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Civil law analysis of digital asset ownership disputes in the development of the modern economy

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ABSTRACT

The rapid development of blockchain-based assets created legal uncertainty regarding their proprietary status and the resolution of ownership disputes under conventional civil law. This study examined the legal characteristics of digital assets, the distinction between technological control and legal ownership, and the adequacy of Indonesian civil law in protecting proprietary interests in the modern digital economy. The study employed normative legal research with a qualitative library research approach through statutory, conceptual, and comparative analyses of legal materials and relevant scholarly literature. The findings demonstrated that digital assets fulfilled essential proprietary characteristics, including identifiable ownership, exclusive control, economic value, transferability, and legal enforceability. The study further found that cryptographic control did not necessarily establish lawful ownership and that Indonesian law remained doctrinally fragmented in addressing blockchain-based property. The study proposed a functional property-rights framework that distinguished technological control from legal entitlement and supported a technology-neutral interpretation of property law. It concluded that strengthening legal certainty required the modernization of Indonesian civil property law while preserving its fundamental doctrinal principles.



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Introduction

The rapid expansion of digital technology has fundamentally transformed the structure of the global economy, giving rise to new forms of economic interaction, investment, and wealth creation that transcend geographical boundaries. The emergence of blockchain technology has accelerated this transformation by introducing decentralized systems capable of recording, transferring, and verifying ownership without centralized intermediaries. Consequently, digital assets—including cryptocurrencies, non-fungible tokens (NFTs), tokenized securities, virtual land, digital collectibles, and other blockchain-based assets—have evolved into economically valuable resources that are increasingly traded, invested, inherited, and commercialized across various digital platforms. Unlike conventional assets, digital assets derive their value from cryptographic authentication, decentralized ledger systems, and programmable ownership mechanisms, allowing ownership rights to be exercised in ways that differ significantly from traditional property arrangements. The rapid growth of decentralized finance (DeFi), tokenization, and blockchain-

based investment ecosystems further demonstrates that digital assets have become an integral component of the modern digital economy rather than merely a technological innovation (Davidson et al., 2018; De Filippi & Wright, 2018; Werbach, 2018b, 2018a; Zetsche et al., 2020). As digital assets continue to gain substantial economic value, legal systems are increasingly challenged to ensure that ownership rights receive adequate legal recognition and protection while maintaining legal certainty for individuals, businesses, and market participants operating within digital environments (Finck, 2019; Yaga et al., 2019).

Despite their growing economic significance, digital assets present legal characteristics that differ considerably from conventional objects governed by classical civil law. Ownership of blockchain-based assets is generally established through cryptographic control of private keys and distributed ledger verification rather than through physical possession, centralized registration, or documentary evidence traditionally recognized under property law. These distinctive characteristics have generated complex legal questions concerning whether digital assets should be recognized as proprietary rights, contractual interests, or merely digital information without independent legal status. Such uncertainty has become increasingly apparent as ownership disputes emerge from unauthorized access to digital wallets, cyberattacks, fraudulent token transfers, smart contract failures, exchange insolvencies, inheritance claims, and cross-border transactions involving multiple legal jurisdictions. These issues are particularly evident in NFT ownership disputes, where decentralized transactions frequently generate complex questions concerning jurisdiction, applicable law, and the recognition of proprietary rights across legal systems (Pradipta & Putri, 2026). The absence of universally accepted legal principles governing ownership, transferability, and legal remedies has consequently created substantial challenges for courts, regulators, and legal practitioners seeking to resolve disputes involving digital assets (Allen, 2019; Low & Teo, 2017). As digital transactions become increasingly integrated into commercial activities, resolving ownership disputes can no longer rely exclusively on conventional interpretations of tangible property but instead requires a broader understanding of proprietary interests capable of accommodating technological developments and the evolving nature of digital wealth (Chan, 2023; Garcia-Teruel & Simón-Moreno, 2021).

Recent legal scholarship has made significant progress in explaining the legal implications of blockchain technology and digital assets from various perspectives. Early studies primarily focused on determining whether cryptocurrencies could be recognized as objects of property under existing legal systems, concluding that conventional legal doctrines require reinterpretation to accommodate decentralized digital assets (Low & Teo, 2017; Allen, 2019). Subsequent studies expanded the discussion by examining tokenization and non-fungible tokens (NFTs), arguing that blockchain technology has transformed ownership into digitally verifiable and programmable proprietary interests capable of representing both tangible and intangible assets (Fairfield, 2021; Garcia-Teruel & Simón-Moreno, 2021). More recent comparative legal scholarship further confirms that cryptoassets increasingly satisfy the essential characteristics of proprietary rights despite their intangible and decentralized nature (Aksoy, 2023; Chan, 2023; Fernandez-Lopez, 2026; Jeng et al., 2025; Lee, 2024). At the same time, studies on decentralized finance have demonstrated that blockchain-based financial ecosystems have substantially increased the volume, complexity, and diversity of digital asset transactions, thereby intensifying legal questions concerning ownership, transferability, control, and dispute resolution (Zetsche et al., 2020). Collectively, these studies demonstrate that digital assets have evolved beyond technological innovation into legally significant economic resources requiring greater doctrinal clarity within property law.

