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# Blockchain as a Tool for Land Access Redistribution in Indonesia

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***Abstract***

*This study investigates the potential of blockchain technology in addressing Indonesia's persistent land inequality and agrarian exclusion. Using a socio-legal and comparative approach, the research first examines the historical roots of unequal land access, from colonial legacies to the limitations of the 1960 Agrarian Law and subsequent redistribution programs that failed to deliver substantive change for farmers, Indigenous peoples, and rural communities. It then critiques Indonesia's ongoing digital transformation through electronic land certificates, highlighting how technical reforms—such as the planned expiration of older forms of proof by 2026—risk reinforcing exclusion when not accompanied by inclusive policies and equitable access. Against this backdrop, blockchain is analyzed not merely as a technical innovation but as a potential framework for rebuilding trust and justice in land governance. Its features—immutability, decentralization, and transparency—offer safeguards against manipulation while enabling the recognition of previously excluded land claims. Lessons from Georgia, Sweden, and India demonstrate that blockchain can strengthen agrarian justice and institutional accountability, yet only when embedded within broader legal reform, institutional capacity, and participatory governance. Ultimately, the findings underscore that blockchain alone will not resolve Indonesia's deep-rooted land challenges. However, if aligned with inclusive land governance, digital literacy efforts, and sustainable development goals, blockchain can serve as a powerful enabler of constitutional aspirations: ensuring land serves the people, protects the vulnerable, and advances justice for all.*

## 1. Introduction

Agrarian reform serves as a cornerstone for achieving equitable development, alleviating poverty, and generating employment in rural areas.[1] Disparities in land ownership and tenure are the primary drivers of land-related conflicts, particularly in

[1] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), *State of Land Rights and Land Governance in Eight Asian Countries* (Quezon City: ANGOC, 2019), p. 135.

plantation regions where land rights are heavily concentrated.[2] In Indonesia, land represents more than a physical asset, it is an embedded socio-cultural, economic, and political resource.[3] Thus, its access and ownership have always been central to the country's development. Despite numerous regulatory frameworks addressing land rights and redistribution, agrarian conflict still persists as complex and multifaceted. Such conflicts are rooted in structural inequalities, competing interests, and legal ambiguities.[4] This has led to a widening disparity in land ownership, whereas access to land for the people has become increasingly restricted, it remains widely open for capital investors. As a result, local communities are gradually being displaced from their access to land.[5]

The National Land Agency (Badan Pertanahan Nasional, "BPN"), under the authority of the Ministry of Agrarian Affairs and Spatial Planning (Kementerian ATR/BPN), is currently undertaking a digital transformation program through the implementation of electronic land services.[6] In the course of this transformation, informal documents, including but not limited to *Girik, Letter C*, and *Petuk D*, will no longer be accepted as valid proof of land ownership after February 2, 2026.[7] This transformation is backed by Article 96 of Government Regulation Number 18 of 2021 concerning Land Registration, which states that written evidence of former customary land owned by individuals must be registered within a maximum period of 5 (five) years from the enforcement date of the regulation.

The government's goal of this policy is to integrate and digitize land records, thereby minimizing land conflicts and enhancing spatial planning.[8] However, this policy presents substantial concerns about equitable access to land rights, especially for individuals and communities whose land tenure is informal, undocumented, or derived from customary practices.[9] Owners of *girik* and similar documents are encouraged to apply for *Sertifikat Hak Milik* (SHM) through local land offices, while numerous marginalized communities lack the administrative capacity, historical proof, and legal

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[2] Ibid, p. 147.

[3] Damianus Krismantoro, "Kebijakan Pencegahan dan Pemberantasan Mafia Tanah: Reforma Agraria di Indonesia," *Jurnal Kewarganegaraan* 6, no. 3 (2022), p. 6031.

[4] Isnaini and Anggreni. A Lubis, *Hukum Agraria : Kajian Komprehensif* (Medan: Pustaka Prima, 2022), p. 93.

[5] Ibid.

[6] Luthfi Sulistyo, "Kementerian ATR/BPN Tingkatkan Pelayanan Melalui Implementasi Layanan Pertanahan Elektronik," Kementerian Agraria dan Tata Ruang Badan Pertanahan Nasional, 7 February 2025, https://www.atrbpn.go.id/berita/kementerian-atrbpn-tingkatkan-pelayanan-melalui-implementasi-layanan-pertanahan-elektronik. Accessed on 24 June 2025.

[7] Kompas.com, "Tak Berlaku Di 2026, Ini Cara Ubah Girik, Letter C, Dan Petuk D Jadi SHM," Kompas.com, 5 February 2025, https://www.kompas.com/tren/read/2025/02/05/163000565/tak-berlaku-di-2026-ini-cara-ubah-girik-letter-c-dan-petuk-d-jadi-shm?page=all. Accessed on 24 June 2025.

[8] Syarifaatul Hidayah et al., "Tantangan dan Peluang Sertifikat Elektronik dalam Reformasi Pendaftaran Tanah di Era Digital .," *Jurnal Ilmiah Nusantara (JINU)* 1, no. 6 (2024), p. 196.

[9] BBC News, "Perubahan sertifikat tanah jadi elektronik dinilai 'sangat rawan' - Bagaimana jaminan dari pemerintah?," BBC News, 6 Juni 2025, https://www.bbc.com/indonesia/articles/cg4vp34en2zo. Accessed on 25 June 2025.

clarity that are often required for this process.[10] For indigenous people, rural populations, and urban poor residents whose land tenure is frequently informal,[11] this issue becomes not only a technical one but also raises a fundamental legal issue of land access.

In the context of Indonesian land law, agrarian conflicts emerge as a result of unharmonized regulations and administrative practices, along with historical grievances related to land dispossession, overlapping jurisdictions, and weak enforcement mechanisms. The Indonesian National Land Agency (BPN) classifies land issues into three main categories: conflicts, disputes, and legal cases.[12] Conflicts usually contain broader sociopolitical dimensions; disputes are more limited in scope and often occur between individuals; and legal cases refer to disputes or conflicts that have escalated into formal judicial proceedings. In 2011 alone, over 14,000 land disputes were reported across Indonesia.[13] These include high-profile cases in regions such as Mesuji (Lampung), Bima (West Nusa Tenggara), and Situbondo (East Java), many of which turned violent. These incidents underscore how unresolved land conflicts can threaten national stability, undermining social cohesion, economic development, and even state legitimacy.[14] Moreover, in 2023, 241 agrarian conflicts were reported that seized 638,188 hectares of agricultural land, customary territories, capture areas, and settlements of 135,608 families.[15] A total of 110 conflict eruptions have victimized 608 land rights defenders as a result of repressive approaches in agrarian conflict areas. This figure tops six other Asian countries, namely India, Cambodia, the Philippines, Bangladesh, and Nepal. This eruption is also due to the Capital City of the Archipelago (IKN), which also contributed the most conflicted area.[16] During the implementation of electronic land certificates, some issues still appear.

Given this situation, the push toward electronic land registration must be accompanied by innovative and inclusive solutions. Here, blockchain technology presents a potential paradigm shift. With its decentralized, tamper-proof, and transparent system, blockchain offers more than just digital efficiency, it offers the possibility of reconstructing land governance systems in a way that is more participatory, secure, and

[10] Kristin Dwi Jayanti, "Perlindungan Hukum Terhadap Pemegang Hak Atas Tanah Sebagai Bukti Kepemilikan Hak Atas Tanah tentang Pendaftaran Tanah" (Skripsi Fakultas Hukum Universitas Islam Sultan Agung (Unissula) Semarang, 2024), p. 104.

[11] Mia Siscawati, *Pertarungan Penguasaan Hutan dan Perjuangan Perempuan Adat* dalam Wacana, *Wacana No. 33 Tahun XVI* (Yogyakarta: Insist Press, 2024), p. 175-176.

