

Research Article

Transformation of Agrarian Law and National Defense in Realizing a Sustainable Digital Land Administration System

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Abstract

The transformation of agrarian law and national defense is increasingly important in realizing a sustainable digital land administration system that can ensure legal certainty, administrative efficiency, data security, and equitable access to land resources. This study aims to analyze the transformation of agrarian law and its relationship with national defense in the development of digital land administration. This research employs a library research method by examining relevant legal regulations, scholarly literature, books, academic articles, and other authoritative sources concerning agrarian law, land administration, digital transformation, and national defense. The findings indicate that digital transformation in land administration requires legal adaptation, institutional strengthening, integrated data governance, and enhanced protection of land information. From a national defense perspective, accurate and secure land data are strategic assets for maintaining territorial sovereignty and preventing land-related conflicts. Therefore, the transformation of agrarian law should be aligned with technological development to establish a transparent, secure, integrated, and sustainable digital land administration system that supports legal certainty and national resilience.

Keywords: Agrarian Law; Digital Land Administration; National Defense.



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INTRODUCTION

Land administration in Indonesia is undergoing a fundamental transformation as the conventional agrarian governance model increasingly encounters the demands of digitalization, legal certainty, institutional integration, and national security. Land

is not merely an economic asset or an object of private ownership; it is also a strategic national resource whose administration is closely connected with spatial governance, state assets, public welfare, and national defense. In practice, however, Indonesia continues to face persistent problems involving overlapping land claims, inconsistent physical and juridical data, prolonged agrarian disputes, incomplete registration, and uncertainty concerning the legal status of land controlled for public and defense purposes. These challenges become particularly significant in the management of defense land. A 2024 study on land controlled by the Indonesian National Defense Forces (TNI) reported that, from approximately 337,331 hectares of land recorded under the Ministry of Defense and TNI organizational units, around 27,010 hectares had not been certified, while approximately 201,014 hectares remained subject to ownership-status problems and potential conflicts with communities and business entities. The study further identified differences between the Ministry of Defense and the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) in recognizing and administering land status as an important source of legal uncertainty. At the policy level, the continuing need for coordination between the Ministry of Defense, ATR/BPN, and the TNI to secure, certify, and administratively organize defense assets demonstrates that land administration has become inseparable from the protection of national strategic assets and the effectiveness of national defense. Thus, the problem is no longer simply whether land can be registered, but whether the agrarian legal system can produce an integrated, reliable, secure, and sustainable land information infrastructure capable of simultaneously guaranteeing legal certainty, protecting community rights, and supporting national defense (Kusmiarto et al., 2021).

The existing literature demonstrates that digitalization has considerable potential to address weaknesses in conventional land administration, but it has not yet fully resolved the legal and institutional problems underlying Indonesia's agrarian governance. Digital transformation is generally expected to make land services more efficient, transparent, accessible, interoperable, and capable of supporting sustainable development. Research on Indonesia's digital land-service readiness emphasizes that modern land administration requires systems that are *fit for purpose*, interoperable, inclusive, and sustainable rather than merely technologically advanced. Similarly, the *Fit-for-Purpose Land Administration* (FFPLA) approach argues that effective land administration should be designed according to actual social, institutional, technological, and legal conditions, with particular attention to tenure security and sustainable development. Indonesian studies of electronic land certificates have likewise identified improvements in administrative efficiency, accessibility, and document security, while simultaneously revealing continuing problems involving inadequate infrastructure, limited digital literacy, data overlap, institutional resistance, and legal uncertainty. More recent scholarship further indicates that electronic certificates cannot automatically guarantee legal certainty because questions concerning evidentiary strength, overlapping claims, historical land records, and the integration of juridical and spatial data remain unresolved. Meanwhile, studies concerning defense land reveal a different but closely connected problem: the legal framework governing agrarian land and the framework governing national defense have not been sufficiently integrated, particularly in relation to historically controlled defense land, administrative authority, certification, and community claims. Consequently, existing theories and approaches tend to examine these issues separately: digital transformation emphasizes technological modernization, agrarian law emphasizes land rights and legal certainty, while

national defense studies emphasize the protection and control of strategic land. Such fragmented approaches are insufficient to explain how legal transformation, digital land administration, data governance, and defense interests can be institutionally integrated into one sustainable land administration framework. The central literature gap therefore lies not in the absence of digitalization policies, but in the absence of a sufficiently integrated legal and governance framework that positions digital land administration as an instrument for simultaneously strengthening agrarian justice, legal certainty, state-asset protection, and national defense(Erfa, 2020).

