

Digitalization of Customary Land Registration and Customary Rights Based on Blockchain for Village Asset Data Security

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Abstract

This study aims to formulate a blockchain-based digitalization model for customary land registration and customary rights in Bone Bolango Regency. The urgency of this research is driven by the need to transform the traditional registration system, which still relies on manual archives and oral legitimacy, into a secure, transparent digital system that aligns with local wisdom. The theoretical framework used encompasses customary rights, digital governance, and blockchain governance. The research method utilizes an ethnographic approach through participatory observation, in-depth interviews with customary leaders, village officials, and the community, as well as analysis of historical documents and regulations related to customary land. The research findings indicate that customary land records in Bone Bolango are still vulnerable to loss, damage, and lack formal legal force, weakening the position of indigenous communities in disputes. On the other hand, the community, especially the younger generation and village officials, demonstrates openness to digitalization, despite limited digital literacy and infrastructure. The potential for blockchain implementation is identified through its advantages in ensuring data immutability, transparency, and its ability to integrate customary values through smart contracts. Blockchain can be a strategic solution to address the weaknesses of traditional record-keeping while strengthening social legitimacy and legal protection of customary rights. Bone Bolango Regency offers

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1. INTRODUCTION

The management of customary land and customary rights has long been a focus of agrarian policy studies in Indonesia, as it concerns legal legitimacy, social justice, and the sustainability of village development. According to Nisa et al. (2024), the absence of a formal registration system often creates uncertainty about the status of customary land and increases the potential for conflict with external parties, including investors and local governments. This situation is exacerbated by the weak legal protection of customary rights in land bureaucratic practices (Permadi, 2023).

A study by Dhiaulhaq & McCarthy (2020) shows that in many regions of Indonesia, agrarian conflicts often stem from disharmony between customary law and the formal state legal system. Without clear records, customary land is vulnerable to being claimed as state land or unilaterally transferred for development purposes. Research by Susanto, (2019) and (Permadi, 2023) also emphasize that customary land registration is not merely a technical aspect, but also a form of recognition of the cultural identity and collective

rights of indigenous communities. Therefore, the need for a customary land registration system that is transparent, secure, and aligned with local values is increasingly urgent, especially in the face of development dynamics.

Boundary conflicts and weak evidence of customary land ownership indicate a serious gap between indigenous communities' need for legal certainty and the availability of adequate recording instruments. Großmann (2024) notes that, to date, recognition of customary rights has relied largely on collective agreements and the legitimacy of customary leaders, while formal, state-recognized recording mechanisms have not yet been fully established. This creates a structural gap that leaves indigenous communities vulnerable when dealing with external parties, both the government and private investors.

Bone Bolango Regency has a long tradition of customary land tenure (Une, 2021; Idris et al., 2025; Kadir et al., 2024); (Moonti et al., 2025), but this situation often leaves indigenous communities without a strong legal basis to defend their rights, even though the land is a source of livelihood and cultural identity. Unfortunately, all of this is only passed down orally from generation to generation without any official government-recognized records. Furthermore, documentation efforts through physical archives conducted by villages have proven ineffective in addressing modern challenges, as they are vulnerable to loss, damage, or even manipulation. This is where the research gap lies: there is still very little research that attempts to integrate local wisdom in customary land management systems with more secure digital technologies, particularly blockchain-based ones.

Implementing blockchain in customary land registration in Bone Bolango could address fundamental issues: legal certainty, archive security, and recognition of indigenous peoples' rights. However, the success of this system's implementation depends heavily on social preparedness, institutional support, and community education strategies. (Kaur & Parashar, 2022) is of the view that this is necessary By involving traditional leaders, village officials, and the younger generation, digitizing customary land records can be part of an inclusive transformation of village governance. Furthermore, previous research has highlighted the potential of blockchain for public asset management (Shojaei et al., 2019). However, its application in the context of customary land is still very limited.