Although previous studies have substantially enriched scholarly understanding of digital assets, several important issues remain insufficiently addressed. First, much of the existing literature examines cryptocurrencies, NFTs, tokenization, decentralized finance, or blockchain governance as separate legal phenomena, resulting in fragmented analyses of digital asset ownership. Second, comparative studies predominantly focus on the recognition of digital assets as property without comprehensively examining how ownership disputes should be resolved within civil law systems, particularly in jurisdictions whose property regimes continue to rely heavily on classical concepts of tangible and intangible property. Third, Indonesian legal scholarship has generally concentrated on regulatory aspects of cryptocurrency trading or the legal status of specific digital assets, while limited attention has been devoted to developing an integrated civil law framework capable of addressing ownership, transfer, inheritance, collateralization, and judicial protection of digital assets as a unified category of property (Bintarto, 2022; Ramadhan & Dadek, n.d.; Sanjaya, 2026; Wijaya et al., 2025). Consequently, there remains a significant theoretical and practical gap regarding how civil law principles should be reconstructed to accommodate ownership disputes arising from the rapid expansion of the modern digital economy. Addressing this gap is essential because legal certainty concerning ownership constitutes the foundation for market confidence, investment security, and effective dispute resolution in increasingly digitalized economic transactions.

Indonesia has experienced significant growth in digital economic activities, accompanied by the increasing adoption of cryptocurrencies, tokenized assets, blockchain-based investment platforms, and other forms of digital property. This development has encouraged the government to strengthen the legal framework governing electronic transactions, personal data protection, and the financial sector through several legislative reforms, including the Law on Electronic Information and Transactions, the Personal Data Protection Law, and the Law on the Development and Strengthening of the Financial Sector (Indonesia, 2008, 2022, 2023). Nevertheless, these legislative instruments primarily regulate electronic systems, digital transactions, data governance, and financial supervision rather than establishing comprehensive civil law principles governing ownership rights over digital assets. Likewise, the Indonesian Civil Code (*Kitab Undang-Undang Hukum Perdata*) continues to conceptualize property rights through traditional classifications that were developed long before blockchain technology and decentralized digital assets emerged as economically valuable objects (Gozali & Hafidah, 2023; Subekti, 1978; Subekti & Tjitrosudibio, 2009). Consequently, fundamental legal questions remain unresolved regarding the legal classification of digital assets, the acquisition and transfer of ownership, evidentiary standards in ownership disputes, inheritance, collateralization, and the legal remedies available when digital assets become the subject of civil litigation. This regulatory fragmentation illustrates the need for a more coherent civil law framework capable of responding to the realities of the modern digital economy.

Against this background, this study aims to examine digital asset ownership disputes from the perspective of civil law by analyzing the legal characteristics of digital assets, evaluating the adequacy of existing Indonesian civil law in protecting ownership rights, and comparing contemporary developments in selected jurisdictions that have progressively recognized digital assets as proprietary interests. This research employs qualitative legal research using a library research approach by examining statutory regulations, legal doctrines, comparative legal scholarship, and academic literature concerning digital assets and property law. Rather than focusing solely on cryptocurrencies or non-fungible tokens as isolated legal phenomena, this study conceptualizes digital assets as an integrated category of proprietary objects whose ownership should be assessed through the fundamental principles of civil law. Through this approach, the research seeks to provide a more comprehensive understanding of the relationship between technological innovation and property law while identifying legal issues that continue to hinder effective protection of digital asset ownership in Indonesia.

The principal contribution of this study lies in its effort to bridge the conceptual divide between traditional civil law doctrines and the rapidly evolving digital economy by proposing a systematic framework for analyzing digital asset ownership disputes. Unlike previous studies that predominantly examine regulatory compliance, financial technology, or specific categories of digital assets, this research develops an integrated civil law perspective that places ownership rights at the center of legal analysis. Such an approach contributes theoretically by enriching contemporary discourse on property law in relation to emerging digital assets, practically by providing analytical guidance for judges, legal practitioners, policymakers, and market participants involved in resolving ownership disputes, and normatively by supporting future legal reform aimed at strengthening legal certainty within Indonesia's digital economy. Ultimately, by clarifying the legal status of digital assets as potential objects of civil property rights and identifying the limitations of the current legal framework, this study is expected to contribute to the ongoing development of a more adaptive, coherent, and technology-responsive system of civil law capable of addressing the challenges of digital economic transformation.

