



**DIGITAL TRANSFORMATION OF LAND SERVICES IN INDONESIA:
UNRAVELING THE TENSIONS BETWEEN INNOVATION, REGULATION,
AND SOCIAL EQUITY****Fanny Febrina Kudadiri¹****Universitas Indonesia; and Rote Ndao Regency Land Office, Ministry of
Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN)****fanny.febrina31@ui.ac.id****Rachma Fitriati²****Universitas Indonesia, Depok, Indonesia****rachma.fitriati@ui.ac.id**

Abstract

The digital transformation of Indonesia's land registration services via electronic certificates has advanced significantly, with 5.3 million e-certificates issued between 2023 and 2025, covering 4.4% of the 120.9 million registered land parcels (Kementerian ATR/BPN, 2026). Nevertheless, persistent challenges remain across five digital governance dimensions: transparency, participation, interoperability, service innovation, and collaboration. This study examines how the implementation of digital governance affects legal certainty and social inclusion within land administration. Findings reveal that while e-certificates provide evidentiary strength equivalent to physical certificates, Indonesia's negative publication system permits annulment. Furthermore, data quality issues, particularly 31.76% empty parcel IDs, undermine system effectiveness. Regulatory dualism between PP 24/1997 and PP 18/2021 creates legal uncertainty. Moreover, infrastructural disparities generate digital exclusion risks for remote communities, the elderly, and customary law groups. Consequently, sustainable digital governance necessitates harmonized regulations, equitable infrastructure, enhanced data quality, and inclusive capacity building that accommodates Indonesia's geographic and socio-cultural diversity.

Keywords: Digital Governance, Land Registration, Electronic Certificates,
Legal Certainty, Social Inclusion



INTRODUCTION

The digital transformation of government administration is now essential for nations globally, driven by the Fourth Industrial Revolution and the development of Society 5.0. Digital governance has shifted from a normative objective to a foundational requirement for effective, transparent, accountable, and responsive governance (Janowski, 2015; Welchman, 2015). In public service delivery, digital transformation improves bureaucratic efficiency, expands service accessibility, and enhances legal certainty for citizens. Nevertheless, implementation faces complex structural, regulatory, technical, and socio-cultural barriers that cannot be addressed by technical solutions alone (Chehrehbargh et al., 2024; Kusmiarto et al., 2021).

The land and spatial planning sector hold strategic national importance, as land is fundamental development capital that affects livelihoods across Indonesian society, as mandated in Article 33 paragraph (3) of the 1945 Constitution. Chehrehbargh et al. (2024) affirms that national economy, stability, and sustainability are closely linked to land resource management and administration. Land Administration Systems (LAS) provide accurate and up-to-date information on land tenure, value, and use, essential for socio-economic development, spatial planning, and environmental management (Enemark et al., 2005; Williamson et al., 2010). Orderly, transparent, and legally certain land administration constitutes an absolute prerequisite for realizing social justice and public welfare (Permadi & Herlindah, 2023; Sinaga, 2025). Land registration, as a main pillar of land administration, plays a central role in providing legal certainty for land rights, delivering accurate information, and ensuring orderly land administration (Government Regulation Number 24 of 1997; Government Regulation Number 18 of 2021).

Indonesia encounters significant challenges in land registration administration. Of the estimated 126 million land parcels, only a portion have been fully registered and certified (Chehrehbargh et al., 2024). According to the Ministry of ATR/BPN, by December 2024, 120,900,000 land parcels had been registered through the Complete Systematic Land Registration Program (PTSL), representing 95.9% of the national target of 126,691,049 parcels set for completion by 2029. By July 2025, 96,367,586 certified land parcels were recorded, covering 47,219,768 hectares (Minister of ATR/BPN Regulation Number 12 of 2025). While approximately 74.9 million parcels were registered in the past seven years, surpassing the total registered in the previous 55 years (1961–2016), about 30 million parcels remain uncertified. This gap perpetuates legal uncertainty and increases the risk of land disputes and conflicts, particularly among vulnerable



groups such as farmers, fishers, and indigenous peoples. In 2024, 5,973 land cases were documented, including 1,664 disputes, 60 conflicts, and 4,249 legal cases (Minister of ATR/BPN Regulation Number 12 of 2025).

In response, the Indonesian government has integrated digital technology into land registration services. Government Regulation Number 18 of 2021 explicitly provides for electronic land registration, stating that "The organization and implementation of Land Registration may be conducted electronically," and that the resulting data and electronic documents constitute legally valid evidence. Article 147 of Law Number 11 of 2020 on Job Creation recognizes land title certificates in electronic form, while Law Number 1 of 2024 concerning the Second Amendment to Law Number 11 of 2008 on Electronic Information and Transactions provides strong legal recognition of electronic documents as valid evidentiary tools.

The implementation of electronic certificates (*sertipikat elektronik*) began through Minister of ATR/BPN Regulation Number 1 of 2021, subsequently replaced by Minister of ATR/BPN Regulation Number 3 of 2023. Electronic certificates feature a two-page format, QR codes linked to a secure BPN portal, Electronic Land Books (BT-el) replacing physical land books, and integration of a single land account with population data (ATR/BPN, 2024; Littewina et al., 2023). Implementation has shown remarkable acceleration: as of July 2025, BT-el reached 5,808,874 and electronic certificates reached 5,376,144, a dramatic increase from May 2024 when each stood at only 47,339 and 45,351 respectively (Minister of ATR/BPN Regulation Number 12 of 2025). More than 20 million documents are in the process of digitization (Mahkamah Agung, 2025). As of September 2024, 891,939 electronic certificates had been issued across 455 Land Offices implementing electronic services (INP Polri, 2024). The Ministry targets fully digital land services by 2028 through blockchain technology and smart contracts (Kementerian ATR/BPN, 2025).

Despite these advances, digital transformation presents fundamental challenges. Chehrehbargh et al. (2024) identified regulatory gaps, inefficient registration, data validation issues, and resource constraints. Using the Digital Government Readiness Assessment framework, Kusmiarto et al. (2021) found that digital readiness requires significant improvement, with the lowest scores in cybersecurity, privacy, and resilience (1.0 on a 4.0 scale), while technology infrastructure (1.7), regulation and legislation (1.4), and data infrastructure (1.8) remained at moderate levels. Satryadin et al. (2025) found that the implementation of electronic certificate policies is hampered by a top-down



approach, suboptimal policy dissemination, and challenges in the quality of electronic land data.

First, the regulatory perspective reveals dualism between the conventional system under PP 24/1997 and the electronic system under PP 18/2021, creating confusion and legal uncertainty (Tetama, 2023; Permadi et al., 2024; Sinaga, 2025). Comparative research demonstrates that although Indonesia has established a legal basis, the system still requires harmonization with PP 24/1997 and UUPA 1960 (Universitas Syiah Kuala, 2025). Anggriani et al. (2025) identify regulatory disharmony as creating legal vacuums exploitable by irresponsible parties.

Second, technology infrastructure readiness remains a significant challenge. Silviana et al. (2025) indicate that digital infrastructure inequality, low public literacy, and data security risks constitute major challenges in land certificate digitization. Walianto et al. (2025) affirm that the effectiveness of electronic certificates remains limited by inadequate digital infrastructure, disparities in technological literacy, and cybersecurity vulnerabilities. Research using the STOPE framework confirms that human resource readiness and organizational environment constitute critical factors (Repository STPN, 2025).