Several studies in other countries (Tavakoli et al., 2024) and (Huang et al., 2025) Studies have shown that blockchain can reduce agrarian conflict by providing transparent ownership records. In Indonesia, (Nugraha et al., 2022), the discourse on using blockchain for customary land is still at the conceptual stage and has not been widely tested in practice at the village level. In Sweden, a project *Land Survey* testing the application of blockchain to speed up the land transaction process and reduce the potential for fraud (Proskurovska, 2023). In Ghana, an initiative used blockchain to provide certainty of land ownership rights for communities previously without legal documents (Mintah et al., 2021). Meanwhile, in Georgia, the government successfully recorded thousands of land transactions using blockchain integrated with the national system (Lazuashvili et al., 2019). Even in Honduras and Kazakhstan, blockchain trials are underway to minimize corruption in land administration (Abdieva, R., & Baigonushova, D., 2024). These studies demonstrate that blockchain implementation can address the limitations of conventional land registration systems in various global contexts. However, until now, there has been little research adapting similar technology to the context of customary land in Indonesia. Therefore, the Bone Bolango study is novel, offering both academic and practical relevance. Therefore, this research holds a significant position in enriching the literature and making a significant contribution to public policy.

Studies on the digitalization of village assets in Indonesia have so far tended to be limited to the use of centralized server-based administration applications, which have several weaknesses, such as vulnerability to cyberattacks, potential data loss, and the risk of misuse by a single authority. Meanwhile, research related to customary land has focused more on legal aspects (Haryanti & Suharto, 2021) and sociological dimensions (Murhaini & Ludang, 2020).

2020), and agrarian conflicts (Darmawan et al., 2023). Few studies have presented practical technical solutions that can be implemented directly at the village level, particularly in the context of customary land registration, which requires a secure system that aligns with local values.

In this context, research in Bone Bolango Regency is significant as a strategic locus for formulating a blockchain-based digital model for customary land registration. Blockchain presents a breakthrough due to its decentralized, immutable, and transparent nature, allowing each record to have an immutable digital footprint that can be verified by all stakeholders. These advantages are still rarely explored in the literature on customary land in Indonesia. Thus, the application of blockchain not only fills the academic gap regarding the integration of technology and customary rights but also provides a practical contribution in the form of an adaptive customary land registration model. safe, as well as strengthening the social legitimacy and legal protection of indigenous communities in Bone Bolango.

The main objective of this research is to formulate a blockchain-based model for digitizing customary land and customary rights records in Bone Bolango Regency, emphasizing the security of village asset data, legal certainty, and strengthening the social legitimacy of indigenous communities. This research not only seeks to map the problems of customary land records, which are still manual and vulnerable to manipulation, but also examines the potential for implementing blockchain as an innovative solution aligned with local wisdom. Therefore, this research is crucial in Bone Bolango Regency as a strategic locus for formulating a model for digitizing customary land records that not only addresses technical data storage issues but also strengthens the social legitimacy and legal protection of indigenous communities.

The theoretical framework in this research is based on three main foundations: *First*, the theory of customary rights and customary land which emphasizes that customary land is a source of identity, social legitimacy, and the basis for the sustainability of customary communities, as explained from the perspective of agrarian law and legal anthropology; *Second*, digital governance theory which emphasizes the use of information technology to increase transparency, accountability, and efficiency in public asset management, so that it is relevant to understanding the transformation of customary land registration from manual to digital; *Third*, Blockchain theory and data decentralization, which view blockchain technology as an instrument for creating a secure, non-manipulation recording system and enabling integration with local wisdom-based social mechanisms. The integration of these three theoretical frameworks will be used in the discussion to explain how blockchain-based digitization of customary land records can address issues of data security, legal certainty, and maintain customary legitimacy in the context of Bone Bolango Regency.

