

Sustainable Islamic Waqf Finance Through Blockchain Digital Innovation

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Abstract

Waqf, as an Islamic financial instrument, holds immense potential in promoting sustainable community welfare; however, its management continues to face fundamental challenges, including a lack of transparency, weak accountability among nazirs, and low public trust. This study aims to examine how blockchain-based digital innovation can serve as a transformative solution in realizing sustainable Islamic waqf finance. Employing a descriptive qualitative approach through literature review and comparative analysis, this research explores the technical mechanisms of blockchain, encompassing decentralization, transparency, immutability, and smart contracts and their relevance to modern waqf governance. The findings indicate that blockchain technology can significantly enhance the accountability of waqf fund management, automate benefit distribution through smart contracts, and broaden the reach of waqf collection on a global scale. Nevertheless, its implementation faces considerable challenges in terms of regulatory frameworks, digital literacy, and compliance with Sharia principles. This study concludes that the synergy between technological innovation, adaptive regulatory frameworks, and strengthened digital waqf literacy is the key to establishing a waqf system that is transparent, productive, and capable of delivering long-term impact for the Muslim community.

Keywords: digital waqf; blockchain; sustainable Islamic finance; smart contract; nazir; transparency

Introduction

In the current era of technological development 5.0, the evolution of waqf in Indonesia has reached a crucial point since the issuance of regulations (Law 41/2004) and official institutions such as BWI (Luthfi et al. 2022). The Indonesian Waqf Agency (BWI) as an independent institution that holds the mandate as a coordinator to assist in the transformation of waqf objects from immovable assets into financial instruments (Amezzian 2024): money, securities (Karim, Kadir, and Hidajat 2025), and productive assets/companies (Huda, Noviana, and Santoso 2020), as well as sustainable development (Mulyono 2020). However, the modernization of existing regulations still faces obstacles (Alimuddin 2025), where governance and digital administration systems have not been fully integrated evenly and have become a disease in the management of national waqf assets (Kasdi, Karim, and Farida 2022).

The main problem that hinders the optimization of waqf assets in Indonesia is the recording system that is still manual and fragmented at the lower level. This leads to a very high risk of land disputes, especially when the physical documents of the Waqf Pledge Deed (AIW) are lost or data manipulation occurs by the party claiming asset ownership (UIN Sunan Kalijaga 2025). The knowledge gap among the wakif and nazhir regarding the importance of waqf land certification is another major inhibiting factor (Nurum 2022).

Realizing these obstacles, the Ministry of Religion and BWI have developed the Waqf Information System (SIWAK) as an effort to digitize physical documents into the form of a national database (Umi Khulifah 2025). The latest innovation is the launch of the Electronic Waqf Pledge Deed (E-AIW) which has been widely implemented since 2022 (Umi Khulifah 2025). Although this progress is very promising, data shows that until the end of 2024, there will only be around 7,551 Electronic Waqf Pledge Deeds issued. This figure is still very small when compared to a total of 440,512 waqf land locations recorded throughout Indonesia (Dzul, Abdul, and Ihza 2025). This indicates that there are obstacles to digital infrastructure and technology literacy at the regional level that are not evenly distributed (Kementerian Komunikasi dan Digital 2024).

