A SCOPING REVIEW ON THE VIABILITY OF BLOCKCHAIN SOLUTION FOR LAND REGISTRY SYSTEMS IN NIGERIA

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ABSTRACT

Inefficiency and fraud are some of the issues afflicting the land administration system in developing countries such as Nigeria. Though highly beneficial, adopting blockchain technology comes with a high degree of complexity and risks. In this study, viability is understood as a combination of technical feasibility, legal and regulatory readiness, and socio-economic acceptability required for sustainable deployment of blockchain-based land registries in practice. Accordingly, this scoping review maps recent literature (2022–2025) to identify how these dimensions of viability are addressed, and where critical readiness gaps remain for Nigeria and comparable developing countries. This scoping review summarizes the specified benefits, challenges, and core focus of current research through the thematic analysis of 20 modern scholarly works. The results show that there is an overwhelming agreement about the possible benefits of technology, including security and transparency. However, there is also substantial and ongoing disagreement about issues of technical readiness, legislative and regulatory gaps, and socio-political issues. The scoping review concludes with a predominant research gap: A lack of a systematic evidence-based framework for stakeholders to systematically assess these viability factors. Accordingly, this study outlines existing research and clarifies a definitive research direction to derive an implementable decision-support tool for the public sector.

Keywords: Blockchain, Land Registry, Decision-Support Framework, Scoping Review, Software Engineering

INTRODUCTION

Land registration is key for any economy as it protects users' rights, ensures access of the users to capital markets, and lends to sustainable development. In addition, secure and effective land registration is necessary for economic and social stability. Nevertheless, many developing countries face systemic challenges in their land registration process. Despite concerted digitalization efforts like the Abuja Geographical Information Systems (AGIS), empirical findings reveal that users experience persistent challenges in service delivery, with high fees, and long waiting times which gradually erodes public trust in the system (Adesola. A., 2024) correct this citation.

Blockchain is a distributed ledger architecture in which transactions are stored in cryptographically linked, time-stamped blocks that are replicated across a network of nodes rather than maintained in a single central database (Dong et al., 2023; Guo & Yu, 2022). Typical blockchain systems comprise peer-to-peer networking, a consensus mechanism for agreeing valid transactions, and smart contracts that automatically execute business rules when predefined conditions are met. In the context of land registration, this architecture can reduce processing time and informal fees by automating routine checks through smart contracts, limiting the discretionary role of intermediaries and providing a transparent, tamper-evident record of ownership and transfers. (how does blockchain solve the problem of high fees and long waiting hours you spoke about in the above papragraph?????). Due to its core characteristics such as decentralisation, timestamped data, cryptography security, and tamper-resistant blocks has a strong value proposition to redesign data intensive, trust-based systems (Dong et al., 2023). The ability of the technology to enhance transparency, automate complex processes through smart contracts, and reduce conflicts over land rights is heavily discussed across present-day literature (Mahlangu et al., 2025).

Implementation of effective use of the technology has the potential to transform land management so as to turn it from an opaque, labor-intensive operation to a secure, efficient, and dependable digital service. However, the decision to roll out this underlying technology is a complex socio-technical undertaking, involving considerable danger and challenges requiring critical analysis (Guo & Yu, 2022). Even though scholarly research on the topic has been increasing rapidly during the past few years, with many systematic reviews published in the last couple of years (M. Zein & Twinomurinzi, 2023), there is a critical need to synthesize what has been found so far to define the current knowledge base exactly and to identify salient gaps for future research. This scoping review fills the bill accordingly by mapping the latest literature to answer the following research questions.

Introduce blockchain technology as a concept. Provide information on its architectures and how it operates