This study uses an ethnographic approach (Sari et al., 2023) to deeply understand the practice of recording customary land and customary rights in Bone Bolango Regency and the possibility of adapting it to a blockchain-based digital system without neglecting local wisdom values. Data collection techniques included participant observation, in which researchers engaged directly with indigenous communities, village officials, and relevant

stakeholders to gather information about traditional land recording mechanisms, challenges faced, and expectations for digitization. Furthermore, in-depth interviews were conducted with customary leaders, village government officials, and community representatives to gain perspectives on village asset data security and social readiness to adopt blockchain technology. This qualitative data was complemented by analysis of historical documents and applicable land regulations, allowing for mapping how the legal framework can be synergized with the proposed technological innovation.

The research stages begin with a preliminary study and literature review to reviewing customary land regulations, customary rights, and identifying villages facing significant problems in recording customary assets. The next stage is ethnographic data collection through observation and in-depth interviews in selected villages, which were then analyzed using source triangulation to test the validity of the information (Agustianti et al., 2022).

2. DISCUSSION

Bone Bolango Regency has a long history of customary land tenure practices passed down through generations by local indigenous communities. Customary land in this region serves not only as an economic asset but also as a symbol of community identity and social ties. For a long time, land tenure has been regulated through mutually agreed-upon customary norms led by traditional leaders. This system fosters collective recognition of territorial boundaries and management rights, despite the absence of official state-recognized documents.

This research discussion aims to provide an in-depth explanation of the field findings obtained through participant observation, in-depth interviews, and document analysis related to customary land registration and customary rights in Bone Bolango Regency. This section not only outlines the actual conditions faced by indigenous communities but also links them to theoretical frameworks and previous studies, resulting in a more comprehensive analysis.

The main focus of the discussion is directed at how traditional customary land registration practices can be identified, their problems analyzed, and their potential mapped for subsequent integration into a blockchain-based digital system. Thus, this discussion serves as a bridge between the empirical reality of indigenous communities and the innovative solution offered by the research, namely a digital model for customary land registration that is secure, transparent, and aligned with local wisdom. To that end, the discussion is divided into several main sub-chapters covering the identification of the existence of customary land and customary rights, traditional registration mechanisms and the problems faced, social readiness and community perceptions of digitalization, the potential for blockchain adoption, the integration of local wisdom with digital systems, and the design of a conceptual model for blockchain-based registration. Each sub-chapter not only presents findings but also provides critical interpretations by referring to theories, regulations, and previous studies, as follows:

a. Existence of Customary Land and Customary Rights

Recognition of customary land in Bone Bolango stems from the community's social legitimacy, where the testimony of traditional leaders and collective knowledge serve as the primary basis for asserting ownership. Indigenous communities place their trust in customary structures as the highest authority in resolving disputes or distributing customary rights. This practice demonstrates the strength of traditional social systems that operate parallel to the state's formal legal system. However, this

form of recognition remains informal and relies on collective memory, making it vulnerable to being forgotten or disputed during conflict.

“... As far as I know, the customary land in Bone Bolango is currently controlled by extended families based on inheritance passed down orally, and most of them do not yet have land certificates, but there are records in the village, for example.

"Land boundaries, and who owns them, are all recorded. So, if a customary land conflict arises, it's sometimes resolved through deliberation. If it ends up in court, it can be a long story." (Interview with Village Head/July 2025)

The results of the study show that customary rights in Bone Bolango are generally passed down orally from generation to generation, as stated by a traditional figure in Bone Bolango Regency who said:

“... The history I know, before any outside influence, the Gorontalo people lived in a social system based on “banua” (community territory) or “pohalaa” (kingdom/customary power), for example in Bone Bolango there were kings Botutihe, Wartabone and others, so in the past land was not owned individually, but by clan/kinship groups or traditional communities. Individual rights were only management rights or use rights, not absolute ownership rights, and before land certificates became mandatory, they still used Girik books as a strong legal basis for land ownership status and customary land.” (Interview with Traditional Leader/July 2025)

Limitations in the formal registration of customary land significantly impact legal certainty for communities. Customary land recognized only through customary law lacks strong protection when confronted with state interests or private investment. This creates a situation where indigenous communities are in a weak position in agrarian disputes, despite their historical and cultural legitimacy. In the absence of formal legal documentation, customary land is vulnerable to being categorized as state land, opening up space for conflict and marginalizing customary rights.