[12] Isnaini and Lubis, *Hukum Agraria : Kajian Komprehensif, Op. cit*, p. 104.

[13] Admin SPI, "Konflik Agraria di Sumbar Rugikan 3.477 Petani," Serikat Petani Indonesia, 19 April 2012, https://spi.or.id/konflik-agraria-di-sumbar-rugikan-3-477-petani/. Accessed on 20 June 2025.

[14] *Ibid*.

[15] Konsorsium Pembaruan Agraria, "Laporan Tahunan Agraria 2023: Konsorsium Pembaruan Agraria," 2024, p. 8.

[16] Admin Konsorsium Pembaruan Agraria, "Konflik Agraria Di Indonesia Tertinggi Dari Enam Negara Asia," 27 February 2024, https://www.kpa.or.id/2024/02/27/konflik-agraria-di-indonesia-tertinggi-dari-enam-negara-asia/#:~:text=Menurut%2520data%2520komparasi%2520keenam%2520negara,sekitar%252%252002%252C2%2520juta%2520orang. Accessed on 21 June 2025.

equitable.[17] Accordingly, blockchain can serve not only as a technological infrastructure but also as a tool for redistributive justice, capable of integrating informal claims, protecting customary land, and increasing public trust.

Therefore, this study seeks to investigate how blockchain can be utilized not merely as a tool of digital transformation, but as an instrument for land redistribution that addresses exclusion in both legal and digital frameworks. Specifically, it is guided by three research questions: (1) What are the historical roots of land access inequality and agrarian conflict in Indonesia? (2) How has the electronic certification policy intensified exclusion for land-vulnerable groups? (3) In what ways can blockchain be designed and implemented to redistribute land access fairly? The aim of this research is to analyze the intersection between agrarian conflict, technological exclusion, and legal reform through blockchain's lens, offering a practical and ethical model for equitable land governance in Indonesia.

Several prior studies have explored the potential of blockchain in enhancing the credibility, security, and efficiency of Indonesia's land administration system. Rosiyati MH Thamrin *et. al* (Blockchain-based Land Certificate Management in Indonesia, ADI Journal on Recent Innovation, 2021), for example, developed a prototype of a blockchain-based land certificate system using a public-to-hybrid Ethereum network, demonstrating that blockchain implementation can reduce processing costs and improve data accessibility through smart contracts and decentralized verification.[18] Mutiara Littewina *et al.* (*Land Certificate Authenticity Using Blockchain Technology in Indonesia*, International Conference on Information and Communicatiaon Technology, 2024) focused on solving data duplication and integrity issues in land certification by proposing a hybrid blockchain integrated with Public Key Infrastructure (PKI) to facilitate peer-to-peer transfers and National Land Agency (BPN) verification.[19] Meanwhile, Herny Christine *et. al* (*A Study of Permissioned Blockchain-Based Framework for Land Ownership Tracking in Indonesia*, Jurnal Interkom, 2022) introduced a permissioned blockchain framework using a proof-of-authority model to limit data manipulation and strengthen tracking mechanisms within the existing PTSL program.[20] Suyus Windayana *et al.* in Design of Blockchain System for Land Services Administration at Ministry of Agrarian and Spatial Planning/National Land Agency (*Business Review and Case Studies*, 2024), taking a systems analysis approach, tested the blockchain's effectiveness in public service contexts within the Ministry of ATR/BPN. His findings revealed ongoing

[17] Goran Sladić et al., "A blockchain solution for securing real property transactions: A case study for serbia," *ISPRS International Journal of Geo-Information* 10, no. 1 (1 Januari 2021), p. 2. https://doi.org/10.3390/ijgi10010035.

[18] Thamrin, Rosiyati MH, Eka Purnama Harahap, Alfiah Khoirunisa, Adam Faturahman, and Kenita Zelina. "Blockchain-based land certificate management in indonesia." *ADI journal on recent innovation* 2, No. 2 (2021): 232-252, DOI: https://doi.org/10.34306/ajri.v2i2.339.

[19] Littewina, Mutiara, Andry Alamsyah, Eva Nurhazizah, and Tanti Ruwani. "Land Certificate Authenticity Using Blockchain Technology in Indonesia." *In 2024 12th International Conference on Information and Communication Technology (ICoICT), pp. 236-243. IEEE, 2024*, DOI: 10.1109/ICoICT61617.2024.10698283.

[20] Christine, Herny, Koo Tito Novelianto, Meta Restiawati, Happrila Yuliana Jayanti, and Afriyadi Afriyadi. "A Study of Permissioned Blockchain-Based Framework for Land Ownership Tracking in Indonesia." *Jurnal Interkom: Jurnal Publikasi Ilmiah Bidang Teknologi Informasi Dan Komunikasi* 17, No. 3 (2022): 119-126.

inefficiencies in the delivery timeline for land certificates and proposed blockchain-enabled smart contracts as a mechanism for increasing transaction accountability and security. While these studies provide important technical foundations, they primarily emphasize system architecture and operational functionality within administrative and institutional boundaries.[21]

This research offers a distinct and necessary contribution by examining blockchain through a socio-legal lens—specifically as a mechanism for land access redistribution and the protection of marginalized claims amid Indonesia's digital land transition. It extends the conversation beyond digitization and efficiency, highlighting the structural exclusion of informal and customary landholders, and proposing blockchain as a potential tool to support equitable land reform. This integrative perspective remains underexplored in existing literature and is critical in ensuring that digital innovation aligns with agrarian justice and inclusive governance.

## 2. Research Methods

This study employs a qualitative socio-legal approach supported by comparative legal analysis. It examines Indonesia's current land governance framework and identifies regulatory, institutional, and technological gaps in the transition to digital systems. To enrich the analysis, this research draws on case studies from Georgia, Sweden, and India countries that have piloted blockchain in land administration. The aim is to offer policy insights and propose how blockchain can be adapted to support fair and inclusive land redistribution in Indonesia.

## 3. Result and Discussion

### 3.1. Historical Roots of Land Access Conflict

After 12 (twelve) years of legal and political struggle, former President Soekarno enacted Law Number 5 of 1960 on Basic Agrarian Principles ("UUPA") on 24 September 1960. This UUPA is drawn from constitutional legitimacy from Article 33(3) of the 1945 Constitution and rooted in Pancasila. This enforcement marked a turning point from the Dutch colonial system known as *domeinverklaring* to a new politico-legal concept: *Hak Menguasai Negara* (HMN) or the Right to Control by the State.[22] As governed in Article 2 of the UUPA, this authority granted the central government to regulate, plan, and organize the allocation and use of land, water, and natural resources.

The UUPA emerged in response to deeply rooted structural inequalities inherited from the colonial and feudal eras.[23] Land disputes between peasants and plantation companies had already begun to surface by 1957, particularly following Soekarno's

[21] Windayana, Suyus, M. Syamsul Ma'arif, Yandra Arkeman, and Irman Hermadi. "Design of Blockchain System for Land Services Administration at Ministry of Agrarian and Spatial Planning/National Land Agency." *Business Review and Case Studies* 5, No. 1 (2024): 158-158, DOI: https://doi.org/10.17358/brcs.5.1.158.

[22] Noer Fauzi Rachman, *Land Reform Dari Masa Ke Masa*, Cetakan Pertama (Yogyakarta: Sekolah Tinggi Pertanahan Nasional, 2012), p. 15.

