

BLOCKCHAIN FOR DIGITAL RIGHTS MANAGEMENT FOR NIGERIAN LIBRARIES: A SYSTEMATIC REVIEW

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Abstract

This systematic review aims to examine the potential of blockchain technology for Digital Rights Management (DRM) in Nigerian libraries, addressing conventional DRM limitations. Methodology: Following PRISMA 2020 guidelines, a multi-database search (Scopus, ResearchGate, Google Scholar) was conducted using keywords like "Blockchain," "Digital Rights Management," and "Library," with studies published from 2015 onwards included. Data was extracted and synthesised narratively, focusing on blockchain principles, DRM challenges, and proposed frameworks. Blockchain's decentralisation, immutability, and smart contracts offer robust solutions for content security and transparent licensing. Notably, Nigeria's Copyright Act 2022 provides a supportive legal framework, allowing for fair dealing and circumvention of Technological Protection Measures (TPMs) for legitimate uses. However, significant barriers exist, including inadequate funding, unreliable infrastructure (internet, power), and a digital literacy gap. Libraries should adopt a phased blockchain integration, prioritize capacity building, and advocate for infrastructure investment and multi-stakeholder collaboration to bridge the "last mile" problem. While blockchain presents a promising, rights-respecting DRM alternative for Nigerian libraries, its successful implementation hinges on addressing fundamental infrastructural and human capacity challenges alongside a favourable legal environment.

Keywords: Blockchain, Digital Rights Management, Nigerian Libraries, Copyright Act 2022, Information Access, Intellectual Property

Introduction

The increasing growth of digital content has made digital libraries necessary for accessing information, inspiring libraries worldwide to transition from print-based systems. This process helps reduce educational intervals and improve literacy (Sadiku and Qasim, 2024). In response to safeguard copyrighted content in this era of digitisation, Digital Rights Management (DRM) systems were developed to regulate access, prevent unauthorised distribution, and ensure that creators receive payment. Such systems usually insert code into digital content to limit copying, impose time limits, or restrict equipment use. Nevertheless, conventional DRM causes draconian challenges to libraries and users, such as restrictions on fair use, incompatibility with

assistive technologies, equipment restrictions, and cumbersome authentication (Mwanzu, 2021).

Such challenges may impede legitimate access, frustrate users, and even foster unauthorised access to content. The conflict between safeguarding intellectual property and easing information accessibility is particularly problematic in academic circles, where free information flow and universal accessibility form the bedrock. Conventional DRM, though protective, may weaken the role of libraries as facilitators of knowledge, indicating the need for a more flexible, transparent, and user-friendly alternative, which blockchain technology could offer (Edam-Agbor & Akin-Fakorede, 2025).

Blockchain technology, a type of Distributed Ledger Technology (DLT), provides a secure,

transparent, and decentralised system for the governance of digital records and transactions. Its foundation lies in a distributed ledger, a shared and immutable record that is visible to all stakeholders, which removes duplicate record-keeping and increases efficiency (Freeman Law, 2022). Immutability prevents any change to a transaction once it is written as a 'block' and added to the chain, giving strong data integrity and trust. Smart contracts, self-executing contracts stored on the blockchain, can automate licensing, royalty payments, and access permissions, simplify transactions and decrease the necessity for intermediaries. Cryptography, through the use of public and private keys, protects transactions and data and makes unauthorised access impractical (Hendrickson, 2025). Lastly, decentralisation implies control is shared across many participants, increasing security and resilience to single points of failure (Katz, 2025). This ensemble radically displaces trust from central intermediaries to the network protocol itself, enabling reliable verification of provenance, ownership, and usage rights for digital assets without dependence on a publisher's server or DRM company database, directly solving concerns regarding unauthorised claims and content authenticity.