This process takes place within the context of traditional rituals, deliberations, or recognition by community leaders, attended by community members. While these oral traditions strengthen social solidarity, the lack of formal documentation creates vulnerabilities when customary land is confronted with state administrative systems or external parties demanding written proof. As a result, inheritance of customary rights is often not recognized in formal legal processes, leaving indigenous communities without a legal basis to defend their claims.

This situation underscores the importance of this research in more systematically identifying the existence of customary land in Bone Bolango. By documenting the history, forms of recognition, and practices of customary land rights inheritance, this research can bridge the gap between customary legitimacy and formal legal requirements. This identification forms the basis for the argument that strengthening legal certainty for indigenous communities is not sufficient by merely maintaining oral traditions but requires support from a modern, secure, state-recognized recording system. Therefore, integration with blockchain technology could be a breakthrough in maintaining social legitimacy while providing legal protection for customary land in Bone Bolango.

Several studies have shown that traditional recording mechanisms are indeed no longer able to answer the complexity of contemporary agrarian issues. (Lubis et al., 2025) emphasized that the formal legal system in Indonesia requires official documents as a basis for recognizing rights, so that oral traditions or Local village archives are

often considered invalid under state law. This weakens the position of indigenous communities in the face of agrarian conflicts and private investment. Similarly, Evitasari et al. (2024) emphasize that without a secure and standardized recording system, indigenous communities are vulnerable to losing their customary rights, despite their strong historical and cultural legitimacy.

On the other hand, international research shows that blockchain technology can be a promising alternative in land registration systems. A case study in Georgia demonstrated that implementing blockchain in land registration successfully increased transparency and reduced ownership disputes (Lazuashvili et al., 2019). Similarly, an initiative in Ghana demonstrated how blockchain can provide legal certainty for communities that previously relied solely on traditional evidence (Mintah et al., 2021). Based on these studies, the implementation of blockchain in Bone Bolango is relevant as a strategy to integrate local indigenous practices with the formal legal system, while addressing the security and transparency challenges of village asset registration.

b. Mechanism for Registering Customary Land and Customary Rights

Traditional land registration in Bone Bolango Regency is still largely done manually through traditional mechanisms. Village officials typically record ownership information in village registers, accompanied by customary certificates or other local documents. This registration is primarily an internal village administrative process and is not always linked to the national land administration system. Furthermore, the legitimacy of ownership is also strengthened by the testimony of traditional leaders who know the boundaries and history of land ownership. According to an interview with one village official, researchers stated:

"... In the past, land distribution and use were regulated by customary law passed down orally. Customary leaders or local leaders (Pulanga, Tumonggolo, Bubato) had the authority to regulate the distribution of agricultural land, pastures, forests, and village land. However, as far as I know, almost all customary land is currently uncertified, although some is registered in the village. Inheritance is based on lineage, usually patrilineal, but there is flexibility depending on family and customary agreements. (Interview with Village Officials/August 2025)