Related Works

Zein and Twinomurinzi (2023) conducted a systematic literature review on blockchain-based land registration on what????, with a particular focus on developing countries, and concluded that while academic interest is increasing, real-world implementations remain scarce due to infrastructural and institutional constraints. Similarly, Dong et al. (2023) and Guo and Yu (2022) offer in-depth technical surveys of blockchain architectures, consensus mechanisms and security properties, highlighting how features such as immutability and distributed validation can mitigate data tampering in traditional registries. of what concept or subject??. Their analyses emphasize that core DLT properties, particularly immutability and distributed consensus, can make unauthorized alteration of records significantly more difficult than in centrally managed databases used by many land agencies. (the sentence is not clear and

incomplete). Bărbuță & Alexandrescu (2024) recommended a framework using dynamic Non-Fungible Tokens (dNFTs) for Property Deed, arguing that tokenization model is inherently more secure and transferrable than traditional database entries. Shuaib et al. (2022) compared three identity management approaches for blockchain based land registries centralised identity, federated identity and self-sovereign identity and concluded that a self-sovereign identity model is most promising for ensuring secure and privacy preserving participation in trust deficient environments. In India, Umrao et al. (2022) proposed a reliable framework to eliminate intermediaries, which are the main source of fraud and disputes. Goyal (2022) did a SWOT analysis of land registration and concluded that blockchain is tamper-proof, but its weakness of high initial infrastructure cost and technical knowledge is a significant hurdle. Putra and Lewiandy (2024) noted the regulatory disharmony in land law specifically in Indonesia that does not accommodate for any electronic transaction which is the same in Nigeria. Mata et al. (2022) studied Malaysia, stating that unstructured land data in traditional databases cannot be secured, as so they proposed blockchain for trust in developing economy. Bayounis et al. (2023) implemented a private blockchain using Business Process Model and Notation (BPMN) in Saudi Arabia demonstrating a working Government controlled system that could balance transparency and regulation. Nevertheless, Ooi at al. (2022) offer a critical perspective coming from Singapore, cautioning against "perils" of assuming blockchain is a panacea. According to Podshivalov (2022), legal modelling provides a balance of public and private interests which is essential for successful implementation.

Babatunde (2024) conducted empirical studies on the Abuja Geographic Information Systems (AGIS) with conclusion that despite digitization, inefficiency and corruption remain entrenched in the centralized system which is what blockchain technology advocates to solve. However, Adilieme et al. (2025) used empirical studies to find that stakeholder perception and resistance from Government officials who directly benefit from it is key. Moreover, legal analysis performed by Babalola et al. (2023) and policy papers produced by Kuppuswamy et al. (2023) observe that Nigeria's Land Use Act and existing laws do not accommodate smart contracts or digital land titles thus creating a significant "legal lag".

Although challenging, the body of literature broadly agrees on the benefits of applying blockchain to land registration. According to Mahlangu et al. (2025) and Okoli et al. (2024), these can be categorized into three broad groups which are fraud prevention, and transparency, through public ledgers, and operational efficiency through automation. Proposals by Muhammad et al. (2022) and Ono et al. (2023) argue that a hybrid approach using in concert with existing GIS systems will present a practical way forward for Anambra States and the FCT.

MATERIALS AND METHODS

This study follows a five-stage methodology framework for scoping reviews, aiming to map the key concepts in a research area, the main sources and the types of evidence available which is according to the principles of the PRISMA extension for Scoping Reviews (PRISMA-ScR).

Identifying the Research Question

The research question for this scoping review is: "What are the key factors identified in the academic literature (2022-2025) that influence the viability of adopting blockchain technology for land registry systems in developing countries?" just the reason for limiting your studies to 2022 to 2025.

The decision to limit this scoping review to studies published between 2022 and 2025 is intentional and methodologically grounded. This period was selected because it captures the most current and relevant evidence on blockchain applications in land registry systems, particularly in Nigeria and comparable developing-country contexts. In recent years, blockchain technology has evolved rapidly, with frameworks such as dynamic NFTs, self-sovereign identity models, and hybrid GIS-blockchain integrations emerging only after 2022. Earlier studies often do not reflect these innovations or the latest technical capabilities. Hence they were excluded to avoid basing the analysis on outdated technological assumptions.

Also considering legal and policy relevance within the Nigerian context. Nigeria's regulatory environment and land-administration laws are actively evolving, and recent studies such as Babalola et al. (2023) and Kuppuswamy et al. (2023) highlight current legal gaps and policy debates that are directly relevant to blockchain-based land registries. By restricting the review to 2022–2025, the evidence base aligns with the present legislative and policy context, rather than with older frameworks that may no longer apply.