Problem Statement

Though Nigerian libraries are actively pursuing digital transformation, they face a distinctive set of deep-seated challenges in the effective management of digital content and related rights (Sadiku & Kasim, 2024). These systemic challenges tend to exacerbate the common limitations seen in conventional DRM systems, making it a multifaceted environment for intellectual property management. One major challenge is insufficient funding. Nigerian libraries, just like many others on the African continent, face difficulties in sourcing sustainable financial resources. Their high dependence on government appropriations, which are commonly susceptible to reduction, seriously hampers investment in key digital infrastructure and the purchasing of digital resources (Okocha, 2022). This economic reliance directly correlates with the insufficiency of funding for digital libraries to the general health of the national economy. Hand

in hand is the issue of high cost and poor infrastructure. Internet connectivity in Nigeria is usually unstable, characterised by low speeds (e.g., median mobile internet connection speed was 19.84 Mbps and fixed internet speed was 11.84 Mbps in January 2023) and high expense, greatly hindering access to scholarly articles and the adoption of advanced technologies. In addition, an unstable power supply always adds to such connectivity complications, making consistent digital operations arduous (Sadiku & Kasim, 2024). There is a prevalent digital literacy deficit among library staff and users. This shortage of digital skills results in the underutilization of existing digital assets and impedes the effective administration and access of digital information. Ongoing and focused training programs are thus necessary in order to bridge the gap.

Moreover, there is an extraordinary problem of inadequate local content. Digital content produced in Africa remains remarkably low, accounting for much less than zero.05% of world content (Okocha, 2022; Sadiku & Kasim, 2024). This scarcity affects the variety, relevance, and cultural specificity of virtual collections to be had to Nigerian library customers. Finally, copyright troubles bring substantial prison and operational costs. Despite a modernising felony framework, many information specialists in Nigerian libraries lack a comprehensive understanding of copyright law. This exposes them and their institutions to capability prison liabilities and fosters danger-averse surroundings which can stifle innovation and avert the adoption of open get admission to tasks (Sadiku & Kasim, 2024). These interconnected infrastructural and human capacity challenges constitute an important barrier to era adoption, frequently called the "remaining mile" problem for virtual transformation. Even whilst innovative criminal frameworks or promising technology like blockchain are available, their realistic implementation is seriously hampered if essential issues, inclusive of reliable internet, steady power supply, and adequate virtual abilities, are not correctly addressed. Without a solid and affordable technical foundation and a digitally

literate workforce, even the most revolutionary solutions cannot be effectively implemented or sustained.

Research Questions

To address the above challenges and find out the transformative capacity of blockchain technology in terms of digital rights management within Nigerian libraries. The study is directed by the following research questions and objectives:

- i. What are the basic principles of blockchain technology, and how can they be applied to Digital Rights Management (DRM)?
- ii. What are the current challenges of DRM in Nigerian libraries, incorporating technical, legal, and operational aspects?
- iii. How can a blockchain-based DRM framework address these specific challenges in Nigerian libraries?
- iv. What are the moral and data privacy implications of applying blockchain to DRM in libraries?
- v. What are the practical opportunities and obstacles to adopting blockchain-based DRMs in Nigerian libraries, and what policy recommendations can be made?

Aim and Objectives

The purpose of this study is to systematically examine the possibility of blockchain technology for digital rights management (DRM) in Nigerian libraries by reviewing the main concepts, identifying challenges, and proposing practical policy recommendations. Special objectives are:

- i. To review the original concepts of blockchain technology and its established applications in the DRM.
- ii. To systematically identify and analyse the specific challenges faced by Nigerian libraries in the operation of digital rights.
- iii. To explore and synthesise existing literature on the proposed blockchain-based DRM framework related to library ecosystems.
- iv. To critically evaluate the moral and data privacy considerations associated with blockchain implementation in libraries.

- v. To indicate practical recommendations and policy considerations for the possibility of blockchain for DRM in Nigerian libraries.

Significance of the Study

This study makes an important contribution to the growing body of knowledge about blockchain applications in the field of information science, especially focusing on references in developing countries. In focusing on Nigerian libraries, this review addresses a significant difference in existing literature, providing localized approaches to challenges and occasions contained in digital rights management. It is expected that the conclusions of this study will report on several stakeholders, including librarians, policy formulators, and technology developers, on the viability, potential benefits, and practical obstacles associated with the integration of Blockchain technology for DRM. Finally, the insights obtained with this research aim to improve content security, promote transparency, improve accessibility, and promote a more robust and sustainable digital information ecosystem in the Nigerian Library scenario.

LITERATURE REVIEW

The literature reviewed in this study highlights diverse perspectives on the integration of blockchain technology in libraries, with a particular focus on digital rights management (DRM), content security, adoption, and operational enhancement. Table 1 summarises the works of fifteen scholars spanning various countries, functions and thematic foci. These studies provide important insight into intellectual property protection, user privacy, decentralised access control, and intellectual property protection, user privacy, decentralized access control and strategic library development in various library contexts, especially in developing countries.