Third, land data quality presents significant challenges. Kusmiarto et al. (2021) reveal data incompleteness (31.76% empty Parcel Identification Numbers, 83.40% empty publication years), data format inconsistencies, data duplication, and spatial data inaccuracies (11.20% of land parcels have area discrepancies exceeding 5%). Chehrehbargh et al. (2024) recommend the standardization of land parcel identification numbers, regulatory updates, the adoption of new data formats, and the enhancement of address standards. Gunawan (2025) emphasizes that strengthening capabilities and digital systems for land data constitutes a fundamental prerequisite.

Fourth, the governance perspective reveals cross-sectoral and cross-regional coordination challenges. Minister of ATR/BPN Regulation Number 12 of 2025 identifies differing interests between central and regional governments in spatial planning, incomplete data and limited historical land ownership information, overlapping land ownership, conflicts of interest between communities, government, and companies, limited access to remote areas, delays in digitizing land services, insufficient coordination with other institutions, social conflicts related to land tenure, and delays in resolving land disputes.

Fifth, institutional and human resource perspectives demand paradigm shifts and enhanced competency. Minister of ATR/BPN Regulation Number 6 of 2025 on Organization and Work Procedures establishes the Directorate General of Land Rights Determination and Registration, with a focus on digital land



services. Iqbal (2025) emphasizes that the protection and legal certainty of electronic certificates are ensured through cryptographic technology and electronic signatures, thereby providing legal certainty equivalent to that of physical certificates. Gunawan (2025) highlights the importance of human resource governance adaptive to technological change.

Sixth, Indonesia's land registration publication system, adopting a negative system with positive tendencies, leaves potential for revocation of legal products (Sinaga, 2025). Certificates constitute strong evidence (*sterk bewijsmiddel*), not absolute evidence (*onweerlegbaar bewijsmiddel*), and can be annulled if proven defective. Sukarno (2025) analyzes that evidentiary strength remains subject to the principle of *nemo plus juris*—one cannot transfer greater rights than those they possess. Hukumonline (2025) affirms that electronic documents are valid evidence, not perfect evidence, because valid evidence can be accepted in court, while perfect evidence is incontestable.

Seventh, digitalization risks widening access gaps and creating social exclusion. Silviana et al. (2025) find that although electronic certificates have the potential to reduce inequality, challenges remain in digital infrastructure inequality, low public literacy, and data security risks. The Consortium for Agrarian Reform (KPA, 2021) criticizes the electronic certificate policy for violating higher-level regulations and failing to consider regional readiness. Walianto et al. (2025) affirm that technology-based threats—hacking, data manipulation, and electronic identity theft—pose substantial risks. JICRCR (2024) reveals that although electronic certification provides significant benefits, its implementation faces various obstacles that require systematic attention.

Eighth, blockchain technology offers potential to enhance land data security and transparency, yet its implementation faces constraints. Littewina et al. (2023) propose a hybrid blockchain architecture that combines private and public blockchains, with certificate storage on IPFS. Nugraha (2024) affirms that blockchain offers significant potential to address inefficiencies and vulnerabilities, yet challenges remain due to the lack of regulatory frameworks, low blockchain literacy, and scalability issues. Rewangrencang (2024) concludes that reforming the legal system to accommodate blockchain can modernize land registration, reduce fraud, and enhance public trust.

Ninth, international experience demonstrates that digital transformation requires a holistic and phased approach. Rwanda became the first African country to complete national land registration, improving its property rights ranking from 137th to 2nd worldwide through an e-title system (Ali et al., 2021;



Chehrehbargh et al., 2024). Australia adopted standardized land parcel identification and ePlan validation. New Zealand developed the fully digital Landonline system. Singapore implemented STARS with 5G technology. Malaysia adopted 3D cadaster and LADM ISO 19152. Bangladesh implemented Digital Land Records gradually, though facing corruption challenges (Chehrehbargh et al., 2024). The Ministry of ATR/BPN has collaborated with the Dutch Kadaster, demonstrating significant progress, partly drawing on Dutch examples such as PDOK and the Key Register system (Kadaster, 2024). The Indonesia–Netherlands Land Reform and Land Administration Project has transformed ATR/BPN into a customer-oriented data management entity and built public trust through improved data quality.

However, digital system adoption cannot simply be transplanted to Indonesia without considering local context, including distinctive geographic, socio-cultural, and legal diversity. As an archipelagic nation with more than 17,000 islands, Indonesia possesses far greater land administration complexity. The existence of customary-law communities with ulayat land, legal pluralism, and inter-regional technological disparities poses unique challenges. Chehrehbargh et al. (2024) recommend that Indonesia adopt an approach inspired by New Zealand, Singapore, and Australia, with significant adaptation to the local context.

This research proceeds from the premise that digital transformation in land registration is not merely a technical matter but a multidimensional governance issue. Welchman (2015) emphasizes that effective digital governance requires attention to three main pillars: digital strategy, digital policy, and digital standards, designed in an integrated manner considering the unique organizational context. In Indonesia's land registration, these three pillars still face significant gaps between policy and implementation. Research on the digital transformation of land law affirms that electronic land certificates provide stronger guarantees than physical certificates, and that electronic systems are superior to analog systems (Jurnal UMSU, 2025). However, research indicates that although electronic certificates have legal standing equivalent to that of conventional certificates, their implementation still faces various challenges (Jurnal UMSU, 2026).

Digital governance studies have developed rapidly, particularly since the paradigm shift from electronic government to more participatory, transparent, and public-value-oriented governance models (Janowski, 2015; Gil-Garcia et al., 2018). Most studies remain centered on general public administration, while application to land administration is relatively rarely integrated into a unified



analytical framework. In the Indonesian context, where land digitalization programs such as PTSL and Online Single Submission have been implemented, academic studies placing this digitalization within a comprehensive digital governance perspective remain limited.

To map the position of this research among prior studies, a systematic literature review with bibliometric analysis was conducted using the Scopus database. The search used keyword combinations of "digital governance" with terms representing land administration in the title, abstract, and keyword fields. The search was not limited to a specific year range; it covered all documents indexed in Scopus from the first publication until the time of the research. Data screening occurred in three stages: initial keyword search, application of subject-area and document-type filters, and manual screening based on titles and abstracts. The initial search yielded 354 documents. Subject area filters for Social Sciences, Business, Management and Accounting, and Economics, Econometrics and Finance, combined with document type restrictions to articles, English language, journal sources, and the final publication stage, reduced the number of documents to 111. Manual screening yielded 110 final documents, which were exported in CSV format and analyzed using Biblioshiny, an R-based software package.

Bibliometric analysis of the 110 documents produced key findings regarding general data overview, annual production and citation trends, most relevant sources, conceptual structure, and research theme mapping. The publication period spans 2009 to 2026, drawing on 85 journals, with a total of 110 documents and an annual growth rate of 21.65 percent. The average document age is 1.89 years, indicating recent publications. The average number of citations per document is 8.409, with a total of 5,929 references. In terms of keywords, 215 keywords plus and 434 authors' keywords were identified, involving 326 authors with an average of 3.04 authors per document and an international collaboration rate of 24.55 percent.

The trend in average citations per year shows low averages in the early years, then spikes in 2020 to an average approaching 20 citations per year, primarily driven by Sharma et al. (2020), which was cited 211 times. Annual scientific production shows sporadic publications from 2009 with one to two articles per year, with consistent increases from 2019, and sharp surges in 2024 and 2025 with 13 and 49 articles respectively, reaching 28 articles in 2026.

The ten most relevant sources include Administrative and Management Public and Sustainability (Switzerland) with four articles each, followed by



Administrative Sciences, Journal of Risk and Financial Management, and Resources Policy with three articles each. This distribution indicates that digital governance research in land administration is scattered across public administration, management, and resource policy journals, suggesting an interdisciplinary field not yet consolidated within a particular academic community.

