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Optimizing the Role of Land Digitalization in Preventing Land Certificate Forgery in a Structural Manner

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Abstract: The increase in land certificate fraud cases highlights the shortcomings of Indonesia's traditional land management system. Because of this circumstance, the government has decided to digitize land through the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) in an attempt to establish a system that is secure, effective, and transparent. The purpose of this study is to examine how land digitization functions in preventing land certificate forgery and assess its effectiveness and implementation challenges from a legal and technical perspective. Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA), Government Regulation Number 18 of 2021, and Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency Number 1 of 2021 concerning Electronic Certificates are just a few of the laws and regulations that are examined using a normative juridical approach. According to the study's findings, the use of electronic certificates, or "e-certificates," can minimize the risk of forgery through a digital verification system, electronic signatures, and cybersecurity-based data storage. However, its effectiveness is still hampered by technological infrastructure, human resource capacity, and issues of personal data protection. Therefore, optimizing land digitization must be accompanied by regulatory harmonization, improved cybersecurity, and strengthening the public's digital legal literacy. These steps are a crucial foundation for realizing an accountable and equitable land system in the digital age.

Keyword: Land Digitalization, Electronic Certificates, Land Certificate Forgery.

INTRODUCTION

In conclusion, the limitation on interest compensation stipulated in Article 27B paragraph (2) of the KUP Law has significant practical and legal implications for taxpayers. This limitation only provides the right to compensation for overpaid tax returns approved in the PAHP (Revised Tax Returns), so that funds withheld during the dispute or objection process do not receive interest. This situation creates legal uncertainty, an imbalance between obligations and rights, and has the potential to undermine taxpayer trust in tax administration. Legal analysis shows that this limitation contradicts the principles of corrective justice, legal

certainty, and equality before the law. Previous literature and case studies indicate that the limitation on interest compensation can weaken tax administration accountability and reduce voluntary compliance, thus threatening the legitimacy and effectiveness of the tax system as a whole.

Based on these findings, the recommendation is to reform Article 27B (2) to expand the scope of interest compensation to cover all tax overpayments, including those resulting from disputes, objections, or administrative corrections. This reform strategy can be implemented through an efficient verification mechanism to ensure compensation is provided fairly without compromising state administrative control. This reform will achieve a balance between taxpayer rights and state authority, increase public trust in tax administration, and strengthen the integrity, accountability, and transparency of Indonesia's tax system. Implementing such reforms will ensure that the principles of fairness, legal certainty, and equality before the law are maintained in tax administration practices. Indonesia's land administration system remains dominated by conventional methods that rely on physical documents and manual bureaucratic processes. (Purba, 2025) Dispersed land data management across various agencies and paper-based archive storage makes land service processes inefficient, error-prone, and vulnerable to manipulation. (Putri, 2020) This situation raises various serious issues, particularly regarding data validity and certificate security. Databoks data recorded 241 agrarian conflict cases throughout 2023, affecting an estimated 638,188 hectares (Ahdiat, 2024), indicating high pressure on land ownership, often leading to disputes and fraudulent practices. This problem is further complicated by the weak verification system and public information transparency in land administration processes.

5,973 land dispute cases were recorded by the National Land Agency and the Ministry of Agrarian Affairs and Spatial Planning in 2024, the majority of which were related to fraud and falsified land certificates. (Brilian, 2024) These cases involve the use of duplicate certificates, the issuance of certificates for the same land, and the practice of brokering land documents. In fact, at the law enforcement level, the police and prosecutors have successfully uncovered various cases of document forgery, including the discovery of 44 fake land certificates in the Riau Islands and several similar cases in other regions. (Kremer, 2025) This phenomenon demonstrates the vulnerability of traditional land administration systems to document crimes due to minimal oversight and limited digital-based verification systems.

The impact of the weakness of conventional land systems is felt not only in legal aspects, but also socially and economically. Socially, agrarian conflicts often cause tension between residents, even leading to violence and loss of housing rights. Economically, uncertainty about land ownership hinders investment and development because investors require strong legal guarantees for assets. Legally, the backlog of land dispute cases burdens the judiciary and undermines public trust in the capacity of the government to ensure land's legal certainty (Meiliawati, 2024) Taking note of this, the government, via the ATR/BPN, began implementing the Electronic Certificate program (INTAN/SIPN) and prepared a roadmap for the use of blockchain and smart contracts towards a fully digital land system by 2028. (Dewi, 2024) This step is explicitly directed at closing the gaps in certificate forgery and building the foundation of a transparent, secure, and accountable land system.