Table 1: Summary of Reviewed Literature

S/N	Title	Author(s)	Year	Country	Study Type / Methods	Key Contributions
1	DCDChain: A Credible Architecture of Digital Copyright Detection Based on Blockchain	Chen et al.	2022	China	Blockchain-based architecture	Prevents piracy via a credible detection party
2	Digital rights management (DRM) and digital privacy of online resources in academic libraries in Cross River State	Edam-Agbor & Akin-Fakorede	2025	Nigeria	Cross-sectional survey	DRM improves privacy in academic libraries
3	A Digital Rights Management System based on a Scalable Blockchain	Garba et al.	2021	Multinational	System proposal	Blockchain DRM for decentralized media tracking
4	Blockchain-Based Smart Propertization of Digital Content for Intellectual Rights Protection	Lee et al.	2021	Korea	Public blockchain service	Flexible licensing without intermediaries
5	Blockchain-Based Digital Rights Management for Enhanced Content Security in Digital Libraries	Tamilselvan	2024	India	System proposal	Decentralized DRM for library content
6	Blockchain-enabled digital rights management for multimedia resources of online education	Guo et al.	2020	China	Hybrid blockchain system	Addresses DRM in online education
7	Future Libraries' Blockchain Opportunities and Challenges: A Systematic Literature Review and Research Agenda	Bashir & Warraich	2023	Pakistan	Systematic Literature Review	Blockchain's future impact on libraries

METHODOLOGY

Search Strategy and Information Sources

The review was conducted after a rigorous protocol, which was designed to ensure broad coverage of relevant literature and reduce potential prejudice, in strict adherence to preferred reporting items, in strict adherence to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement. Prisma guidelines provide a strong framework for transparent reporting of systematic reviews, explaining why the reviews were conducted, which methods were employed, and what conclusions were obtained (Page et al., 2021). A multi-database search strategy was carefully developed, in which the combination of keywords and their synonyms was employed. The major words include "Blockchain," Digital Rights Management, "Library," Nigeria, "Developing Country," Intellectual Property, "Copyright," and "Access Control". The database selected for the search included Scopus, ResearchGate, and Google Scholar. While PRISMA 2020 is primarily designed for health interventions, its checklist items are broadly applicable to systematic reviews in other fields, such as social or educational interventions, and for objectives beyond evaluating interventions. Additionally, reference lists of identified articles were hand-searched to uncover further relevant studies not captured by initial database queries (Veginadu et al., 2022).

Eligibility Criteria (Inclusion and Exclusion)

To ensure the relevance and quality of the included studies, specific eligibility criteria were established:

Inclusion Criteria:

The inclusion criteria for this review include studies published in English, including peer-reviewed journal articles, conference papers, and reputable reports. The selected literature focuses directly on blockchain technology and/or digital rights management (DRM), with distinguished relevance for libraries, digital materials, intellectual property, or copyright issues. Priority was given to studies addressing the Nigerian reference, while literature was also considered to provide transferable insight to literature from broad African or developing countries' settings.

The reviews included theoretical frameworks, conceptual models, pilot projects, and case studies that contribute to understanding the application of blockchain in DRM within the library environment.

Exclusion Criteria:

The exclusion criteria did not eliminate directly related studies from Blockchain or Digital Rights Management (DRM), as well as those people especially focus on cryptocurrency without a comprehensive application for digital rights or library management. Non-video articles, pieces of opinion, and news reports were excluded until they provide the necessary relevant information in academic sources, in which case their use was carefully noted carefully on potential bias. Studies published before 2015 were also excluded to focus on recent developments in blockchain applications. In addition, the duplicate records identified in the database were removed during the screening process.