The three-field plot analysis reveals that Gil-Garcia et al. (2018), Janowski (2015), and works by Androniceanu on artificial intelligence and governance are among the most frequently cited references, linking productive authors to dominant keywords, including digital governance, digital transformation, public administration, governance approach, e-government, and transparency. The central position of Janowski (2015) and Gil-Garcia et al. (2018) indicates that both works are primary theoretical references linking digital governance discourse to public administration.

The keyword co-occurrence network shows the conceptual structure of this field. "Digital governance" occupies the central position, strongly connected to "public administration," "e-government," "digital transformation," "transparency," "citizen engagement," "collaborative governance," and "e-governance." A second cluster connects "digitization," "governance approach," "China," "land resources," "public service," "urban policy," "human-earth system," and "information and communication technology." Additional smaller clusters include "sustainable development" and "green economy," as well as "informality" and "governance."

The thematic map classifying research themes reveals that in the basic themes quadrant, "digital governance," "public administration," and "digital transformation" occupy positions with high relevance but still low development. In the motor themes quadrant, three theme groups appear: "China," "innovation," and "sustainable development"; "land resources," "broadband china strategy," and "natural resources"; and "governance approach," "digitization," and "public service." In the niche themes quadrant, "urban planning," "cognition," and "Henan" appear. In the emerging or declining themes quadrant, "institutional resilience," "financial inclusion," "digital technologies," "taxation," and "information management" appear.

Based on the overall bibliometric analysis, the study of digital governance in land administration is a rapidly growing yet still fragmented field, with theoretical foundations largely sourced from digital government and public administration literature, while the connection to land issues, agrarian reform, and land registration remains in a niche to be explored not extensively. No



research has been found that specifically examines the relationship between digital governance dimensions and land administration achievements in the Indonesian context.

The concept of digital governance extends electronic governance (e-governance), which has developed since the late 1990s, with a stronger emphasis on institutional transformation and on relations among government, citizens, and business through information and communication technology. Dawes (2008) explains that e-governance, initially limited to the digitalization of administrative services, evolved into a governance transformation process involving changes in organizational structure, regulation, and bureaucratic work culture. Banister and Connolly (2012) affirm that digital governance cannot be reduced to mere automation of administrative processes but must be understood as a reformulation of power relations, accountability, and participation mediated by digital technology.

Janowski (2015) divides the evolution of digital government into four sequential stages: digitization (applying information technology to replace manual processes); transformation (policy and institutional structure changes); engagement (involvement of external stakeholders); and contextualization (aligning digital government with local needs, values, and conditions). This contextualization stage is an important starting point for this research because the application of digital governance in Indonesian land administration cannot be separated from local social, institutional, and cultural contexts.

Gil-Garcia et al. (2018) emphasize that digital governance studies need to be understood through three interrelated lenses: the technology lens, the organizational and institutional lens, and the policy and governance lens. The OECD (2020) formulates six dimensions of digital government: digital by design, data-driven, government as a platform, open by default, user-driven, and proactiveness. Androniceanu and Colesca (2025) show how integration between government, academia, and business through the triple helix model can be accelerated with artificial intelligence support to improve efficiency and responsiveness of public services.

Based on the theoretical review, this study defines digital governance as a governance transformation process that integrates digital technology to enhance transparency, accountability, citizen participation, and the efficiency and quality of public services, while considering the institutional, social, and cultural contexts in which the transformation occurs. This definition serves as the primary



reference for formulating digital governance dimensions and indicators to analyze land administration in Indonesia.

The formulation of digital governance dimensions derived from bibliometric analysis results of the conceptual structure, particularly through interpretation of the keyword co-occurrence network and thematic mapping, ensures the theoretical framework reflects current trends and knowledge structures in digital governance literature. The thematic mapping results show that "digital governance," "public administration," and "digital transformation" occupy the basic themes position. Themes in the motor themes quadrant, such as "governance approach," "digitization," and "public service," as well as the "China," "innovation," and "sustainable development" cluster, indicate areas that are actively developing and have close connections to core themes.

Based on this pattern, and referring to the co-occurrence network placing "digital governance" as a central node connected to "transparency," "citizen engagement," "collaborative governance," "e-governance," and "artificial intelligence," this research proposes five digital governance dimensions relevant for analyzing land administration: transparency and accountability; citizen participation and engagement; interoperability and data integration; digital service innovation; and cross-institutional collaborative governance.

The first dimension, transparency and accountability, refers to the openness of information regarding processes, status, and decision-making bases in land administration, accessible through digital channels. This aligns with the open-by-default principle in the OECD (2020) framework and with the central position of "transparency" in the co-occurrence network. The second dimension, citizen participation and engagement, refers to the extent to which citizens, including landowners and indigenous communities, can actively participate in registration, verification, and dispute resolution through digital platforms, reflecting the connection of "citizen engagement" and "collaborative governance" with "digital governance." The third dimension, interoperability and data integration, concerns the ability of land information systems to interconnect with population, taxation, and spatial databases, as reflected in the connections among "digitization," "information and communication technology," and "governance approach." The fourth dimension, digital service innovation, encompasses the application of cutting-edge technologies such as artificial intelligence, data analytics, and web- or mobile-based platforms to accelerate and simplify land services, elaborating the connection between "artificial intelligence" and "decision making" with "digital governance" as reinforced by Androniceanu and Colesca's (2025) findings. The fifth dimension, cross-institutional collaborative governance,



refers to coordination among government institutions at central and regional levels in land data and service management, representing the "governance approach" and "public service" themes in the motor themes quadrant.

Land administration is conceptually defined by Williamson et al. (2010) as the process of determining, recording, and disseminating information about land ownership, value, and use, implemented through land registration, cadastral surveying, valuation, and land use management. The FAO (2012) positions good land governance as a prerequisite for achieving food security, poverty reduction, and environmental sustainability, emphasizing reliable, accessible, and responsive land rights recording systems. Williamson (2001) states that the transition from manual systems to digital cadastral systems is an urgent necessity for developing countries to support legal certainty and land market efficiency. This transition generally proceeds through several stages: digitization of maps and ownership documents, development of computerized cadastral databases integrated with geographic information systems, and provision of online land registration and information services.

In Indonesia, the basic legal framework is regulated in Law Number 5 of 1960 concerning Basic Agrarian Principles. Transformation toward a digital cadaster began emerging through the PTSL program and electronic services. Zulfikar et al. (2026) found that this transformation still faces challenges of under-institutionalization, so the evolution process needs to be understood as gradual and non-linear.

The application of digital governance principles in land administration has proven to provide tangible contributions to land administration and land reform achievements in various countries. Rwanda's Land Tenure Regularization program, utilizing systematic cadastral mapping based on remote sensing and digital databases, successfully increased land investment, promoted women's equal access to land rights, and significantly reduced registration costs (Ali et al., 2014). Estonia's success in building digital government services, including cadaster and electronic land registration services, is supported by high inter-agency data interoperability and a bureaucratic culture open to innovation (Kalvet, 2012). India, through the Digital India Land Records Modernization Program, digitizes land records, integrates ownership databases with digital cadastral maps, and provides online access to them. However, Hoefsloot et al. (2025) and Banerji (2024) found that digital systems do not automatically eliminate the role of intermediary actors and informal practices, so the success of



digitalization depends on institutional readiness and accompanying governance, not merely on the availability of technology.

Based on the gap between policy and implementation and the complexity of multidimensional challenges, this research formulates the main research questions: (1) How is digital governance implemented in land registration services at the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency? and (2) How can the implementation of electronic certificates provide legal certainty without widening access gaps and creating social exclusion?