Land certificate forgery is one of the most common crimes in the Indonesian land system and is the root of many agrarian disputes. These forms of forgery are not limited to physical forgery alone, but also include certificate duplication through data manipulation, multiple issuances of the same land parcel, and the use of doctored digital documents. (Siagian, 2021) In some cases, fake certificates are made to resemble official documents, complete with forged registration numbers and digital signatures. These methods have developed with the increasing economic value of land and the weakness of manual

administrative systems that have not been fully integrated digitally, thus opening up opportunities for certain parties to exploit system gaps and weak oversight. (Jelita, 2024)

The factors contributing to the widespread practice of land certificate forgery are both structural and cultural. From a structural perspective, the lack of integration of the national land database makes it difficult to verify ownership quickly and accurately. Lengthy and multi-layered bureaucratic processes increase the potential for irregularities, especially when people are tempted to use the services of brokers or unofficial intermediaries. Meanwhile, from a cultural perspective, low legal and digital literacy among the public prevents them from understanding the importance of verifying certificates through the official ATR/BPN channels. Weak internal oversight and a weak data security system also increase the risk of information misuse, both by individuals within the institution and external parties with access to land data. (Ina, 2025)

Various cases uncovered in the field demonstrate that certificate forgery is not an isolated incident, but rather a systemic symptom of weak land governance. This phenomenon has been recognized by the government, as reflected in ATR/BPN's efforts to promote land digitization through an electronic certificate program and the development of a blockchain-based system. These efforts are aimed at creating a more transparent digital verification mechanism and preventing duplication of land ownership data. Thus, land certificate forgery must be understood not only as a legal issue but also as a systemic transformation challenge that demands technological updates, bureaucratic reform, and increased public awareness of the importance of land document security in the digital age. (Susilowati, 2024)

Strategic measures have been taken by the Indonesian government to digitize the land management system through the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN). The Complete Systematic Land Registration (PTSL), a nationwide initiative to expedite the land registration process across Indonesia so that every property parcel has distinct legal standing, is one of the major programs supporting this transition. PTSL aims not only to accelerate land certification but also to prepare a comprehensive and integrated land database as a prerequisite for a digital land system. Through this program, the government strives to improve the validity of spatial and legal data while reducing the potential for disputes due to discrepancies between field data and administrative documents. Digitalization then became a logical continuation of PTSL, manifested in the Electronic Certificate (E-Certificate) policy as a form of modernization of information technology-based land services. (Mujiburohman, 2018)

The legal foundation for the land digitization policy stems from Indonesian land registration is based on the legal and philosophical framework of Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA). According to Article 19, paragraph (1), "to guarantee legal certainty, the Government shall conduct land registration throughout the territory of the Republic of Indonesia in accordance with provisions stipulated by Government Regulation." The provision demonstrates the state's responsibility to ensure legal certainty regarding land ownership rights, and in the modern context, digitization is an effective method for realizing this principle. By using a digital system, the land registration process can be conducted more transparently, efficiently, and legally accountable, while reducing reliance on physical documents that are easily damaged or manipulated. (Prakoso, 2021)

Government Regulation Number 18 of 2021 about Management Rights, Land Rights, Apartment Units, and Land Registration strengthens the operational basis for land digitalization. According to Article 84, paragraph (1), this rule specifically governs the process for putting computerized land registration into effect, which states that "the organization and implementation of land registration can be carried out electronically." Paragraph (2) of the same article emphasizes that the results of this implementation can be

"electronic data, information, and/or documents." Meanwhile, Article 85 paragraph (1) explains that the implementation of electronic land registration will be carried out in stages according to the readiness of the electronic system developed by the ministry. (Ardani, 2019) Thus, this PP provides formal legitimacy for the implementation of a digital land system and regulates the implementation stages so that it can run consistently and measurably according to available institutional and technological capacity.