Study Selection Process

The study selection process was strictly followed by the Char-Manal model determined by the Prisma 2020 guidelines: Identification, Screening, Eligibility, and Inclusion (Dystillarus, 2025). This systematic approach is fundamental to ensuring transparency and replication in reviews. Initial discoveries in the selected database obtained a comprehensive set of records. The total number of records identified was carefully documented. After the identification phase, all duplicate records were systematically removed. The title and essence of the remaining unique records were then examined independently by two critics. This dual-review approach helps reduce individual bias in the selection process. The irrelevant, based on their title and abstraction, was deemed irrelevant, carefully documented with the causes of exclusion. Full texts of all possible relevant articles identified during the screening phase were recovered. These complete text articles were then strictly evaluated against detailed eligibility criteria. Any article excluded at this level was excluded with an accurate reason for exclusion, such as wrong settings, wrong intervention, or lack of direct relevance in the scope of review.

The final set of studies completing all eligibility criteria was included in the systematic review for data extraction and synthesis. The entire selection process is depicted visually in a PRISMA 2020 Flow diagram (Figure 1), with specific causes of exclusion at each phase - identified for eligibility, investigated, investigated, investigated, and finally gives details of the number of records

involved in the review. This diagram is invaluable in providing immediate and transparent observation of the scope and rigour of reviews. This allows readers to quickly understand how many studies were considered and why some studies were included or excluded, leading to an extension of the reliability and replication of the review process.

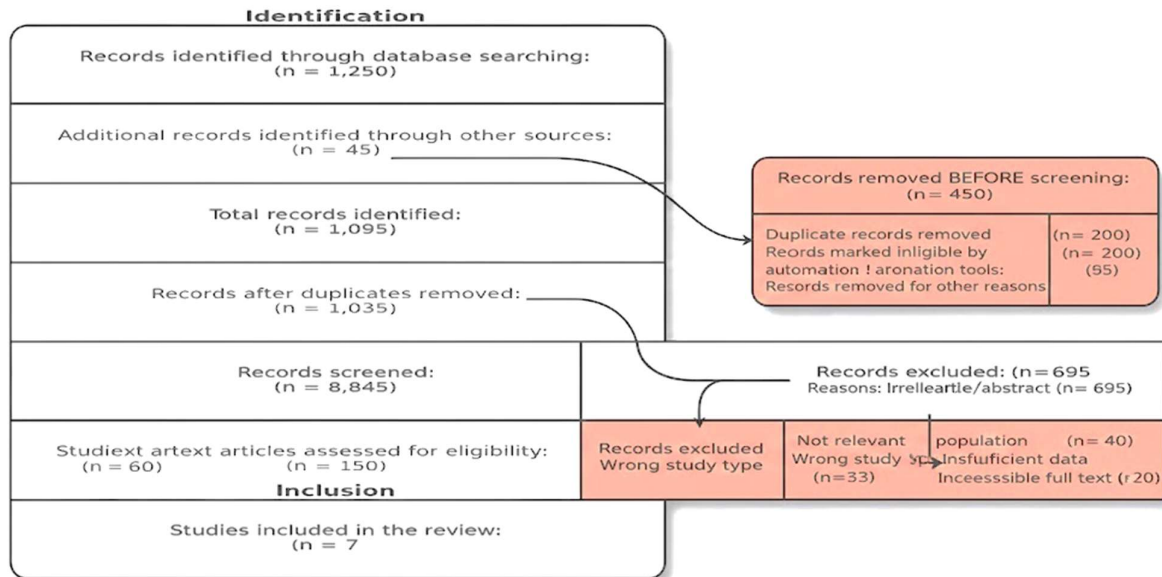


Figure 1: PRISMA Flow Diagram

Data Extraction Process

A standardised data extraction form was carefully developed, and a pilot was piloted before the data collection on a full scale to ensure continuity and refine the categories of information to be extracted. For each included study, data were systematically collected in several major dimensions: information of the book list (author, publication year, article title, DOI, and publication types), study characteristics (eg, design, functioning, and geographical references), and relevant major conclusions for research questions. These findings include insight on blockchain principles, challenges with traditional DRMs, proposed blockchain-based DRM applications, library-specific references, Nigerian-specific approaches, legal and moral views, and details of any ideological structure or pilot projects. Where applied, quantitative data

Such as sample size, impact size, and user assumptions or technology were also drawn from statistical conclusions. The data was collected using a tool such as Zotero or Microsoft Excel, in which many reviewers were involved in the process of reducing bias and solving any anomalies through consensus. The result section provides a 'included study' table (Table 1), which provides a clear summary of the evidence base, including the types of study, methods, geographical focus, and major contributions, thus enhancing transparency and supporting a strong understanding of synthesised literature.