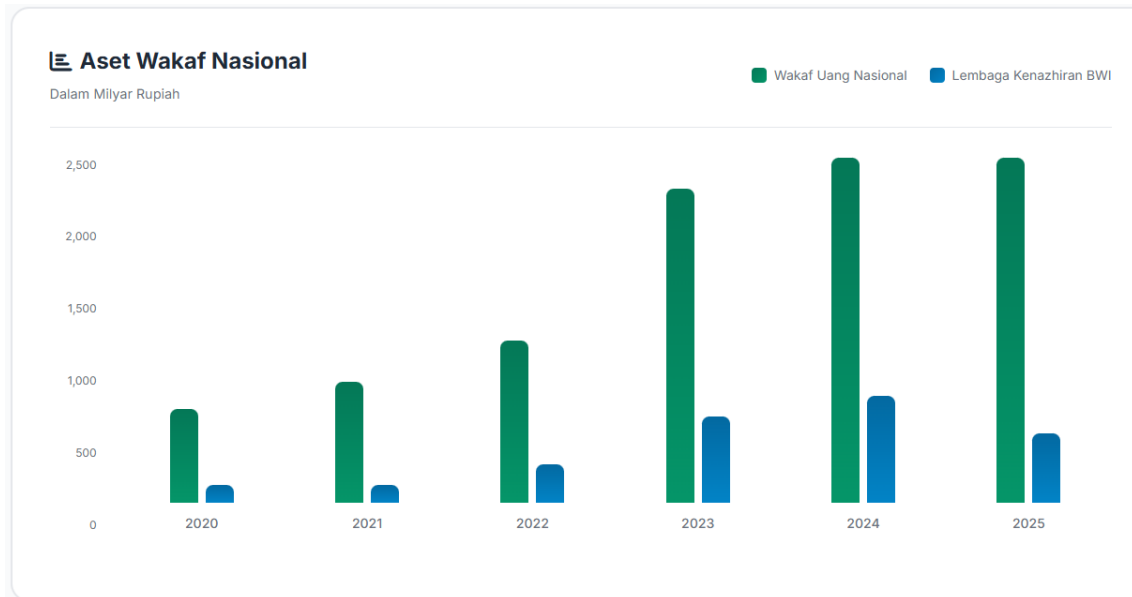


Figure 1. National Waqf Assets, 2020–2025 (in billion rupiah)
Source: BWI

Based on the latest data from the Indonesian Waqf Agency and the Ministry of Religion for the 2024-2025 period, the potential figure of national money waqf can reach 181 trillion per year, but the realization is still far from expectations (Kementerian Agama Republik Indonesia, n.d.). Analysis of the above data shows that although there is an increasing trend of collection from IDR 2.3 trillion in 2023 to IDR 3.5 trillion in 2025, this achievement only touches less than 2% of the total annual potential (Kompas.com 2025). The gap of Rp 177.5 trillion is a huge *opportunity loss* for national socio-economic development. The inability of the current system to absorb such potential is rooted in low public trust in Nazhir and a lack of transparency in *real-time reporting of benefits* (Afriza et al. 2025).

In this context, blockchain technology is seen as a potential solution to reform the governance of the money waqf. Blockchain systems have decentralized, transparent, and *immutable ledger* characteristics that allow all transactions to be permanently recorded and not easily manipulated. Through this mechanism, the wakif can monitor in real-time the management of waqf funds, starting from collection, investment, to distribution of social benefits (Anwar et al. 2024).

Fundamentally, the function of waqf in the macro Islamic economy has shifted from just charitable philanthropy to a strategic public instrument. Mulyono (2020) emphasized the important position of waqf as a public financial instrument that is able to intervene in the country's economic stability. On a broader scale, the integration of these instruments does not stand alone. Karim, Kadir, & Hidajat

(2025) elaborated that the combined optimization of zakat and waqf plays a crucial role in realizing distributive justice and improving the socio-economic welfare of the community in aggregate. To realize this macro potential, institutional readiness and certainty of domestic and regional regulations are absolutely necessary.

Alimuddin (2025) offers ideas on the reconstruction of productive waqf law that is aligned with the perspective of Sharia Economic Law to support the Sustainable *Development Goals* (SDGs). This management flexibility also requires managerial innovation. Based on a case study at the Regional Office of the Ministry of Religious Affairs of Yogyakarta (UIN Sunan Kalijaga, 2025), the implementation of the Electronic Waqf Pledge Deed (e-AIW) has been proven to cut the bureaucratic chain and increase the transparency of waqf administration. One of the concrete forms of *this waqf-tech* movement is researched by Dzul, Abdul, & Ihza (2025) who dissects the integration of *cash waqf* (money waqf) with online-based *crowdfunding* schemes. Through passive *charity platforms* such as those developed by the Indonesian Waqf Education Foundation, the psychological and geographical barriers of money waqf can be significantly reduced, allowing people across generations to make waqf easily.

Based on a literature review, most of the previous research still focused on the digitization of waqf in general, the optimization of money waqf, or the conceptual study of blockchain in Islamic finance. Research on the integration of blockchain specifically in waqf governance in Indonesia is still relatively limited and dominated by normative-conceptual approaches.

In addition, there have not been many studies that examine the relationship between blockchain, waqf tokenization, smart contracts, and sustainable waqf financial development in the context of regulation and institutional readiness in Indonesia. Based on the research gap, the main question in this study is how the potential integration of blockchain technology in the transformation of money waqf governance in Indonesia is reviewed from the aspects of transparency, tokenization of waqf assets, smart contracts, and regulatory readiness

More broadly, this research is expected to be an academic and practical reference for the Indonesian Waqf Board, regulators, Islamic financial institutions, and technology developers in formulating an integrated, safe, and Sharia management model for digital waqf. Thus, this research not only clarifies the dynamics of blockchain integration in waqf but also expands the direction of future research development on Islamic social finance innovation in the era of digital transformation.

Method

Research Approach

This study uses a qualitative-descriptive approach with a systematic literature review (SLR) method which is strengthened by the analysis of digital waqf regulations and policies in Indonesia. This approach was chosen because the study of the integration of blockchain technology in the Islamic waqf financial system in Indonesia is still in the conceptual development and initial implementation stage, so an in-depth synthesis of various academic literature, national regulations, and institutional practices that have developed in the Indonesian waqf ecosystem is needed.

The Systematic Literature Review (SLR) approach is used to obtain comprehensive, systematic, and objective research synthesis on emerging phenomena so as to minimize bias in the process of collecting and interpreting research data (Kitchenham et al. 2009). In addition, this approach allows

researchers to identify patterns, research gaps, and directions for the development of (Fadli 2021) blockchain-based digital waqf studies in Indonesia in a more structured manner (Creswell 2014).