Against this background, this study aims to analyze the transformation of agrarian law and national defense in realizing a sustainable digital land administration system in Indonesia. More specifically, the study seeks to examine how the transformation of Indonesia's agrarian legal framework can accommodate digital land registration and electronic land documentation while strengthening the legal certainty and integrity of land data; to analyze the relationship between digital land administration and the administration, protection, and certification of land designated for national defense; and to formulate an integrated legal and institutional framework capable of connecting agrarian governance, digital technology, spatial information, and national defense interests. The study also seeks to identify the regulatory and institutional gaps that hinder interoperability between land administration institutions and defense authorities and to determine the legal principles necessary for ensuring that digital transformation does not merely replace physical documents with electronic ones but fundamentally improves the reliability, transparency, security, accessibility, and sustainability of the national land administration system. This objective is consistent with the broader development of electronic land administration in Indonesia, particularly following the introduction of electronic land certificates and subsequent regulatory developments governing electronic land documents. Accordingly, the research moves beyond an assessment of whether digitalization is effective and instead investigates how agrarian law itself must transform to provide a legal foundation for an integrated digital land administration system that is capable of serving both civilian land governance and strategic national defense requirements(Widiyono & Khan, 2023).

The central argument of this study is that the sustainability of Indonesia's digital land administration system cannot be achieved through technological modernization alone; it requires a corresponding transformation and harmonization of agrarian law, institutional authority, land-data governance, and national defense policy. The persistence of uncertified defense land, conflicting claims, fragmented administrative records, and discrepancies between physical, juridical, and institutional recognition demonstrates that digitizing existing procedures without restructuring the underlying legal and institutional architecture may reproduce existing problems in digital form. Conversely, an integrated system that connects cadastral and registration data, strengthens legal recognition of electronic land records, establishes clear institutional responsibilities, protects sensitive defense-related information, and ensures interoperability among ATR/BPN, the Ministry of Defense, the TNI, and relevant local authorities has the potential to strengthen both legal certainty and national resilience. Recent scholarship on sustainable electronic land administration similarly emphasizes that successful digital transformation depends on the interaction of integrated land data, supportive regulation, institutional capability, security, and governance rather than technology alone. Therefore, this study advances the proposition that agrarian-law transformation should be understood as the legal-institutional foundation of sustainable digital land

administration, while national defense should be treated as an integral strategic dimension of land governance rather than as a separate administrative domain. On this basis, the study is important because it seeks to develop a more comprehensive conception of digital land administration—one that not only improves administrative efficiency and land-right certainty but also safeguards strategic state assets, reduces agrarian conflict, strengthens institutional coordination, and contributes to a resilient and sustainable national land governance system(Erwiningsih, 2023).

METHOD

The object of this study is the transformation of agrarian law and national defense governance in the development of a sustainable digital land administration system in Indonesia. The study focuses on the problems emerging from the transition from conventional to digital land administration, particularly those concerning legal certainty, land registration, electronic land certificates, data integration, institutional authority, overlapping land claims, and the protection and administration of land used for national defense purposes. These issues are examined as interconnected legal and institutional phenomena rather than as separate administrative problems. Particular attention is given to the extent to which the existing agrarian legal framework is capable of responding to technological transformation while simultaneously accommodating the strategic requirements of national defense. The object of analysis therefore encompasses the regulatory, institutional, and governance dimensions of digital land administration, including the relationship between agrarian law, electronic land records, spatial and juridical land data, state land assets, and defense land. Through this focus, the study seeks to understand the legal transformation required to establish a land administration system that is not only digitally efficient but also legally certain, institutionally integrated, secure, and sustainable(Huda et al., 2024).

This study employs a qualitative library research method, in which the analysis is conducted through systematic examination of written sources relevant to the transformation of agrarian law, national defense, and digital land administration. The primary data consist of authoritative and relevant literature addressing the series of problems associated with land administration transformation in Indonesia, including legislation and regulatory documents, scholarly books, academic publications, legal studies, and other authoritative written materials that directly discuss agrarian law, land registration, electronic land certificates, digital land administration, and defense land governance. Secondary data comprise supporting literature concerning the broader conceptual and theoretical dimensions represented by the principal keywords of the study, including agrarian law reform, digital transformation, land governance, land administration, legal certainty, sustainability, institutional integration, data governance, and national defense. These secondary sources are obtained from academic books, peer-reviewed journal articles, research reports, conference papers, dissertations, theses, and other scientific publications. The selection of literature is based on its relevance to the research questions, academic credibility, substantive contribution, and capacity to explain the relationship between legal transformation, digitalization, and strategic land governance. Accordingly, library research in this study is not limited to collecting descriptive information but is used to construct a comprehensive legal and conceptual understanding of the problem under investigation(Metaferia et al., 2023).