[23] Ibid, p. 4.

nationalization policy.[24] These tensions intensified in 1965, when many peasants, particularly those cultivating redistributed or contested land, were accused of being affiliated with the Indonesian Communist Party.[25] As a result, countless peasants were displaced from their lands, often without legal recourse or restitution, setting a precedent of agrarian marginalization that would persist for decades.[26]

To address these disparities, the UUPA introduced a national land reform agenda aimed at dismantling exploitative landholding patterns, including: (1) legal reform, (2) abolition of foreign and colonial land concessions, (3) gradual elimination of feudal exploitation, (4) redistribution and regulation of land tenure and ownership, and (5) systematic land-use planning aligned with national capacity. At its core, land reform was framed as a revolutionary tool to create a just, socialist society based on Pancasila values.[27]

Land considered as excess, *absentee*, or ex-feudal (such as *swaparaja* lands) was targeted for redistribution under this program.[28] Local land reform committee was established with the mandate of Government Regulation No. 224/1961 in the purpose of identify these lands and distribute them to eligible farmers. Soekarno foresaw that landowners who yield their excess ownership of land would be fairly compensated and could turn to industry, while redistribution would promote equity, increase agricultural productivity, and restructure society.[29] However, according to the Report of Minister of Agrarian Affairs in January 1965, this land reform process was impeded by several challenges, including incomplete land inventories, sabotage by the land reforms' landlords resistance, internal conflicts within reform committees, and intimidation against farmers organizations.[30] Morever, the lack of sustained political support and systemic resistance led to several cases where redistributed lands were subsequently deprived, both openly and covertly, by former owners.[31]

With the political shift in 1966, the New Order regime under former President Soeharto systematically overturned agrarian reform efforts. Land policy framework was shifted from redistribution toward development-oriented land use.[32] Through the militarization of the territorial administration and the dissolution of land reform courts (Law No. 7/1970), land reform was stripped of institutional backing.[33] Soeharto's regime promoted large-scale infrastructure and resource extraction projects.[34] Indonesia's economic policy under Soeharto was shaped by competing paradigms that included

[24] Ibid, p. 31.
[25] Siti Rakhma Mary Herwati dan Yanuar Sumarlan, "Peasants' Land Rights Claims Over Plantation Companies' Sites in Central Java, Indonesia (1998-2014)," *Indonesia Law Review* 6, no. 1 (2016), p. 113. https://doi.org/10.15742/ilrev.v6n1.164.
[26] Ibid.
[27] Noer Fauzi Rachman, *Op. cit.*, p. 47.
[28] *Ibid.*, p. 49.
[29] *Ibid*.
[30] *Ibid*., p. 52-53.
[31] *Ibid*, p. 55.
[32] Isnaini and Lubis, *Op. cit.*, p. 12.
[33] Noer Fauzi Rachman, *Op. cit*. p. 64.
[34] *Ibid*., p. 56.

nationalism, populism, predatory bureaucratism, and liberalism.[35] Within this landscape, bureaucratic predators (*birokratis predators*) emerged, whereby civilian and military officials exploited their positions to grant land, forest, and mining concessions to domestic conglomerates. Agrarian offices, once tasked with equitable redistribution, were repurposed to facilitate land acquisition for state-backed development.[36]

These transformations have had long-lasting implications. Over time, they reshaped Indonesia's agrarian society, embedding structural contradictions that remain unresolved today. Four major forms of incompatibility now define the sector:[37]

a. persistent inequality in the control and ownership of agrarian resources;
b. mismatched or inefficient allocation of land and other agrarian assets;
c. a narrow view that reduces "agrarian issues" solely to land matters—often divided simplistically into forest and non-forest areas; and
d. the lack of coherence across legal frameworks and sectoral policies, where land use decisions are made without adequate consideration of broader social and environmental interests.

A brief window for change emerged in 1998, when the fall of Soeharto weakened the centralized state apparatus and opened space for grassroots mobilization.[38] Seizing this opportunity, many peasant communities across Java, Sumatra, and Sulawesi began to reclaim lands they had long been excluded from. In numerous cases, these direct actions resulted in the return of land to local communities. However, the state soon responded with a mixed strategy: while some conflicts were channeled into formal negotiations or limited agrarian reform initiatives, others were met with repression, including criminal charges, lawsuits, and the use of hired enforcers.[39]

This historical trajectory, shaped by ideological shifts, administrative inertia, and elite capture, sowed the seeds for today's entrenched land access conflicts. The original vision of land reform as a vehicle for justice was gradually eclipsed by development imperatives, often at the expense of smallholders and indigenous communities. In 2010, Indonesia's population reached approximately 237.64 million, with an almost even distribution between urban and rural populations.[40] However, the decade that followed witnessed a significant decline in rural agrarian livelihoods. Around 5.09 million peasant families exited the agricultural sector, many of whom became landless peasants, informal laborers, or part of the growing urban poor—an outcome closely tied to the persistent and rapid rate of land conversion.[41]

The annual conversion of agricultural land ranged from 100,000 to 110,000 hectares during this period.[42] This trend culminated in a striking figure from the Ministry of

[35] *Ibid*., p. 58.
[36] *Ibid*., p. 59-60.
[37] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), *Op. cit*., p. 137.
[38] Isnaini and Lubis, *Op. cit*., p. 13.
[39] Siti Rakhma Mary Herwati and Yanuar Sumarlan, *Loc. cit*.
[40] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), Op cit., p. 147.
[41] *Ibid*.
[42] Ministry of Agriculture, "Agricultural Land Statistics Data for 2012- 2016" (Jakarta, 2016).

Agrarian and Spatial Planning, which recorded a total conversion of 650,000 hectares between 2013 and 2018, shrinking Indonesia's agricultural land from 7.75 million hectares in 2013 to 7.10 million hectares in 2018.[43]

The 2013 Agricultural Census by BPS painted a revealing portrait of the peasant class. Indonesia then had 31.7 million peasants, with a stark gender imbalance: 24.36 million men (76.84%) and only 7.34 million women (23.16%).[44]Additionally, a generational crisis was underway: the majority of farmers—14.21 million (54.37%)—were aged between 35 and 54, signaling that farming was becoming an unattractive option for younger generations.[45] This reluctance was fueled not only by declining economic returns but also by the persistent perception of farming as a low-status occupation. Many children of farmers no longer aspired to work in the fields, reflecting a broader disengagement from the agrarian economy.

The structural marginalization of peasants has been exacerbated by the state's issuance of large-scale land use permits to corporations, particularly in the plantation and forestry sectors. By 2018, palm oil plantations had expanded to 14.309 million hectares.[46] In parallel, as of 2017, the Ministry of Environment and Forestry had issued forest use licenses (HPT, HP, HPK, HTI) to 499 enterprises, covering a staggering 68.7 million hectares.[47] These licenses placed vast areas of land in the hands of private and state-owned enterprises, intensifying the dispossession of smallholders.[48]

These historical injustices continue to manifest in present-day conflicts. In 2024, the Agrarian Reform Consortium (KPA) reported 295 agrarian conflicts, impacting over 1.1 million hectares and displacing more than 67,000 families across 349 villages.[49] This marks a 21% increase from 2023, further confirming the persistence of systemic land issues.[50] Amid the national political distractions of the 2024 elections, rural communities experienced widespread evictions, criminalization, and repression, often justified by state narratives of investment, infrastructure, and digital transformation.[51] These episodes demonstrate how unresolved structural grievances and elite-driven land policies continue to marginalize those who rely on land for their survival.

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[43] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), *Loc. cit*.

[44] Central Bureau of Statistics (BPS), "2013 Agricultural Census," 2013, http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Metadata/metadata_3/IDN_ ENG_MR_2013.pdf.

[45] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), *Op. cit.*, p. 147.

[46] General Directorate of Plantation of the Ministry of Agriculture, "Statistics of Palm Oil Plantations in Indonesia 2015-2017" (Jakarta, 2017).

[47] General Directorate of Forest Planology and Environment Planning, "Annual report 2016. Jakarta: Ministry of Environment and Forestry (Indonesia)," 2016.