Regulation of the Minister of ATR/BPN Number 1 of 2021 concerning Electronic Certificates further regulates the practical application of this policy, and it is currently substantially continued by Regulation of the Minister of ATR/BPN Number 3 of 2023 concerning the Issuance of Electronic Documents in Land Registration Activities. Article 2 paragraph (1) of this law specifies that "land registration can be carried out electronically," while Article 12 paragraph (1) emphasizes that land that already has certain rights will be issued with e-Certificates through an electronic system. Furthermore, Article 5 paragraph (1) emphasizes that electronic documents and their printouts constitute valid legal evidence, equal to physical certificates. It demonstrates that the government is not simply replacing the form of certificates but rather establishing a new legal system that recognizes the legality of electronic documents in land activities. The prior objective of this digitalization policy is to create a transparent, efficient, secure, and trustworthy land system, reduce corruption and certificate forgery, and strengthen legal certainty over land ownership rights in the digital era. (Suharto, 2023)

Although land digitization brings various strategic benefits to the land administration system in Indonesia, its implementation still faces various structural and technical obstacles. One of the main challenges lies in the limited information technology infrastructure, particularly in areas with weak internet access and limited technological resources. Land digitization requires a reliable data network, a secure central server, and a robust inter-agency integration system to ensure real-time access and verification of land data. However, Indonesia's vast and diverse geography means that digital infrastructure has not yet been fully equitable. Furthermore, many regional land offices still rely on manual systems, making the transition to electronic systems often slow and uneven across regions. Budgetary and technical capacity constraints also hamper the adoption of advanced technologies such as blockchain, or the multi-layered security systems needed to protect land data. (Prasetyo, 2023)

The next challenge relates to low digital literacy among both the public and government officials. Digitalization demands a paradigm shift from traditional bureaucratic systems to technology-based public services. However, most people, especially in rural areas, lack an adequate understanding of how to access digital land services or verify the authenticity of electronic certificates. Furthermore, some government officials are also not fully prepared for the shift to a digital work system, both in terms of technical skills and the mental readiness to adapt to the new system. The lack of training, coaching, and incentives to increase human resource capacity is a significant inhibiting factor. As a result, digital transformation often occurs only at the policy level without being accompanied by real changes in service and oversight practices on the ground. (Fitrianingsih, 2021)

In addition to technical and human resource barriers, threats to cybersecurity and personal data protection are also crucial issues in the implementation of land digitalization. Land data contains sensitive information, such as owner identity, land area, economic value, and land rights, which are highly susceptible to misuse if not properly protected. The risk of data leaks, hacking, or manipulation of digital documents could give rise to new forms of land crimes in digital format. Cases of government data leaks across various sectors serve as an important reminder that information security systems must be a top priority in this digital transformation. (Prasetyo A.S., 2025) Therefore, the implementation of encryption systems,

regular cyber audits, and coordination with the National Cyber and Crypto Agency (BSSN) needs to be strengthened to maintain public trust in the digital land system.

In this regard, optimizing land digitization is an urgent need to truly achieve the primary goal of preventing land certificate forgery. Digitization essentially provides a much more robust verification tool through digital signature systems, integrated databases, and blockchain-based document validation that are difficult to manipulate. However, its effectiveness depends on the government's ability to integrate legal, technical, and social aspects within a comprehensive strategic framework. From a legal perspective, regulatory harmonization is necessary so that all forms of electronic documents are legally recognized and protected by law. From a technical perspective, digital systems must be designed with high security standards and interoperability across agencies. Meanwhile, from a social perspective, increasing public legal and digital literacy needs to be a priority so that the public becomes not only users but also active monitors of the transparency of land services. Through this structural and multidimensional approach, land digitization serves not only as an administrative innovation but also as an instrument of legal reform that promotes certainty, justice, and security in land management in the digital era.

METHOD

In order to analyze legal norms controlling land digitization in the context of preventing land certificate counterfeiting, this study employs a normative juridical method. A conceptual approach and a statutory approach are among the methods employed. Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA), Government Regulation Number 18 of 2021 concerning Management Rights, Land Rights, Apartment Units, and Land Registration, and Regulation of the Minister of ATR/BPN Number 3 of 2023 concerning the Issuance of Electronic Documents in Land Registration Activities are just a few of the pertinent regulations that are examined in order to implement the statutory approach, together with other clauses like Law Number 27 of 2022 about Personal Data Protection (PDP) and Law Number 11 of 2008 concerning Electronic Information and Transactions (ITE). Modern legal notions like e-certificates, data protection in electronic systems, and land digitalization are all understood through the use of the conceptual method. The study's secondary data sources include tertiary legal materials (legal dictionaries and encyclopedias), secondary legal materials (books, journals, research findings, and scientific papers), and primary legal materials (statutory regulations). Through inventorying and evaluating pertinent books, library research was used to gather data. Additionally, descriptive and qualitative data analysis methods were used to analyze legal norms and connect them to land digitization implementation procedures, in order to produce systematic and in-depth legal arguments regarding the role and optimization of digitalization in preventing land certificate forgery in Indonesia.