Based on Law Number 5 of 1960 concerning the Main Principles Agrarian, the State recognizes the customary rights of indigenous peoples as long as they still exist and are in line with national interests. Based on interviews with employees of the Bone Bolango Regency National Defense Agency, researchers stated that: "... In Bone Bolango, many customary lands, in fact, almost all customary lands has not been officially registered so its status is vulnerable to being taken over by the state if it is considered state land, especially if a conflict occurs, which could become a big problem, if in the future there is a government project or Companies take land for development purposes, often without adequate compensation, because customary land lacks a formal title. Much customary land is converted to HGB (Building Use Rights) or HGU (Cultivate Use Rights) for plantations or infrastructure projects. Therefore, participatory mapping of customary land, documentation of ownership history, and legal strengthening are needed, including formal registration of customary land until the issuance of customary land certificates in Bone Bolango. (Interview with the National Land Agency of Bone Bolango/August 2025). The results of this study align with the study by Evitasari et al. (2024. shows that customary land registration in many regions of Indonesia is still rely heavily on social legitimacy based on oral tradition,

while available written evidence is generally limited to local documents such as village registers or customary certificates. This situation creates legal vulnerability when indigenous communities confront state land administration mechanisms that require official certificates as the basis for ownership claims. (Yunita Bernanda et al., 2025) even emphasized that the lack of formal documents is one of the main causes of the weak bargaining position of indigenous communities in agrarian disputes, even though they have social and historical recognition of the land in question. Furthermore, research (Dewa Gede Edi Praditha & I Made Bagus Wibisana, (2024) highlights that oral inheritance of customary land rights is indeed able to maintain the continuity of cultural values, but is legally vulnerable to disputes due to a lack of proper documentation. This finding is also consistent with a study (Yadri Irwansyah, 2024), which states that oral traditions in land registration often give rise to differences in interpretation between generations, particularly regarding territorial boundaries and inheritance rights, thus posing a risk of internal and external conflict. Thus, the results of this study strengthen the existing literature that reliance on fragile physical archives and easily distorted oral traditions creates a serious gap between the social legitimacy of indigenous communities and the formal legal certainty of the state.

c. Understanding Digital Technology

Indigenous communities in Bone Bolango Regency still have a wide range of understanding of digital technology. Some, particularly the younger generation, are beginning to use the internet and smartphone-based applications for everyday purposes. Research shows that for most traditional leaders and village officials accustomed to manual systems, digitizing customary land registration is still considered a new and difficult concept to grasp. This knowledge gap illustrates the fundamental challenges in introducing a blockchain-based registration system. Interviews with village officials regarding land registration revealed the following responses:

“... In my opinion, there are indeed various problems in the village related to the registration of customary land, for example: Overlapping with forest status, then technical capacity and mapping/registration costs, as well as the large number of areas managed by customary law but categorized as forest areas by Sectoral decisions (Ministry of Forestry) have resulted in administrative problems with customary claims. Furthermore, much evidence of ownership is oral or in the form of old girik (land titles), requiring verification. Participatory mapping is indeed very helpful in registering customary land, but it requires effort, time, and good coordination for the results to be used for official registration. Furthermore, much customary land in Bone Bolango has not been formally registered; customary data is often stored informally, and inter-agency coordination and standardization of storage still need to be strengthened to reduce disputes. Registration and archiving of customary land are still oral or in the hands of individuals and royal families/descendants. (Interview with Village Officials/August 2025) Traditional figures generally give a cautious response to the idea digitizing customary land records. They acknowledge the potential of technology to maintain data security and reduce conflict, but continue to emphasize the importance of upholding customary values and deliberation mechanisms in every process. Some customary leaders worry that digitalization could erode the role of customary institutions if not designed inclusively. Therefore, the involvement of customary leaders from the design stage to implementation is crucial to ensuring that the digital system

remains aligned with the social legitimacy of indigenous communities. This is in line with the statement from the National Land Agency (BPN) of Bone Bolango Regency, which emphasized:

“... The recording, storage, and security of customary land data in Gorontalo, particularly in Bone Bolango Regency, is currently a mixed bag. There are formal efforts (registration by the ATR/BPN and local government, digitization of spatial maps), but much customary land, if not all, in Bone Bolango still relies on local customary recognition and is not yet fully registered, making it prone to disputes. The Bone Bolango Regency Land Office has implemented a PTSL program and improved registration quality, which indicates a shift to more structured/digital data storage at the BPN level. This is done to improve the security of legal administration (certificates, measurement maps). However, for customary land itself, much, if not all, is not yet formally registered, and customary boundaries are often determined verbally/community-based, making it vulnerable to disputes and difficult to officially “lock” data. (Interview with the Bone Bolango National Land Agency/August 2025)