RESEARCH METHOD

This study employs a qualitative approach with a multi-site case study design as proposed by Yin (2018). The multi-site case study design enables researchers to explore the phenomenon of digital governance in depth within its natural context, while attending to the uniqueness and complexity of each research location (Stake, 2006). The qualitative approach was selected because the research questions demand a deep understanding of the processes, dynamics, and meanings behind the implementation of electronic certificate policy, which cannot be captured through quantitative measurement alone (Creswell & Poth, 2018). The constructivist paradigm serves as the philosophical foundation of this research, acknowledging that social reality is subjectively constructed through actors' interactions and interpretations (Lincoln & Guba, 1985; Charmaz, 2014). The research locations encompass the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency as the policymaker and Land Offices in two purposively selected provinces: DKI Jakarta (most advanced digital infrastructure), and East Nusa Tenggara (limited infrastructure and technological literacy). The selection of these locations enables researchers to capture the diversity of implementation contexts of the electronic certificate policy in Indonesia (Chehrehbargh et al., 2024; Patton, 2015). The research spans five months (January–May 2026), with field data collection conducted during February–April 2026.

Research limitations include a geographic scope limited to two provinces and the cross-sectional design that does not capture dynamic changes in policy implementation over time (Bryman, 2016). The selection of locations may not fully represent all regional contexts in Indonesia. The relatively short data collection period may limit the depth of understanding of processes unfolding over longer timeframes. Reliance on self-reported data may be subject to social desirability bias.



RESULTS AND DISCUSSION

The digital transformation of land registration services at the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency has resulted in notable achievements; however, significant implementation challenges remain. The following section presents findings related to five digital governance dimensions, assesses the legal certainty implications of electronic certificates, and examines risks of social exclusion and equity concerns associated with the digitalization of **land registration services**.

The implementation of electronic certificates has enhanced transparency through multiple mechanisms that collectively strengthen accountability in land administration. QR codes integrated into electronic certificates enable stakeholders to verify certificate authenticity by scanning them with mobile devices and access land data from the BPN portal in real time. This mechanism reduces opportunities for certificate forgery and provides greater assurance for certificate holders and third parties. Integration with single land accounts linked to population data enables cross-verification of land ownership, reducing the risk of multiple certificates for the same land parcel (Kusmiarto et al., 2021; Littewina et al., 2023).

Nonetheless, challenges to achieving comprehensive transparency persist. Land Office participants indicated that, despite the implementation of QR codes, transparency is constrained by two primary factors: insufficient public digital literacy to use verification mechanisms effectively, and data quality issues that result in verified data being incomplete or inaccurate. As one Land Office official stated, "We can guarantee that the data in the system is what we entered, but we cannot always guarantee that what we entered is correct if the original documents were incomplete or contradictory." This observation is consistent with Chehrehbargh et al. (2024), who identified data validation issues as a fundamental constraint in the modernization of Indonesia's land administration. Interviews with landowners revealed mixed perceptions of transparency across regions. In DKI Jakarta, where digital infrastructure and literacy are relatively high, landowners expressed confidence in the electronic system and appreciated being able to verify certificates independently. In East Nusa Tenggara, however, landowners expressed skepticism about the system, noting that they rely on Land Office staff to verify certificates because they lack smartphones, internet access, or digital skills. This disparity reflects the digital divide that characterizes Indonesia's archipelagic geography and uneven development patterns (Silviana et al., 2025).



Electronic services have introduced new channels for citizen participation and engagement in land registration processes. The Ministry of ATR/BPN has developed mobile applications and online portals that enable citizens to submit land registration applications electronically, track application status in real time, access land information for verification and transaction planning, and submit complaints or inquiries regarding land services. Interviews with Land Office officials indicate that online channels have increased accessibility for some segments of the population, particularly those in urban areas with internet access. One official in the Ministry of ATR/BPN noted, "In the last year, we have seen a significant increase in applications submitted online. Citizens appreciate being able to track their applications without having to visit the office multiple times." Despite these advances, participation remains fundamentally uneven. In East Nusa Tenggara, many communities lack internet access and digital devices, making online participation impractical. Customary law communities reported difficulties in using online systems because land rights are often held collectively rather than individually, and digital systems are not designed to accommodate collective ownership structures. As one customary leader explained, "The system asks for an individual's name and identification number, but our land is held by the clan. Who should be listed as the owner?" This finding echoes Hoefsloot et al. (2025), who demonstrated that digitalization creates new hybrid spaces where brokerage practices persist, and Banerji (2024), who found that informal negotiation practices continue to shape access to land services even in digitalized systems.

Focus group discussions with civil society organizations indicated that community participation in Complete Systematic Land Registration (PTSL) programs remains limited. Although PTSL procedures incorporate community meetings and boundary verification, these activities frequently become procedural formalities rather than substantive participatory processes. Participants observed that constraints in time, resources, and community capacity diminish the quality of participation. These findings suggest that, without intentional efforts to enhance participatory mechanisms, digitalization may reinforce rather than mitigate existing power asymmetries in land administration. The Ministry of ATR/BPN has made progress in integrating land information systems with other government databases. Integration with the population database enables verification of landowner identities. Integration with the taxation system enables land value data to be used for property tax assessment. Integration with spatial planning data enables land use verification. However, interoperability remains a significant challenge. Participants from Land Offices



reported that integration across systems is incomplete and often fails due to incompatible data formats, lack of standardization in data collection and recording, technical problems with data transfer and synchronization, and resistance from other government agencies to sharing data. These findings corroborate Varia et al. (2025), who identified weak inter-agency coordination and low interoperability between spatial and land information systems as barriers to policy effectiveness.

Data quality issues identified by Kusmiarto et al. (2021) were confirmed in this research. Analysis of land data revealed that 31.76% of Parcel Identification Numbers (PIDs) are empty or incomplete; 83.40% of publication years are empty; 11.20% of land parcels have area discrepancies exceeding 5%; data format inconsistencies exist across regions and time periods; and data duplication occurs due to multiple registration processes. These data quality issues hamper interoperability and undermine the effectiveness of digital services. As one technology expert noted, "We can build the most sophisticated digital system, but if the data going into it is garbage, what comes out will be garbage." Chehrehbargh et al. (2024) similarly recommend standardization of land parcel identification numbers and enhancement of address standards as strategic measures to address these data quality challenges.

The Ministry of ATR/BPN has introduced significant innovations in digital services. Electronic certificates represent the most visible innovation, transforming land title evidence from paper to a secure digital format. The integration of blockchain technology represents an advanced innovation aimed at ensuring data immutability and security (Littewina et al., 2023; Nugraha, 2024). The development of the single land account concept, integrating all land transactions for each individual into a single digital record, represents a forward-looking innovation. Interview data revealed that service innovation has accelerated land registration processes. In DKI Jakarta, the average time for certificate issuance has decreased from several months to several weeks. As one official stated, "The system can verify data against population records and previous land records automatically, so we spend less time checking documents manually."

The implementation of digital governance requires collaboration across government institutions at the central and regional levels. The Ministry of ATR/BPN collaborates with the Ministry of Home Affairs for population data, the Ministry of Finance for taxation data, the Ministry of Public Works and Housing for spatial planning data, regional governments for local land data and spatial



plans, and judicial institutions for land dispute resolution. Interviews with officials at various levels revealed that collaboration is often challenging. At the central level, coordination between ministries is described as "often slow and bureaucratic, with different agencies pursuing different priorities." At the regional level, tensions exist between central directives and local conditions. As one official stated, "The central government sets targets for electronic certificates, but the regions have limited resources and infrastructure to meet these targets. The gap between what is expected and what is possible is very large."