The theoretical foundation of this study combines Land Administration Theory, Fit-for-Purpose Land Administration (FFPLA), and the concept of sustainable land governance as complementary analytical perspectives. Land Administration Theory, particularly associated with the work of Peter F. Dale and John D. McLaughlin (1999) in Land Administration, conceptualizes land administration as a system involving the determination, recording, and dissemination of information concerning ownership, value, use, and development of land. This perspective provides the basic assumption that an effective land administration system requires reliable land information and institutional arrangements capable of supporting legal, economic, social, and environmental objectives. The study further adopts the Fit-for-Purpose Land Administration approach, developed through the work of Enemark, McLaren, and Lemmen (2014), which emphasizes that land administration systems should be flexible, affordable, inclusive, participatory, and capable of responding to the actual social, legal, institutional, and technological conditions of a particular country. In addition, the study employs the principles of sustainable land governance, which understand land administration as a mechanism that must balance economic development, social justice, environmental sustainability, legal certainty, and institutional accountability. The combination of these theoretical perspectives provides the analytical assumption that digitalization should not be regarded merely as the replacement of paper-based procedures with electronic technologies; rather, it represents a transformation of the legal, institutional, informational, and governance architecture of land administration. These theoretical foundations are therefore used to assess whether Indonesia's transformation of agrarian law and national defense land governance can support a digital land administration system that is legally reliable, institutionally coordinated, socially responsive, and sustainable (Gunarto et al., 2023).

The research process is conducted through several systematic stages of literature identification, collection, classification, examination, comparison, and synthesis. The first stage involves identifying literature relevant to the principal themes of the study, namely agrarian law transformation, digital land administration, electronic land certificates, land registration, land governance, national defense, defense land, legal certainty, and sustainability. The second stage involves collecting information from written sources, including academic books, statutory and regulatory materials, previous research, scholarly papers, peer-reviewed journal articles, research reports, dissertations, theses, institutional publications, and other relevant written documents. The collected literature is subsequently classified according to its substantive relevance, such as sources discussing the legal framework of land administration, sources examining digital transformation, sources addressing defense land and national defense interests, and sources providing theoretical and conceptual foundations. The third stage consists of close reading and critical examination of the selected sources to identify arguments, concepts, findings, regulatory developments, institutional problems, and proposed solutions relevant to the research objectives. The fourth stage involves comparing information obtained from different sources in order to identify similarities, differences, inconsistencies, developments, and unresolved issues. Finally, the relevant information is synthesized into an integrated analytical framework that explains the relationship between agrarian law transformation, digital land administration, and national defense. This process ensures that the conclusions of the study are derived from a systematic examination of the available literature rather than from isolated interpretations of

individual sources(Hafiddin et al., 2024).

The data obtained through the literature research are analyzed using content analysis. Content analysis is employed as a systematic technique for studying and processing textual information in order to identify recurring patterns, relationships, concepts, arguments, and significant information contained within the collected literature. The analysis begins with the organization and reduction of the collected materials by selecting information directly related to the research objectives. The relevant textual content is then coded and categorized into several analytical themes, including agrarian legal transformation, digital land administration, legal certainty, electronic land documentation, land-data integration, institutional coordination, defense land governance, national defense, and sustainability. The categorized information is subsequently examined comparatively to identify relationships between legal norms, institutional practices, technological developments, and governance challenges. Particular attention is given to inconsistencies between existing legal arrangements and the requirements of digital land administration, as well as to institutional gaps that may affect the protection of defense land and other strategic state assets. The final stage of analysis involves interpreting the identified patterns and relationships through the theoretical perspectives employed in the study. Through this process, content analysis enables the research to move beyond a descriptive review of literature toward an analytical synthesis concerning how agrarian law and national defense governance should be transformed to establish a sustainable, integrated, secure, and legally certain digital land administration system in Indonesia(Kadi et al., 2024).