Despite support from village officials and youth, digital literacy challenges remain significant. Not everyone has access to digital devices or understands how blockchain technology works. Furthermore, limited internet infrastructure in some villages exacerbates the situation, putting digitalization at risk of creating unequal access. If this is not addressed, the implementation of digital systems could potentially widen the gap between tech-savvy communities and those still reliant on manual traditions. Based on these findings, community education strategies are key to preparing social readiness for the digitalization of customary land records. Education should not only focus on technical aspects.

The system's use must also be linked to customary values so that communities feel this technology strengthens, rather than replaces, their traditions. Collaboration between village governments, customary leaders, educational institutions, and the younger generation is necessary to build equitable digital literacy. With the right strategy, blockchain-based digitization of customary land records can be socially acceptable and serve as a legal protection instrument for the Bone Bolango indigenous community. Findings regarding low digital literacy and limited infrastructure

This finding aligns with studies by Doloji (2025) and Sadam et al. (2024), which emphasize that technology adoption in rural Indonesia is often hampered by limited internet access and gaps in community understanding of new technologies. This is further supported by a study by Prilosadoso et al. (2024), which shows that the success of digitalizing public services at the village level is largely determined by the readiness of human resources, particularly the understanding of digital technology among village officials and the community. Without interventions such as training and community education, digitalization efforts risk excluding groups lacking digital skills.

Furthermore, research (Gómez-Carmona et al., 2023) emphasizes that successful digital transformation in indigenous communities requires an approach that is not only technical but also cultural. This means that new technologies such as blockchain can only be accepted if they are linked to the indigenous values prevailing within the community. Meanwhile, Magoro & Bidwell (2022), through their study of digital inclusion in developing countries, also emphasize the importance of multi-stakeholder collaboration between local governments, educational institutions, and youth groups to build equitable digital literacy. Thus, the results of the Bone Bolango study, which

recommends a community education strategy based on collaboration between local actors, are strongly supported by previous literature, both in national and global contexts.

d. Design of a Blockchain-Based Digitalization Conceptual Model

The conceptual model for blockchain-based digitization of customary land registration in Bone Bolango Regency was designed to address the challenges of manual registration, which is prone to loss, damage, and manipulation. This model design places the registration process starting from the village as the primary node, with the involvement of village officials, customary leaders, and customary institutions as validators. Customary land ownership data is digitally recorded through a blockchain system, making each entry immutable and verifiable by all authorized nodes. With this mechanism, registration is not solely dependent on a single party but is distributed collectively, making it more transparent and reliable. The results show that the dominant village government response to the implementation of the blockchain-based digitization model:

“... In my opinion, the community and traditional leaders will accept it. open arms if this technology is used for good things, especially regarding guarantees of archiving security, which, of course, will be more accepted if the technology is applied with a participatory approach, where the figures Customary law is involved in planning, implementation, to data utilization. This shows that technology is not simply "accepted" or "rejected," but rather that acceptance is strongly influenced by the method and socio-cultural context in which the technology is used. In my opinion, many things are needed when we talk about digital, including: Stable internet access & devices such as village computers, traditional leaders' smartphones, local servers, or the cloud. Then, storage & backup space, so that data is safe even if the device is damaged. In addition, a village/community service center can be a digital connection where residents come to manage records. Regarding the role of youth, where I believe youth can be a digital bridge, they are more familiar with technology, and can help traditional leaders who are less familiar. Therefore, it is necessary to form a traditional youth team (a kind of village digital secretariat) whose duties include: documenting traditional maps & stories, inputting data into the system, maintaining community digital accounts & security. Youth can also produce local educational content (short videos, infographics) about the importance of digital registration of customary land. (Interview with Village Head/July 2025)