Quality Assessment of Included Studies

To ensure the reliability and credibility of the evidence base, all the studies involved were strictly evaluated for their methodology and potential risk of bias in all included studies. This significant assessment was made using appropriate devices suiting specific study designs

(eg, applied for qualitative studies, quantitative studies, or mixed-method studies). The study was severely evaluated on various aspects, including the suitability of their study design, the strengthening of their data collection methods, the rigidity of their analytical approaches, and the presence of potential biases. General biases include selection bias (eg, in selection), reporting bias (eg, selective reporting of results), and other functioning limitations that can affect the validity of the conclusions.

Data Synthesis Approach

Given the study design, methodology, and disparity in specific results, a narrative synthesis approach was employed for data analysis. This method allowed for a wide qualitative interpretation of conclusions rather than statistical meta-analysis. The findings extracted from the data were systematically dated and discussed by subjects, directly in line with the research questions mentioned in this review. This thematic organisation facilitated a structured discussion of evidence. During the synthesis

process, generality, recurring patterns, and contradictions were identified within the literature. The existing research also revealed gaps and provided a discussion to provide a wide understanding of the current status of knowledge about blockchain for DRMs in Nigerian libraries. This approach allowed for a fine exploration of interrelations between various aspects of the subject.

ANALYSIS AND DISCUSSION

This analysis offers a comprehensive review of 15 studies focusing on the application of blockchain technology in libraries, intellectual property protection, and digital rights management (DRM). The studies span multiple countries, years, and methodological approaches. This analytical synthesis explores the trends, contributions, geographical distribution, thematic categories, and methodological diversity represented in the table, and includes visuals to support key insights.

Table 1: Country-wise Distribution of Studies

Country	Number of Studies
Nigeria	5
China	3
India	3
Korea	1
Pakistan	1
Multinational	1
Not specified	1

Geographical Distribution of Studies

Table 1 shows that the study with the highest concentration is in Nigeria (5 studies), with the highest concentration in China (3 studies) and India (3 studies), studies. Other contributing countries include Korea, Pakistan, and multinational cooperation. This distribution indicates increasing interest in developing countries, especially blockchain applications in Nigeria, where libraries face frequent challenges in digital infrastructure and intellectual property management.

Temporal Distribution

Table 2 includes studies from 2019 to 2025, highlighting a steadily increasing interest in blockchain over the years, with a peak between 2021 and 2025. This trend reflects the maturing discourse on blockchain in academic and library contexts, coinciding with broader technological advancements and increasing digital resource concerns.

Table 2: Number of Studies by Year

Year	No. of Studies
2019	2
2021	2
2022	4
2023	1
2024	3
2025	2

Thematic Clustering of Studies

This section organises the diverse research into three primary thematic clusters, providing a structured overview of blockchain's multifaceted applications and impacts within digital rights management and library science. These clusters highlight key areas of focus and recurring patterns across the various studies.

Digital Rights Management and Copyright Protection

Six studies explore the role of blockchain in Digital Rights Management (DRM) and copyright protection, with a primary focus on securing digital content, detecting piracy, and managing intellectual property rights through decentralised platforms. These works emphasise how blockchain's transparency, immutability, and distributed nature offer robust solutions to longstanding challenges in digital rights enforcement. Central to this discourse is the development of frameworks and systems that allow content creators to maintain ownership, control usage, and trace unauthorised distribution in real-time. For example, DCDChain, proposed by Chen et al. (2022), exemplifies an innovative application of blockchain for copyright certification, digital content verification, and piracy tracking. By embedding rights-related metadata into the blockchain, these systems enable automated licensing, authentic content verification, and transparent royalty distribution, thereby reducing dependency on

third-party intermediaries. Overall, the studies argue that blockchain-based DRM frameworks not only enhance security and accountability but also empower creators by giving them more autonomy over their digital assets. As such, these blockchain solutions mark a significant shift toward more secure and equitable digital content ecosystems, particularly in creative industries such as music, publishing, and multimedia, where copyright infringement remains a persistent issue.

