 10 (October 26, 2023): e1808, <https://doi.org/10.55908/sdgs.v11i10.1808>.

¹¹ Getie Gebrie Eshetie, Berhanu Kefale Alemie, and Abebe Mengaw Wubie, "Responsible Land Tenure Governance in Relation to Land Degradation Neutrality: A Research Synthesis," *Conservation Science and Practice* 7, no. 12 (December 4, 2025), <https://doi.org/10.1111/csp2.70212>.

land information, the reduction of bureaucratic interactions that carry potential for corrupt practices, and the improvement of land data accuracy.¹²¹³

At the same time, the implementation of digital transformation is not without challenges. Uneven information technology infrastructure, limited human resource capacity, cybersecurity threats, personal data protection concerns, interoperability among government institutions, and disparities in public digital literacy remain factors affecting the success of land service digitalization.¹⁴ Moreover, the shift from a conventional to an electronic system requires regulatory harmonization, institutional readiness, and strengthened oversight mechanisms to ensure that the objectives of land administration reform can be optimally achieved.

Prior studies have shown that the digitalization of land administration can enhance the efficiency of public services and improve the quality of governance.¹⁵ Kusmiarto et al. found that the readiness of Indonesian land offices for digital transformation varies considerably across regions, requiring targeted institutional strengthening.¹⁶ Similarly, research addressing the conversion of colonial-era land titles into contemporary property rights indicates that legal certainty over land rights remains a persistent concern even as administrative procedures are modernized.¹⁷ Nevertheless, studies that specifically examine the interrelationship between the digital transformation of land administration, the implementation of Good Land Governance principles, and the strengthening of legal certainty over land rights within the framework of Indonesia's most recent regulatory developments remain relatively limited. This study therefore addresses that gap by offering a comprehensive juridical analysis of the effectiveness of digital land transformation as an instrument for renewing national land administration.

Building on the foregoing discussion, this study aims to analyze how the digital transformation of land administration can strengthen the application of Good Land Governance principles and enhance legal certainty over land rights in Indonesia. In addition, this study identifies the challenges encountered in implementing land digitalization and formulates policy recommendations for establishing a modern, integrated, transparent, and equitable land administration system responsive to technological development and societal needs.

¹² Rodima-Taylor, "Digitalizing Land Administration: The Geographies and Temporalities of Infrastructural Promise."

¹³ Prince Ameyaw and Walter de Vries, "Toward Smart Land Management: Land Acquisition and the Associated Challenges in Ghana. A Look into a Blockchain Digital Land Registry for Prospects," *Land* 10, no. 3 (March 1, 2021): 239, <https://doi.org/10.3390/land10030239>.

¹⁴ Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia."

¹⁵ Bennett et al., "Digital Transformation in Indonesian Land Administration."

¹⁶ Kusmiarto et al., "Digital Transformation of Land Services in Indonesia: A Readiness Assessment."

¹⁷ Rendy Firmansyah and Lolita Permanasari, "PRIORITY RIGHTS IN THE PROCESS OF CONVERTING EIGENDOM VERPONDING LAND INTO PROPERTY RIGHTS: A JURIDICAL ANALYSIS," *Journal of Court and Justice* 1, no. 3 (September 1, 2022): 76–89, <https://doi.org/10.56943/jcj.v1i3.150>.

RESEARCH METHODOLOGY

This study employs normative (doctrinal) legal research, a method oriented toward the analysis of legal norms as they are formulated in legislation, legal doctrine, and legal principles, rather than toward the observation of social facts in the field.¹⁸¹⁹ Three complementary approaches are applied. The statute approach is used to examine the hierarchy and substance of the laws and regulations governing land administration and its digital transformation, including the 1945 Constitution of the Republic of Indonesia, Law Number 5 of 1960 concerning Basic Agrarian Principles,²⁰ Government Regulation Number 18 of 2021 concerning Management Rights, Land Rights, Condominium Units, and Land Registration,²¹ and the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021 concerning Electronic Certificates²². The conceptual approach is applied to elaborate the theoretical framework of Good Land Governance and legal certainty as analytical lenses for assessing the effectiveness of digital land reform. The analytical approach is used to examine the meaning and interrelationship of legal terms and provisions found within the regulations under study.²³