RESULTS AND DISCUSSION

The Role of Land Digitalization in Preventing Land Certificate Forgery

Beginning with Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA), Indonesia's land digitization implementation has a solid and multi-layered legal foundation. The implementation of national land administration, which ensures legal certainty for land rights, is primarily based on this statute. The UUPA's Article 19 paragraph (1) makes it clear that "to guarantee legal certainty, the Government shall conduct land registration throughout the territory of the Republic of Indonesia according to the provisions regulated by Government Regulation." This provision indicates the obligation of the state, through the National Land Agency/Ministry of Agrarian Affairs and Spatial Planning (ATR/BPN), to establish a land registration system capable of offering the community legal protection. In the

development of technology and demands for efficiency in public administration, land digitization is a modern embodiment of the mandate of Article 19. Through an electronic system, the government can guarantee legal certainty more effectively, accurately, and transparently compared to a manual system that is prone to errors and data manipulation. (Rahmawati, 2021)

Government Regulation Number 18 of 2021 concerning Management Rights, Land Rights, Apartment Units, and Land Registration lay out the next legal foundation. This regulation specifically lays out the legal foundation for the adoption of electronic land registration. According to paragraph (1) of Article 84, "the organization and implementation of land registration can be carried out electronically," while Article 84 paragraph (2) emphasizes that the results of this implementation can be in the form of "electronic data, information, and/or documents." Furthermore, Article 85 paragraph (1) stipulates that "the implementation of electronic land registration will be implemented in stages, taking into account the readiness of the electronic system developed by the ministry." With this provision, the government has full legitimacy to transform the land registration system from a physical document-based system to a digital one. This regulation not only broadens the scope of land administration law but also marks a paradigm shift in state asset governance, where the legal validity of documents no longer depends on their physical form, but rather on the authenticity of the data stored electronically. (Sunari, 2025)

The Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number 1 of 2021 Regulation regarding Electronic Certificates contains more specific implementing provisions. This regulation was later improved by the Minister of Agrarian Affairs and Spatial Planning/BPN Number 3 of 2023 regarding the Issuance of Electronic Documents in Land Registration Activities. In this regulation, Article 2 paragraph (1) emphasizes that "land registration can be carried out electronically," while Article 12 paragraph (1) explains that land that already has certain rights, such as ownership rights, management rights, or mortgage rights, can be registered electronically and an e-Certificate issued. Furthermore, Article 5 paragraph (1) emphasizes that "electronic documents as referred to in Article 4 paragraph (3) and/or their printouts constitute valid legal evidence and an extension of valid evidence in accordance with applicable procedural law in Indonesia." Thus, electronic certificates have the same legal standing as physical certificates. (Sahrina, 2023)

According to the Indonesian land system, electronic certificates have the same legal validity as paper certificates. Permen ATR/BPN Number 3 of 2023 concerning the Issuance of Electronic Documents in Land Registration Activities further clarified the provisions of Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency (Permen ATR/BPN) Number 1 of 2021 concerning Electronic Certificates. According to this regulation's Article 5 Paragraph 1, "electronic documents as referred to in Article 4 paragraph (3) and/or printed copies thereof constitute valid legal evidence and an extension of valid evidence in accordance with applicable procedural law in Indonesia." This provision confirms that both electronic documents and printed copies have the same legal force as conventional land certificates. (Dinata, 2022) Therefore, electronic certificates are a legal tool whose legitimacy is acknowledged by the court in addition to being an administrative innovation, so that it has an evidentiary function that is equal to a physical certificate.