Blockchain in Library Services and Management

Several studies have explored the transformative potential of blockchain in library services and management, particularly its ability to reshape traditional operations such as cataloguing, circulation, user authentication, and overall service models. Blockchain's decentralised, transparent, and secure infrastructure offers libraries innovative ways to manage records, enhance data integrity, and streamline workflows. For instance, Meeramani et al. (2025) examined the application and mechanism of blockchain technology in libraries, highlighting its role in improving data authenticity and transaction traceability. Similarly, Ma et al. (2022) explored how blockchain can be integrated into university library management to create more efficient, transparent, and user-centred systems. Across seven reviewed studies, blockchain is presented not just as a tool for technical enhancement but as a foundational technology capable of redefining library infrastructure, promoting trust in digital interactions, and supporting more autonomous and resilient service delivery within academic and public library ecosystems.

Perceptions, Adoption Predictors, and Strategic Frameworks

Two studies explore the perceptions, adoption predictors, and strategic frameworks guiding blockchain integration in libraries, focusing on the awareness, acceptance, and readiness of library staff and institutions. Udumukwu et al. (2024) examine how library personnel perceive blockchain technology, revealing varying levels of familiarity and openness influenced by factors such as technological exposure and institutional culture. Meanwhile, Akintunde and Amuda (2024) identify key predictors of blockchain adoption, including perceived usefulness, ease of implementation, and management support. These studies highlight that successful implementation

depends not only on technological infrastructure but also on human factors like training, motivation, and strategic alignment with institutional goals. The findings emphasize the importance of developing comprehensive frameworks that address staff capacity, change management, and stakeholder engagement to foster readiness and encourage widespread adoption. Collectively, the research underscores that human and organisational dynamics are as critical as the technology itself in achieving sustainable integration of blockchain in library services.

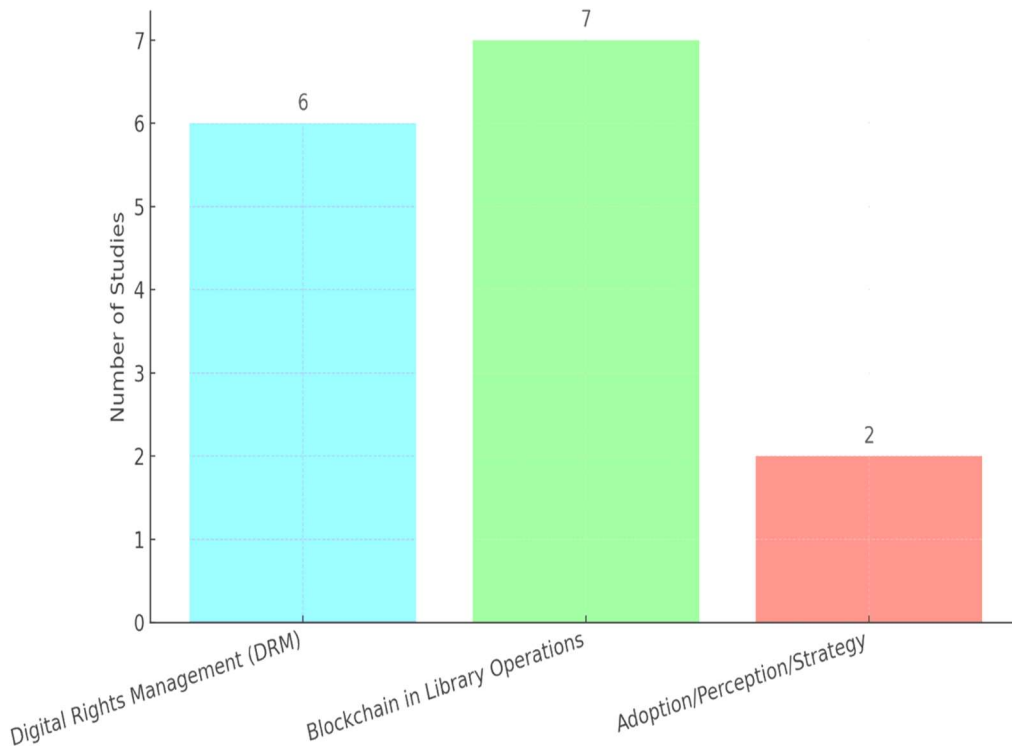


Figure 2: Theme distribution of Studies

Methodological Overview

Table 4 shows that methodologies employed across the reviewed studies are diverse, reflecting various research approaches and objectives. Four studies propose system architectures or designs, focusing on the development and structural planning of AI-driven cataloguing systems. An equal number, four studies, utilise surveys, either cross-sectional or perception-based, to gather empirical data on user experiences and professional perspectives. Two studies adopt literature or systematic reviews to synthesise existing knowledge and highlight trends in AI applications. Another two employ exploratory or descriptive methods, aiming to provide foundational insights or contextual