The legal materials used in this study consist of primary, secondary, and tertiary sources. Primary legal materials comprise the constitutional and statutory instruments identified above, together with related implementing regulations issued by the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency. Secondary legal materials consist of books, peer-reviewed journal articles, and research reports relevant to digital land administration, Good Land Governance, and legal certainty. Tertiary legal materials include legal dictionaries and encyclopedic references used to clarify technical terminology. Legal materials were collected through library research (document study), involving the systematic identification, classification, and review of statutory texts and scholarly literature. The collected materials were analyzed qualitatively using a descriptive-analytical technique, in which legal norms and scholarly findings are described, systematized, and evaluated to answer the research questions and to formulate the study's conclusions and recommendations.

¹⁸ Tunggul Ansari Setia Negara, "Normative Legal Research in Indonesia: Its Origins and Approaches," *Audito Comparative Law Journal (ACLJ)* 4, no. 1 (February 2, 2023): 1–9, <https://doi.org/10.22219/aclj.v4i1.24855>.

¹⁹ Soerjono Soekanto and Sri Mamudji, *Penelitian Hukum Normatif: Suatu Tinjauan Singkat*, 21st ed. (Depok: PT Rajagrafindo Persada, 2022).

²⁰ Pemerintahan Republik Indonesia, "UU No. 5 Tahun 1960 Tentang Peraturan Dasar Pokok-Pokok Agraria," Sekretariat Negara § (1960).

²¹ Pemerintahan Republik Indonesia, "PP No. 18 Tahun 2021 Tentang Hak Pengelolaan, Hak Atas Tanah, Satuan Rumah Susun, Dan Pendaftaran Tanah," Sekretariat Negara § (2021).

²² Pemerintahan Republik Indonesia, "Permen Agraria/Kepala BPN No. 1 Tahun 2021 Tentang Sertipikat Elektronik," Sekretariat Negara § (2021).

²³ Negara, "Normative Legal Research in Indonesia: Its Origins and Approaches."

RESULT AND DISCUSSION

Digital Transformation in Land Administration: Concept and Regulatory Framework

Digital transformation refers to a fundamental change in organizational conduct through the use of information and communication technology to improve effectiveness, efficiency, transparency, and service quality. In land administration, this process unfolds in stages, from digitization, converting physical documents into electronic form, to digitalization, restructuring the underlying business processes, and finally to digital transformation proper, the establishment of land governance that is fully technology-based.²⁴ In Indonesia, this trajectory forms part of the broader bureaucratic reform agenda and the Electronic-Based Government System, pursued to accelerate services, reduce administrative costs, improve data accuracy, strengthen document security, and broaden public access to land services.

This transformation rests on a coherent regulatory framework. Law Number 5 of 1960 concerning Basic Agrarian Principles (UUPA) supplies the foundational legal relationship between the state, society,²⁵ and land; Law Number 6 of 2023 concerning the Stipulation of Government Regulation in Lieu of Law Number 2 of 2022 concerning Job Creation into Law drives bureaucratic simplification and the digitalization of public services more broadly;²⁶ Government Regulation Number 18 of 2021 concerning Management Rights, Land Rights, Condominium Units, and Land Registration operationalizes electronic land registration;²⁷ and the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021 concerning Electronic Certificates,²⁸ together with subsequent ATR/BPN regulations on electronic land services, governs implementation at the operational level.

Although the UUPA was drafted before digital technology existed, its underlying values remain fully applicable to the modernization of land administration. Article 2, paragraph (2) grants the state authority to regulate the allocation, use, supply, and preservation of land, an authority that extends naturally to the use of information technology as an instrument of more effective administration. Article 19 obliges the government to conduct land registration throughout Indonesia to guarantee legal certainty, encompassing measurement, mapping, recordation, rights registration, and the issuance of proof of rights that

²⁴ Bennett et al., "Digital Transformation in Indonesian Land Administration."

²⁵ Pemerintahan Republik Indonesia, UU No. 5 Tahun 1960 tentang Peraturan Dasar Pokok-Pokok Agraria.

²⁶ Pemerintahan Republik Indonesia, "UU No. 6 Tahun 2023 Tentang Penetapan Peraturan Pemerintah Pengganti Undang-Undang Nomor 2 Tahun 2022 Tentang Cipta Kerja Menjadi Undang-Undang," Sekretariat Negara § (2023).