[48] Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC) and Land Watch Asia (LWA), *Op cit.*, p. 148.

[49] Konsorsium Pembaruan Agraria, "Catatan Akhir Tahun 2024 Konsorsium Pembaruan Agraria Adakah Reforma Agraria di Bawah," 2024, p. 19.

[50] Ibid.

[51] Ibid, p. 48&50.

Throughout 2024, the Agrarian Reform Consortium (KPA) documented 295 agrarian conflicts, affecting over 1.1 million hectares of land and more than 67,000 families across 349 villages.[52] These figures represent a 21% increase from 2023 and mark the continuation of a troubling trend under the second term of President Joko Widodo.[53] While Indonesia's political elite remained consumed by the spectacle of the 2024 electoral contest, rural communities were subjected to a wave of evictions, criminalizations, and violent repression—much of it carried out in the name of investment, infrastructure, and digital governance.[54]

## 3.2. Exclusion in Digital Era

Indonesia is taking major steps to modernize its land administration system, and one of the most significant changes is the introduction of electronic land certificates. This move, led by the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN), marks a shift toward digitizing how land ownership is recorded and managed. The legal basis for this transition is outlined in Ministerial Regulation No. 3 of 2023, which provides the framework for issuing digital land documents, commonly known as *Sertipikat-el*. These digital certificates store both legal and physical land data in the *Buku Tanah Elektronik (BT-el)* system.[55]

This initiative builds on earlier efforts, including Government Regulation No. 18 of 2021, which legally supports electronic land registration, and Ministerial Regulation No. 1 of 2021, which first introduced the concept of e-certificates into the national land policy. In the process, Land Deed Officials (PPATs) play a critical role, as they're responsible for preparing, verifying, and uploading land-related data into the digital system.[56] Their involvement ensures that transactions remain legally sound and follow established procedures. In fact, as stated in Government Regulation No. 24 of 1997, land transfers can only be registered whether on paper or online, if they're backed by an official deed from a PPAT.[57]

This transformation starts with converting physical certificates into digital form, laying the groundwork for a more efficient and transparent land system. The national digital transformation program is targeted for completion within five years, with a minimum milestone of digitizing 50 percent of the total 124 million land parcels by the end of this year (2025).[58] This policy is grounded in Ministerial Regulation of ATR/BPN No. 1 of 2021, which outlines the digital transformation of Indonesia's national land administration system. But while the benefits are clear, *e.g.* faster services, better data

[52] Ibid, p. 19.
[53] Ibid.
[54] Ibid.
[55] Hidayah et al., *Op. cit.*, p. 187.
[56] Ibid, p. 189.
[57] Apik Handayani dan Reni Anggriani, "Digital Transformation of Land Certificates by PPAT in Kulon Progo Regency Transformasi Digital Sertifikat Tanah oleh PPAT di Kabupaten Kulon Progo," *Social Humanities, Religious Studies and Law* 2, no. 1 (2022): 184–99, https://doi.org/10.18196/umygrace.v2i1.447.
[58] Tempo, "Menteri ATR/BPN Imbau Pemilik Sertifikat Tanah 1961-1997 Segera Beralih Ke Sertifikat Elektronik," Tempo, 24 May 2025, https://www.tempo.co/ekonomi/menteri-atr-bpn-imbau-pemilik-sertifikat-tanah-1961-1997-segera-beralih-ke-sertifikat-elektronik-1533750.

protection, and more accountability, the real challenge lies in making sure the shift is inclusive and accessible to everyone.[59] Otherwise, it can widen the digital divide that leaves the most vulnerable behind, especially if it is done without accessibility for all segments of society.[60]

Many communities, particularly those whose land claims are documented only through informal instruments such as *Letter C* and *Girik*, face the possibility of losing their rights during the transition.[61] This vulnerability is intensified by Article 96 of Government Regulation No. 18 of 2021, which mandates that such informal documents must be registered and formally recognized within five years of its enactment. By 2 February 2026, *Letter C* and *Girik* will no longer be considered valid evidence of ownership if not registered. [62] As a result, individuals and groups who are unable to meet the administrative and bureaucratic requirements, especially those in rural or underserved regions, risk being excluded from legal recognition entirely.

Dewi Kartika, Secretary General of the Agrarian Reform Consortium (KPA), warns that digital certification should come *after*—not before—the state fulfills its constitutional mandate to systematically register all land, starting from the village level as the Basic Agrarian Law envisions.[63] The fact that many corporate-owned land certificates overlap with territories claimed by local communities also raises a critical concern. If the validation of these digital records happens behind closed doors, managed solely by ATR/BPN or with businesses involved but no public oversight, then the risks are obvious. Implementing digital land systems without first resolving those overlaps could worsen existing conflicts and widen inequality on the ground.[64]

From the standpoint of the user, while the digitalization policy may benefit urban and upper-middle-class citizens with reliable access to technology and infrastructure, it systematically sidelines marginalized urban communities and poorer rural populations who lack digital access.[65] This can be seen from the fact that although rural communities make up only 43% of Indonesia's population, yet they represent 58% of those without internet access.[66] Moreover, reflecting from the survey carried out by Kominfo on the

[59] Hidayah et al., *Loc. cit*.

[60] Felippa Amanta, "Unpacking Indonesia's Digital Accessibility," The Jakarta Post, 30 Juni 2022, https://www.thejakartapost.com/paper/2022/06/29/unpacking-indonesias-digital-accessibility.html. Accessed on 23 June 2025.

[61] Dody Pramana, "Girik Tidak Akan Berlaku Lagi Di Tahun 2026, Begini Tanggapan Kementerian ATR/BPN," Kantor Pertanahan Kabupaten Magetan, 1 October 2025, https://kab-magetan.atrbpn.go.id/berita/girik-tidak-akan-berlaku-lagi-di-tahun-2026-begini-tanggapan-kementerian-atrbpn. Accessed on June 20, 2025.

[62] Kompas.com, "Tak Berlaku Di 2026, Ini Cara Ubah Girik, Letter C, Dan Petuk D Jadi SHM."Accessed on 18 June 2025.

[63] Ady Thea DA, "6 Kritik KPA untuk Kebijakan Sertipikat Tanah Elektronik," Hukum Online.com, 4 Februari 2021, https://www.hukumonline.com/berita/a/6-kritik-kpa-untuk-kebijakan-sertipikat-tanah-elektronik-lt601d3bfeb8060/?page=2. Accessed on 10 June 2025.

[64] Admin Konsorsium Pembaruan Agraria, "Konflik Agraria Di Indonesia Tertinggi Dari Enam Negara Asia."

[65] Ady Thea DA, "6 Kritik KPA untuk Kebijakan Sertipikat Tanah Elektronik."