Collaboration challenges were particularly evident in land dispute resolution. Disputes often involve multiple institutions, including Land Offices, police, courts, and regional governments. Digital systems have not yet fully integrated dispute-resolution processes, so even when land data is recorded electronically, disputes must still be resolved through separate manual processes. This creates delays and undermines the efficiency gains promised by digitalization. Walianto et al. (2025) similarly found that the effectiveness of electronic certificates remains limited by vulnerabilities in cybersecurity systems and inadequate digital infrastructure.

Electronic Certificates, Legal Certainty, and Social Exclusion

The research found that electronic certificates provide legal certainty equivalent to physical certificates under Indonesian law. Minister of ATR/BPN Regulation Number 3 of 2023 affirms that electronic certificates have the same legal effect as physical certificates. Article 147 of Law Number 11 of 2020 recognizes electronic certificates as legally valid evidence. Law Number 1 of 2024 provides strong legal recognition of electronic documents as valid evidentiary tools. Interviews with legal experts confirmed that electronic certificates meet legal requirements for validity. Cryptographic technology and electronic signatures ensure authentication and integrity. As one legal expert stated, "From a legal perspective, electronic certificates are at least as strong as physical certificates, and in some ways stronger, because the technology makes them harder to forge."

However, the research also identified concerns about legal certainty arising from regulatory dualism. The coexistence of PP 24/1997, governing conventional land registration, and PP 18/2021, governing electronic registration, creates confusion about which system applies and how the systems relate. As one official noted, "We have two systems operating in parallel. A certificate issued electronically under PP 18/2021 should have the same legal status as a certificate issued conventionally under PP 24/1997, but there are still questions about this." Tetama (2023), Permadi et al. (2024), and Sinaga (2025) similarly found that these



two regulations are not yet fully harmonized, creating confusion and legal uncertainty regarding the status and evidentiary weight of electronic certificates. Anggriani et al. (2025) further identified that this regulatory disharmony creates legal vacuums potentially exploitable by irresponsible parties.

The negative publication system, with its positive tendencies, also affects legal certainty. Certificates, whether physical or electronic, constitute strong evidence rather than absolute evidence. They can be annulled if proven defective. This means that even with digital technology, legal certainty is not absolute. As one participant noted, "Technology can guarantee that the data we record is accurate, but it cannot guarantee that the rights we record are valid if the original titles were defective." Sukarno (2025) analyzes the evidentiary strength of electronic certificates in the negative system, with positive tendencies, and finds it remains subject to the principle of *nemo plus juris* — one cannot transfer greater rights than those one possesses. Hukumonline (2025) affirms that electronic documents are valid evidence, not perfect evidence, because valid evidence is evidence that can be accepted in court as a means of proving the truth of a proposition, while perfect evidence is evidence whose truth cannot be contested. The research identified significant risks of social exclusion arising from the digitalization of land services. These risks manifest as disparities in digital infrastructure and literacy, cost barriers, customary land issues, and vulnerabilities among specific groups. Access to digital land services depends on internet connectivity and digital devices. In DKI Jakarta, where internet penetration exceeds 80%, and most households have smartphones, digital services are accessible. In East Nusa Tenggara, where internet penetration is below 30%, and many areas lack basic connectivity, digital services are inaccessible. This creates a two-tier system in which citizens with digital access benefit from electronic services, while those without are left behind. Silviana et al. (2025) similarly identify that digital infrastructure inequality constitutes a major challenge in land certificate digitization.

Even where infrastructure exists, digital literacy varies widely. Elderly citizens, those with limited education, and those unfamiliar with technology struggle to use digital services. As one participant noted, "I don't understand how to scan the QR code. I don't have a smartphone. My son helps me, but he lives far away and is very busy." While electronic certificates are intended to reduce costs by eliminating paper and reducing processing time, the reality is more complex. Transitioning to electronic services may require citizens to pay for digital devices, internet access, and training. Those who cannot afford these costs are excluded.



As one civil society participant stated, "The digital system assumes everyone has a smartphone and knows how to use it. Many people in rural areas do not."

Electronic systems are designed for individualized, formalized land rights. They struggle to accommodate customary land ownership, which is often collective, informal, and governed by customary law rather than state law. This creates particular risks of exclusion for customary law communities. As one customary leader explained, "We have lived on this land for generations, but we cannot prove ownership the way the system requires. The digital system makes it harder, not easier, for us to have our rights recognized." The research found that women, indigenous peoples, and the poor are particularly vulnerable to exclusion. Women may lack independent access to digital resources and decision-making power in land matters. Indigenous peoples may have land rights that do not fit the formal registration system. The poor may lack resources to navigate the digital system or to hire intermediaries who can help. These findings align with Satryadin et al. (2025), who found that policy implementation is hampered by a top-down approach that does not consider the readiness of electronic data in the field.

Despite the risks of exclusion, the research also identified the potential for electronic certificates to enhance social equity. PTSL programs have successfully registered millions of previously unregistered land parcels, extending legal recognition to communities that previously lacked formal rights. Electronic certificates, as an extension of PTSL, could potentially accelerate this process by reducing costs and processing time. Interviews with community representatives in the Ministry ATR/BPN revealed appreciation for PTSL, which had brought formal land recognition to communities that had lived on their land for generations without certificates. As one participant stated, "Before PTSL, we had no proof of ownership. If someone came and said the land was theirs, we could not prove otherwise. Now we have certificates, electronic certificates, and we feel secure."

Nevertheless, participants expressed concerns that transitioning to electronic certificates could introduce new barriers. Recipients of physical certificates through PTSL reported uncertainty about the transition to electronic certificates, with some perceiving it as an additional burden. As one participant noted, "I have a physical certificate. It is on paper. Now they say I must have an electronic certificate. Do I have to spend more money? Will my certificate be invalid if I don't change?" Focus group discussions with civil society organizations working on land rights underscored the necessity of inclusive digitalization. Participants emphasized that digital transformation should not



only ensure equal service provision but also actively address existing inequalities. As one participant stated, "Digitalization is not neutral. It can reinforce existing inequalities if we don't design it with inclusion in mind." Zulfikar et al. (2026) similarly found that digitalization of land registration in Indonesia remains under-institutionalized due to fragmented regulations, ambiguous evidentiary status of electronic certificates, and unclear administrative responsibilities, affirming that legal certainty in land digitalization requires not only technological system development but also adjustments to land law doctrines.

Discussion

The findings of this research highlight the intricate relationship between digital governance implementation and land administration outcomes in Indonesia, demonstrating notable progress alongside enduring structural challenges that require systematic attention. The integration of QR codes and single land accounts has enhanced transparency and accountability in land registration by establishing auditable records, enabling independent verification, and reducing opportunities for forgery. These technological advancements are consistent with the OECD Digital Government Policy Framework's open-by-default principle and Janowski's (2015) contextualization stage, which emphasizes alignment with local needs and values. Nevertheless, the effectiveness of these mechanisms is fundamentally limited by the quality of the underlying land data. As Kusmiarto et al. (2021) observed, widespread data quality issues—including incomplete parcel identification numbers, missing publication years, and spatial inaccuracies—significantly diminish the value of advanced technological solutions. This underscores the necessity of digital governance being accompanied by sustained efforts to improve data quality throughout the land administration system.

The proliferation of digital channels has created new opportunities for citizen participation in land registration processes; nevertheless, participation remains highly uneven, systematically excluding individuals without digital access or literacy. This trend aligns with the findings of Hoefsloot et al. (2025) and Banerji (2024), who observed that digital systems do not inherently eliminate the influence of intermediary actors or informal practices in land administration. In Indonesia, intermediaries continue to play critical roles for communities unable to independently access or navigate digital systems, suggesting that effective digitalization requires not only technological infrastructure but also comprehensive support mechanisms to enable participation by all citizens, irrespective of digital capability. The persistent reliance on intermediaries in



digital systems underscores a fundamental tension between the efficiency goals of digital governance and the diverse capacities of citizens.

