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Harmonization of Blockchain-Based Electronic Land Certificate Regulations from the Perspective of Information Disclosure and Personal Data Protection

Lily Kalyana[1]
[1]Universitas Islam Syekh-Yusuf, Tangerang, Indonesia, lkalyana@unis.ac.id

Corresponding Author: lkalyana@unis.ac.id[1]

Abstract: The digital transformation of land administration through the implementation of electronic certificates opens up opportunities for increased efficiency, transparency, and legal certainty in the land registration system in Indonesia. Blockchain technology offers advantages in the form of data integrity, transaction transparency, and decentralized verification mechanisms, but these characteristics also pose legal challenges, particularly regarding the protection of personal data of land rights holders. This study aims to analyze the normative conflict between the principle of public information transparency and the state's obligation to protect personal data in the blockchain-based land registration ecosystem, while simultaneously formulating an ideal regulatory harmonization model. The research method employed is normative juridical with a legislative, conceptual, and comparative approach through an analysis of the national legal framework, including the Basic Agrarian Law (UUPA), Government Regulation Number 24 of 1997 concerning Land Registration, Law Number 14 of 2008 concerning Public Information Disclosure, Law Number 11 of 2008 in conjunction with Law Number 19 of 2016 concerning Electronic Information and Transactions, and Law Number 27 of 2022 concerning Personal Data Protection, as well as comparisons with international practices such as Estonia and the GDPR approach in the European Union. The study reveals a tension between the immutable and distributed nature of blockchain transparency and personal data protection principles such as consent, data minimization, and the right to correction. Existing regulations still do not fully accommodate decentralized technology designs, potentially creating legal loopholes. The proposed harmonization model emphasizes the use of permission blockchains, layered access systems, privacy-by-design, and the separation of sensitive data storage through off-chain mechanisms. A techno-legal approach is crucial to ensure that technological innovation aligns with the protection of citizens' constitutional rights and the principle of legal certainty in digital land administration.

Keyword: Electronic Certificates, Blockchain, Digital Land Registration, Public Information Disclosure, Personal Data Protection

INTRODUCTION

Digital transformation in land administration is a response to the need for more efficient, accurate, and adaptive modernization of agrarian governance in the face of developments in information technology (Limbong & Sitohang, 2026). Conventional certificate systems based on physical documents face various obstacles, such as the potential for forgery, limited access, and difficulties integrating data between agencies (Hidayah et al., 2024). Digitization presents an opportunity to improve the quality of public services through a more transparent and accessible system. Electronic certificates are part of bureaucratic reform aimed at strengthening legal certainty over land rights through digital data-based registration (Jagadhita, 2025). This change is not simply a conversion of document formats, but rather a paradigm shift in land administration toward a digital ecosystem that demands the reconstruction of legal norms.

The digitalization policy implemented by the ATR/BPN reflects the state's efforts to accelerate the modernization of the land registration system through the integration of information and communication technology (Rizal, 2025). This digitalization process not only touches on the technical aspects of archiving but also changes the mechanisms for verifying, storing, and distributing land information (Az-zahra et al., 2025). Land registration, which previously relied on manual procedures, is now shifting to an electronic system that can minimize administrative errors and expedite the service process (Yanti et al., 2024). This policy has legal implications, as digital data has become the primary source of proof of rights. This change in the form of evidentiary media requires strong normative legitimacy to avoid legal uncertainty.

The use of blockchain technology in land registration systems is attracting attention because it offers a distributed and difficult-to-manipulate recording model (Mandia & Dirgahayu, 2025). Blockchain allows every transaction to be permanently recorded in a network independent of a central authority. The trustless nature of verification ensures that data validity is not determined solely by a single institution but is verified collectively through cryptographic mechanisms. Such a system has the potential to increase public trust in land administration (Nugraha & Kusmiarto, 2024). However, blockchain integration also requires an in-depth analysis of the technology's compliance with national legal principles.

The immutable nature of blockchain creates an unalterable record once data is entered into the system. This property is considered advantageous because it reduces the risk of data manipulation and increases information integrity (Chic & Bilqisthi, 2024). A distributed ledger allows data to be stored on multiple interconnected nodes, thereby reducing reliance on a single central server (Bellaj et al., 2024). Transparency is another characteristic often associated with blockchain, as every transaction can be tracked chronologically. These properties raise legal questions about how to balance data security and the protection of individual rights.