RESULTS AND DISCUSSION

3.1. The Transformation of Agrarian Law as the Foundation of Digital Land Administration

The literature analysis demonstrates that the transformation of agrarian law is a fundamental prerequisite for establishing a sustainable digital land administration system in Indonesia. Land administration can no longer be understood merely as a bureaucratic process for registering land rights and issuing certificates. In the digital era, land administration has evolved into an integrated governance system involving legal norms, cadastral information, spatial data, institutional authority, electronic documents, data security, and public access. The *Fit-for-Purpose Land Administration* approach emphasizes that a land administration system should be designed according to the actual needs and institutional, legal, social, and technological conditions of a country rather than simply adopting technologically sophisticated solutions. Its framework identifies spatial, legal, and institutional frameworks as interconnected components of effective land administration. This finding is particularly relevant to Indonesia because the transition from conventional certificates to electronic land documents changes not only the form of documentation but also the mechanisms through which land information is created, validated, stored, accessed, transferred, and used as evidence. Therefore, agrarian legal transformation must provide a normative foundation capable of recognizing digital land information while preserving the principles of legal certainty, authenticity, transparency, accountability, and protection of land rights(Adinegoro, 2023).

The transformation is reflected in the development of Indonesia's regulatory framework for electronic land registration. Government Regulation Number 18 of 2021 provides a legal basis for electronic land registration, while Ministerial Regulation of ATR/BPN Number 3 of 2023 regulates the issuance of electronic documents in land-registration activities. Research examining the implementation of electronic registration under Government Regulation Number 18 of 2021 identifies practical challenges involving incomplete identity information, insufficient public understanding, local administrative practices, and inaccurate spatial coordinates. These findings indicate that the transformation of agrarian law cannot be reduced to regulatory recognition of electronic documents. The effectiveness of digital land administration depends on whether the legal framework is accompanied by accurate cadastral data, interoperable institutional systems, adequate technological infrastructure, competent human resources, and public understanding. Consequently, the transformation of agrarian law should be directed toward creating an integrated legal architecture in which substantive land rights and digital administrative procedures reinforce one another (Sanjaya, 2023).

3.2. Electronic Land Certificates and the Problem of Legal Certainty

One of the most significant findings concerns the relationship between electronic land certificates and legal certainty. Electronic certificates offer important administrative advantages because land information can be stored systematically, digitally authenticated, protected through technological mechanisms, and integrated within a national information system. Recent literature identifies encryption, audit trails, and data synchronization as potential advantages of electronic certificates. However, these technological features do not automatically eliminate substantive land disputes. A recent study of legal certainty in Indonesia's electronic land certificate system notes that overlapping claims, double certificates, weak integration of national land data, and questions regarding evidentiary strength remain important problems. Similarly, research on the legal protection of electronic certificate holders concludes that administrative validity requires reinforcement through stronger regulation and digital-security mechanisms. Thus, the research findings establish an important distinction between technical security and substantive legal certainty. A document may be technically secure against unauthorized alteration while the underlying land right may still be contested because of historical ownership, overlapping boundaries, incomplete registration, or conflicting evidence (Halim, 2025).

This distinction is particularly important in Indonesia's land-law system because digitizing problematic historical data does not automatically correct the substantive problems contained within that data. If an inaccurate boundary, duplicate ownership record, or disputed right is transferred into a digital database without prior verification, digitalization may simply reproduce the existing legal problem in a more technologically sophisticated form. Recent research on the transition from traditional to digital land administration in Ponorogo similarly reports that historical data overlap, inadequate infrastructure, and insufficient socialization constitute significant obstacles to digital transformation. Therefore, the transformation should follow a principle of "verify before digitize." Existing land records should undergo juridical and spatial verification before becoming part of an authoritative digital database. This principle would strengthen the credibility of digital land information and prevent the

national digital land administration system from becoming a repository of unresolved historical inconsistencies(Iqbal, 2025).