From a socio-political perspective, key issues such as stakeholder resistance, institutional corruption, and broader socio-political barriers are dynamic and context-sensitive. Focusing on recent studies allows this review to capture contemporary realities in Nigeria, as illustrated for example by Adilieme et al. (2025), who document current patterns of governmental resistance, rather than relying on outdated perceptions of institutional behaviour.

Finally, this timeframe reflects the current stage of research maturity in the field. As discussed in the Results and Discussion, most Nigerian-focused studies remain conceptual rather than empirical, and there is a notable absence of pilot implementations or large-scale prototypes. By concentrating on the 2022–2025 literature, this scoping review intentionally foregrounds the present gap between theoretical proposals and practical deployment, thereby providing a sharper evidence-based foundation for articulating future research directions.

Identifying Relevant Studies

The sources for this review consist of 20 (the number of papers are just too few for a review paper or paper that seeks to establish a fact) peer-reviewed papers, which were sourced from academic databases such as ResearchGate, Google Scholar, IEEE Xplore and ACM Digital Library. The search techniques used focused on keywords such as "blockchain", "land registry", "land administration", "Nigeria", and "Abuja". This number is a direct reflection of the current state of research in the field rather than a limitation of the review process. Blockchain applications in land registry systems particularly within the Nigerian context remain an emerging area of study, with most contributions appearing only in the last three years. By applying strict inclusion criteria (peer-reviewed, published between 2022–2025, and directly addressing blockchain in land

administration), we ensured that the review captured only high-quality and highly relevant studies.

Study Selection

The study selection has some inclusion and exclusion criteria applied to the pool of sources to ensure high quality and relevance.

Inclusion Criteria

i. The source was published between 2022 and 2025.
ii. The primary topic is the application, challenge, or value of blockchain technology in registering or land administering.
iii. The research paper, thesis, or formal white paper is peer-reviewed.

Exclusion Criteria

i. The article was written prior to 2022. Justfy why the years specify are chosen
ii. Articles prior to 2022 were excluded because they largely pre-date current regulatory debates and country-specific pilots in Nigeria and comparable jurisdictions, and thus offer limited insight into contemporary viability conditions.
iii. The source is not peer-reviewed

Charting of the Data

A data-charting form was developed to extract key pieces of information from each selected paper. The extracted information are: (a) author and year, (b) research type, (c) primary focus, (d) geographical context, and (e) key findings (benefits and challenges)

Collating, Summarizing, and Reporting of Results

The charted data was analysed in two ways. Firstly, a quantitative mapping of the features of the included sources. Secondly, a qualitative thematic analysis was done to ascertain themes regarding the viability factors was performed.

RESULTS AND DISCUSSION

Factors Influencing Viability

The utilization of the 20 selected papers answers the research question by identifying three critical categories of factors that influence viability: Technological Capablities, Legal and Regulatory Readiness, and Socio-Economic Barriers.

i. ***Technological Factors (Security vs Complexity):*** According to the literature, security and data integrity are the main viability factors for adoption. Bayounis et al. (2023) and Umrao et al. (2022) presents technical evidence that decentralized ledgers can successfully prevent record tampering that happens in centralized databases (Mata et al., 2022). Goyal and Singh (2022) point "High Initial Cost" and "Complexity" as key weaknesses in their SWOT analysis. Your analysis should focus on the fact of the technological development in Nigeria. Is there technology for implementation, is there the technical-know how, is the technology afford to implement in Nigeria, etc In the Nigerian context, the reviewed studies suggest that core blockchain infrastructure (cloud platforms, networking and cryptographic libraries) is technically accessible, but large-scale deployment of a national land-registry blockchain would demand substantial investment in reliable connectivity, secure data centres and skilled personnel

(Okoli et al., 2024; Muhammad et al., 2022). Goyal and Singh's (2022) identification of high initial costs and complexity resonates strongly here: Nigeria's current budgetary constraints and limited pool of blockchain-savvy engineers imply that, although technically feasible, widespread deployment is only partially viable at present without targeted capacity-building and phased implementation.