The principle of public information transparency plays a crucial role in land administration because it provides public access to information about the legal status of a plot of land (Pareda et al., 2025). Access to this information helps prevent disputes, supports secure transactions, and strengthens legal certainty for good-faith third parties (Yumardi & Pratama, 2024). Information disclosure regulations encourage governments to provide relevant data transparently. Digital systems expand the potential for rapid and broad access to information through the internet. Challenges arise when high transparency has the potential to expose personal data that should be protected.

Personal data protection is a state obligation that has received increasing attention following the development of digital technology and large-scale data processing (Daeng et al., 2023). Land ownership data can contain information on individual identity, economic value, and the location of highly sensitive assets (Adnyani et al., 2024). Misuse of this information can pose security risks and privacy violations. Personal data protection regulations emphasize the principles of data minimization, limiting the purpose of use, and the right of data subjects

to control their information (Rianarizkiwati, 2022). A transparent blockchain system presents a dilemma because openness can conflict with the need to maintain personal data confidentiality.

The normative conflict between information transparency and personal data protection is a central issue in the development of distributed technology-based electronic certificates. Transparency is needed to ensure accountability in land administration and protect the public interest (Susilowati, 2024). Individual privacy demands restrictions on access to certain data to prevent misuse. The tension between these two principles is not merely a technical issue, but concerns fundamental values in modern legal systems that must be harmonized. Legal analysis is needed to formulate proportional limits so that both principles can coexist without negating each other.

The legal risk of overexposure of landowner data becomes a serious concern when digital technology enables widespread and rapid access to information. The uncontrolled dissemination of data can facilitate individual profiling or economic exploitation by irresponsible parties. Blockchain systems that permanently store data pose additional problems because changes or deletions to information cannot be easily performed (Ernawati et al., 2025). The right to correct incorrect or irrelevant data becomes difficult to achieve if the technological architecture is not designed from the outset to accommodate this need. Protection of privacy rights requires a legal design that considers technical aspects from the system planning stage.

The urgency of regulatory harmonization arises because technological development often outpaces the adaptation of legal norms. Land regulations, information disclosure, and personal data protection have different but overlapping objectives. Without proper harmonization, the implementation of new technologies may create normative conflicts, leading to legal uncertainty. A harmonization approach requires not only regulatory revisions but also adjustments to technical policies and institutional governance. This effort aims to ensure that the digitization of land administration remains aligned with the protection of citizens' human rights.

The theory of legal certainty provides an analytical framework for assessing whether electronic certificates can guarantee the stability and clarity of land rights status. Legal certainty requires clear, consistent, and predictable rules so that the public has confidence in the administrative system (Hasima et al., 2023). Digitization offers the potential to improve data accuracy and reduce manipulation that often occurs with physical documents. New systems must also be able to guarantee that technological changes do not undermine the legitimacy of proof of rights. Legal certainty analysis helps measure whether technological innovations actually strengthen or create new risks.

Privacy protection theory has become relevant as digital technology expands the ability of both the state and the private sector to collect and process individual data. Privacy is no longer understood simply as a private personal space, but as the right to control information about oneself (Pakina & Solekhan, 2024). Electronic certificates that store data in digital format require more complex protection mechanisms than conventional documents. The principle of privacy by design emphasizes the importance of incorporating data protection from the design stage of technological systems (Mugiono & Wiraguna, 2025). This perspective helps ensure that digital innovation does not compromise individuals' fundamental rights.

Digital constitutionalism and techno-regulation offer theoretical approaches to understanding the relationship between digital technology and the legal norms that govern it. Digital constitutionalism highlights how constitutional values such as the right to privacy, transparency, and accountability are translated in the digital space. Techno-regulation views technology not only as an object to be regulated but also as a regulatory instrument that can shape behavior (De Gregorio & Radu, 2022). The principle of proportionality serves as a tool to balance conflicting interests through an analysis of the goals, needs, and proportions of

policy decisions (Fiqri & Frinaldi, 2025). This approach helps formulate a harmonization model that is able to maintain a balance between information transparency and personal data protection without hindering technological innovation.