In the model design, node authority is determined based on the structure customary institutions and village government. Customary leaders act as overseers of social legitimacy, village officials are responsible for administration, and village institutions such as the Village Consultative Body (BPD) or Village Leadership Council (LPM) serve as checks and balances. Data validation is conducted by consensus through a blockchain system, where every change or new entry must be approved by the authorized authority. Interviews with customary leaders revealed that:

“... In my opinion, there are no direct sources that mention the acceptance of customary land registration technology by the Gorontalo indigenous people. However, if the use of this technology is considered beneficial and can guarantee the preservation of customary land in Bone Bolango, then it is likely that customary leaders will be more open to the use of this technology to “understand,” or “recognize,” and “protect” all customary matters without eliminating the recognition of customary rights. Therefore, success depends on the direct

involvement of customary leaders in the digitization process. I believe it is legitimate and beneficial to use, because the registration data cannot be changed unilaterally. This means that ownership/customary rights records are more difficult to falsify or manipulate. This further reduces the risk of “dual certification” or archive manipulation. Meanwhile, both customary communities and the government can access the information at any time. It can be connected to digital maps (GIS) to visually display land boundaries. Customary rights records that have been entered into the blockchain system can become “permanent digital evidence” that is recognized in the long term, even if the government regime changes. (Interview with Customary Leader/July 2025) Security is a key advantage of this model because blockchain allows encrypted, non-manipulable data storage. Furthermore, the system is designed to be accessible gradually, depending on the community's digital literacy capacity, for example, through a simple mobile app or village terminal. Numerous studies confirm that although blockchain promises data security and transparency, human resources (HR) readiness is a major inhibiting factor in its implementation. (Adel, (2024) and (Dwivedi & Vig, 2024), emphasize that blockchain adoption in developing countries faces serious challenges in digital literacy, technical skills, and institutional capacity. This means the technology cannot be readily implemented in indigenous communities without a lengthy process of education, training, and familiarization. Similarly, Mohammad & Vargas (2022) indicate that the success of a blockchain-based record-keeping system depends heavily on the socio-cultural readiness of local communities to accept change, not just their technological readiness.

Studies in Indonesia also strengthen this argument (Abdieva, R., Baigonushova, D., 2024) and (Kushadajani & Permana, 2020) found that the digitalization of public services in villages is often slow due to the limited understanding of the community and village officials in operating new systems. Even when simple applications are available, their use remains limited if not accompanied by an intensive digital literacy program. Thus, the implementation of blockchain for customary land registration in Bone Bolango does have a positive direction, but it cannot be implemented instantly. The process requires gradual steps such as community education, limited trials, and regulatory support to ensure the community is fully prepared to manage the new system. Due to limited resources, both in terms of community digital literacy, technological infrastructure, and institutional support, the implementation of blockchain for customary land registration in Bone Bolango Regency cannot be done instantly. This process requires careful, gradual planning and is adjusted to social readiness and technical capacity at the village level. Based on these considerations, the researchers formulated a Prototype Roadmap for Blockchain Implementation in Bone Bolango as a strategic guide to ensure that the adoption of this technology is effective, sustainable, and remains aligned with the values of local wisdom of indigenous communities. This means that, although the blockchain-based digitalization model is relevant for Bone Bolango, its successful implementation requires a long-term strategy in the form of digital literacy training (Budiarto et al., 2024), provision of internet infrastructure (Doloi, 2025), and synchronization with national regulations (Kusriyah, 2021) so that it does not just stop at the prototype level.