ii. ***Legal Factor:*** Legal interoperability is a most influencing viability. Putra and Lewiandy (2024) refer to this as "regulatory disharmony" in Indonesia which correlates strongly with the Nigerian situation discussed by Babalola et al. (2023). According to Ooi et al. (2022), if digital land titles are not legally defined, blockchain records could not be admissible in court. (this mean the technology is not legally viable currently in Nigeria) These findings collectively indicate that blockchain-based land registries are not yet legally viable in Nigeria what??, because digital land titles and smart-contract-based transactions lack explicit recognition under current law (Babalola et al., 2023; Ooi et al., 2022). In practical terms, if a system is not legally valid i.e., its records are not admissible or enforceable in court then its technical soundness alone cannot translate into operational viability for public-sector adoption.

iii. ***Socio-Economic Factors:*** Umrao et al. (2022) suggested that intermediaries are the cause of disputes and fraud. Therefore, the viability of blockchain depends on cutting out intermediaries. The skills gap, as indicated by Goyal and Singh (2022), means that viability is limited to local talent that can manage such complex systems. In the light of this paragraph, relate it to the situation in Nigeria and state whether it is viable or not. For Nigeria, the socio-political literature points to entrenched patronage networks around land allocation and rent-seeking behaviour within existing registries (Adilieme et al., 2025; A. A., 2024). Because blockchain would reduce discretionary control and informal opportunities for gain, resistance from beneficiaries of the status quo significantly undermines short-term viability, even if the technology could, in principle, improve efficiency and trust. Thus, from a socio-economic perspective, current viability appears low without strong political will, change-management strategies and incentives that align stakeholders with more transparent processes.

Features of the Selected Studies

Table 1 maps each included study against research type, primary focus and geographical context. Three notable patterns emerge from this mapping.

First, there is a clear geographical concentration on Nigeria: 7 of the 10 papers directly address the Nigerian context, and 3 of these focused specifically on Abuja. While this number is not large enough to claim *strong* empirical saturation, it does indicate growing local academic engagement with blockchain-based land administration challenges in Nigeria. (3 is too few for strong applicability)

Second, conceptual proposals and review type studies dominate the sample. Twelve of the twenty papers are integrated reviews, survey papers, conceptual frameworks or technical proposals, whereas only four report empirical field data or implemented prototypes. This imbalance suggests that the research area is

still relatively immature, with scholars primarily theorizing potential solutions rather than testing them in real-world land registry environments. (incomplete statement). Third, the thematic foci of the studies span technical architecture, legal and regulatory analysis, and sociopolitical barriers, but these themes are unevenly distributed across countries. Technical framework and architecture papers are more common in non-Nigerian settings (e.g., Saudi Arabia, Malaysia, India), where

authors report working prototypes or detailed system designs, while Nigerian studies more often highlight legal gaps, institutional resistance and governance concerns. This pattern underpins our later finding that viability in Nigeria is constrained more by legal institutional readiness and sociopolitical conditions than by the intrinsic capabilities of blockchain technology.

Table 1: Mapping the Selected Literature

Reference Literature	Research Type	Primary Focus	Geographical Context
(Mahlangu et al., 2025)	Integrated Review	Benefits & Barriers	General / Developing
	Empirical Study (Survey)	Socio-Political / Economic Barriers	Nigeria
(Adilieme et al., 2025)	Empirical Study (GIS Analysis)	Problem Analysis (AGIS Inefficiency)	Abuja, Nigeria
	Review Paper	Opportunities & Challenges	Nigeria
(Adesola. A., 2024)	Technical Proposal (dNFTs)	Technical Solution	General
	Policy Analysis (White Paper)	Legal & Regulatory	Nigeria
(Okoli et al., 2024)	Conceptual Proposal	Strategic Approach	Anambra, Nigeria
	Conceptual Proposal (Framework)	Technical Solution	Abuja, Nigeria
(Bărbuță & Alexandrescu, 2024)	Systematic Literature Review	Barriers	General
	Survey Paper	Technical Overview	General
(Kuppuswamy et al., 2023)	Survey Paper	Technical Security	General
	Comparative Review	Technical Solution (Identity Management)	General
(Ono & Ekebuike, 2023)	Legal Analysis	Legal and Regulatory Barriers	Nigeria
	Technical Framework	Private Blockchain Property Management	Saudi Arabia
(Muhammad et al., 2022)	Technical Analysis	Database vs Blockchain	Malaysia
	Technical Framework	Eliminating Intermediaries	India
(M. Zein & Twinomurinzi, 2023)	Empirical (SWOT)	Implementation Cost	India
	Legal Analysis	Data Ownership/Perils	Singapore
(Dong et al., 2023)	Legal Modelling	Implementation Models	Russia/General
	Legal Analysis	Regulatory Disharmony	Indonesia