METHOD

This research employs a normative juridical research method focused on analyzing legal norms, legal principles, and doctrines related to the digitalization of land administration and personal data protection in the use of blockchain technology. The approach employed includes a statute approach to examine relevant laws and regulations, such as the Basic Agrarian Law (UUPA), Government Regulation Number 24 of 1997 concerning Land Registration, Law Number 14 of 2008 concerning Public Information Disclosure, Law Number 11 of 2008 in conjunction with Law Number 19 of 2016 concerning Electronic Information and Transactions, and Law Number 27 of 2022 concerning Personal Data Protection; a conceptual approach to examine the concepts of legal certainty, privacy protection, and digital constitutionalism; and a comparative approach through a study of international practices related to digital land registration and blockchain governance. The analysis was conducted qualitatively using systematic and teleological interpretation methods to identify normative conflicts between the principles of information disclosure and personal data protection, while simultaneously formulating a regulatory harmonization model based on a techno-legal approach that aligns with the Indonesian legal system.

RESULTS AND DISCUSSION

Digital Transformation of Land Administration and Electronic Certificates

The evolution of the land registration system reflects a major shift from paper-based administrative mechanisms to integrated digital governance. The conventional system was initially designed to ensure the orderly recording of land rights through physical archives and manual procedures controlled by state institutions. This model holds historical value because it created a relatively stable administrative structure, but developments in modern society have given rise to the need for greater speed, efficiency, and accuracy. Digitization has become a strategic step to address these needs through the use of electronic databases that enable real-time information processing. This change has significant implications for how the state views land data as a strategic asset that must be managed systematically.

A comparison between conventional and digital systems demonstrates a paradigm shift from document-based administration to data-driven administration. Manual systems often face obstacles such as document duplication, delays in information updates, and limited public access. Digital systems offer opportunities to address these weaknesses through data integration, automated verification, and more accurate tracking of transaction histories. This transformation also transforms the relationship between the state and citizens by enabling faster and more transparent access to information. Another equally significant impact is the shift in legal responsibility of data management institutions, which must ensure the security and validity of digital information.

The function of land registration in creating legal certainty is the primary foundation of the land registration system. Registration serves as a means of publication that guarantees that the ownership status of a plot of land can be officially verified. Legal certainty depends on data accuracy and the consistency of recording procedures carried out by land authorities. Digital systems have the potential to improve registration quality by reducing administrative errors and increasing the speed of data updates. This change requires adjustments to legal norms so that electronic certificates retain the same or even stronger evidentiary power as physical documents.

The publicity principle in agrarian law serves as a mechanism to ensure that information regarding the legal status of land is accessible to interested parties. This principle is closely related to the protection of good-faith third parties in land transactions. Adequate access to information helps prevent ownership conflicts and increases administrative transparency. Digitalization expands the scope of publicity because data can be accessed through more open electronic systems. Challenges arise when a high level of openness potentially clashes with the need to maintain the confidentiality of landowners' personal data.

The concept of electronic land certificates represents a shift from physical documents to digital representations with legal force. An electronic certificate is not simply a digital file, but part of an information system that records ownership data in a structured manner. The legal definition of an electronic certificate must include aspects of authentication, data integrity, and a reliable verification mechanism. The validity of an electronic certificate depends on the technology used and the regulations governing its issuance process. Clarity of legal character is crucial to avoid any doubt regarding its evidentiary status in land disputes.

The evidentiary status of electronic certificates is a central issue because traditional evidentiary law often places physical documents as the primary evidence. Digital transformation demands recognition that electronic data can have the same evidentiary value as long as it meets certain standards. Electronic signature mechanisms, encryption, and audit systems are crucial factors in ensuring document authenticity. This paradigm shift requires extensive outreach to law enforcement officials and the public to eliminate doubts about the validity of digital certificates. Strengthening regulations related to electronic evidence helps build trust in the new system.

The integration of blockchain technology in land registration opens up opportunities to increase transparency and data security through a distributed recording mechanism. Public blockchains offer a high level of transparency because data can be accessed by multiple parties within an open network. Private blockchains grant specific authorities greater control in managing access and validating transactions. Permissioned blockchains offer an alternative that combines transparency and access control, making them more suitable for state administration needs. The choice of blockchain type is a strategic decision that influences the balance between information transparency and personal data protection.

The use of smart contracts in land registration allows for the automation of certain processes, such as transaction verification or changes in ownership status. Smart contracts operate based on pre-programmed code, reducing the need for manual intervention. This automation can increase efficiency and reduce the potential for human error. Challenges arise when complex legal rules must be translated into simple algorithmic logic. Judicial analysis is necessary to ensure that the use of smart contracts does not eliminate the necessary discretion in legal practice.