Method

This study employed a normative legal research design using a qualitative approach to examine civil law issues concerning digital asset ownership disputes in the development of the modern digital economy. Normative legal research was selected because the primary objective of this study was to analyze legal norms, statutory regulations, legal doctrines, and scholarly arguments rather than to investigate empirical behavior or measure quantitative variables. Accordingly, the study focused on evaluating the adequacy of existing civil law principles in regulating ownership rights over digital assets and identifying legal gaps that contribute to ownership disputes. The research adopted a library research method in which legal arguments were developed through a systematic examination of legal materials and academic literature. The analysis was limited to legal issues concerning ownership, transfer, legal protection, dispute resolution, inheritance, and proprietary interests in digital assets within the context of civil law. This methodological scope was considered appropriate because the legal recognition of digital assets remains a normative issue requiring doctrinal interpretation rather than empirical verification.

The corpus of legal materials consisted of primary, secondary, and tertiary legal sources selected purposively according to their relevance to the research objectives. Primary legal materials included the Indonesian Civil Code (*Kitab Undang-Undang Hukum Perdata*), Law Number 11 of 2008 concerning Electronic Information and Transactions and its subsequent amendments, Law Number 27 of 2022 concerning Personal Data Protection, and Law Number 4 of 2023 concerning the Development and Strengthening of the Financial Sector. Secondary legal materials comprised peer-reviewed journal articles, scholarly books, conference proceedings, and comparative legal studies published between 2017 and 2026 addressing digital assets, blockchain technology, cryptoassets, tokenization, decentralized finance, property law, civil law, inheritance, and secured transactions. The literature also included comparative studies on ownership regimes (Eggen et al., 2026), digital patrimony (Fernandez-Lopez, 2025), Islamic perspectives on cryptoassets (Ahmed, 2024), blockchain property systems (Konashevych, 2020), and blockchain consensus mechanisms relevant to digital asset governance (Bano et al., 2019). To ensure the relevance and quality of the literature, only academic publications directly discussing legal aspects of digital asset ownership or property rights were included, while publications focusing exclusively on technical blockchain engineering, computer science, or investment analysis without legal discussion were excluded. Tertiary legal materials, including legal dictionaries, official reports, and authoritative academic databases, were consulted to clarify legal terminology and support conceptual interpretation where necessary.

Legal materials were collected through a systematic document review following four sequential stages. First, relevant legislation and academic publications were identified based on predetermined keywords, including digital assets, property rights, civil law, cryptoassets, blockchain, tokenization, and ownership disputes. Second, the identified materials were screened according to publication quality, legal relevance, publication period, and consistency with the research objectives. Third, the selected legal materials were classified into thematic categories consisting of (i) legal concepts of digital assets, (ii) characteristics of proprietary rights, (iii) ownership and transfer mechanisms, (iv) civil law disputes involving digital assets, (v) comparative legal developments, and (vi) legal reform in Indonesia. Finally, information extracted from each source was synthesized through comparative reading and legal interpretation to identify converging legal principles, doctrinal inconsistencies, and unresolved legal issues concerning ownership disputes. This structured procedure was intended to ensure transparency and enable other researchers to replicate the literature selection and analytical process using comparable inclusion criteria.

The collected legal materials were analyzed using an integrated doctrinal approach combining the statute approach, conceptual approach, and comparative approach. The statute approach was employed to examine the coherence between Indonesian legislation and the legal issues arising from digital asset ownership. The conceptual approach was applied to evaluate whether digital assets satisfy the essential characteristics of proprietary objects under civil law by analyzing concepts of ownership, possession, transferability, exclusivity, and legal protection developed in contemporary legal scholarship. The comparative approach was used to examine legal developments in selected jurisdictions that have progressively recognized digital assets as proprietary interests, enabling the identification of legal principles potentially adaptable to the Indonesian legal system. Data analysis followed qualitative legal reasoning through descriptive, analytical, interpretative, and comparative techniques, allowing statutory provisions and legal doctrines to be critically examined within the broader context of technological developments and the digital economy.