The acceptance of electronic certificates is consistent with Law Number 11 of 2008 concerning Electronic Information and Transactions (ITE Law), as modified by Law Number 19 of 2016, according to evidentiary law. The ITE Law's Article 5 Paragraph 1 says that “electronic information and/or electronic documents and/or printouts thereof constitute valid legal evidence,” and Article 6 emphasizes that electronic documents are regarded as

legitimate as long as the data they contain can be viewed, accessed, and its integrity ensured. With this provision, the legality of electronic certificates gains cross-regulatory legitimacy, not only in the land sphere but also in the broader national legal system. This principle of legal validity ensures that digital proof of land ownership has the same strong legal protection as conventional documents and can be used in legal proceedings, both civil and criminal, in the event of disputes or violations of land rights. (Meiliawati, 2024)

Normative technical factors, such as the use of electronic signatures, a digital registration system, and electronic system-based validation, ensure the legal validity of electronic certificates in addition to their formal legality. The Minister of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) Regulation and the ITE Law's provisions, electronic signatures serve as a substitute for manual signatures, providing authentication value and document integrity. Through the use of certified electronic signatures, each digital certificate can only be issued by a verified authority, namely the Ministry of ATR/BPN. Meanwhile, the digital registration system used relies on an integrated national database, allowing the legal origin of all land ownership data to be traced. This electronic system-based validation ensures three key principles of digital document security: authenticity, integrity, and non-repudiation, which cumulatively create stronger legal force and evidence than manual systems. (Ricardo, 2024)

In preventing forgery, land digitization provides a far stricter legal mechanism than conventional systems. Through the implementation of a centralized and encrypted electronic database, all land data is stored in a single national system accessible only to authorized users. Every administrative process, from registration and transfer of rights to data updates, must undergo digital verification and identity authentication based on a legal security system (legal tech). It minimizes the possibility of certificate forgery, as the system immediately detects any data discrepancies or document manipulation. In an electronic system, duplicate certificates cannot be issued for the same land parcel without detection, as each parcel has a unique identifier permanently recorded in the database.

Furthermore, the digital land law system also implements an audit trail mechanism, which automatically records every activity within the system, including data changes, user access, and electronic transactions. This audit trail has important legal value because it can serve as authentic evidence in the event of violations, manipulation, or cybercrimes related to land data. With this automated recording system, every administrative action is recorded chronologically and cannot be deleted, thereby increasing the accountability of authorized institutions and officials. The existence of this system log also aligns with the principles of transparency and traceability in modern administrative law, where every government decision or action can be tracked and accounted for. This strengthens the preventive function of land digitalization in preventing forgery, while also providing legal assurance of the authenticity of electronic certificates.

According to Article 19 of the Basic Agrarian Law, the idea of legal certainty (lex certa), which serves as the foundation for national land management, is directly tied to this digitization system. Electronically stored digital data offers advantages in verification and tracking compared to physical documents, as all information is integrated into a single, transparent, and legally accessible national system. Thus, digitalization not only improves administrative efficiency but also strengthens legal protection for land ownership rights. The legal certainty created by this digital system serves as a primary preventative tool in eliminating the potential for certificate forgery, as any data changes can be directly verified through a legally valid electronic system. Therefore, from a normative perspective, land digitalization represents a modern implementation of the principle of agrarian legal certainty, which positions technology as a law enforcement tool to protect community land rights in the digital era.

Land digitalization has significant legal implications for handling criminal acts of land certificate forgery, particularly regarding evidentiary procedures. Whereas previously the evidentiary process relied heavily on the physical authenticity of documents, such as certificates, official signatures, or agency stamps, in digital systems, the evidentiary process shifts to the authenticity of electronic data recorded in the system. With the implementation of electronic certificates (e-certificates), proof of land ownership no longer consists of physical paper, but rather digital documents with metadata and an electronic footprint. This change shifts the legal evidentiary paradigm from document-based evidence to data-based evidence, where the test is no longer the physical certificate, but the authenticity of digital data, electronic signatures, and system records that prove the document was legally generated and authorized by the Ministry of ATR/BPN system.

The requirements of Law Number 11 of 2008 about Electronic Information and Transactions (ITE Law), as amended by Law Number 19 of 2016, which specifically acknowledges the legal power of electronic documents, are in line with this change in evidential patterns. The ITE Law's Article 5, paragraph (1) declares "electronic information and/or electronic documents and/or printouts thereof constitute valid legal evidence." Additionally, Article 6 highlights that electronic papers are deemed legitimate if the data they contain can be accounted for, viewed, and its integrity ensured. Based on this, electronic certificates resulting from land digitization have a strong legal standing in the court process. In cases of forgery, the evidence submitted includes not only printed documents but also system logs, digital signatures of officials, and electronic verification records that can determine whether the certificate was generated legally or through system manipulation.