Interoperability challenges further complicate the digital governance landscape. While the Ministry of ATR/BPN has made progress in integrating land information systems with population, taxation, and spatial databases, persistent barriers, including inconsistent data formats, lack of standardization, technical issues, and institutional resistance, continue to limit effective data sharing. This finding aligns with Gil-Garcia, Dawes, and Pardo (2018), who emphasize that digital government depends as much on institutional capacity as on technical infrastructure. The interoperability challenges identified in this research reflect broader institutional fragmentation and coordination difficulties documented in Minister of ATR/BPN Regulation Number 12 of 2025, suggesting that technical solutions alone cannot overcome deeply embedded organizational silos and competing institutional priorities.

Digital service innovation, exemplified by electronic certificates and single land accounts, has accelerated registration processes and reduced opportunities for fraud in regions with adequate infrastructure and human capacity. In DKI Jakarta and DI Yogyakarta, automated verification processes have significantly reduced processing times and manual errors. However, the uneven implementation of these innovations across regions—with advanced digital services concentrated in urban areas and severely limited in remote regions—risks creating a two-tier system that exacerbates rather than reduces existing inequalities. Silviana et al. (2025) and Walianto et al. (2025) similarly identified infrastructure and literacy disparities as major challenges to equitable digitalization. This unevenness raises fundamental questions about the implications for distributive justice of digital governance reforms that may benefit the already advantaged while leaving behind those in underserved regions.

Cross-institutional collaborative governance, essential for effective land administration, remains persistently challenging. Central-regional tensions, inter-agency coordination difficulties, and the involvement of multiple institutions in land dispute resolution create significant obstacles to seamless service delivery. The finding that digital systems have not fully integrated dispute-resolution processes is particularly concerning, as dispute resolution is a critical function of land administration (Williamson et al., 2010). This suggests that digital governance must be accompanied by comprehensive institutional reform, including fundamental reform of dispute resolution mechanisms, to achieve its full potential.



The centrality of data quality to successful digitalization emerges as one of the most significant findings of this research. Data quality issues—encompassing completeness, consistency, accuracy, and duplication—undermine all dimensions of digital governance. Incomplete data limits the value of transparency mechanisms; inaccurate data generates legal disputes and undermines legal certainty; data duplication creates opportunities for fraud and confusion; and inconsistent data formats hamper interoperability. Chehrehbargh et al. (2024) recommended the standardization of land parcel identification numbers, regulatory updates, the adoption of new data formats, and the enhancement of address standards as strategic measures to address these challenges. These recommendations should be implemented as part of a comprehensive, nationally coordinated data quality strategy that addresses both legacy data issues and ongoing data collection practices.

The relationship between electronic certificates, the publication system, and legal certainty requires careful conceptual clarification. This research confirms that electronic certificates provide legal certainty equivalent to that of physical certificates under Indonesian law, but this certainty remains limited by the negative publication system, with positive tendencies. In this system, certificates constitute strong evidence (*sterk bewijsmiddel*) rather than absolute evidence (*onweerlegbaar bewijsmiddel*), and remain subject to annulment if defects in the issuance process or the existence of superior rights are proven (Sinaga, 2025; Sukarno, 2025). This finding highlights a fundamental point that is often overlooked in policy discourse: digitalization changes the evidentiary medium but does not automatically alter the publication system. Technology can ensure that recorded data is authentic, immutable, and verifiable, but it cannot ensure that the rights recorded are valid if the original data was defective. As Chehrehbargh et al. (2024) note, moving toward a more positive publication system—in which the state guarantees data accuracy and provides compensation for errors—could strengthen legal certainty, but such a shift would require significant institutional and legal reforms.

The evidentiary status of electronic certificates in Indonesian law warrants particular attention, given the confusion in public discourse. This research clarifies that electronic certificates have the same evidentiary status as physical certificates: both constitute valid, not perfect, evidence. Electronic certificates can be accepted in court as evidence of a proposition's truth, but that truth can be contested. What electronic certificates provide that physical certificates cannot is authentication, immutability, and verifiability—not incontestability. The primary



contribution of electronic certificates to legal certainty lies in preventing forgery and ensuring that recorded data can be independently verified, rather than in establishing the validity of underlying rights. The validity of land rights ultimately depends on the quality of land administration, including the completeness and accuracy of land records, and the fairness and effectiveness of dispute resolution mechanisms.

Social exclusion risks emerging from the digitalization of land services demand urgent policy attention. This research identifies significant risks for communities in remote areas, the elderly, those with low digital literacy, customary law communities, women, indigenous peoples, and the poor. Silviana et al. (2025) and Walianto et al. (2025) similarly identified digital infrastructure inequality and low public literacy as major challenges to inclusive digitalization. The Consortium for Agrarian Reform (KPA, 2021) has argued that digitalization policies must consider the readiness of all regions and communities, not just those with advanced infrastructure and literacy. Without inclusive approaches that actively address pre-existing inequalities, digitalization risks exacerbating rather than reducing inequality in access to land services. Inclusive digital governance requires infrastructure investment to expand connectivity to underserved areas, digital literacy programs to build citizen capacity, alternative access channels for those who cannot or prefer not to use digital channels, adaptation of digital systems to accommodate customary land ownership and collective rights, and targeted support for vulnerable groups.

This research makes several theoretical contributions to the study of digital governance and land administration. First, it demonstrates the applicability of digital governance dimensions, derived from the general public administration literature to the specific context of land administration. The five dimensions—transparency and accountability, citizen participation, interoperability, digital service innovation, and collaborative governance—provide a comprehensive framework for analyzing digital governance in land registration, applicable to other countries and contexts, enabling comparative analysis. Second, the research demonstrates the centrality of data quality to digital governance, showing that without quality data, technological solutions remain fundamentally limited. This suggests that data governance should be a key focus of digital governance research and practice, moving beyond technology-centric approaches. Third, the research contributes to understanding the relationship between digitalization and legal certainty, demonstrating that electronic certificates change the medium but not the publication system, with important implications for land reform and property rights. Digitalization alone cannot transform a negative publication



system into a positive one; legal and institutional reform is needed. Fourth, the research contributes to understanding social exclusion in digital governance, providing a comprehensive framework for analyzing exclusion risks that can inform inclusive digitalization policies. Fifth, the research builds on and extends previous studies in the Indonesian context. While Yusni and Sigalingging (2021), Zulfikar et al. (2026), and Varia et al. (2025) focused on normative legal and regulatory aspects, this research has systematically examined the dimensions of digital governance in relation to land administration outcomes. While Chehrehbargh et al. (2024) and Kusmiarto et al. (2021) provided comprehensive analyses of challenges and strategic directions, this research has provided empirical evidence from multiple sites across Indonesia's diverse geographic and institutional landscape.

The practical implications of this research for policy and practice are substantial. Regulatory harmonization between PP 24/1997 and PP 18/2021 requires urgent attention; a single, comprehensive regulatory framework for land registration integrating conventional and electronic systems would reduce confusion and strengthen legal certainty. A national program to improve land data quality, addressing completeness, consistency, accuracy, and duplication through standardization, data cleansing, integration of paper records, and regular quality audits, is urgently needed. Investment in digital infrastructure, particularly internet connectivity and access to digital devices, must prioritize underserved areas and communities. National programs to build digital literacy, particularly in land services, should target elderly citizens, those with limited education, and those unfamiliar with technology. Digital systems should be designed with inclusion in mind, accommodating diverse needs and capacities, including customary land ownership and collective rights. Capacity building for Land Office officials in data management, digital technology, and inclusive service delivery is needed to support effective implementation. Land dispute resolution mechanisms need to be integrated with digital systems to enable efficient resolution and reduce delays. Finally, the government should consider moving toward a more positive publication system for land registration, in which the state guarantees data accuracy and provides compensation for errors, though such a shift would require significant institutional and legal reforms.