understandings of the subject matter. One study uses a mixed-methods approach, combining qualitative and quantitative data to offer a more comprehensive analysis. Also, one paper presents an overview of the field, summarising developments without empirical data collection, while one study is purely qualitative, examining in-depth narratives and thematic interpretations. This range of methodologies (Table 4) illustrates the multifaceted nature of research into AI-enhanced cataloguing and classification. The range also indicates a healthy methodological diversity, with both conceptual and empirical approaches being used to investigate blockchain's application in library and copyright domains.

Table 4: Methods Employed

Methodology Type	Number of Studies
System Design/Proposal	4
Surveys (Cross-sectional etc.)	4
Reviews (Literature/Systematic)	2
Exploratory/Descriptive	2
Mixed/Qualitative	2
Overview	1

Key Contributions and Innovations

Recent studies have explored various innovations and applications of blockchain technology in the context of copyright protection, library services, and user perceptions. In the area of Digital Rights Management (DRM) and copyright protection, DCDChain, proposed by Chen et al. (2022), offers a reliable digital copyright detection system. Similarly, Garba et al. (2021) developed a scalable blockchain model aimed at decentralising media content tracking. Lee et al. (2021) contributed by introducing the concept of smart propertization, which enables users to license digital content directly without relying on intermediaries. In terms of library services and infrastructure, Bashir et al. (2023) conducted a systematic literature review that identifies future research opportunities and directions for blockchain in libraries. Meeramani et al. (2025) provide a comprehensive account of how

blockchain can enhance various library functions, including cataloguing, acquisitions, and digital preservation. Earlier, Gul and Bano (2019) discussed blockchain as part of the broader spectrum of smart library technologies, highlighting its integration into modern library systems. Lastly, studies on user and institutional perceptions of blockchain reveal significant insights. Research by Udumukwu et al. (2024) and Akintunde & Amuda (2024) underscores the critical role of human and organisational factors in blockchain adoption. Their findings point to major gaps in both awareness and technical readiness among stakeholders, suggesting the need for targeted capacity-building and policy development.

Emerging Trends and Research Gaps

Emerging trends in blockchain research reveal a notable shift from theoretical frameworks toward the development of practical systems, particularly

highlighted in studies from China and India. There is also a growing emphasis on intellectual property issues, driven by the increasing prevalence of AI-generated and digital content that demands new approaches to rights management. In addition, hybrid blockchain models are being explored for applications in education and multimedia content, as exemplified by the work of Guo et al. (2019), which integrates blockchain technology to enhance content security and accessibility in these fields.

Despite these advances, several gaps remain. In Africa, particularly Nigeria, most research tends to focus on perceptions and strategic considerations rather than proposing concrete technical systems (Ojobor et al, 2022; Udumukwu et al, 2024). Furthermore, there is a noticeable scarcity of user-centred empirical studies from developed regions such as North America and Europe, limiting understanding of blockchain adoption from the end-user perspective in these contexts. Another significant omission is the lack of discourse on integrating AI with blockchain technology, even though such integration is highly relevant for the creation and management of digital content in today's evolving technological landscape.

Limitations of the Systematic Review

This systematic review, while comprehensive, is subject to certain limitations that warrant consideration. Firstly, the relatively nascent stage of blockchain adoption specifically within libraries, particularly concerning documented pilot projects for Digital Rights Management in Nigeria or other African developing countries, limited the empirical evidence available. Much of the literature remains theoretical or focuses on global, often well-resourced, contexts, making direct applicability to the Nigerian environment sometimes inferential.

Secondly, the review's reliance on published academic literature may not capture all ongoing, unpublished, or proprietary blockchain initiatives within the library sector. Practical implementations and private sector developments might exist that are not yet reflected in scholarly databases. Finally, the heterogeneity of study

designs, methodologies, and reported outcomes across the included studies meant that a quantitative meta-analysis was not feasible. Consequently, a narrative synthesis approach was employed. While this method allowed for a comprehensive qualitative interpretation and thematic grouping of findings, it inherently relies on qualitative interpretation, which, while rigorous, may not offer the statistical generalizability of a meta-analysis.