Digitalization also broadens the scope of legal liability for certificate forgers, both external and internal to the institution. While in conventional systems, perpetrators are typically individuals or land mafias who falsify physical documents, in digital systems, perpetrators can include those who manipulate data, unauthorized access, or hack electronic land systems. Anyone who willfully and without authorization gains access to another person's computer or electronic system faces criminal penalties under Article 30 of the Electronic Information and Transactions (ITE) Law. Additionally, according to Article 35 of the ITE Law, anybody who willfully and without authorization manipulates, produces, modifies, or removes, or damages electronic information with the intention of making the data appear to be genuine can be punished for the crime of electronic forgery. Therefore, certificate forgery in the digital era can be classified as a cybercrime, with specific criminal penalties stipulated in the national electronic law system.

Internal institutions, such as ATR/BPN employees, are also not exempt from legal responsibility if involved in the manipulation or misuse of the digital land system. Based on Law Number 30 of 2014 concerning Government Administration, every public administration official is required to exercise their authority in accordance with procedures and must not abuse their position for personal gain. If an official is involved in altering electronic data or issuing electronic certificates without proper procedures, their actions can be categorized as maladministration or even corruption if they involve elements of personal gain or harm to the state. This emphasizes that digitalization does not eliminate individual responsibility but rather clarifies the legal trail through a digital audio system that can detect every user activity. With an electronic audit trail, every administrative and criminal violation can be accurately traced, strengthening the principle of legal accountability in digital land governance.

In the context of land ownership, land digitization is a tool to guarantee legal clarity and protection for land rights holders in addition to being a way to increase administrative efficiency. The digital system allows ownership data to be verified quickly and accurately through an integrated national database, thereby reducing the potential for overlapping,

duplication, or copying of certificates. The system's transparency allows the public to easily verify the authenticity of their land certificates through the official ATR/BPN portal without having to go through a third party. Thus, digitalization creates preventative legal protection, as potential disputes and fraud can be prevented early through electronic data-based public verification mechanisms. This system also increases public trust in land institutions, as all administrative processes are conducted transparently and digitally documented.

Article 19 of Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA) requires the government to ensure legal certainty regarding land rights for all citizens. From a normative standpoint, the use of digital systems in land administration is a tangible expression of this principle. Electronic certificates, which have the same legal authority as physical certificates but are more secure and transparent, have made this legal certainty digital. Land digitization, therefore, is not merely a bureaucratic modernization program, but rather a legal instrument that strengthens the protection of community land rights. With a system based on technology and law, the state is present concretely in providing legal certainty, preventing administrative irregularities, and creating a more just, transparent, and accountable national land system in the digital era.

Land Digitalization Optimization Strategy to More Effectively Prevent Land Certificate Forgery

Optimizing land digitalization cannot be effective without the support of a robust, reliable, and secure information technology (IT) infrastructure. This infrastructure readiness includes the construction of large-capacity servers, a stable and fast communication network, and a nationally standardized data center. The existence of a data center plays a crucial role as a digital storage location for all land information, which must meet high security and reliability standards to prevent data loss or corruption. Furthermore, a multi-layered security system is required to protect data from cyberattacks or unauthorized access. In this context, the integration of the ATR/BPN digital land system with other institutions such as the Civil Registration Agency (Dukcapil) (for owner identity verification), the Ministry of Finance (for tax and BPHTB synchronization), banks (for electronic mortgage rights), and local governments (for zoning and spatial planning) is crucial. This integration creates an interconnected data ecosystem and minimizes the opportunity for data manipulation or falsification of landowner identities.

The use of modern technologies such as blockchain, cloud systems, and artificial intelligence (AI) is also a key part of the strategy to strengthen land infrastructure. Blockchain technology, for example, enables permanent, transparent, and irreversible recording of every land transaction, thus providing a natural mechanism to prevent forgery of land documents. Meanwhile, cloud systems provide efficiency in data storage and processing, allowing for cross-regional access with a high level of security. AI-based verification plays a role in data validation, detecting anomalies, and identifying potential administrative irregularities or indications of digital crime. By embracing this technology, Indonesia's land system can be more adaptable to developments in the digital era and provide guaranteed security and public transparency regarding all land registration activities.