The benefits of blockchain use include increased data security, transaction transparency, and a reduced risk of information manipulation. An immutable recording system ensures high data integrity. Legal risks remain, as the immutable nature can make it difficult to correct data in the event of recording errors. Jurisdictional issues can also arise if blockchain networks involve nodes across borders operating under different legal systems. Evaluating the benefits and risks is crucial to ensure that technology adoption does not create new problems in land governance.

The legal challenges of land digitization include data security, system interoperability, and state accountability within an increasingly complex structure. Data security must be a priority because land information has high economic and social value. Interoperability is necessary for land systems to connect with other databases, such as population administration or taxation, without compromising individual privacy. State accountability must remain intact despite the decentralized nature of the technology used. Establishing an adaptive regulatory

framework is key to ensuring that land digitization aligns with the protection of citizens' rights and the principles of the rule of law.

Normative Conflict Between Information Disclosure and Personal Data Protection

The principle of information disclosure plays a crucial role in land administration because it directly relates to legal certainty for the public. The land registration system is designed to ensure that the legal status of a land plot is truly understood by all interested parties, including prospective buyers, creditors, and government institutions. This principle is rooted in the need to prevent disputes and ensure that every transaction is based on valid information. Regulations regarding information disclosure in Indonesia are stipulated in Law Number 14 of 2008 concerning Public Information Disclosure, which affirms the public's right to obtain information from public bodies. Land administration, as part of a public service, must balance transparency with the responsibility to safeguard certain data from misuse.

Transparency as a means of legal certainty is also reflected in the principle of publicity in agrarian law, particularly in the land registration system stipulated in Government Regulation Number 24 of 1997 concerning Land Registration. Land registration serves not only as an administrative record but also as a publication mechanism that provides legal protection for third parties. Access to land status information allows the public to conduct due diligence before making transactions. Administrative transparency helps prevent data manipulation or double transactions that can be detrimental to multiple parties. Information disclosure is a crucial instrument for maintaining the integrity of the national land system.

Public access to land status information often includes data on land area, location, type of land title, and records of land transfers. This information is necessary to ensure that transactions are conducted safely and transparently. Regulations provide the public with access to public information, but not all data is freely accessible. Article 17 of Law Number 14 of 2008 stipulates exceptions for information that could harm certain interests or violate individual privacy. Land administration must establish clear boundaries regarding which data is public and which must be protected.

The boundaries of public information have become a complex issue as digitalization increases the ability for widespread and rapid access. Information that was previously difficult to access physically is now available in integrated online systems. This situation raises questions about the extent to which transparency can be implemented without violating privacy rights. The principle of information classification is necessary to prevent the uncontrolled dissemination of sensitive data, such as owner identities or transaction values. Regulations must provide clear technical guidelines regarding access restriction mechanisms to maintain a balance between transparency and individual protection.

Protecting the personal data of land rights holders is becoming increasingly important with the development of digital registration systems. Law Number 27 of 2022 concerning Personal Data Protection provides a legal framework to protect individual data from misuse. Land ownership data can include full names, addresses, identity numbers, and highly sensitive economic information. This data relates not only to identity but also to potential security risks for the owner. Legal protection is necessary to ensure that administrative digitization does not create new vulnerabilities to privacy violations.

The concept of ownership data as personal data requires land agencies to comply with the data processing principles stipulated in the Personal Data Protection Law. The principle of consent requires valid consent before data is processed or shared with other parties. The principle of data minimization requires that only relevant and necessary data be collected. Purpose limitation requires that data be used in accordance with the original purpose for which it was collected. The right to correction gives individuals the right to correct inaccurate or incomplete data.

Normative conflicts in the blockchain ecosystem arise because the nature of this technology does not always align with the principles of personal data protection. Blockchain transparency provides permanent access to transaction history, while privacy protection requires restricting access to certain information. The conflict between transparency and privacy becomes more complex when land ownership data is stored in a ledger that is visible to multiple parties. Legal systems must define clear boundaries regarding the level of transparency that is permitted. Technology design must consider legal requirements from the earliest stages of development.

The immutable nature of blockchain creates new issues related to the right to data erasure. This principle is recognized in various modern data protection regimes, including international practices such as the European Union's GDPR. Once data is permanently recorded, modifying or deleting it becomes highly difficult. The right to correct inaccurate data may therefore be limited when the system architecture does not support revisions. This tension highlights the need for technical solutions, such as off-chain storage or specialized encryption, to preserve legal flexibility.