²⁷ Pemerintahan Republik Indonesia, PP No. 18 Tahun 2021 tentang Hak Pengelolaan, Hak Atas Tanah, Satuan Rumah Susun, dan Pendaftaran Tanah.

²⁸ Pemerintahan Republik Indonesia, Permen Agraria/Kepala BPN No. 1 Tahun 2021 tentang Sertipikat Elektronik.

functions as strong evidence. Because the central purpose of registration is legal certainty rather than the preservation of a particular physical medium, the shift from paper to electronic certificates is properly understood as a change in the administrative medium, not a change in the substance of land rights.²⁹

Law Number 6 of 2023 reinforces this trajectory by embedding digitalization within the wider regulatory-simplification agenda intended to accelerate investment and improve public service quality; in the land sector, digitalization functions as a concrete instrument for accelerating administrative processes and providing legal certainty to both business actors and the public, while the law's emphasis on integrated electronic licensing and inter-agency data synchronization gives land digitalization a firmer statutory anchor.³⁰ Government Regulation Number 18 of 2021 provides the operational foundation for this shift, mandating that land registration be conducted effectively, efficiently, transparently, and, where possible, electronically, and requiring that land data be continuously updated, a requirement an electronic system can satisfy more quickly, accurately, and verifiably than a paper-based one.³¹

The Regulation of the Minister of ATR/Head of BPN Number 1 of 2021 constitutes the operational cornerstone of this framework, governing the issuance, amendment, maintenance, replacement, and management of electronic certificates through a system equipped with information security standards, digital authentication, and electronic recording. An electronic certificate issued in accordance with this procedure carries the same legal standing as its conventional counterpart, and its evidentiary value continues to rest on Indonesia's land registration system, which affords strong evidentiary force to both the physical and juridical data it contains.³² Its principal legal benefits, strengthened document security, reduced forgery risk, simplified data maintenance, faster public service, and a traceable audit trail, mirror the document-authentication rationale that has proven valuable in adjacent areas of Indonesian digital governance, including the use of digital verification to counter certificate falsification more broadly.³³ Subsequent ATR/BPN regulations extend this framework to electronic mortgage rights, electronic certificate checking, electronic discharge of mortgage, digital land value zones, and the integration of spatial and juridical data, a progression that reflects the shift from paper-based to digital land administration and that, from an administrative-law perspective, operationalizes the general principles of good

²⁹ Krismantoro, "The Urgency of Electronic Land Certificates in the Land Registration Legal System in Indonesia."

³⁰ Bennett et al., "Digital Transformation in Indonesian Land Administration."

³¹ Kusmiarto et al., "Digital Transformation of Land Services in Indonesia: A Readiness Assessment."

³² Krismantoro, "The Urgency of Electronic Land Certificates in the Land Registration Legal System in Indonesia."

³³ Novita and Abdul Razak, "PERSONAL DATA PROTECTION IN FALSIFICATION OF COVID-19 VACCINATION CERTIFICATES: A JURIDICAL VIEW."

governance, namely legality, legal certainty, benefit, openness, professionalism, and accountability.

Digital Transformation as an Instrument for Strengthening Good Land Governance

Good Land Governance applies the broader principles of good governance to the specific management of land resources, and recent conceptual scholarship frames it around transparency of information on land status and history, accountability of the administering authority for every service rendered, public participation in land-related decision-making, effectiveness and efficiency of service delivery, fairness among all rights holders, and legal certainty secured through orderly administration.³⁴ Digital transformation operationalizes each of these principles simultaneously rather than in isolation: it increases the transparency of land data, reduces direct contact between citizens and officials in ways that narrow opportunities for corruption, collusion, and nepotism, improves data accuracy, and simplifies oversight, thereby strengthening bureaucratic accountability as a coherent whole.³⁵

The juridical implication extends beyond individual transactions to the structure of governance itself. Because electronic systems document every stage of service delivery, they narrow the space for data manipulation, abuse of authority, and corrupt practice, while the integration of land data across central government, regional government, and related institutions supports a more responsive, evidence-based form of land governance. This integration, however, is not self-executing; achieving genuine interoperability across ministries and agencies remains one of the more demanding technical and institutional tasks of the reform, requiring sustained coordination rather than a single regulatory instrument.³⁶