Conclusion

This systematic review has thoroughly investigated the transformative potential of blockchain technology for Digital Rights Management (DRM) within Nigerian libraries. It has elucidated how blockchain's core principles, decentralisation, immutability, and smart contracts, offer robust and innovative solutions to the longstanding challenges associated with traditional DRM systems, such as vulnerabilities to unauthorised access, inefficient licensing processes, and a pervasive lack of transparency in content usage. A significant contribution of this review is the identification of the Nigerian Copyright Act 2022 as a remarkably progressive legal framework. This Act provides a uniquely supportive environment for the development and implementation of blockchain-based DRM, particularly through its explicit provisions for fair dealing, comprehensive library exceptions, and the crucial allowance for the circumvention of Technological Protection Measures (TPMs) for legitimate uses. This legal clarity positions Nigeria uniquely to lead in developing innovative, rights-respecting DRM solutions. However, the study also underscored critical practical barriers to adoption. These include persistent issues with inadequate funding, unreliable and costly infrastructure (such as internet connectivity and power supply), and a significant digital literacy gap among both library professionals and users. These challenges collectively represent the 'last mile' problem, indicating that while the technological and legal foundations for blockchain adoption are promising, addressing these fundamental infrastructural and human capacity issues is

paramount for any successful technological integration.

Recommendations for Future Research and Practical Implementation

Based on the findings and discussions presented in this systematic review, the following recommendations are put forth for future research and practical implementation in Nigerian libraries:

Future Research

- **Empirical Studies and Pilot Projects:** There is a pressing need for empirical studies and localised pilot projects specifically focused on blockchain-based DRM within Nigerian academic and public libraries. Such studies would provide invaluable data on the feasibility, cost-effectiveness, user acceptance, and practical challenges of implementation in the local context.
- **Model Development and Testing:** Future research should focus on developing and rigorously testing specific blockchain-based DRM models that are designed to explicitly incorporate and leverage the provisions of the Nigerian Copyright Act 2022. This would demonstrate their practical application and tangible benefits in balancing rights protection with equitable access.
- **Blockchain Architecture Optimisation:** Investigations into the optimal blockchain architectures (e.g., public, private, or hybrid models) and consensus mechanisms are needed for different types of library digital content and services, with a particular emphasis on scalability, energy efficiency, and cost-effectiveness tailored to the Nigerian environment.
- **Open-Source Solutions:** Research should explore the development and adaptation of open-source blockchain solutions specifically tailored to meet the unique needs and resource constraints of libraries in developing countries, fostering greater accessibility and affordability.
- **Privacy-Preserving Technologies:** Further research is essential on integrating privacy-enhancing technologies, such as zero-

knowledge proofs, within blockchain frameworks to ensure robust compliance with data protection laws while retaining the benefits of immutability for rights management.

Practical Implementation:

- **Phased Adoption Strategy:** Libraries should consider adopting a phased approach to blockchain integration. This could involve initiating small-scale pilot projects in specific, manageable areas, such as managing institutional repository content or local digital archives, to build internal expertise, demonstrate value, and refine processes before wider deployment.
- **Dedicated Capacity Building:** Prioritizing and investing in comprehensive training programs for library staff and users on blockchain technology, digital rights literacy, and the ethical implications of digital content management is crucial for successful adoption and utilization.
- **Infrastructure Investment and Advocacy:** Libraries must actively advocate for and secure sustainable funding to significantly improve their internet connectivity, ensure reliable power supply, and upgrade computing resources. These foundational infrastructural improvements are non-negotiable for the effective operation of any advanced digital system.
- **Multi-Stakeholder Collaboration:** Fostering strong collaborations between libraries, local content creators, technology developers, legal experts, and relevant government bodies is essential. This collaborative ecosystem can provide the necessary technical support, legal guidance, and policy alignment for successful blockchain-based DRM implementation.
- **Proactive Policy Advocacy:** Libraries should proactively engage with policymakers to ensure that evolving blockchain and digital asset regulations continue to support their fundamental mission of equitable information access,

robust digital preservation, and the protection of intellectual property rights in the digital age.

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