Moreover, blockchain traceability, while beneficial for transparency, may conflict with the principle of confidentiality. The ability to track entire transaction histories provides a high level of transparency, but can expose patterns of individual activity that should be private. Data that can be traced chronologically is at risk of being used for profiling without the data owner's consent. The balance between auditability and confidentiality protection is a key issue in the development of blockchain-based land systems. Regulations must define anonymization or pseudonymization standards that comply with data protection principles.

Distributed ledgers present new challenges to the concept of state accountability because data is not stored in a single central authority. A decentralized structure can improve system security, but it also raises questions about who is responsible in the event of a data breach. The state retains a constitutional obligation to protect citizens' rights, even if the technology used is distributed. Determining the role of data controller or data processor is crucial within the legal framework for personal data protection. The governance system must ensure an effective oversight mechanism.

Constitutional analysis is necessary to assess the balance between the right to information and the right to privacy as part of human rights. Article 28F of the 1945 Constitution of the Republic of Indonesia grants everyone the right to obtain information, while Article 28G paragraph (1) provides for the protection of privacy, honor, and security. Both rights are equally important and cannot be prioritized absolutely. The balancing test serves as a method to assess the proportionality of policies governing access to information and personal data protection. This approach helps ensure that the use of digital technology in land administration respects the principles of the rule of law and the protection of human rights.

Model of Regulatory Harmonization and Ideal Legal Design

An evaluation of Indonesian regulations related to land digitization needs to begin with the agrarian legal framework, which serves as the foundation for regulating land rights. Law Number 5 of 1960 concerning Basic Agrarian Regulations (UUPA) establishes the basic principles of land ownership and registration to ensure legal certainty for rights holders. Government Regulation Number 24 of 1997 concerning Land Registration provides the technical basis for the registration system, including the function of publishing land data as a means of legal protection for third parties. The digitization of land certificates through the ATR/BPN policy has implications for changes in evidence and data management mechanisms. The regulatory structure, originally designed for physical documents, requires new interpretations to accommodate digital technology-based systems.

Law Number 27 of 2022 concerning Personal Data Protection (UU PDP) is a relevant legal instrument for managing electronic certificates. Article 20 of the PDP Law regulates the principles of personal data processing, including a lawful basis for processing, clear purposes, and protection of data subjects' rights. Land ownership data containing individual identities can be categorized as personal data and, therefore, must be processed carefully. The data subject's right to access, correct, and delete data is regulated by several provisions, including Articles 5 and 11 of the PDP Law. The immutable nature of blockchain technology has the potential to create tension with the principle of the right to correct or delete such data.

Law Number 14 of 2008 concerning Public Information Disclosure provides the legal basis for transparency in state administration, including the management of land information. Article 2 states that all public information is open and accessible to the public, except for information that is exempted. Article 17 regulates categories of information whose access can be restricted, particularly if it relates to privacy protection or strategic state interests. Digital systems enable broader distribution of information than conventional methods. Challenges arise when the boundaries of public information have not been formulated in detail for the highly transparent environment of blockchain technology.

Law Number 11 of 2008 concerning Electronic Information and Transactions, as amended by Law Number 19 of 2016, legitimizes the use of electronic documents as legal evidence. Article 5, paragraph (1) states that electronic information and/or electronic documents constitute valid legal evidence. This recognition paves the way for the implementation of electronic certificates in land administration. Digital systems utilizing blockchain must still comply with the principle of electronic system reliability as stipulated in Article 15 of the ITE Law. The integration of these various regulations demonstrates overlapping norms that require harmonization to avoid conflicting interpretations.

Identification of regulatory gaps shows that there are no specific rules explicitly governing the use of blockchain in the national land registration system. Land regulations focus more on administrative aspects and proof of rights, while data protection regulations emphasize the security of personal information. The lack of norms regarding data correction mechanisms in immutable systems has the potential to create legal issues in the future. The overlap between information disclosure and personal data protection requires more detailed technical guidelines to ensure that technology implementation does not violate existing legal principles. Regulatory harmonization is a crucial step to ensure alignment between legal regimes.

International comparisons provide important perspectives for designing adaptive regulatory models. Estonia is known as one of the countries with an advanced digital land registration system through the integration of e-government and blockchain technology. The system uses a permissioned network approach that restricts access to authorized parties only. The integration of national digital identities allows for tighter access controls to sensitive data. This practice exemplifies how transparency and privacy protection can be balanced through appropriate technology design.