[66] Natasya Zahra, "Enhancing Inclusion in the National Digital Literacy Index: From Measurement to Empowerment," *Center for Indonesian Policy Studies* Policy Brief, no. 19 (2023):

Status of Indonesia Digital Literacy, only 26.67% of the workforce uses digital tools, while 57% have never accessed banking services and 70% have never accessed public services online.[67]

Additionally, digital safety scored the lowest (3.10/5), which points the weakest pillar in digital literacy. Among Southeast Asian nations, it ranks among the bottom three in terms of internet safety and public confidence in online platforms. In fact, Indonesia is placed 83rd out of 100 countries when it comes to trust in information shared on social media.[68] This low ranking reflects broader concerns about digital safety and public vulnerability online. Data also shows that the country's overall digital literacy remains below the ASEAN average, sitting at 62% compared to the regional benchmark of 70%.[69]

This condition reflects both infrastructural and skills-based inequality. Remote regions lack electricity and network coverage, while many citizens, especially older adults, lack sufficient proficiency to benefit from digital services. These gaps are driven not only by unequal access to infrastructure, such as electricity and internet connectivity in remote areas, but also by limited digital skills across the population. Many citizens, particularly older generations and rural communities, struggle to navigate digital tools confidently. High costs of smartphones and computers further limit access for low-income groups. Even where devices are available, the lack of digital proficiency often prevents people from using them meaningfully, underscoring that true inclusion in the digital era demands both access and ability.[70]

On the other hand, KPA reveals a signification escalation in agrarian conflicts in 2024, involving 295 documented cases, affecting over 1,1 million hectares of land and displacing more than 67,000 families in 349 villages. Among the most affected in 2024 were: farmers (173 of 295 conflicts), urban poor (56), Indigenous peoples (53), and fishing communities (13). Particularly, farmland was most impacted, covering 178 cases over 326,224 hectares, displacing 46,642 farming households, or more than 93,000 individuals.[71] These figures align with Statistics Indonesia's report of rising landlessness: from 2013 to 2023, the number of smallholder (gurem) farmers rose from 14.25 million to 17.24 million, while the total farming population dropped from 31 million to 29.34 million.[72] What is particularly striking is that most of these 2024 conflicts are not new, but rather latent or long-standing disputes that re-erupted due to unilateral actions by private corporations, state-owned enterprises, local governments, and state security

7, https://repository.cips-indonesia.org/media/publications/567714-enhancing-inclusion-in-the-national-digi-843210f3.pdf.

[67] Edy Sutrisno et al., "Digital Divided: How Indonesian Public Service Affected?," *JPPI (Jurnal Penelitian Pendidikan Indonesia)* 10, no. 3 (2024): 456, https://doi.org/10.29210/020244613.

[68] Zahra, *Op. cit.*, p. 5.

[69] Edy Sutrisno, *et. al.*, *Op. cit.*, p. 457; Khoirul Anam, "Paling Rendah di ASEAN, Tingkat Literasi Digital RI Cuma 62%. CNBC Indonesia," CNBC Indonesia, 14 February 2023, https://www.cnbcindonesia.com/tech/20230214171553-37-413790/paling-rendah-di-asean-tingkat-literasi-digital-ri-cuma-62.

[70] Edy Sutrisno, *et. al.*, *Loc. cit*.

[71] Konsorsium Pembaruan Agraria, "Catatan Akhir Tahun 2024 Konsorsium Pembaruan Agraria Adakah Reforma Agraria di Bawah," p. 46.

[72] Ibid., p. 45.

forces.[73] Of the total, 181 conflicts were triggered by private sector operations, covering 788,614 hectares and displacing over 39,000 families.[74] State-owned enterprises like PTPN and Perhutani were responsible for 46 cases, while local governments instigated 42 conflicts—often due to unilateral land claims or development programs on farmland and residential areas.[75] Even central actors like the Land Bank Agency, State Authorities, and the military (TNI) were complicit in multiple conflicts, with the latter implicated in five violent land disputes in 2024.[76]

This agrarian exclusion is exacerbated by technology-driven policies that overlook structural inequalities. Programs such as Kartu Tani, Kartu Nelayan, and fishing zone regulations, ostensibly meant to empower rural producers, often serve the interests of larger capital holders or are co-opted by bureaucratic rent-seeking and fertilizer mafias.[77]

## 3.3. Blockhain for Land Access Redistribution

### 3.3.1. Characteristics, Potential, and Mechanisms of Blockchain Technology in Land Access Redistribution Systems

In the pursuit of equitable and transparent agrarian reform, blockchain technology offers key characteristics that can significantly support these objectives. One of the main advantages of blockchain lies in its decentralized and distributed nature, meaning no single authority controls the entirety of the data.[78] In the land sector, this is particularly relevant as it can prevent the dominance of bureaucracy or land elites over the collection and control of agrarian information.[79] Muhammad Yafi, founder of Blocktogo, asserts that "blockchain enables the distribution of data authority to all parties within the network, thereby creating a trustless system—one that does not rely on a single entity to be trusted."[80] Consequently, the monopolization of information by

[73] Ibid., p. 48.
[74] Ibid., p. 50.
[75] Ibid.
[76] Ibid.
[77] Ibid., p. 47.
[78] Mohd Javaid et al., "Blockchain technology applications for Industry 4.0: A literature-based review," *Blockchain: Research and Applications* (Zhejiang University, 1 Desember 2021), https://doi.org/10.1016/j.bcra.2021.100027, p. 7. See also, Shubhani Aggarwal et al., "Blockchain for smart communities: Applications, challenges and opportunities," *Journal of Network and Computer Applications* 144, no. April (2019): 28, https://doi.org/10.1016/j.jnca.2019.06.018.
[79] Faisal Surya Pratama, Adi Sulistiyono, dan Hari Purwadi, "Prevention of Double Certificates by Implementing Blockchain," *International Journal of Business, Economics and Law* 30, no. 2 (2023), p. 47. See also, Fauzi Amri, Poltak Sihombing, dan Syahril Efendi, "Blockchain in Land Registry," *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram* 11, no. 1 (20 Januari 2023): 218–23, https://doi.org/10.33394/j-ps.v11i1.6537. See also Aidil Rezjki Suljztan Syawaludin and Rinaldi Munir, "Registration of Land and Building Certificate Ownership using Blockchain Technology," in *8th International Conference on ICT for Smart Society: Digital Twin for Smart Society, ICISS 2021 - Proceeding* (Institute of Electrical and Electronics Engineers Inc., 2021), https://doi.org/10.1109/ICISS53185.2021.9533191, p. 3.
[80] Interview results by the author with Muhammad Yafi Tonrusdi, an expert, blockchain technology developer, and President Director of PT Indonesia Blockchain Persada, who has

a handful of actors can be minimized, while simultaneously promoting transparency and accountability.[81]

The immutability characteristic also constitutes a crucial value in addressing Indonesia's chronic land-related issues, particularly concerning overlapping claims and document manipulation.[82] Once a transaction or data entry is validated, it cannot be altered or deleted as it becomes tied to a unique hash.[83] "This is especially critical in the context of agrarian disputes," said Yafi, "as blockchain stores a permanent record that cannot be edited or manipulated."[84] This means that digital records of land ownership and changes thereto are rendered more legally reliable.

Moreover, blockchain is inherently transparent and participatory.[85] All stakeholders in the network—civil society, farmer groups, state institutions, and non-governmental organizations—can access identical data in real-time. This transparency facilitates procedural justice and eliminates information asymmetry, which often hinders fair land distribution. In terms of data validation, blockchain employs consensus mechanisms such as Proof of Stake, which opens participatory space for local actors.[86] According to Yafi, "with such mechanisms, indigenous communities or farmers can actively engage in the verification process, rather than being passive objects."[87] This strengthens the social legitimacy of land redistribution outcomes.

Pursuant to abovementioned, the mechanism of blockchain technology applications in the context of land redistribution is not merely conceptual. Nevertheless, the authors suggest that its application may be realized through various specific technical mechanisms. Firstly, the mapping and digitalization of unregistered lands can be undertaken by integrating blockchain with smart contract technology and geospatial metadata. Lands previously in unofficial or disputed status can be permanently and transparently recorded in a digital system.

Secondly, blockchain can be utilized to record land rights through a digital certification system based on Non-Fungible Tokens (NFTs). Each digital land certificate may be represented as a unique NFT, incorporating metadata such as owner name, National Land Agency (BPN) ID, and geospatial coordinates into the blockchain. Yafi supported

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extensive experience in developing this technology for various public and private institutions, conducted on May 20, 2025, via video conference.