Table 1. Major Findings on the Transformation of Digital Land Administration

Dimension	Existing Problem	Finding from Literature	Required Transformation
Legal	Fragmented and evolving regulations	Electronic land administration requires stronger normative integration	Harmonization of agrarian, electronic-information, and land-registration regulations
Juridical data	Overlapping claims and historical inconsistencies	Digitalization does not automatically resolve substantive disputes	Verification and validation before digitization
Spatial data	Inaccurate boundaries and coordinates	Reliable cadastral data is essential	Integrated and continuously updated spatial database
Institutional	Fragmented authority	Digital land administration requires interoperability	Integrated coordination among ATR/BPN, local authorities, and other state institutions
Evidence	Questions concerning evidentiary strength	Electronic documents need clear legal recognition	Stronger rules concerning authenticity, evidence, and dispute resolution
Security	Cybersecurity and unauthorized access	Technical security is essential but insufficient	Multi-layer data security and access governance
Public access	Limited digital literacy	Digital transformation may create exclusion	Public education and inclusive digital services
Sustainability	Technology-focused modernization	Sustainable land administration requires legal, spatial, and institutional integration	Long-term governance framework

3.3. From Digitalization to Integrated Land Data Governance

The findings further indicate that the central challenge is not simply the digitization of documents but the establishment of integrated land-data governance. Land administration generates several categories of information, including juridical data concerning rights and legal status, physical data concerning boundaries and location, spatial data concerning land use, and institutional information concerning the authority responsible for land management. When these categories are maintained separately, the possibility of inconsistencies increases. Conversely, integration allows land parcels to be associated with a coherent set of legal, spatial, and administrative

information. The FFPLA framework is relevant because it emphasizes credible, complete, and usable land information rather than technological sophistication for its own sake. The framework specifically identifies the need for spatial, legal, and institutional arrangements that operate together (Marella & Silviana, 2024).

For Indonesia, this means that a sustainable digital land administration system should move toward a single authoritative land-information architecture in which each parcel has a consistent spatial identity, juridical status, ownership or control information, land-use status, and institutional history. Such integration would be particularly important for preventing double certification and identifying land-use conflicts. Studies concerning multiple certificates have demonstrated that weaknesses in land administration, including insufficient supervision, registration problems, and inadequate mapping, can contribute to overlapping claims and disputes. Therefore, digital transformation should be accompanied by mechanisms for continuous data synchronization and verification rather than treating the issuance of an electronic certificate as the final stage of administration (Habibi et al., 2025).

3.4. Agrarian Law Transformation and National Defense

The analysis reveals that national defense constitutes a strategic but insufficiently integrated dimension of land administration. Defense land is fundamentally different from ordinary privately controlled land because its management is connected with strategic state interests, military infrastructure, territorial security, and national sovereignty. Historical regulations concerning defense and security land have recognized the need to register defense land while simultaneously protecting information classified as sensitive or secret. This creates a distinctive governance requirement: defense land must be included within a reliable land administration system, but the information system must also accommodate differentiated levels of access and confidentiality (Hidayah et al., 2024).

The existence of land disputes involving defense institutions demonstrates the importance of accurate land registration and institutional coordination. Research on multiple land certificates involving national defense institutions in Bandung, for example, identifies inadequate land administration, registration problems, and insufficient supervision as factors contributing to disputes. At the state level, the Indonesian government has also emphasized the importance of maintaining and organizing government assets to prevent prolonged land problems, including assets managed by defense institutions. These findings indicate that defense land should not remain outside the broader transformation of the national land administration system. Instead, it should become part of the integrated system through a differentiated governance mechanism that combines administrative integration with information security (Aji, 2022).

3.5. The Defense-Land Data Paradox: Integration versus Confidentiality

An important conceptual finding of this study is what may be described as the defense-land data paradox. On the one hand, defense land requires integration into the national land administration system to guarantee legal certainty, prevent overlapping claims, protect state assets, and maintain accurate spatial records. On the other hand, unrestricted disclosure of detailed information concerning strategic defense

installations may create security risks. Historical regulations on defense land already recognize the necessity of maintaining confidentiality in defense-related land registration and documentation. Therefore, the solution should not be complete openness or complete institutional separation. Instead, Indonesia requires a tiered land-information governance model(Suyanto, 2021).

Under such a model, basic legal and administrative information could be accessible to authorized land administration institutions, while sensitive spatial information concerning military facilities, strategic installations, and defense infrastructure would be subject to restricted access. The digital system should consequently distinguish between public land information, institutional land information, restricted strategic information, and classified defense information. Such differentiation would allow the state to achieve interoperability without compromising national security. In this respect, national defense should be incorporated into digital land administration not as an exception that prevents integration but as a specialized governance category requiring differentiated access controls.