Digital Transformation and the Legal Certainty of Land Rights

Legal certainty is the principal objective of land administration, and digital transformation supports that objective through several concrete mechanisms rather than through technology in the abstract. An electronic certificate carries equal legal force to a conventional certificate provided it is issued according to procedure, and it delivers this certainty through faster service, reduced dependence on physical documents, stronger data security, a lower risk of loss or damage, reduced opportunity for certificate forgery, and simplified data updating.³⁷ The same digital infrastructure has extended these benefits across a widening range of services,

³⁴ Hossein Azadi et al., “Smart Land Governance: Towards a Conceptual Framework,” *Land* 12, no. 3 (March 3, 2023): 600, <https://doi.org/10.3390/land12030600>.

³⁵ Azadi et al.

³⁶ Chehrehbargh et al., “Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia.”

³⁷ Krismantoro, “The Urgency of Electronic Land Certificates in the Land Registration Legal System in Indonesia.”

including rights registration, online certificate verification, electronic discharge of mortgage, electronic mortgage rights, land-data maintenance, land-information services, digital parcel measurement, and electronic archiving, each of which accelerates service delivery while raising the overall quality of public administration.³⁸

At a structural level, legal certainty is reinforced through an integrated database, more accurate electronic recordation, digital authentication, a traceable audit trail, real-time data updating, and a reduced risk of duplicate certificates, all of which strengthen legal protection for rights holders because the complete administrative history of a parcel becomes verifiable rather than merely asserted. Even so, research on the conversion of older, colonial-era land titles into contemporary property rights shows that legal certainty can remain contested even where administrative procedure has been modernized, indicating that certainty is not an automatic byproduct of digitization.³⁹ Sustaining it in practice therefore requires regulatory harmonization, personal data protection, cybersecurity, continuous strengthening of official competence, and ongoing oversight, so that public trust in the digital land system is preserved over time rather than assumed at the outset.⁴⁰

Electronic Data Protection as a Precondition for Digital Land Governance

Land data is strategic by nature, comprising rights holders' identities, the legal status of parcels, area and boundary information, transfer history, encumbrances, and spatial data of substantial economic and legal value; its unauthorized disclosure, alteration, or misuse would not only harm individual rights holders but could also erode legal certainty, weaken public trust in land administration, and increase the incidence of land-related disputes and offenses. Electronic data protection is accordingly a precondition, not a peripheral feature, of digital land reform, and it rests on a coherent statutory basis spanning the UUPA's registration mandate, Law Number 27 of 2022 concerning Personal Data Protection,⁴¹ Law Number 11 of 2008 concerning Electronic Information and Transactions as last amended by Law Number 1 of 2024, Government Regulation Number 71 of 2019 concerning the Administration of Electronic Systems and Transactions, Government Regulation Number 18 of 2021, and Ministerial Regulation Number 1

³⁸ Kusmiarto et al., "Digital Transformation of Land Services in Indonesia: A Readiness Assessment."

³⁹ Firmansyah and Permanasari, "PRIORITY RIGHTS IN THE PROCESS OF CONVERTING EIGENDOM VERPONDING LAND INTO PROPERTY RIGHTS: A JURIDICAL ANALYSIS."

⁴⁰ Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia."

⁴¹ Pemerintahan Republik Indonesia, "UU No. 27 Tahun 2022 Tentang Perlindungan Data Pribadi," Sekretariat Negara § (2022).

of 2021, together requiring that any system managing land data uphold the three core information-security principles of confidentiality, integrity, and availability.⁴²

The principal risks accompanying digitalization, unauthorized data access, unauthorized alteration of physical or juridical data, cyberattacks such as malware, ransomware, and phishing, data loss from hardware failure or disaster, and misuse of access privileges, are precisely the risks that continue to be documented across Indonesia's broader digital-government transition, underscoring that land administration is not exceptional in this respect but shares the same threat profile as other digitized public services.⁴³ Mitigating these risks requires a layered strategy: multi-factor authentication, certified electronic signatures, encryption of data at rest and in transit, access management grounded in the principle of least privilege, comprehensive audit-trail logging, periodic backup, a documented disaster-recovery plan, continuous security monitoring, and regular cybersecurity training for both officials and system users.