To enhance the credibility of the findings, this study employed doctrinal triangulation by comparing statutory provisions, judicial and scholarly interpretations, and comparative legal scholarship addressing similar legal issues. Cross-referencing among legal sources was conducted to minimize interpretative bias and to ensure consistency in legal reasoning. The analysis assumed that digital assets possess sufficient economic value and legal significance to warrant examination under civil property law principles, regardless of differences in technological architecture or regulatory classification. Nevertheless, this study has several limitations. First, the analysis is confined to normative legal materials and therefore does not evaluate judicial practice or empirical behavior of market participants. Second, comparative analysis is limited to jurisdictions that have demonstrated significant legal developments concerning digital assets and does not seek to compare all existing legal systems comprehensively. Finally, given the rapid evolution of blockchain technology and digital financial markets, future legislative developments may require further refinement of the legal framework proposed in this study.

Results and Discussions

This study finds that the most fundamental issue surrounding digital assets is no longer whether they possess economic value, but whether they can be recognized as proprietary objects under contemporary civil law. The doctrinal analysis undertaken in this research demonstrates that digital assets have evolved beyond technological innovations into legally significant assets that increasingly perform the same economic and juridical functions as conventional forms of property. Unlike traditional tangible objects, digital assets derive their existence from decentralized blockchain networks and are controlled through cryptographic mechanisms rather than physical possession. Nevertheless, the absence of physical form does not negate their proprietary character because ownership in modern civil law is ultimately defined by the legal relationship between a person and an economically valuable object rather than by materiality alone. This finding indicates that the defining elements of ownership—exclusive control, transferability, economic value, and legal protection—may also be fulfilled by blockchain-based assets, thereby justifying their recognition within the contemporary law of property. Accordingly, the principal challenge for civil law is not to create an entirely new institution of ownership, but to reinterpret existing proprietary doctrines so that they remain capable of accommodating digital assets without undermining the fundamental principles of legal certainty and ownership protection.

This interpretation is supported by the comparative legal literature reviewed in this study. Allen (2019) argues that the central question of private law should not be confined to determining whether digital coins constitute money, commodities, or securities, but rather whether they should be recognised as legally ownable objects. Allen further proposes the concept of *res digitales* to explain that digital assets represent a new category of property existing natively within digital environments rather than merely constituting contractual rights or electronic information. Likewise, Chan (2023) observes that contemporary legal discourse should move beyond debating the legal status of cryptoassets and instead focus on how proprietary rights—including ownership, transfer of title, and legal protection—operate within blockchain ecosystems. Collectively, these arguments reinforce the present finding that the legal significance of digital assets derives from their proprietary function rather than from their technological architecture alone. Consequently, ownership should be assessed according to the legal consequences produced by an asset instead of its physical characteristics, allowing civil law to evolve consistently with technological developments without abandoning its conceptual foundations.

The present study also finds that the functional characteristics of digital assets increasingly correspond with the essential attributes traditionally associated with property rights. Blockchain technology enables the exclusive control of assets through cryptographic authentication, permits voluntary transfer between parties without requiring centralized verification, records ownership history through immutable distributed ledgers, and creates economically valuable interests capable of commercial exploitation. These characteristics distinguish digital assets from ordinary digital information, which may be copied or reproduced indefinitely without affecting ownership. By contrast, blockchain-based assets possess identifiable ownership and scarcity, enabling them to function as transferable proprietary interests. Fairfield (2022) explains that tokenization fundamentally transforms the legal representation of ownership because blockchain tokens may embody legally transferable interests in both tangible and intangible assets. Similarly, Garcia-Teruel and Simón-Moreno (2021) demonstrate that tokenization enables ownership rights to be represented digitally without eliminating the legal principles governing proprietary protection. Rather than replacing civil law, blockchain technology therefore provides a new technological mechanism through which ownership rights may be created, exercised, and transferred. This conclusion strengthens the argument that digital assets satisfy the substantive characteristics required for recognition as objects of property under civil law.

Another important finding emerging from this study is that recognizing digital assets as proprietary objects does not require abandoning the traditional principles of civil law. Instead, it requires adopting a functional interpretation of ownership capable of responding to technological innovation while preserving the core values of property law. Comparative legal developments demonstrate an increasing convergence between common law and civil law jurisdictions in recognising that economically valuable digital assets deserve proprietary protection despite differences in doctrinal approaches. Çağlayan Aksoy (2023) argues that both legal traditions increasingly acknowledge the applicability of property law principles to cryptoassets, although they employ different analytical frameworks. Likewise, Garcia-Teruel & Simón-Moreno (2021) concludes that without recognising digital assets as property, legal systems cannot adequately protect ownership, inheritance, transfer, or enforcement rights, thereby undermining legal certainty within digital markets. These comparative developments support the principal finding of this study that digital assets should no longer be viewed as exceptional technological phenomena but as a natural extension of property

law responding to the transformation of wealth in the modern digital economy. Accordingly, the recognition of digital assets as proprietary objects constitutes the doctrinal foundation upon which effective civil law protection and dispute resolution must subsequently be constructed.