Besides infrastructure, equally important aspects are cybersecurity and personal data protection. Given that land data contains sensitive information such as owner identity, area, location, and land value, cybersecurity is a key pillar for successful digitalization. The government needs to implement a multi-layered security system that includes data encryption, dual authentication systems, active firewalls, and early detection of hacking attempts. This also aligns with Law Number 27 of 2022 concerning Personal Data Protection (PDP Law), which regulates the obligations of public institutions to protect citizens' personal data from leaks or misuse. The enactment of the principles of the PDP Law must become the

operational standard in the digital land system to maintain public trust and ensure the legal security of land data.

Enforcing digital security requires more than just software; it also requires a strict control system through regular security audits and an end-to-end encryption system. The application of certified digital signatures to electronic certificates serves as a legal and technical instrument that guarantees the authenticity and integrity of documents. Regular system audits are necessary to ensure there are no security gaps that could be exploited by irresponsible parties. Furthermore, a rapid incident response mechanism and reliable cyber forensics must be established so that any violations or digital attacks on the land system can be identified, promptly addressed, and used as a basis for law enforcement. This approach is not only reactive to threats but also preventive in maintaining the reliability of the digital system that underpins national land administration.

The success of land digitization is determined not only by technology but also by the quality of the human resources (HR) managing it. ATR/BPN officials, as the primary implementers, need to possess high competency in information technology, digital security, and cyber law to be able to operate the electronic land system professionally and accountably. Low digital literacy among officials remains a barrier that must be addressed through technical training and competency certification. This training should encompass an understanding of the system's operational techniques, data security, and the legal aspects inherent in all electronic activities, including the use of digital signatures and the validation of land ownership data. With competent human resources, the risk of administrative errors and information leaks can be significantly reduced.

Furthermore, public digital literacy also plays a crucial role in maintaining the effectiveness and validity of the digital land system. As land rights holders, the public must understand how to access, verify, and protect their electronic certificates to prevent them from being easily deceived or manipulated by third parties. Therefore, the government needs to intensify public education through outreach, training, and digital campaigns to enable the public to use electronic land services independently and securely. Collaboration with universities, research institutions, and civil society organizations can also be an effective strategy to strengthen legal capacity and digital land technology in Indonesia. This way, land digitization can run optimally, not only from a technical perspective, but also in terms of legal awareness and public participation as part of a transparent, secure, and equitable system.

The ongoing overlap and inconsistency among the laws governing Indonesia's land registration system are one of the biggest obstacles to the implementation of land digitization. In order to guarantee legal certainty and uniform application on the ground, regulatory harmonization is an essential first step. Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA), which forms the main basis, Government Regulation Number 18 of 2021, Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency Number 3 of 2023 concerning the Issuance of Electronic Documents, Law Number 11 of 2008 concerning Electronic Information and Transactions (UU ITE), and Law Number 27 of 2022 concerning Personal Data Protection (UU PDP) are just a few of the interconnected regulations that are currently in effect. All of these regulations overlap and play different roles in supporting land digitization. However, without synchronization, they have the potential to create overlapping authority and legal uncertainty in their implementation. Harmonization is necessary to ensure a balance between agrarian law, digital law, and data protection. For example, the provisions in the UUPA and PP 18/2021 need to be aligned with the principles of data security and electronic document validity in the ITE Law and the PDP Law, so that the implementation of electronic certificates can have strong legitimacy across all aspects of national law. In addition to regulatory harmonization, standardization of digital data and procedures across land offices is also essential to ensure

uniform digitalization implementation and avoid regional disparities. Currently, the level of readiness and capacity of digital infrastructure at land offices in various regions varies, resulting in inconsistent service processes. This standardization encompasses land data formats, input and validation procedures, verification mechanisms, and the security systems implemented in each region. The ATR/BPN needs to establish a uniform, digital-based national Standard Operating Procedure (SOP), with a central oversight system to ensure compliance. This step is crucial to ensure that all land data in Indonesia is stored in a compatible format and system, enabling national integration to occur without technical or administrative barriers.