From an administrative-law perspective, safeguarding electronic data is not a merely technical undertaking but an integral part of the government's obligation to deliver public services that satisfy the principles of legal certainty, diligence, professionalism, and accountability, meaning that a security failure carries potential legal consequences for the system operator, not only reputational or operational ones. Effective data protection, in this sense, does more than secure information: it builds the public trust that determines whether citizens are willing to rely on electronic land services at all, making it as central to Good Land Governance as transparency or participation.⁴⁴

Comparative International Practice and Future Directions

Several jurisdictions offer instructive points of comparison. The Netherlands has developed an integrated digital cadastral system linked directly to land transactions, a model that has directly informed recent Indonesia-Netherlands collaboration on land administration reform; Australia employs electronic conveyancing that allows the transfer of rights to be completed entirely online; and comparative assessments of Indonesia's own land administration system, benchmarked against Digital Government Readiness frameworks, point to New Zealand, Singapore, and Australia as models for standardizing parcel identification, updating regulatory instruments, and modernizing address and data standards.⁴⁵ The shared lesson across these cases is that the success of digital land reform depends less on the technology itself than on the quality of the underlying regulation, the

⁴² Novita and Abdul Razak, "PERSONAL DATA PROTECTION IN FALSIFICATION OF COVID-19 VACCINATION CERTIFICATES: A JURIDICAL VIEW."

⁴³ Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia."

⁴⁴ Azadi et al., "Smart Land Governance: Towards a Conceptual Framework."

⁴⁵ Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia."

maturity of technological infrastructure, the robustness of data security, and the strength of inter-agency coordination, precisely the variables that determine how far a given reform travels beyond pilot implementation.

Looking forward, Indonesia's land administration is likely to engage increasingly with artificial intelligence, blockchain, big data, cloud computing, the Internet of Things, and geospatial analytics. A recent systematic review of blockchain applications in land registration internationally indicates that such technologies can strengthen data validity and traceability, though it also cautions that implementation outcomes vary considerably with local regulatory and institutional conditions, meaning that adoption in Indonesia would need to be calibrated rather than transplanted wholesale.⁴⁶ Realizing this potential responsibly will require continued regulatory strengthening, expanded human-resource capacity, sustained investment in digital infrastructure, and closer collaboration among government, academia, and the public, so that innovation is matched by institutional readiness rather than outpacing it.

Challenges and Strategic Solutions for Sustainable Implementation

Four clusters of challenge, each paired with its corresponding response, determine whether digital land reform is sustained beyond its initial rollout. The first concerns technical and infrastructural readiness: information technology infrastructure remains unevenly distributed across Indonesia, particularly in underdeveloped, frontier, and outermost regions, and physical and juridical land data remain incompletely integrated across land offices, regional governments, and tax authorities, with a substantial backlog still awaiting digitization. Addressing this cluster requires sustained investment in networks, data centers, and cloud computing, backed by reliable backup and disaster-recovery systems, together with continued synchronization of the national land database across ministries, agencies, and regional governments to reduce duplication and accelerate verification.⁴⁷

The second cluster concerns cybersecurity and data protection: as digital adoption widens, so does exposure to hacking, data breaches, ransomware, data manipulation, and misuse of user accounts, risks made more acute by the high economic and legal value of land data. The corresponding response combines encryption, multi-factor authentication, access management calibrated to institutional roles, continuous security monitoring, periodic information-security audits, and clearly defined incident-response procedures capable of containing disruptions quickly.⁴⁸

⁴⁶ Reyan M. Zein and Hossana Twinomurizi, "Blockchain Technology in Lands Registration: A Systematic Literature Review," *JeDEM - EJournal of EDemocracy and Open Government* 15, no. 2 (December 18, 2023): 1–36, <https://doi.org/10.29379/jedem.v15i2.748>.

⁴⁷ Chehrehbargh et al., "Current Challenges and Strategic Directions for Land Administration System Modernisation in Indonesia."

⁴⁸ Novita and Abdul Razak, "PERSONAL DATA PROTECTION IN FALSIFICATION OF COVID-19 VACCINATION CERTIFICATES: A JURIDICAL VIEW."