The second major finding of this study is that ownership disputes involving digital assets primarily arise from the growing separation between technological control and legal ownership. The doctrinal analysis indicates that blockchain technology establishes ownership through cryptographic control of private keys, whereas civil law traditionally determines ownership through legally recognized acts, documentary evidence, and statutory rules governing acquisition and transfer of property rights. Although blockchain enables an individual possessing a private key to exercise exclusive control over a digital asset, such control does not necessarily establish lawful ownership. In many situations, technological control may result from unauthorized access, cyberattacks, phishing schemes, fraudulent transfers, smart contract vulnerabilities, or other unlawful acts that do not extinguish the legitimate proprietary interests of the original owner. Consequently, blockchain verification should not be interpreted as conclusive evidence of legal ownership because distributed ledger technology records transactional validity rather than the legality of the underlying legal relationship. This finding demonstrates that ownership disputes concerning digital assets remain fundamentally civil law disputes involving entitlement, proprietary protection, and legal accountability, rather than purely technical disputes concerning blockchain authentication.

This distinction between *de facto* technological control and *de jure* legal ownership represents one of the most significant legal implications emerging from the present research. Classical civil law recognizes ownership as a legal relationship that confers the broadest authority over an object while simultaneously imposing legal limits and obligations upon the owner. By contrast, blockchain technology recognizes only cryptographic authority, allowing transactions to be executed automatically without assessing the legal legitimacy of the person initiating the transfer. Consequently, situations frequently arise in which an individual possesses effective technological control over a digital asset despite lacking lawful proprietary entitlement. Conversely, a lawful owner may lose practical access to an asset through theft of private keys, fraudulent wallet recovery, unauthorized smart contract execution, or exchange insolvency while retaining a legitimate legal claim under property law. These circumstances reveal that blockchain technology cannot independently determine proprietary rights because technological authentication and legal entitlement operate according to fundamentally different normative principles. Therefore, the resolution of digital asset ownership disputes ultimately depends upon legal reasoning capable of distinguishing lawful ownership from mere technological control.

The comparative literature reviewed in this study strongly supports this interpretation. Chan (2023) argues that contemporary property law should focus not on the abstract classification of cryptoassets but on determining how proprietary rights are acquired, transferred, protected, and enforced within blockchain systems. This approach shifts legal analysis from technological characteristics toward the legal consequences generated by blockchain transactions. Likewise, Fairfield (2021) emphasizes that digital assets, particularly non-fungible tokens, should be treated as personal property because ownership disputes concern proprietary entitlement rather than contractual performance alone. Similarly, Garcia-Teruel and Simón-Moreno (2021) observe that tokenization modifies the technological representation of ownership but does not eliminate the necessity of legal rules governing title, transfer, and protection of proprietary interests. Collectively, these studies indicate that blockchain technology facilitates ownership transactions but does not replace the legal doctrines required to determine whether those transactions produce legitimate proprietary consequences. The present study therefore argues that technological innovation should be understood as complementing, rather than substituting, civil law institutions responsible for protecting ownership rights.

The findings also demonstrate that the decentralised nature of blockchain significantly complicates evidentiary standards in civil litigation. Under conventional property law, ownership disputes are generally resolved through documentary evidence, registration systems, contractual instruments, or physical possession. In contrast, blockchain-based transactions are evidenced through distributed ledger records, digital wallet addresses, transaction hashes, and cryptographic signatures, none of which independently establish the legal identity or lawful entitlement of the parties involved. Consequently, civil courts cannot rely exclusively upon blockchain records when determining ownership because technological evidence merely confirms that a transaction occurred, not that it occurred lawfully. Instead, judges must evaluate blockchain evidence together with contractual relationships, statutory provisions, surrounding factual circumstances, and general principles of civil law. This integrated evidentiary approach preserves legal certainty while preventing blockchain technology from becoming a mechanism through which unlawful transfers automatically acquire legal legitimacy.