Table 2. Proposed Land-Information Governance Model for Defense Land

Information Category	Examples	Access Level	Governance Principle
Public	General parcel status, non-sensitive registration information	Public/limited public	Transparency
Administrative	Institutional ownership/control, registration history	Authorized institutions	Accountability
Strategic	Detailed location of strategic facilities	Restricted	Proportionality
Classified	Sensitive military infrastructure and operational information	Highly restricted	National security
Audit Data	Record of access, modification, and verification	Authorized auditors	Traceability

3.6. The Role of Interoperability in Sustainable Land Administration

The research findings indicate that institutional interoperability is as important as technological interoperability. A digital platform cannot create integrated governance if the institutions using that platform continue to operate according to separate databases, procedures, standards, and legal interpretations. The land administration system therefore requires interoperability among ATR/BPN, ministries and agencies managing state assets, local governments, defense institutions, and other relevant actors. The literature on FFPLA supports this perspective by treating the institutional framework as one of the three fundamental components of a functioning land administration system alongside spatial and legal frameworks.

Interoperability should include at least four dimensions: technical interoperability, data interoperability, legal interoperability, and institutional interoperability.

Technical interoperability concerns the ability of different information systems to communicate. Data interoperability concerns standardized formats and consistent identifiers. Legal interoperability concerns the compatibility of regulations governing access, use, verification, and evidentiary status of information. Institutional interoperability concerns the division of responsibilities among government bodies. Without these four dimensions, digitalization may create several isolated systems rather than one integrated national land administration infrastructure.

Table 3. Dimensions of Interoperability in Digital Land Administration

Dimension	Main Question	Strategic Requirement
Technical	Can systems communicate?	Compatible digital architecture
Data	Can information be exchanged and interpreted consistently?	Standardized land identifiers and data formats
Legal	Can data be legally recognized across institutions?	Harmonized regulations
Institutional	Who creates, verifies, updates, and controls data?	Clear authority and accountability
Security	Who may access sensitive information?	Role-based access and cybersecurity
Operational	Can information support decision-making?	Real-time or periodically synchronized data

3.7. Digital Land Administration as an Instrument of Agrarian Justice

The transformation of land administration should also be evaluated from the perspective of agrarian justice. A technologically sophisticated system does not necessarily produce a socially just system. The FFPLA approach emphasizes that land administration should support security of tenure for all and should be designed around people's actual relationships with land. This principle is important because digitalization can potentially generate a new form of inequality when individuals or communities lack access to digital services, adequate documentation, technological literacy, or the resources necessary to correct erroneous data.

The findings therefore suggest that sustainable digital land administration must retain mechanisms for human verification, administrative correction, dispute resolution, and participatory land governance. Digital systems should support legal processes rather than replace them. Where a community disputes the accuracy of digital land data, the system should provide an accessible mechanism for submitting objections and supporting evidence. Similarly, government officials should retain the authority and responsibility to verify disputed information. The digital system must therefore be conceived as a governance infrastructure rather than as an autonomous decision-making mechanism.

3.8. Cybersecurity and the Protection of Digital Land Rights

Another major finding concerns cybersecurity. The transformation from physical certificates to electronic documents changes the nature of risks associated with land rights. Conventional documents may be vulnerable to physical loss, destruction, or

forgery, whereas digital systems face risks involving unauthorized access, data manipulation, identity theft, system failure, ransomware, and cyberattacks. Recent Indonesian scholarship identifies cybersecurity and regulatory readiness as important determinants of public trust in electronic land certificates.

Consequently, cybersecurity should be treated as an integral component of agrarian legal certainty. The legal framework should regulate not only who owns or controls land but also who may create, modify, verify, access, and audit digital land information. An electronic certificate should be supported by mechanisms such as electronic signatures, authentication, encryption, access logs, data backups, disaster recovery, and continuous security auditing. The principle should be that the integrity of the land database is itself a component of the integrity of land rights. If the database can be manipulated without detection, the legal certainty provided by the electronic certificate becomes vulnerable.

3.9. Toward a Sustainable Digital Land Administration Model

Based on the synthesis of the literature, this study proposes that Indonesia's sustainable digital land administration should be constructed through five interconnected pillars: legal transformation, data integration, institutional interoperability, security governance, and social inclusion. These pillars should not operate independently. Legal transformation provides legitimacy; integrated data provides informational reliability; institutional interoperability provides administrative coordination; security governance protects information and strategic assets; and social inclusion ensures that digital transformation contributes to equitable access to land rights and public services.