[81] Suyel Namasudra et al., "The Revolution of Blockchain: State-of-the-Art and Research Challenges," *Archives of Computational Methods in Engineering* 28, no. 3 (2021), p. 1499, https://doi.org/10.1007/s11831-020-09426-0. See also, Damiano Di Francesco Maesa dan Paolo Mori, "Blockchain 3.0 applications survey," *Journal of Parallel and Distributed Computing* 138 (1 April 2020), p. 99. https://doi.org/10.1016/j.jpdc.2019.12.019.

[82] Konstantinos Christidis and Michael Devetsikiotis, "Blockchains and Smart Contracts for the Internet of Things," *IEEE Access* (Institute of Electrical and Electronics Engineers Inc., 2016), p. 2293, https://doi.org/10.1109/ACCESS.2016.2566339. See also, Suyel Namasudra et al., *loc.cit.*; Aggarwal et al., op.cit., hlm. 15.

[83] Konstantinos Christidis and Michael Devetsikiotis, *loc.cit.*

[84] Interview results by the author with Muhammad Yafi Tonrusdi, loc.cit.

[85] Aggarwal et al., *op.cit.*, hlm. 15.

[86] Aggarwal et al., *op.cit.*, hlm. 17.

[87] Interview results by the author with Muhammad Yafi Tonrusdi, loc.cit.

that, "Land can be transformed into a digital asset that cannot be forged."[88] This offers an innovative solution for the equitable recognition of land rights for smallholder farmers or indigenous communities.

Furthermore, transaction and ownership validation can be conducted through a distributed ledger system, whereby transactional data—such as the transfer of ownership—passes through the stages of broadcast, verification, validation, block inclusion, and hash generation. This process is automatically executed by various nodes within the blockchain network, ensuring data security and efficiency.

The government may also leverage blockchain to facilitate digital land distribution as part of agrarian reform programs. This system can be integrated with the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) as the foundation for digital registration, expediting distribution processes and enabling open public verification. In the long term, blockchain supports post-redistribution monitoring, as any change in ownership or land use can be detected—crucial in preventing illicit re-concentration of land by elites.

The normative implications of these mechanisms are illuminated by Joel Reidenberg's theory of Lex Informatica, that emphasizes that the architecture of information systems itself operates as a form of regulation, where the design of technological infrastructures determines permissible behaviors in the digital environment.[89] This theory suggests that the code underlying digital platforms carries normative force equivalent to legal norms, effectively translating policy choices into technical rules that constrain or enable user conduct. In this sense, technology does not merely support legal frameworks but actively shapes them, as system design embeds values, limitations, and enforcement mechanisms into the digital environment.[90]

In blockchain, compliance is not enforced by bureaucrats but by consensus algorithms, cryptographic verification, and smart contracts that automatically validate ownership and govern user behavior. For instance, NFTs as digital land certificates illustrate how rights and their transferability are regulated by protocols rather than administrative discretion. This technical enforcement offers efficiency and transparency but also raises fundamental concerns about accountability and legitimacy, as the normative power to shape conduct is effectively exercised by developers and algorithms. Applying blockchain to agrarian reform therefore embodies Reidenberg's insight: technological systems themselves act as regulators. To ensure alignment with Indonesia's constitutional goals, such systems must be deliberately designed to embed values of justice, legal certainty, and social utility, so that efficiency does not come at the expense of inclusivity or fairness.

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[88] Interview results by the author with Muhammad Yafi Tonrusdi, loc.cit.

[89] Reidenberg, Joel R, "Lex Informatica: The Formulation of Information Policy Rules through Technology," *Texas Law Review* 76, no. 3 (1998): 553–93, http://ir.lawnet.fordham.edu/faculty_scholarshipat:http://ir.lawnet.fordham.edu/faculty_scholarship/42. p. 592-593.

[90] Putranto, Rahmat Dwi, *Teknologi Hukum Paradigma Baru Hukum Di Dunia Digital* (Jakarta: Kecana Prenada Media, 2023). p. 22.

### 3.3.2. Regulatory, Institutional, and Implementation Challenges in Blockchain Adoption

Despite its vast potential, the application of blockchain in Indonesia's land administration system faces various regulatory, institutional, and technical challenges. At present, the absence of an explicit legal framework is the principal barrier. There is no legislation—whether in the Basic Agrarian Law or ATR/BPN policy—that explicitly acknowledges the use of blockchain, smart contracts, or NFTs in land systems.

Institutionally, the readiness of agencies such as ATR/BPN and local governments remains limited. Yafi notes that "current digitalization efforts by ATR/BPN merely involve scanning documents, without incorporating full metadata structures compatible with blockchain."[91] This illustrates that genuine digital transformation has yet to occur. Existing systems such as SIMTARU or PTSL are not designed for interoperability with blockchain technology, necessitating institutional reform and IT infrastructure enhancement.

Additionally, digital literacy among the population remains low, particularly among farmers and indigenous communities—the primary targets of agrarian reform. Without adequate inclusion and facilitation, the deployment of this technology risks fostering technological exclusion. Therefore, blockchain implementation must be participatory and inclusive, accompanied by training and community empowerment programs.

Lastly, data security and system integration issues cannot be overlooked. Although blockchain data is immutable, the blockchain system itself must be safeguarded against cyber threats. According to Yafi, "access to the blockchain must be protected through layered authentication systems, and strong encryption must be used in data integration across systems."[92] Moreover, the standardization of interoperability with existing land administration systems must be promptly developed to ensure blockchain does not operate in isolation from the national framework.

Viewed through Gustav Radbruch's framework, law is oriented toward three fundamental values—justice, legal certainty, and utility—collectively known as the theory of the purposes of law.[93] Justice requires that similar cases be treated alike, not only formally but also in accordance with conscience and moral reasoning.[94] Radbruch famously stated, "Summum ius, summa iniuria", emphasizing that true justice is grounded in moral conscience.[95] Legal certainty demands the consistent application of law to protect individual rights and to ensure that people clearly understand which actions are permitted or prohibited, thereby safeguarding them from arbitrary state

[91] Interview results by the author with Muhammad Yafi Tonrusdi, loc.cit.

[92] Interview results by the author with Muhammad Yafi Tonrusdi, loc.cit.

[93] Savić, Vanja Ivan, "Radbruch's Formula and the Conscience of a Saint: Cardinal Alojzije V. Stepinac," Studia z Prawa Wyznaniowego 26 (2023): 147–70, https://doi.org/10.31743/spw.14455. p. 150-151; See also, Rahardjo, Satjipto, *Ilmu Hukum*, Cet-IX (Bandung: PT Citra Aditya Bakti, 2021). p. 20.

[94] Lemek, Jeremias, *Mencari Keadilan Pandangan Kritis terhadap Penegakan Hukum di Indonesia* (Yogyakarta: Galang Press, 2007). p. 25.

[95] *Ibid*.

power.[96] Utility, meanwhile, requires that law bring real benefits, contributing to the well-being and happiness of the majority of society.[97] Radbruch ultimately considered utility the "core" of legal philosophy, interpreting it as a synthesis of justice and legal certainty that is infused with humanitarian values and oriented toward the common good.[98]

Within this framework, the challenges of applying blockchain in Indonesia's land administration system become more apparent. The absence of an explicit legal framework undermines legal certainty, as neither citizens nor institutions have clear guidance on the use of blockchain, smart contracts, or NFTs in land governance. Institutional and infrastructural limitations weaken the element of utility, since the technology has not yet produced tangible benefits for society. At the same time, low digital literacy among farmers and indigenous peoples risks violating justice, as unequal access could exacerbate existing inequalities in land rights. Issues of data security and system integration further highlight the need to balance legal certainty (through protection of rights and consistent rules) with utility (ensuring that systems are secure and functional). Therefore, aligning blockchain implementation with Radbruch's philosophy requires regulation, institutional reform, and infrastructure development that not only guarantee legal certainty but also ensure inclusive justice and real societal benefit as a form of the common good.