Another important implication concerns the relationship between decentralisation and legal accountability. One of the central narratives surrounding blockchain technology is that decentralisation eliminates the need for institutional intermediaries and reduces reliance on legal regulation. However, the present analysis does not support this proposition. Rather, decentralisation redistributes legal risks among users, software developers, digital asset exchanges, wallet providers, and network participants, thereby creating new forms of legal responsibility rather than eliminating existing ones. Zetzsche et al. (2020) similarly explain that decentralised finance does not remove the role of law but instead requires legal systems to develop regulatory and private law mechanisms capable of governing new institutional arrangements created by blockchain technology. Accordingly, ownership disputes within decentralised ecosystems continue to require legal institutions capable of allocating responsibility, protecting legitimate owners, and providing effective civil remedies when digital assets are unlawfully transferred or misappropriated. This finding reinforces the argument that civil law remains indispensable to the governance of digital assets despite the technological autonomy offered by blockchain systems.

Taken together, these findings demonstrate that the principal legal challenge does not arise from blockchain technology itself but from the absence of an integrated legal framework capable of reconciling technological control with proprietary entitlement. Recognising this distinction provides an important conceptual foundation for the future development of civil law because it clarifies that ownership disputes involving digital assets cannot be resolved exclusively through technological verification or contractual interpretation. Instead, they require a coherent doctrinal framework capable of integrating blockchain-generated evidence into the broader system of property law while preserving the fundamental principles of ownership, legal certainty, fairness, and judicial protection. Consequently, any future reform of Indonesian civil law should prioritize the development of legal standards governing ownership verification, evidentiary assessment, and proprietary remedies applicable to blockchain-based assets rather than focusing exclusively on technological regulation.

The third major finding of this study is that the legal uncertainty surrounding digital asset ownership in Indonesia is fundamentally rooted in the conceptual limitations of the existing civil law regime rather than solely in the absence of specific legislation governing digital assets. The analysis reveals that Indonesian law has acknowledged the rapid development of the digital economy through legislation regulating electronic transactions, personal data protection, and financial sector innovation. Nevertheless, these regulatory developments remain sectoral and administrative in nature, providing legal certainty for electronic systems and financial supervision without establishing a coherent framework governing proprietary rights over digital assets. Consequently, disputes concerning ownership, transfer, inheritance, collateralization, and judicial enforcement continue to be resolved through conventional property law doctrines that were developed long before the emergence of blockchain technology. This finding demonstrates that the principal legal challenge is conceptual rather than regulatory: existing civil law has not yet evolved sufficiently to recognize digital assets as a distinct category of proprietary objects capable of receiving comprehensive legal protection.

Similar legal uncertainty also extends to inheritance and secured transactions involving digital assets. Recent Indonesian scholarship has highlighted the absence of explicit legal mechanisms governing succession of cryptoassets (Alvaro & Hadiati, 2026) as well as their use as collateral under Indonesian positive law (Shafira et al., 2026). These developments further demonstrate the need for an integrated property law framework capable of accommodating multiple legal functions of digital assets.

From the perspective of Indonesian civil law, this conceptual limitation becomes particularly evident when interpreting the provisions of the Indonesian Civil Code governing property rights. Article 499 of the Civil Code broadly defines property as every object and every right capable of ownership, thereby providing a sufficiently flexible doctrinal foundation for recognizing economically valuable intangible assets. However, the Civil Code does not provide further guidance regarding digital objects whose existence depends entirely upon distributed ledger technology and cryptographic verification. Likewise, the traditional distinction between movable and immovable property under Article 503 was formulated within a legal environment in which ownership was closely associated with physical objects or rights expressly recognized by legislation. Although these provisions do not explicitly exclude digital assets, neither do they establish legal criteria for determining ownership, transfer of title, or evidentiary standards applicable to blockchain-based property. Similarly, Article 570, which recognizes ownership as the fullest legal right over an object, presupposes that the object itself can be identified through conventional legal mechanisms. In the context of blockchain technology, however, ownership is exercised through decentralized digital control that cannot be fully explained by traditional concepts of possession or physical delivery. Consequently, the existing provisions of

the Civil Code provide a valuable normative foundation but remain insufficient to address the unique legal characteristics of digital assets.

The doctrinal gap identified in this study is consistent with recent Indonesian legal scholarship. Ramadhan and Dadek (2025) argue that digital assets may be understood as intangible movable property; however, they emphasize that Indonesian property law has not yet developed legal mechanisms capable of accommodating blockchain-based ownership because traditional concepts of *bezt*, *eigendom*, and *levering* continue to presuppose physical control or centralized legal recognition. Similarly, Wijaya et al. (2025) conclude that digital assets possess the essential characteristics of property, including economic value, transferability, and exclusive ownership, yet legal certainty remains weak due to fragmented regulation distributed across different statutory regimes rather than integrated within the law of property. Furthermore, Sanjaya (2026) demonstrates that legal issues surrounding non-fungible tokens, virtual land, and blockchain-based assets increasingly challenge the conventional understanding of "objects" under Article 499 of the Civil Code and therefore require explicit recognition of virtual objects as legally protected proprietary interests. Collectively, these studies support the present finding that Indonesia's principal legal deficiency lies not in recognizing the economic importance of digital assets but in the absence of a coherent doctrinal framework capable of integrating them into the existing system of civil property law.