Table 4. Proposed Framework for Sustainable Digital Land Administration

Pillar	Core Function	Expected Outcome
Legal Transformation	Harmonize agrarian and digital regulations	Legal certainty
Integrated Land Data	Connect juridical, physical, and spatial information	Reliable land information
Institutional Interoperability	Coordinate ATR/BPN, defense institutions, and local governments	Administrative consistency
Security Governance	Protect data and regulate differentiated access	Cybersecurity and national security
Social Inclusion	Provide access, education, verification, and dispute mechanisms	Agrarian justice
Continuous Updating	Maintain and audit land information	Long-term sustainability

The proposed framework is consistent with the fundamental principle of FFPLA that land administration should be sustainable, inclusive, affordable, and capable of providing secure land rights at scale. However, the present study extends this perspective by incorporating national defense as an explicit dimension of digital land governance. In this model, sustainability is not limited to environmental or

administrative sustainability but encompasses legal, institutional, technological, social, and national-security sustainability.

3.10. Synthesis: Transformation of Agrarian Law and National Defense

The overall findings demonstrate that the transformation of agrarian law and national defense should be understood as a process of institutional and legal restructuring rather than merely technological modernization. Electronic certificates, digital registration, and computerized land databases constitute important instruments, but their effectiveness depends on the quality of the legal and institutional environment in which they operate. Recent research confirms that electronic land certificates can improve administrative efficiency and data security but continue to face challenges involving legal certainty, overlapping claims, evidentiary issues, public trust, and regulatory reinforcement.

The principal contribution of the present study is therefore the integration of three domains that are frequently examined separately: agrarian law, digital land administration, and national defense. The study argues that defense land should be included within the national digital land administration architecture while being governed through differentiated security and access mechanisms. At the same time, digitalization must be accompanied by juridical verification, spatial validation, institutional interoperability, cybersecurity, and accessible dispute-resolution mechanisms. This approach prevents two opposite risks: first, the risk of treating defense land as an isolated administrative domain and thereby perpetuating fragmented records; and second, the risk of treating all land information as ordinary public data without considering national-security implications.

Table 5. Comparative Analysis: Conventional versus Sustainable Digital Land Administration

Aspect	Conventional System	Digital System	Sustainable Digital Model
Documentation	Physical certificates	Electronic certificates	Digitally authenticated and legally integrated documents
Data	Fragmented records	Centralized digital records	Integrated, verified, continuously updated data
Verification	Manual	System-assisted	Juridical + spatial + digital verification
Institutional relations	Sectoral	Partially connected	Fully interoperable
Defense land	Separate/limited integration	Digitally recorded	Integrated with differentiated security controls
Security	Physical protection	Cybersecurity	Cybersecurity + national-security governance
Public service	Office-based	Online	Hybrid, inclusive, and accessible

Disputes	Often reactive	Data-assisted	Preventive, traceable, and evidence-based
Sustainability	Administrative continuity	Technological modernization	Legal, institutional, technological, social, and security sustainability

3.11. Discussion of the Research Proposition

The findings support the proposition formulated in the Introduction that technology alone cannot establish a sustainable digital land administration system. Digital transformation becomes meaningful only when technological change is accompanied by corresponding changes in agrarian law, institutional relationships, data governance, and national defense policy. This proposition is supported by the literature showing that electronic land certificates can provide technical advantages while leaving unresolved questions concerning substantive legal certainty and evidentiary status. It is also consistent with the FFPLA approach, which rejects the assumption that sophisticated technology by itself constitutes an effective land administration system and instead emphasizes fit-for-purpose spatial, legal, and institutional frameworks.

Accordingly, the transformation of agrarian law should be directed toward the creation of an integrated and adaptive legal framework. Such a framework should recognize electronic land information, establish clear rules regarding its evidentiary status, ensure the authenticity and integrity of digital records, regulate institutional responsibilities, and establish differentiated access to sensitive information. In relation to national defense, the framework should guarantee that defense land is registered, spatially identified, and legally protected while preventing sensitive military information from being unnecessarily exposed. In relation to the public, it should guarantee accessibility, transparency within appropriate limits, and effective mechanisms for correcting inaccurate information and resolving disputes.