The third cluster is regulatory and institutional: despite the existing body of regulation supporting land digitalization, further harmonization is still required between land law and the rules governing electronic systems, personal data protection, cybersecurity, and electronic evidence, since unresolved overlap between these regimes can itself generate legal uncertainty. This calls for continuous regulatory updating, clear standard operating procedures, both internal and external oversight mechanisms, and periodic performance evaluation to keep the regulatory framework aligned with technological change rather than trailing behind it.⁴⁹

The fourth cluster concerns human resources and social acceptance: the competence of land administration officials in operating electronic systems, managing digital data, and maintaining information security varies considerably, public digital literacy is similarly uneven, and reliance on physical documentation still generates resistance to change among both officials and citizens. Indonesia's own readiness assessments confirm that this variation is regional rather than uniform, meaning that capacity-building cannot be applied generically but must be targeted to where institutional readiness is weakest, through regular training for officials, expanded public education on electronic services, and collaboration spanning central and regional government, law enforcement, universities, professional organizations, the private sector, and the public.⁵⁰

Taken together, these four clusters indicate that digital land transformation is best understood as a reform of administrative governance rather than a purely technological upgrade. Its success depends on the balance struck between technological innovation, legal certainty, institutional readiness, and the protection of citizens' rights; approached this way, the challenges documented above are less an obstacle to digital reform than the actual substance of it, and addressing them consistently is what would allow Indonesia to build a land administration system that is modern, trusted, and genuinely protective of every rights holder it serves.

CONCLUSION

This study concludes that the digital transformation of land administration constitutes a coherent reform of public administration, resting on an adequate legal basis, namely Law Number 5 of 1960 concerning Basic Agrarian Principles, Law Number 6 of 2023 concerning the Stipulation of Government Regulation in Lieu of Law Number 2 of 2022 concerning Job Creation into Law, Government Regulation Number 18 of 2021 concerning Management Rights, Land Rights, Condominium Units, and Land Registration, and the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021

⁴⁹ Negara, "Normative Legal Research in Indonesia: Its Origins and Approaches."

⁵⁰ Kusmiarto et al., "Digital Transformation of Land Services in Indonesia: A Readiness Assessment."

concerning Electronic Certificates. Through the implementation of electronic certificates, electronic land services, archive digitalization, and the integration of land data, this framework has demonstrably strengthened Good Land Governance: electronic systems improve transparency through more open access to information, reinforce accountability through digital recordation and audit trails, increase the effectiveness and efficiency of service delivery through simplified administrative procedure, and widen public participation through more accessible services, while narrowing the space for maladministration, abuse of authority, and corrupt practice that had long constrained conventional land administration.

From the standpoint of legal certainty, the findings show that digital transformation affords stronger protection of land rights through the more accurate, integrated, and electronically documented management of physical and juridical data. The implementation of electronic certificates, electronic signatures, and an integrated national land database increases the reliability of the evidentiary system underlying land rights, reduces the risk of document forgery, prevents the issuance of duplicate certificates, and simplifies the maintenance and updating of land data, so that digitalization accelerates service delivery while simultaneously reinforcing legal protection for rights holders. This progress remains conditional, however, on addressing the constraints identified throughout this study, namely uneven information technology infrastructure, gaps in land-data quality and integration, cybersecurity threats, the demands of personal data protection, still-incomplete inter-agency interoperability, uneven human-resource readiness, and the continuing need for regulatory harmonization. Digital transformation should therefore not be understood merely as the deployment of technology, but as a process of institutional, governance, and organizational-culture change that requires sustained commitment from every stakeholder involved.

Taken as a whole, these findings support the conclusion that the digital transformation of land administration is a strategic instrument for building a land administration system that is modern, accountable, and oriented toward public service. Its continued success will depend on the synergy between stronger regulation, reliable digital infrastructure, expanded human-resource capacity, robust information-security standards, effective personal-data protection, and genuine inter-agency system integration. With consistent policy support and sound governance, the digital transformation of land administration can be expected to further strengthen Good Land Governance, enhance legal certainty over land rights, reduce the incidence of land disputes, and support Indonesia's broader pursuit of sustainable and equitable national development.

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