The European Union's approach through the General Data Protection Regulation (GDPR) provides high standards for personal data protection that can serve as a reference. The GDPR regulates the principles of lawfulness, fairness, transparency, data minimization, and accountability relevant to digital land data management. Data subject rights, such as the right to rectification and the right to erasure, emphasize the importance of flexibility in data processing systems. Challenges arise when using blockchain because its immutability can potentially conflict with the right to data erasure. Several European countries have adopted hybrid solutions that separate sensitive data from the main ledger.

Blockchain governance practices in other countries demonstrate a variety of comparable implementation models. Sweden has tested a blockchain-based land registration system to improve the efficiency of property transactions. Dubai is developing a blockchain government

project with the aim of increasing transparency in public administration. These implementation models do not always use public blockchains, but rather adopt private or permissioned networks. The choice of technological architecture is a key factor in maintaining the balance between openness and data protection.

A techno-legal harmonization model can begin with the use of permissioned blockchain as a more suitable solution for land administration. This system enables clear and structured access control so that only certain parties can view sensitive data. Permissioned blockchains maintain data integrity through a consensus mechanism but provide flexibility in setting access rights. This approach helps the state maintain control over data while leveraging the advantages of blockchain technology. Harmonization between technology and law can be achieved through a system design that aligns with data protection principles.

A layered access system is a crucial component of a harmonized design because it allows for data classification based on sensitivity levels. Public information, such as rights status, can be accessed on a limited basis, while the owner's personal data can only be accessed by authorized parties. The privacy-by-design principle requires that data protection be incorporated from the system design stage, not as an add-on after implementation. Off-chain storage for sensitive data provides a solution that allows the blockchain to store hashes or data references without revealing their true contents. Zero-knowledge proofs can be used to verify transactions without revealing personal data details.

The ideal governance design positions the state as the data controller, with primary responsibility for managing digital land data. This role aligns with the provisions of the PDP Law, which regulates the data controller's responsibility for data security and compliance. An audit mechanism is needed to ensure that the system operates according to legal and technical standards. Periodic audits can be conducted through an independent supervisory agency authorized to review the system's integrity. Clear governance helps prevent misuse of the technology while maintaining public trust.

Data correction mechanisms in immutable systems are a key challenge that must be addressed through legal and technological design. Possible solutions include adding a revision layer that records changes without deleting previous data. This approach maintains ledger integrity while also providing space for the right to correct data, as stipulated in the PDP Law. The governance system must establish clear procedures regarding who is authorized to make changes and how those changes are recorded. Harmonizing regulations and appropriate technological design can create a digital land registration ecosystem that balances transparency, security, and the protection of individual rights.

CONCLUSION

The development of blockchain-based electronic certificates presents a new dynamic that highlights the tension between the principle of information transparency and the obligation to protect personal data. The transparency inherent in blockchain holds strategic value in strengthening legal certainty and increasing public trust in the land registration system, but its immutable and traceable nature also has the potential to increase the exposure of land rights holders' personal data. National regulations already have a normative foundation through the Basic Agrarian Law (UUPA), Government Regulation No. 24 of 1997 concerning Land Registration, Law No. 14 of 2008 concerning Public Information Disclosure, Law No. 11 of 2008 in conjunction with Law No. 19 of 2016 concerning Electronic Information and Transactions, and Law No. 27 of 2022 concerning Personal Data Protection. An evaluation of these legal frameworks reveals overlapping norms that are not yet fully synchronized, particularly regarding the limits on land data transparency in digital systems and privacy protection mechanisms within distributed technology architectures. Regulatory harmonization

is an urgent need to ensure that technological innovation does not create legal uncertainty or violate citizens' constitutional rights.

Strategic recommendations should be directed toward reformulating the ATR/BPN policy, explicitly regulating the standards for the use of blockchain technology, including the classification of public and personal data in the digital land registration system. Integrating personal data protection principles from the system design stage is crucial to ensure the technology aligns with the provisions of the PDP Law, particularly regarding the principles of consent, data minimization, and the right to data correction. The chosen blockchain model should be based on a permissioned network with a layered access mechanism to ensure transparency without compromising the confidentiality of individual data. The use of off-chain storage for sensitive data and the application of cryptographic methods such as zero-knowledge proofs can be technical solutions that align with legal requirements. A techno-legal approach that integrates technology design and legal norms provides direction for the development of a digital land system that is more adaptive, accountable, and oriented toward protecting human rights.

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