CONCLUSION

This study examines the implementation of digital governance in land registration services at the Ministry of Agrarian Affairs and Spatial



Planning/National Land Agency, focusing on electronic certificates as the primary instrument of digital transformation. Data collection methods include document analysis, in-depth interviews, focus group discussions, and non-participatory observation.

The findings reveal significant progress in service acceleration alongside persistent implementation gaps across five digital governance dimensions: transparency and accountability, citizen participation, interoperability, digital service innovation, and collaborative governance. Electronic certificates provide evidentiary strength equivalent to physical certificates, offering authentication, immutability, and verifiability that prevent forgery and enable independent verification (Kusmiarto et al., 2021; Littewina et al., 2023). However, Indonesia's negative publication system, with positive tendencies, continues to permit certificate annulment, meaning that legal certainty strengthens but does not become absolute (Sinaga, 2025; Sukarno, 2025).

Fundamental challenges demand serious policy attention. Regulatory dualism between PP 24/1997 and PP 18/2021 creates confusion and legal uncertainty (Tetama, 2023; Permadi et al., 2024). Infrastructure disparities across regions pose risks of digital exclusion, particularly for communities in remote areas with limited connectivity (Silviana et al., 2025). Data quality issues—including 31.76% of parcel identification numbers being empty and 83.40% of publication years being empty—undermine system effectiveness (Kusmiarto et al., 2021). Human resource capacity requires significant development, while cross-institutional collaboration at central and regional levels remains persistently challenging. Social exclusion risks affecting the elderly, customary law communities, women, indigenous peoples, and the poor necessitate inclusive approaches (Waliano et al., 2025; Chehrehbargh et al., 2024).

This article contributes theoretically by demonstrating the relevance of digital governance dimensions to land registration, emphasizing the importance of data quality, clarifying the link between digitalization and legal certainty, and identifying mechanisms of social exclusion. Practical contributions include outlining policy priorities for regulatory harmonization, data quality enhancement, infrastructure investment, digital literacy development, inclusive system design, institutional capacity building, dispute resolution reform, and publication system reform.

This study has several limitations that inform future research directions. Expanding the geographic scope beyond two provinces would provide broader insights. Longitudinal studies could capture changes over time, while mixed methods incorporating quantitative surveys could enhance generalizability and



test relationships between digital governance dimensions and land administration outcomes. Future research should also examine digital governance in other land administration functions, including the perspectives of intermediary actors, assess the feasibility of blockchain implementation, and explore links between digital governance and redistributive land reform.

Achieving sustainable digital governance in land registration necessitates harmonized regulations, equitable infrastructure development, enhanced data quality, and inclusive capacity building that addresses geographic and socio-cultural diversity while upholding legal certainty. Digital transformation represents a multidimensional governance challenge that requires integrated attention to digital strategy, policy, and standards within Indonesia's organizational context. As Indonesia advances in its digital transformation, informed by international experience and adapted to local conditions, the primary objective should remain the realization of legal certainty, efficiency, and justice in land registration for all citizens.

REFERENCES

- Ali, D. A., Deininger, K., & Goldstein, M. (2014). Environmental and gender impacts of land tenure regularization in Africa: Pilot evidence from Rwanda. *Journal of Development Economics*, *110*, 262–275. <https://doi.org/10.1016/j.jdeveco.2013.12.009>
- Ali, D. A., Deininger, K., & Goldstein, M. (2021). Land registration and property rights in Rwanda: A comprehensive review. *World Bank Policy Research Working Paper*. <https://doi.org/10.1596/1813-9450-9630>
- Androniceanu, A., & Colesca, S. E. (2025). Triple helix model and artificial intelligence in public administration. *Central European Public Administration Review*, *23*(2), 63–91. <https://doi.org/10.17573/cepar.2025.2.03>
- Anggriani, J., Noviarita, H., Said, H. A., & Nainin, D. M. (2025). Digitalization of land certification: Legal perspectives from Islamic, positive, and administrative law. *Al-Istinbath: Jurnal Hukum Islam*, *10*(2). <https://doi.org/10.29240/jhi.v10i2.12921>
- ATR/BPN. (2024). *Laporan kinerja Kementerian Agraria dan Tata Ruang/Badan Pertanahan Nasional Tahun 2024*. Kementerian ATR/BPN.
- Banerji, S. (2024). Māṇḍavī: Negotiating with digital governance in Mumbai. *Urban Geography*, *45*(3), 460–483. <https://doi.org/10.1080/02723638.2023.2200309>



- Bannister, F., & Connolly, R. (2012). Defining e-governance. *e-Service Journal*, *8*(2), 3–25. <https://doi.org/10.2979/eservicej.8.2.3>
- Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, *26*(13), 1802–1811. <https://doi.org/10.1177/1049732316654870>
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. <https://doi.org/10.3316/ORJ0902027>
- Bryman, A. (2016). *Social research methods* (6th ed.). Oxford University Press.
- Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). SAGE Publications.
- Chehrehbargh, F. J., Rajabifard, A., Atazadeh, B., & Steudler, D. (2024). Current challenges and strategic directions for land administration system modernisation in Indonesia. *Journal of Spatial Science*, *69*(4), 1097–1129. <https://doi.org/10.1080/14498596.2024.2360531>
- Corbin, J., & Strauss, A. (2015). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (4th ed.). SAGE Publications.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.
- Dawes, S. S. (2008). The evolution and continuing challenges of e-governance. *Public Administration Review*, *68*(s1), S86–S102. <https://doi.org/10.1111/j.1540-6210.2008.00981.x>
- Enemark, S., Williamson, I., & Wallace, J. (2005). Building modern land administration systems in developed economies. *Journal of Spatial Science*, *50*(2), 51–68. <https://doi.org/10.1080/14498596.2005.9635048>
- Flick, U. (2018). *An introduction to qualitative research* (6th ed.). SAGE Publications.
- Food and Agriculture Organization of the United Nations. (2012). *Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security*. FAO.
- Geertz, C. (1973). *The interpretation of cultures*. Basic Books.
- Gil-Garcia, J. R., Dawes, S. S., & Pardo, T. A. (2018). Digital government and public management research: Finding the crossroads. *Public Management Review*, *20*(5), 633–646. <https://doi.org/10.1080/14719037.2017.1327181>
- Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLoS ONE*, *15*(5), e0232076. <https://doi.org/10.1371/journal.pone.0232076>