Based on these findings, this study argues that future legal reform should prioritize the reconstruction of Indonesian property law through a functional property-rights approach. Under this approach, legal recognition should not depend upon the physical form of an asset but upon its ability to perform the essential legal functions traditionally associated with ownership. An asset should therefore qualify as an object of proprietary rights when it demonstrates identifiable ownership, exclusive control, economic value, transferability, legal enforceability, and the capacity to become the subject of legal relations. These functional characteristics are already evident in many categories of digital assets, including cryptocurrencies, non-fungible tokens, tokenized assets, and other blockchain-based property. Adopting a functional approach would enable Indonesian civil law to accommodate technological innovation without abandoning its fundamental doctrinal principles, thereby preserving legal continuity while simultaneously increasing adaptability to future developments.

This proposed reconstruction differs from many existing regulatory approaches that classify digital assets according to technological categories or financial functions. Instead of creating separate legal regimes for cryptocurrencies, NFTs, tokenized securities, virtual land, or future blockchain applications, the functional property-rights approach establishes a technology-neutral legal framework applicable to all digital assets possessing proprietary characteristics. Such an approach promotes doctrinal consistency because legal protection is based upon the nature of the legal relationship rather than the underlying technology. It also enhances legal certainty by enabling courts to apply uniform principles when resolving ownership disputes involving different forms of digital assets. Most importantly, this approach ensures that future technological innovation does not require continuous legislative revision whenever new categories of digital assets emerge, thereby making Indonesian property law more resilient and responsive to the continuing transformation of the digital economy.

The implications of this reconstruction extend beyond theoretical legal development. For legislators, the findings support the harmonization of the Civil Code with digital economy legislation through the introduction of general provisions recognizing digital assets as proprietary objects capable of ownership, transfer, inheritance, collateralization, and judicial protection. For courts, the proposed framework provides doctrinal guidance for distinguishing legal ownership from technological control, enabling judges to assess blockchain-generated evidence alongside conventional civil law principles when resolving ownership disputes. For businesses and digital asset holders, greater legal certainty would strengthen investor confidence, reduce transactional risks, and encourage responsible innovation within Indonesia's expanding digital economy. Accordingly, this study concludes that the modernization of Indonesian civil law should focus not on replacing established property law doctrines but on extending their application through a principled and technology-neutral interpretation capable of accommodating the realities of digital assets in the twenty-first century.

The findings of this study have important theoretical, practical, and regulatory implications for the future development of civil property law in the digital economy. Theoretically, this study extends the contemporary discourse on digital assets by demonstrating that proprietary status should be determined according to the legal functions performed by an asset rather than its physical characteristics. The doctrinal analysis indicates that digital assets satisfy the essential attributes traditionally associated with ownership, including exclusivity, transferability, economic value, and legal enforceability. Consequently, the recognition of digital assets

should not be regarded as a departure from classical property law but rather as a continuation of its historical evolution in response to technological and economic transformation. By distinguishing legal ownership from technological control, this study also contributes a conceptual framework capable of explaining why blockchain verification alone cannot conclusively determine proprietary entitlement in civil disputes. This distinction provides a clearer analytical basis for interpreting ownership conflicts involving cryptocurrencies, non-fungible tokens, tokenized assets, and other blockchain-based property.

From a practical perspective, the findings demonstrate that effective dispute resolution requires courts to integrate blockchain-generated evidence with conventional principles of civil law rather than relying exclusively upon technological verification. Distributed ledger records, wallet addresses, transaction hashes, and cryptographic signatures provide valuable evidentiary information concerning digital transactions; however, these technological records should be assessed together with contractual relationships, statutory provisions, and general principles governing proprietary rights. Such an integrated approach enables judges to distinguish lawful ownership from unlawful technological control while preserving the principles of fairness, legal certainty, and judicial protection that underpin civil law. For legal practitioners, policymakers, and digital asset market participants, this analytical framework provides greater clarity regarding ownership verification, transfer of title, inheritance, collateralization, and civil remedies, thereby reducing legal uncertainty within Indonesia's expanding digital economy.