Bibliographic Analysis of Research Focus

The selection of literature shows that research focus is distributed geographically. Figure 1 shows that about half of the studies reviewed focused on Nigeria, showing perhaps more

local academic interest in resolving this problem as opposed to studies from elsewhere.
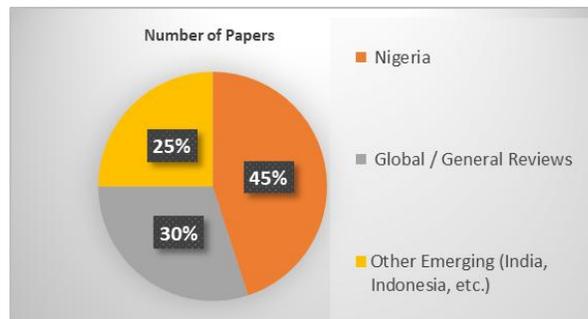

Figure 1: Research Focus Based on Geography

Comparative Analysis of Viability Barriers

One of the key findings of this review is that identified barriers in the Nigerian literature differs from global literature. The

potential barriers identified by the different research studies were categorized into technical, legal, and socio-political barriers. This was identified by themes found in the papers.

Figure 2 illustrates this more, in Global analysis, Technical Complexity is cited as the major challenge at 50%, whereas Nigerian context overwhelming agree that Socio-Political Resistance and Legal Gaps combined at (70%) is the major barrier. If the more advanced nations had technical complexities, how will that not be a factor in Nigeria. Many advanced nations are still finding implementation of blockchain a challenge due to computing challenges and facility.

Therefore, if technically advanced countries still struggle with blockchain's complexity, Nigeria will also face significant technical challenges; yet our review shows that, at present, legal gaps and institutional resistance are even more critical barriers to viability.
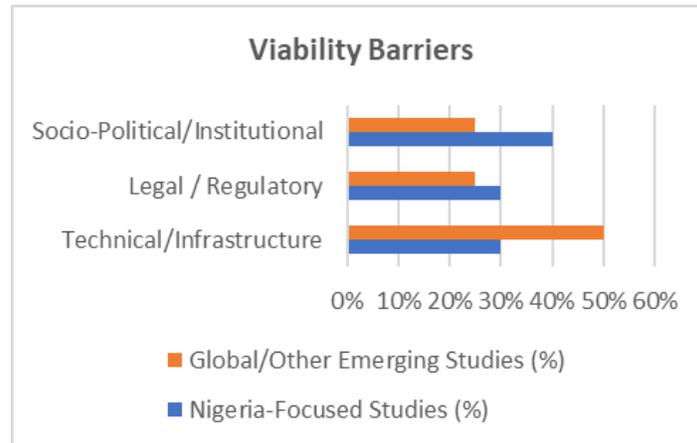

Figure 2: Visibility Barriers

This difference suggests that the 'viability' of blockchain in Nigeria is not a software engineering but an institutional concern. Authors based in Saudi Arabia like Bayounis et al. (2023) are able to show off working prototypes thanks to a "supportive regulatory environment." Authors based in Nigeria (Adilieme, 2025; Babalola et al., 2023) argue that "Regulatory disharmony" and entrenched corruption are pre-technical blockers that stop the best software engineering solution from working.

Analysis of Technical Architecture Viability

Shuaib et al. (2022) conducted a comparative identity model analysis (is this a computing model or social model). The comparative identity model analysis by Shuaib et al. (2022) is fundamentally a computing model, not a social model. It evaluates different technical architectures for identity management; centralized, federated, and self-sovereign identity (SSI) based on features such as control, point of failure, privacy, and resilience. These are computational and system design parameters that directly affect how blockchain-based land registries can be implemented. The model also has social implications, since identity management influences user trust and participation. But the framework itself is rooted in computing and software engineering, with its primary purpose being to compare technical viability of identity architectures in trust-deficient environments like Nigeria.