### 3.3.3. Comparative Case Studies and Adoption Prospects in Indonesia

Efforts to implement blockchain technology in land data management are not novel at the global level. Numerous countries have embarked on similar initiatives—either on a pilot or national scale—to address fundamental land governance challenges such as ownership conflicts, document forgery, bureaucratic inefficiency, and low public trust in land registration institutions. Case studies from Georgia, Sweden, and India offer instructive lessons relevant to the Indonesian context.

Georgia stands as one of the pioneers in implementing blockchain for land registration. Since 2016, the country began integrating blockchain systems through a collaboration between the National Agency of Public Registry (NAPR) and Bitfury Group.[99] Notably, Georgia also operates under a civil law system[100] and a negative publication model in land registration—similar to Indonesia.[101] Blockchain adoption was pursued in response to entrenched issues: corrupt bureaucracy, overlapping claims, and high

[96] Notohamidjojo, O., *Soal-Soal Pokok Filsafat Hukum*, (Salatiga: Griya Media, 2012). p. 33-34.
[97] Mertokusumo, Sudikno, *Mengenal Hukum: Suatu Pengantar* (Yogyakarta: Liberty, 2008). p. 80.
[98] Zajadło, Jerzy, "Axiology of Law – from General to Specific Philosophy of Law," *Studia Iuridica Lublinensia* 32, No. 4 (2023): 191–217, https://doi.org/10.17951/sil.2023.32.4.191-217. p. 204.
[99] Qiuyun Shang and Allison Price, "A Blockchain-Based Land Titling Project in the Republic of Georgia: Rebuilding Public Trust and Lessons for Future Pilot Projects," *Innovations: Technology, Governance, Globalization* 12, no. 3–4 (1 Januari 2019), p.74, https://doi.org/10.1162/INOV_A_00276.
[100] The Constitution of Georgia, Constitutional Law of Georgia, No. 2071, 23 March 2018, Article 4(4).
[101] *See*, Georgian Law on Public Regulation, Article 9(1).

transaction costs.[102] With blockchain, every registration transaction is permanently recorded on an immutable ledger, thereby enhancing efficiency and public trust in government.[103]

As emphasized by Muhammad Yafi, CEO of Blocktogo, "We see Georgia as a highly inspirational reference point. They also use a negative publication system. Their initial challenges mirror ours: overlapping data, lengthy processes, and minimal public trust." Georgia's success did not occur overnight. Legal reform, cadastral digitalization, and public-private partnerships formed essential foundations.[104] Nonetheless, Georgia continues to face challenges, particularly in digital infrastructure and human resource capacity—concerns highly pertinent to Indonesia as well.[105]

Meanwhile, Sweden developed a blockchain-based land registration system through a pilot project initiated by the land authority Lantmäteriet, in collaboration with private firms such as Chromaway and Telia.[106] Its main goals were administrative efficiency, enhanced transparency, and reduced input errors.[107] Although Sweden already has an advanced digital land administration system, legal constraints persist—for instance, the lack of recognition for electronic signatures in certain property transactions.[108]

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[102] Arturo Castellanos dan Raquel Benbunan-Fich, "Digitalization of Land Records: From Paper to Blockchain," *Thirty Ninth International Conference on Information System,* San Fransisco (2018), p. 6. See also, Per Aarvik, "Anti-corruption reforms have been successful in Georgia, but blockchain is stealing the limelight," The U4 Anti-Corruption Recource Centre, https://www.u4.no/blog/anti -corruption-reforms-successful-in-georgia-blockchain-stealing-limelight, accessed 1 June 2025.

[103] Qiuyun Shang and Allison Price, *op.cit.*, p. 72-78.

[104] Nino Lazuashvili, Alex Norta, dan Dirk Draheim, "Integration of Blockchain Technology into a Land Registration System for Immutable Traceability: A Casestudy of Georgia," *Lecture Notes in Business Information Processing* 361 (2019), p. 38, https://doi.org/10.1007/978-3-030-30429-4_15.

[105] Mohammed Shuaib et al., "Current Status, Requirements, and Challenges of Blockchain Application in Land Registry," *https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/IJIRR.299934* 12, no. 2 (19 Agustus 2022), p. 7-8, https://doi.org/10.4018/IJIRR.299934. See also, Benbunan-Fich dan Castellanos, *Op.Cit.*, 7.; Shang dan Price, *Op.Cit.*, 77.

[106] Anetta Proskurovska dan Sabine Dörry, "The blockchain challenge for Sweden's housing and mortgage markets," *Environment and Planning A* 54, no. 8 (1 November 2022), p. 1570, https://doi.org/10.1177/0308518X221116896/ASSET/84E8B427-68CD-49D8-BC3F-E76D23773965/ASSETS/IMAGES/LARGE/10.1177_0308518X221116896-FIG1.JPG. See also, https://www.lantmateriet.se/en/about-lantmateriet/our-organization/.

[107] Ibid. See also, Johannes P Paavo dan Rafael Rodríguez-Puentes, "A systematic literature review on blockchain-based titles registries for transparent land administration," *International Science and Technology Journal of Namibia* 17, no. 1 (2024), p. 72, https://journals.unam.edu.na/index.php/ISTJN/article/view/1873.

[108] "Land Registry in Sweden | Blockchain for the People | Use Cases," Blockchain Machetemag, 2016, https://blockchain.machetemag.com/sweden/land-registry-sweden/. See also, Juliet Mcmurren, Andrew Young, dan Stefaan Verhulst, "Blockchange: Addressing Transaction Costs Through Blockchain and Identity in Swedish Land Transfers," 2018, p. 3. See also, Paavo, *Op.Cit.*, 79.

Sweden's experience underscores the necessity of regulatory reform to accommodate technological innovation.[109]

A similar approach was adopted in India, particularly in Amaravati District, Andhra Pradesh, which became a pilot site for blockchain-based land data management.[110] This system integrates blockchain with Geographic Information System (GIS) technology within a private blockchain network, in which government agencies and stakeholders act as nodes to verify data changes.[111] As a result, ownership transfers became faster, more transparent, and resistant to manipulation.[112]

The international experiences of Georgia, Sweden, and India illustrate that the successful application of blockchain in land systems hinges on a combination of legal reform, robust system integration, and strengthened institutional and human capacity. These examples make it clear that blockchain is not a plug-and-play solution; rather, its implementation must be embedded within a comprehensive restructuring of land governance frameworks. Each case highlights specific enabling conditions and persistent challenges, offering valuable comparative insights for Indonesia. The following table outlines key aspects of each country's approach and their relevance to the Indonesian context:

[109] Lazuashvili, Norta, and Draheim, *Loc. cit*. See also, Snall, M., Kempe, M., Hallare, B., and Hjelte, H. (2016). The Land Registry in the blockchain. Technical report, The Swedish.; Mapping, cadastre and land registration authority, Telia Company, ChromaWay and Kairos Future.

[110] Anjali Kaushik, "New technology interventions including blockchain technology in land record and registry management in India," *ACM International Conference Proceeding Series*, 23 September 2020, p. 149, https://doi.org/10.1145/3428502.3428521;PAGE:STRING:ARTICLE/CHAPTER. See also, Vinay Thakur et al., "Land records on Blockchain for implementation of Land Titling in India," *International Journal of Information Management* 52, no. March (2020), p. 101940, https://doi.org/10.1016/j.ijinfomgt.2019.04.013.

[111] Kapoor, Amit, Mark Esposito, and Mukul Anand. "Land Record Management in India." *Available at SSRN 4811021* (2024): 13. See also, Comincioli, Luca Mario, and Global Economic Governance. "The Role of Blockchain in Improving Land-users' Rights (Can blockchain solve corruption problems in land administration in developing countries?-The case of India)." *Mémoire de Master joint Global Economic Governance and Public Affairs, CIFE European Institute, Luiss School of Government, Rome, 100p* (2021): 36.; Swaroopa Royadu, "Self-Guide For Purchasing the Land-The Digital India Land Modernization Program [DILRMP]," *Jus Corpus LJ* 3 (2022): 1133.