Table 1 Prototype Roadmap Implementation Blockchain Of Bone Bolango

No	Level	Time	Activity Home	Output
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- | | | | | |
|---|----------------------------|-----------|--|--|
| 1 | Preparation
& Education | 0–1 years | <ul style="list-style-type: none">• Blockchain socialization to traditional and village leaders• Basic digital literacy workshop• Discussion on the integration of customary values. | <ul style="list-style-type: none">• Basic understanding of the community. Village/customary “champion” teams are formed. |
|---|----------------------------|-----------|--|--|

2	Digitalization Manual Archives	1–2 year	<ul style="list-style-type: none"> • Migrating physical archives to the database digital. • Simple application based on mobile/village terminal. 	<ul style="list-style-type: none"> • Database digital customary land • Social legitimacy reinforced.
3	Scale Blockchain Implementation Limited	2–3 years	<ul style="list-style-type: none"> • Custom validation for digital data. • Blockchain trial in 1–2 villages.- Main nodes: village, traditional institutions , BPD/LPM • Data security training & simple smart contract. 	<ul style="list-style-type: none"> • Village blockchain is working (pilot project) • People start to access digital data
4	Cross-Village Integration & Regulation	3–5 years	<ul style="list-style-type: none"> • Inter-village blockchain expansion • Collaboration with local government (regulation & internet) • Synchronization with the law 	<ul style="list-style-type: none"> • Inter-village blockchain network • Regional policies strengthen
5	Replication & Sustainability	>5 years	<ul style="list-style-type: none"> • Model evaluation & refinement • Replication to other districts • Customary smart contracts (inheritance rights, disputes, 	<ul style="list-style-type: none"> land national legality customs. territorial boundaries).

- A secure, inclusive & sustainable record keeping system.

Source: Processed by Researchers in 2025

3. COVER

This study concludes that blockchain-based digitization of customary land records is a strategic step to address the classic problem of manual record keeping, which is prone to loss, damage, and disputes. Blockchain is an instrument capable of ensuring data security, transparency, and immutability, while still allowing for integration with local wisdom values. Thus, customary land records are not only strengthened technically but also gain stronger social and legal legitimacy. These findings also emphasize that the successful implementation of technology is not merely a technical matter but is highly dependent on social readiness, human resource capacity, and institutional and regulatory support. The transformation process to a blockchain-based system requires measurable stages, starting from community education and digitizing manual archives to limited-scale system trials. With a phased approach, the technology can be adopted without disrupting the entrenched customary social order. The formulated blockchain-based model for digitizing customary land records is not only relevant to address local issues but can also be replicated in other regions with similar characteristics. Therefore, the results of this study provide a conceptual contribution to the academic literature and practical suggestions for public policy in the field of customary land management and customary rights.

Based on the research results, it is recommended that the local government of the Regency Bone Bolango, together with traditional institutions and village officials, will immediately develop a strategy Collaborative effort to prepare for the implementation of blockchain-based digitalization of customary land registration through digital literacy education, strengthening village internet infrastructure, and developing supporting regulations that support the protection of customary rights. Furthermore, the involvement of traditional leaders and the younger generation must be prioritized to ensure this transformation process is not only legally valid but also socially and culturally acceptable, enabling the Bone Bolango model to develop into a national reference for safe, inclusive, and equitable village asset governance.

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List of Sources

In this research process, the researcher interviewed approximately 15 key informants consisting of traditional figures, village officials, the National Land Agency (BPN) of Bone Bolango Regency, and the general public in several villages in Bone Bolango Regency.

1. Village Heads and Village Apparatus at 6 village offices in Bone Regency Bolango was interviewed during the period of June-July at approximately: 09.00 WELCOME – 14.00 WELCOME
2. BPN employees of Bone Bolango Regency on August 5, 2025 at: 09.00 WELCOME – 10.00 WELCOME
3. Traditional leaders in Bone Bolango Regency were interviewed during the period of June-July at approximately 09.00 WITA – 14.00 WITA
4. Community leaders of Bone Bolango Regency were interviewed during the period of July-August at approximately: 09.00 WITA – 14.00 WITA

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