The findings likewise demonstrate that future legal reform should prioritize the modernization of Indonesian property law through a technology-neutral approach rather than through fragmented regulation of individual categories of digital assets. Instead of creating separate legal regimes for cryptocurrencies, non-fungible tokens, virtual land, or future blockchain applications, Indonesian civil law should adopt general proprietary principles applicable to all digital assets that exhibit identifiable ownership, exclusive control, economic value, transferability, and legal enforceability. Such an approach would maintain doctrinal consistency within the Civil Code while simultaneously providing sufficient flexibility to accommodate future technological innovation. Accordingly, the contribution of this study lies not merely in identifying legal uncertainty surrounding digital assets, but in proposing a functional property-rights framework that integrates technological developments into the existing principles of Indonesian civil law. This framework offers a normative foundation for future legislative reform and judicial interpretation while preserving the fundamental objectives of property law, namely legal certainty, ownership protection, and equitable dispute resolution.

Table 1. Synthesis of Research Findings and Their Implications for Indonesian Civil Law

Research Findings	Supporting Authorities	Authors' Interpretation	Implications for Indonesian Civil Law
Digital assets satisfy the functional characteristics of proprietary objects despite lacking physical form.	Allen (2019); Low & Teo (2017); Chan (2023); Fairfield (2021).	Property should be defined according to its legal functions rather than material existence.	Expand the interpretation of Article 499 of the Civil Code to encompass digital assets as proprietary objects.
Ownership disputes originate from the distinction between technological control and legal ownership.	Garcia-Teruel & Simón-Moreno (2021); Zetzsche et al. (2020).	Blockchain verification alone cannot determine lawful ownership in civil disputes.	Develop evidentiary standards integrating blockchain records with conventional civil law principles.
Existing Indonesian regulation remains fragmented and lacks doctrinal integration.	Ramadhan & Dadek (2025); Wijaya et al. (2025); Sanjaya (2026).	Legal uncertainty results from conceptual limitations within property law rather than merely from regulatory gaps.	Harmonize the Civil Code with digital economy legislation through comprehensive property law reform.
Future legal reform should adopt a technology-neutral property regime.	Çağlayan Aksoy (2023); De Filippi & Wright (2018).	Functional proprietary principles are more sustainable than technology-specific regulation.	Introduce a general doctrine of digital property applicable to present and future forms of digital assets.

Source: Developed by the authors (2026).

The synthesis presented in Table 1 demonstrates that the three principal findings of this study collectively answer the research objectives established in the Introduction. More importantly, they illustrate that resolving digital asset ownership disputes requires not only regulatory adaptation but also doctrinal reconstruction within Indonesian civil law. By positioning digital assets as proprietary objects assessed through functional ownership principles and by distinguishing technological control from legal entitlement, this study provides a coherent analytical framework that supports greater legal certainty while remaining consistent with the fundamental doctrines of property law. These findings form the basis for the conclusions presented in the following section.

Conclusions

Digital asset ownership disputes demonstrate that the transformation of economic value in the digital era requires a corresponding evolution of civil property law. This study concludes that digital assets can be recognized as proprietary objects when they perform the substantive functions traditionally associated with property, particularly identifiable ownership, exclusive control, economic value, transferability, and legal enforceability. The central difficulty in resolving digital asset disputes lies in the distinction between technological control and legal ownership: possession of a private key may enable effective control over an asset but does not necessarily establish lawful proprietary entitlement. This distinction confirms that blockchain verification cannot independently determine ownership and must operate alongside civil law principles governing title, transfer, evidence, and legal remedies. In the Indonesian context, the principal challenge is therefore not merely the absence of specific digital asset regulation, but the limited doctrinal integration between conventional property law and the technological characteristics of blockchain-based assets. Existing civil law principles provide a normative foundation for legal protection, but they require an evolutionary and technology-neutral interpretation capable of accommodating emerging forms of digital property.

The principal contribution of this study lies in proposing a functional property-rights framework that distinguishes technological control from legal entitlement while integrating digital assets into the conceptual structure of Indonesian civil law. This framework offers a more coherent alternative to fragmented, technology-specific regulation because it allows proprietary protection to be determined by the legal functions of an asset rather than by its technological form. Such an approach is relevant to legislators seeking to modernize Indonesian property law, courts resolving disputes involving blockchain-generated evidence, and market participants requiring greater certainty regarding ownership, transfer, inheritance, collateralization, and civil remedies. Accordingly, strengthening legal certainty in the modern digital economy requires the development of a coherent doctrine of digital property that preserves the fundamental principles of civil law while remaining adaptable to technological change. As this study is limited to normative and library-based analysis, future research should examine judicial practice, blockchain-based evidentiary problems, and the practical application of digital property doctrines through empirical and comparative investigation.

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