[112] Nir Kshetri, "Blockchain as a tool to facilitate property rights protection in the Global South: lessons from India's Andhra Pradesh state," *Third World Quarterly* 43, no. 2 (2022), p.380-381, https://doi.org/10.1080/01436597.2021.2013116. See also, Pessarlay, W. (2023). India's Pune taps blockchain for property registration after year-long pilot. See also, Oprunenco, A. and Akmeemana, C. (2018). Using blockchain to make land registry more reliable in India.

**Table 1.** Comparative International Case Studies on Blockchain Adoption in Land Governance and Their Relevance to Indonesia

| Key Factor | Georgia | Sweden | India | Implication of Indonesia |
|---|---|---|---|---|
| **Legal Framework** | Codified and specialized blockchain law | Codified law with legal gaps (e-signature) | Incremental reform via modernization programs | Needs comprehensive codification and enabling legislation |
| **Governance Structure** | NAPR + Bitfury public-private model | Centralized with stakeholder integration | Decentralized pilot with GIS integration | Requires inter-agency coordination and public-private partnerships |
| **Technological Infrastructure** | Moderate (UN e-Gov rank: 61st) | Advanced digital infrastructure | Varies by state, often limited | Invest in national digital infrastructure and system interoperability |
| **Data Quality and Digitization** | 1.3 million documents digitized | Legacy digitization since 1970s | Mixed quality; resurvey efforts under DILRMP | Requires accurate baseline data, systematic digitization, and GIS use |
| **Public Participation and Inclusion** | Increased, but with trust gaps | High, but needs legal modernization | Access via SMS; inclusion challenges persist | Must address digital divide and ensure equitable access to services |
| **Resilience and Oversight** | Cybersecurity concerns remain | Strong governance but needs legal update | Vulnerable to data errors and power asymmetries | Build robust oversight, cybersecurity, and accountability mechanisms |

Source: processed, analyzed, and organized by the Author

Through a comparative lens, Indonesia can tailor its blockchain adoption by: (1) learning from Georgia's institutional reform and legal clarity; (2) adopting Sweden's integrated digital workflow while updating national legal frameworks; and (3) addressing digital literacy and infrastructure gaps as seen in India. Ultimately, blockchain is not a standalone solution but a complement to systemic reform in land administration. To realize its full potential, Indonesia must pursue a multi-dimensional strategy encompassing legal, institutional, technological, and social readiness.

Building on these international insights, the Indonesian context presents a compelling case for blockchain integration to strengthen a land administration system long plagued by complexity, inefficiency, and persistent conflict. A key opportunity lies in enhancing agrarian justice and mitigating land disputes. With its core attributes—immutability and transparency—blockchain enables a robust and tamper-resistant land system. Land transactions recorded on blockchain will be permanent, traceable, and unalterable without legitimate consensus from all authoritative nodes. As Muhammad Yafi remarked, "Imagine if every land certificate had a unique hash and was automatically recorded on the ledger—overlapping claims or duplicate certificates would be impossible. This is the trustless system sorely needed in Indonesia's agrarian context."[113] This statement highlights how blockchain can break the chain of recurring issues such as certificate duplication, illegal sales, or unlawful land occupation.

Beyond that, blockchain can also reinforce data-driven land access and distribution governance. By establishing a single source of truth integrating ATR/BPN, local governments, and financial institutions, land data management can be conducted in a synchronized, consistent, and automated manner. This system would form the backbone of agrarian reform policy implementation, including redistribution of ex-HGU land, land bank management, and land ceiling enforcement. The use of smart contracts can also expedite verification, validation, and execution of land administration processes electronically.

Moreover, the application of blockchain technology in land administration aligns closely with the broader objectives of sustainable development. Its integration can directly contribute to the realization of several key Sustainable Development Goals (SDGs). First, in line with SDG 1 (No Poverty), secure and equitable access to land is a critical component in poverty alleviation efforts, particularly for smallholder farmers and indigenous communities whose livelihoods depend heavily on land tenure security. Second, SDG 10 (Reduced Inequalities) is supported through transparent and accountable mechanisms of land redistribution made possible by blockchain, thereby addressing longstanding agrarian disparities. Lastly, SDG 16 (Peace, Justice, and Strong Institutions) is reinforced as blockchain serves not merely as a technical innovation, but as an instrument of institutional reform—enhancing transparency, curbing corruption, and promoting accountability within land governance systems. Through these contributions, blockchain underscores its transformative potential not only in the domain of land rights, but also in advancing inclusive and equitable development.

Finally, blockchain has the potential to bolster public trust in agrarian reform programs and establish a credible national land database. This database would enable: (1) legal clarification of land status, (2) low-risk, land-based collateral financing mechanisms, and (3) inter-agency collaboration in agrarian law enforcement and spatial planning.

Viewed through Gustav Radbruch's philosophy of law, blockchain's role in Indonesia's agrarian reform directly intersects with the three fundamental purposes of law: justice, legal certainty, and utility. Its immutability ensures legal certainty by preventing overlapping claims and certificate duplication, while its transparency promotes justice

[113] Interview results by the author with Muhammad Yafi Tonrusdi, *loc.cit*.

through equal access to trustworthy information for farmers, indigenous peoples, and other stakeholders. At the same time, the broader socio-economic benefits of blockchain—such as supporting poverty reduction, reducing inequality, and strengthening institutions in line with the Sustainable Development Goals—embody the element of utility, which Radbruch regards as the synthesis of justice and legal certainty oriented toward the common good. In this light, blockchain is not only a technical instrument but also a normative tool capable of realizing the very objectives of law itself within Indonesia's agrarian governance.

In conclusion, blockchain is not merely a technological innovation but a transformative tool capable of reshaping Indonesia's land governance system into one that is more just, efficient, and legally credible.

## 4. Conclusion

Indonesia's long-standing struggles with land inequality cannot be separated from its history. From colonial land control to post-independence policies that failed to dismantle elite ownership, land access has remained deeply unfair for many communities. This study began by exploring those historical roots, showing how efforts like the 1960 Agrarian Law and various redistribution programs have yet to deliver meaningful change for small farmers, Indigenous peoples, and rural land users. Land continues to be concentrated in the hands of the few, while those who depend on it most still face legal uncertainty and exclusion.

These structural injustices are now being compounded by Indonesia's transition toward full electronic land registration. While this digital transformation aims to improve efficiency and transparency, it also risks reinforcing exclusion—particularly for communities whose land rights are informal, undocumented, or based on custom. The planned expiration of older forms of proof by 2026 exemplifies how well-intentioned technical reforms, if not grounded in inclusive policies and equitable access, may reproduce or even intensify existing disparities.

In this context, blockchain emerges as more than a technological innovation—it offers a framework for rebuilding trust and equity in land governance. Its features, such as immutable recordkeeping, decentralized validation, and transparent data sharing, provide strong safeguards against manipulation while enabling the formal recognition of previously excluded land claims. Through mechanisms like digital land tokens, community-based verification, and integration with national systems, blockchain holds the potential to support a more just, accountable, and inclusive land administration model. Lessons from Georgia, Sweden, and India show, however, that successful implementation depends on legal clarity, institutional capacity, and grassroots participation.

Ultimately, blockchain alone will not resolve Indonesia's deep-rooted land challenges. Yet, when embedded within broader legal reform, participatory governance, and digital inclusion efforts, it can be a powerful enabler of agrarian justice. By aligning innovation with equity, Indonesia can move closer to realizing its constitutional vision: land that serves the people, safeguards the vulnerable, and advances justice for all.

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