In addition, a supervisory agency or special unit to handle national digital land governance needs to be established. This agency's function is to ensure that the digital system remains compliant with legal principles, ethics, and public data security. This supervisory unit could be under the direct coordination of the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) but collaborate with the National Cyber and Crypto Agency (BSSN) and the Ministry of Communication and Informatics (Kemenkominfo) for data security and integrity. This agency should also be authorized to conduct periodic audits, system evaluations, and investigations into violations or irregularities within the digital land system. With strong and structured oversight, the potential for abuse of authority, data manipulation, or information leaks can be minimized, ensuring that the digital land system operates transparently, securely, and legally accountable.

Optimizing land digitalization must also involve transparency and public participation as a form of effective social control. The public must be given access to non-confidential data, such as land parcel status, location, or digital maps, through official government platforms. This access is crucial so that the public can verify their own land information, thereby suppressing the practice of brokering or land mafia. Public data transparency also increases public trust in the land system, as all processes can be accessed and verified without the need for bureaucratic channels or intermediaries. The government can develop a web-based public verification system and mobile application, allowing the public to verify the authenticity of land certificates by entering a unique identification code. This system not only provides convenience but also serves as a means of public education to understand how the digital land system operates transparently and securely.

Beyond the benefits of transparency, public involvement also has a direct impact on increasing the accountability of land institutions. When the public has access to information and a digital complaint mechanism, oversight of the performance of officials will increase, thereby reducing the risk of administrative irregularities or data manipulation. Transparency also encourages collaboration between the government and the public in maintaining the integrity of the system, with the public acting as a social watchdog, reporting any irregularities or indications of violations through the provided digital channels. Thus, the digital land system serves not only as an administrative tool but also as a participatory instrument that strengthens good governance in the agrarian sector.

All of the above strategies will be more effective if supported by cross-agency collaboration and the integrated use of innovative technology. Land digitization cannot be implemented in isolation by the ATR/BPN alone. It must involve other institutions such as the Ministry of Communication and Information, the National Civil Service Agency (BSSN), the National Police, the Attorney General's Office, the Ministry of Finance, and banking institutions to create an integrated and mutually supportive system. This collaboration enables the use of cutting-edge technologies such as blockchain, smart contracts, and GIS-based digital mapping to ensure the authenticity, validity, and security of land data. The application of blockchain technology, for example, can ensure that every land transaction is permanently recorded and cannot be changed, while smart contracts can be used to automate the legal and

transparent transfer of land rights. This aligns with the ATR/BPN roadmap towards fully digital land services by 2028, which targets Indonesia to have an integrated, secure, and fraud-free digital land system. With synergy between institutions and the support of advanced technology, Indonesia's land system will be able to transform into a modern agrarian governance model that ensures legal certainty, efficiency, and justice for all citizens.

CONCLUSION

Based on the previous discussion, it can be concluded that land digitization is a strategic step by the state to achieve legal certainty and prevent the crime of land certificate forgery. Conventional land administration systems, which still rely on physical documents, have proven vulnerable to manipulation, duplication, and land mafia practices. The government has created a legal basis for the use of electronic certificates (e-Certificates), which have the same legal force as physical certificates, through a solid legal foundation, such as the Basic Agrarian Law (UUPA) (Law No. 5 of 1960), Government Regulation No. 18 of 2021, and Regulation of the Minister of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) No. 3 of 2023. The presence of this electronic system not only supports bureaucratic efficiency but also strengthens legal evidence through the implementation of digital signatures, data encryption, and forensically verifiable audit trails. Thus, digitalization is not merely an administrative innovation, but rather a legal transformation that strengthens land rights protection and encourages the creation of more transparent, accountable, and fraud-free land governance.

The recommendations include the need for continuous optimization in the implementation of land digitization through synergy between legal, technical, and social aspects. The government needs to accelerate the strengthening of information technology infrastructure and expand integration between agencies such as the ATR/BPN, Dukcapil, BSSN, the Ministry of Communication and Information, and financial institutions to create a secure and connected land data ecosystem. Furthermore, increasing human resource capacity and public digital literacy are also key to ensuring the system's widespread access and understanding. Likewise, strengthening regulations through regulatory harmonization and the establishment of a digital land oversight agency needs to be implemented immediately to ensure the security, accountability, and protection of rights holders' personal data. With consistent policy support, innovative technologies such as blockchain and smart contracts, and active community involvement, land digitization in Indonesia will be able to achieve its goals as an effective system in preventing certificate forgery and ensuring legal certainty of land ownership.

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