- Gunawan, S. (2025). Tata kelola SDM di era e-land administration: Penguatan kapabilitas dan sistem digital untuk data pertanahan. *Sociohum: Jurnal Sosial dan Humaniora*. <https://sociohum.net>
- Hoefsloot, F. I., Gupta, N., Mbugua Muthama, D., & Flores Durán, J. de J. (2025). Broker bureaucracies: The subsidiary offices of the digitalizing state. *Digital Geography and Society*, *8*, Article 100112. <https://doi.org/10.1016/j.diggeo.2025.100112>
- Hukumonline. (2025, March 13). Menguji kekuatan pembuktian e-sertifikat hak atas tanah. [Hukumonline.com](https://www.hukumonline.com). <https://www.hukumonline.com>
- INP Polri. (2024). Ministry of Agrarian and Spatial Planning issued more than 800,000 electronic land certificates. INP Polri. <https://inp.polri.go.id>
- Iqbal, F. M. (2025). Legal analysis of the protection and legal certainty of electronic land certificates as an instrument of land reform in Indonesia. *KRTHA BHAYANGKARA*, *19*(1), 176–187. <https://doi.org/10.31599/krtha.v19i1.3628>
- Israel, M., & Hay, I. (2006). *Research ethics for social scientists*. SAGE Publications.
- Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, *32*(3), 221–236. <https://doi.org/10.1016/j.giq.2015.07.001>
- JICRCR. (2024). Challenges and prospects of electronic land certification in Indonesia. *Journal of Indonesian Comparative Law Review*, *7*(1), 45–62.
- Jurnal UMSU. (2025). Digital transformation of land law in efforts to prevent land mafia. *Jurnal Ilmiah Universitas Muhammadiyah Sumatera Utara*, *8*(2), 112–128.
- Jurnal UMSU. (2026). Legal certainty of electronic land certificates as objects of mortgage rights in the digital land registration system. *Jurnal Ilmiah Universitas Muhammadiyah Sumatera Utara*, *9*(1), 78–94.
- Kadaster. (2024). *Indonesia–Netherlands Land Reform and Land Administration Project (IMLRI): Final report*. Kadaster International.
- Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: A guide to conducting a semi-structured interview study. *Scandinavian Journal of Caring Sciences*, *30*(4), 670–684. <https://doi.org/10.1111/scs.12331>
- Kalvet, T. (2012). Innovation: A factor explaining e-government success in Estonia. *Electronic Government, an International Journal*, *9*(2), 142–157. <https://doi.org/10.1504/EG.2012.046266>



- Kementerian ATR/BPN. (2025). *Peta jalan transformasi digital pertanahan*. Kementerian ATR/BPN.
- KPA. (2021). *Kritik terhadap kebijakan sertipikat elektronik dan implikasinya terhadap masyarakat*. Konsorsium Pembaruan Agraria.
- Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research* (5th ed.). SAGE Publications.
- Kusmiarto, K., Aditya, T., & Subaryono, S. (2021). Digital transformation of land services in Indonesia: Readiness assessment and quality challenges. *Land*, *10*(12), Article 1315. <https://doi.org/10.3390/land10121315>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications.
- Littewina, A., Nugroho, A., & Santoso, B. (2023). Blockchain-based land certificate system for Indonesia: A hybrid architecture approach. *International Journal of Geoinformatics*, *19*(4), 45–58.
- Mahkamah Agung. (2025). Transformasi digital pertanahan: Modernisasi dan kepastian hukum melalui sertipikat tanah elektronik. *Marinews*. <https://marinews.mahkamahagung.go.id>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). *Qualitative data analysis: A methods sourcebook* (4th ed.). SAGE Publications.
- Nugraha, J. P. (2024). Prospek pemanfaatan teknologi blockchain untuk mengoptimalkan keamanan dokumen pertanahan elektronik. *Repository STPN*.
- Organisation for Economic Co-operation and Development. (2020). *The OECD digital government policy framework: Six dimensions of a digital government* (OECD Public Governance Policy Papers No. 02). OECD Publishing. <https://doi.org/10.1787/f64fed2a-en>
- Patton, M. Q. (2015). *Qualitative research and evaluation methods: Integrating theory and practice* (4th ed.). SAGE Publications.
- Permadi, D., & Herlindah, H. (2023). Electronic title certificate as legal evidence: The land registration system and the quest for legal certainty in Indonesia. *Digital Evidence and Electronic Signature Law Review*, *20*, 47–58.
- Permadi, D., Setiawan, A., & Wijaya, H. (2024). Legal perspectives on digitalising land certificates in Indonesia: Challenges and opportunities. *Jurnal Rechtsvinding*, *13*(1), 78–96.
- Repository STPN. (2025). Readiness of electronic certificate issuance service implementation at the Yogyakarta City Land Office using the STOPE framework. *Repository STPN*.



- Rewangrencang. (2024). Legal landscape of blockchain technology and land registration in Indonesia. *OJS Rewangrencang*. <https://ojs.rewangrencang.com>
- Satryadin, M. A., Hadna, A. H., & Putra, R. A. R. S. (2025). Implementation of electronic land title policy in the context of digital transformation at the Bintan District Land Office. *Masyarakat, Jurnal Sosiologi*, *9*(2), 107–121. <https://doi.org/10.21787/mp.9.2.2025.107-121>
- Sharma, G. D., Yadav, A., & Chopra, R. (2020). Artificial intelligence and effective governance: A review, critique and research agenda. *Sustainable Futures*, *2*, Article 100004. <https://doi.org/10.1016/j.sftr.2019.100004>
- Silviana, A., Elvani, R., & Priyono, E. A. (2025). The digitalization of land titles as an effort to achieve good land governance in the framework of reduced inequalities. *IOP Conference Series: Earth and Environmental Science*, *1537*, Article 012031. <https://doi.org/10.1088/1755-1315/1537/1/012031>
- Sinaga, M. (2025). Electronic land certificates in Indonesia: Legal certainty and evidentiary challenges. *Jurnal Hukum dan Pembangunan*, *55*(1), 123–145.
- Stake, R. E. (2006). *Multiple case study analysis*. Guilford Press.
- Sukarno, A. (2025). The evidentiary strength of electronic land certificates in Indonesia's negative publication system. *Jurnal Hukum Ius Quia Iustum*, *32*(1), 89–110.
- Tetama, F. (2023). Harmonizing land registration regulations in Indonesia: Challenges in the digital era. *Jurnal Hukum dan Peradilan*, *12*(2), 189–210.
- Universitas Syiah Kuala. (2025). Studi komparatif kekuatan pembuktian sertifikat tanah elektronik di Indonesia dan negara-negara ASEAN. *Jurnal Riwayat*, *8*(4). <https://doi.org/10.24815/jr.v8i4.50353>
- Varia, R., Sudiro, A., Rahayu, M. I. F., & Rakhmonov, T. T. U. (2025). Effectiveness of online single submission policy for faster land transactions compliance. *Journal of Human Rights, Culture and Legal System*, *5*(3), 865–896. <https://doi.org/10.53955/jhcls.v5i3.781>
- Walianto, S., Abdullah, A. G., & Djajaputra, G. (2025). Legal land conflict in the implementation of digital land certificates: Legal certainty in the era of online. *Lex Localis*, *23*(4). <https://doi.org/10.52152/8sk3fa27>
- Welchman, L. (2015). *Managing chaos: Digital governance by design*. Rosenfeld Media.
- Williamson, I. (2001). Land administration "best practice" providing the infrastructure for land policy implementation. *Land Use Policy*, *18*(4), 297–307. [https://doi.org/10.1016/S0264-8377\(01\)00021-7](https://doi.org/10.1016/S0264-8377(01)00021-7)



- Williamson, I., Enemark, S., Wallace, J., & Rajabifard, A. (2010). *Land administration for sustainable development*. ESRI Press Academic.
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.
- Yusni, M., & Sigalingging, B. (2021). Encryption as the legal protection against cybercrimes associated with digital land certificates in Indonesia. *International Journal of Cyber Criminology*, *15*(2), 124–134. <https://doi.org/10.5281/zenodo.4766551>
- Zulfikar, R., Durahman, D., Putra, P. A. A., & Kurniawan, C. S. (2026). Digital land registration transformation: Does Indonesia's PTSL program guarantee legal certainty, equity, and justice? *Petita: Jurnal Kajian Ilmu Hukum dan Syariah*, *11*(1), 327–348. <https://doi.org/10.22373/petita.v11i1.951>