The ultimate finding is that a sustainable digital land administration system should function as national legal and governance infrastructure, rather than merely as an electronic replacement for paper certificates. Its sustainability depends on the capacity of the legal system to adapt to technological change, the ability of institutions to share reliable information, the protection of strategic state assets, and the inclusion of citizens in the digital transformation process. In this context, agrarian law provides the normative foundation, digital technology provides the infrastructure, integrated land data provides the informational foundation, institutional interoperability provides the governance mechanism, and national defense provides a strategic-security dimension. The convergence of these elements offers a more comprehensive pathway toward a resilient Indonesian land administration system capable of supporting legal certainty, agrarian justice, state-asset protection, national defense, and sustainable development.

3.12. Main Research Findings

The content analysis can therefore be summarized into the following principal findings:

No.	Main Finding	Implication
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1	Digitalization alone does not guarantee legal certainty	Agrarian law must transform alongside technology
2	Historical land-data inconsistencies can be reproduced digitally	Data must be verified before digitization
3	Electronic certificates strengthen administrative efficiency but do not automatically eliminate disputes	Substantive verification remains necessary
4	Defense land requires integration into the national land system	Defense land cannot remain institutionally isolated
5	Defense-related information requires differentiated access	Integration must coexist with confidentiality
6	Institutional interoperability is essential	ATR/BPN and relevant state institutions require coordinated governance
7	Cybersecurity is part of land-right protection	Digital land databases require continuous security controls
8	Digital transformation can create exclusion	Public digital literacy and alternative access mechanisms are necessary
9	Sustainable land administration requires legal, spatial, and institutional integration	FFPLA principles are highly relevant
10	National defense should be treated as a strategic dimension of land governance	Agrarian and defense policies should be harmonized

Overall Discussion

Taken together, the findings establish that the transformation of agrarian law and national defense should be positioned within a broader paradigm of sustainable digital land governance. The Indonesian experience demonstrates that the transition from physical to electronic land administration is not simply a technological project. It is a legal and institutional transformation that affects the meaning of evidence, the management of state assets, the protection of land rights, the relationship between government institutions, and the security of strategic information. Existing literature confirms that electronic certificates offer significant opportunities for improving administrative efficiency and data management, but unresolved issues involving overlapping claims, evidentiary strength, regulatory coherence, infrastructure, public literacy, and cybersecurity remain.

Therefore, the sustainable model proposed by this research rests on a simple but fundamental principle: digital land administration must be legally valid, spatially accurate, institutionally interoperable, technologically secure, socially inclusive, and strategically compatible with national defense requirements. The transformation of agrarian law becomes the foundation that connects these dimensions. Without legal transformation, digitalization risks becoming merely administrative modernization. With legal and institutional transformation, however, digital land administration can become an instrument for strengthening legal certainty, reducing land conflicts, protecting state assets, improving public services, and supporting national resilience.

CONCLUSION

This study concludes that the transformation of agrarian law is a fundamental

prerequisite for realizing a sustainable digital land administration system in Indonesia. The findings demonstrate that digitalization through electronic land registration and electronic land certificates cannot, by itself, resolve persistent problems of legal uncertainty, overlapping land claims, inaccurate spatial information, fragmented institutional authority, and incomplete administration of strategic state assets. A sustainable digital land administration system requires the simultaneous transformation of legal norms, land-data governance, institutional coordination, cybersecurity, and public accessibility. In this context, the principles of Fit-for-Purpose Land Administration provide an important foundation because they emphasize the integration of spatial, legal, and institutional frameworks according to the actual conditions and needs of land governance. The study therefore establishes that digital transformation should be understood not merely as the conversion of physical documents into electronic formats, but as a comprehensive restructuring of the legal and institutional architecture governing land rights, registration, information, and public administration.

Furthermore, the study concludes that national defense must be positioned as an integral strategic dimension of digital land administration rather than as a separate administrative domain. Defense land requires reliable registration, juridical and spatial verification, institutional interoperability, and continuous data updating to ensure legal certainty and protect state assets; at the same time, sensitive defense information requires differentiated access and strong security governance. Accordingly, the sustainable model proposed by this study rests on five interconnected principles: legal harmonization, integrated and verified land data, institutional interoperability, differentiated information security, and social inclusion. The integration of these principles can strengthen legal certainty, prevent land-data conflicts, protect defense assets, improve administrative efficiency, and support national resilience. The principal implication is that Indonesia's future land administration policy should pursue technological innovation together with agrarian legal reform and defense-governance integration, thereby transforming digital land administration into a resilient national governance infrastructure capable of supporting agrarian justice, state-asset protection, national defense, and sustainable development.

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