Table 2 highlights their findings that are significant for Nigerian setting, which is trust deficient. In digital identity management, three main models are relevant for land-registry applications: centralised identity, federated identity and self-sovereign identity (Shuaib et al., 2022). In a centralised identity model, a single authority (e.g., a land registry) creates and controls user credentials; in a federated identity model, multiple service providers rely on a common identity provider (as in single sign-on arrangements); and in a self-sovereign identity (SSI) model, users manage cryptographic credentials in digital wallets and selectively disclose attributes without relying on a central identity intermediary. These models differ in terms of control, privacy and resilience, which are crucial for trust-deficient settings such as Nigeria. you did not introduce that centralised, federated identity and self-sovereign concepts. Write and introduce these concepts before comparing.

Table 2: Comparative Identity Model Analysis

Feature	Centralized Identity (Traditional)	Federated Identity (SSO)	Self-Sovereign Identity (SSI)
Control	Authority controls data	Identity Provider controls data	User controls data
Point of Failure	Single Point of Failure	Semi-Centralised	Decentralized (No SPOF)
Privacy	Low	Medium	High
Viability for Nigeria	Low: Prone to internal fraud	Medium: Reliance on 3rd parties	High: Best for restoring trust

Discussion

The outcome of the chosen papers indicates an intense divide in current research. The theoretical potential of blockchain in resolving the trust deficit for land administration is fully endorsed on the one hand. The literature has established that the architectural features of blockchain, namely decentralization and immutability specifically address the malfunctioning of AGIS currently due to fraud and lack of transparency

(Muhammad et al., 2022; Okoli et al., 2024). It is agreed that from a software engineering perspective, technically, blockchain is valid and robust. In reality, the practical application of this scenario turns out to be more complex.

The mapping in Table 1 highlights that technical proposals (e.g., Bărbuță & Alexandrescu, 2024; Shuaib et al., 2022). The main finding is that blockchain features do not determine its viability but rather its context specifically in Nigeria (in Nigeria). The technology is there, but political will, legal frameworks and technical infrastructure that enable it is way behind. This causes a "readiness gap," which means that a technical sound solution might not work because of things that are not technical. The comparative analysis of barriers shows that, globally, technical complexity is often cited as the dominant challenge, whereas in Nigeria socio-political resistance and legal gaps account for around 70% of the reported obstacles. This indicates that the viability of blockchain for Nigerian land administration is primarily constrained by institutional and legal readiness, rather than by the intrinsic maturity of the technology.

Our analysis revealed that the literature is dominated by conceptual proposals and reviews, with very few empirical implementations. This finding itself is significant: it highlights the immaturity of the research area and underscores the critical evidence gap that must be addressed before blockchain can be viably adopted in Nigeria's land registry systems.

Thus, while the number of papers is modest, it is representative of the current scholarly landscape. The strength of this review lies in its ability to synthesize these recent contributions, identify thematic patterns (technological, legal, and socio-political factors), and expose the readiness gap that hinders practical deployment. In this way, the scoping review fulfills its purpose by clarifying the state of knowledge and charting a clear direction for future research.

CONCLUSION

This scoping review has systematically captured the academic landscape on the issue of blockchain technology's viability for land registry systems in developing countries, with focus on Nigeria between 2022 and 2025. Through a thorough examination of these studies, the strong evidence indicates that the theoretical uses of Blockchain to increase security, transparency, and automation in land administration system. This review clearly describes a divergence whereby although technological tools are prudent enough from a software engineering perspective, non-technical barriers make deployment of the technology less practicable.

Legal frameworks, technical infrastructures and socio-political resistance to transparency which constitutes the readiness gap presently hinder successful implementation. The analysis also reveals an overwhelming reliance on conceptual proposals, rather than on empirical evidence, which includes the absence of data from actual pilot implementation or prototype in Nigeria. This indicates that blockchain could be used in land administration for limiting fraud and improving efficiency. The way forward is not further theoretical validation but resolution of the contextual and empirical gaps. Overall, the evidence suggests that blockchain for land registration in Nigeria is technically feasible and potentially advantageous, but only partially viable at present because legal frameworks and socio-political conditions are insufficiently prepared to support enforceable, large-scale deployment.

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