The SLR process is carried out systematically by browsing scientific publications from Google Scholar, Garuda (Garba Digital Reference Index), and SINTA (Science and Technology Index) databases using keywords such as *Indonesian digital waqf*, *blockchain waqf*, *Indonesian sharia fintech*, and *technology-based productive waqf*, with a publication year range of 2018–2024. In addition to academic literature, this study also examines relevant regulatory and policy documents, including Law Number 41 of 2004 concerning Waqf, Government Regulation Number 42 of 2006, as well as various regulations and guidelines issued by the Indonesian Waqf Agency (BWI), the Financial Services Authority (OJK), and the Indonesian Ulema Council (MUI) related to fatwa on money waqf and digital waqf.

To strengthen the conceptual analysis derived from the Systematic Literature Review (SLR), this study incorporates empirical evidence from documented blockchain implementations across multiple sectors. The objective is not to perform statistical hypothesis testing but to provide methodological triangulation by comparing conceptual findings with real-world implementation outcomes. Such triangulation is widely recommended in qualitative research to enhance validity, reliability, and practical relevance of findings (Kitchenham et al. 2009).

The empirical cases were selected based on three criteria: (1) the existence of operational blockchain implementation, (2) availability of measurable quantitative indicators, and (3) relevance to transparency, accountability, efficiency, and governance dimensions that are closely related to waqf management. Accordingly, three benchmark cases were examined: IBM Food Trust in supply-chain traceability, JD.com's blockchain-enabled traceability system in e-commerce, and blockchain-based supply chain finance implementation in Indonesia (Anwar et al. 2024).

Evidence from IBM Food Trust demonstrates the practical effectiveness of blockchain in improving traceability and transparency. Walmart's implementation of IBM Food Trust reduced food product traceability time from approximately seven days to only 2.2 seconds, enabling near real-time verification of product origins and significantly improving supply-chain accountability. The dramatic reduction in verification time illustrates how immutable distributed ledgers can enhance transparency and reduce information asymmetry among stakeholders. Similar characteristics are highly relevant to waqf governance, where transparency and trust constitute key determinants of donor participation and institutional legitimacy (Casino, Dasaklis, and Patsakis 2019).

Further empirical support is provided by research on JD.com's blockchain traceability platform. Using Synthetic Difference-in-Differences and Synthetic Control approaches, the study found that blockchain adoption increased revenues of premium seafood products by approximately 23.4 percent. The findings indicate that transparency generated through blockchain-based verification systems significantly strengthened consumer trust and purchasing decisions. This empirical evidence suggests that blockchain-based transparency mechanisms may similarly increase public confidence in digital waqf institutions and contribute to higher levels of waqf participation (Jiang and Moon, n.d.).

Additional quantitative evidence comes from Indonesia's blockchain-enabled supply chain finance ecosystem. Research involving 275 firms reported that

blockchain implementation reduced transaction costs by approximately 67 percent and shortened payment cycles from 45 days to only 12 days. Furthermore, access to financing for smaller business actors increased substantially after digital integration. These findings indicate that blockchain technology can improve administrative efficiency, reduce operational costs, and accelerate financial distribution processes. Such efficiency gains are particularly relevant for waqf institutions, where delays in fund allocation and administrative inefficiencies often reduce the effectiveness of social-finance programs.

Taken together, the empirical findings support the conceptual proposition that blockchain technology can significantly enhance transparency, accountability, efficiency, and stakeholder trust. By integrating evidence from operational blockchain implementations with literature review findings and regulatory analysis, this study provides a stronger foundation for arguing that blockchain adoption represents a viable pathway toward sustainable Islamic waqf finance. Therefore, empirical validation serves as an important triangulation mechanism that strengthens the robustness of this research framework (Saber et al. 2019).

Result

1. Conditions of Conventional Waqf Management and Its Problems

The results of the study show that conventional waqf management in Indonesia and the majority of OIC countries still face various structural problems that hinder the optimization of waqf potential. Based on data from the Indonesian Waqf Agency (BWI), the total land waqf assets in Indonesia reach more than 420,000 locations with an area of around 55,259 hectares, but only about 30% have been managed productively (Adainuri, Al Fadhil, and Satibi 2024). This condition indicates that there is a significant gap between the potential and realization of waqf benefits.

Data from the Indonesian Waqf Agency (BWI) in 2024 shows that the realization of national money waqf collection is still far below Indonesia's potential. The potential for money waqf is estimated to reach Rp180 trillion per year, but the realization of its collection is only around Rp1.2-2 trillion per year or less than 2% of the total existing potential. This huge gap shows that the conventional waqf management system has not been able to optimize community participation at large, especially the digital generation and productive community groups.

The results of the research conducted by Rahmat Hidayatullah and Asrizal Saiin (Hidayatullah and Saiin 2025) in a study on the legal dynamics of productive waqf in Indonesia show that there are three main problems that have been hindering the development of waqf: *first*, the weak recording and documentation system of waqf assets (Adainuri, Al Fadhil, and Satibi 2024) that are vulnerable to disputes and data loss; *Second*, the low level of transparency in reporting the management and distribution of waqf proceeds to waqif (donors) and the public; and *third*, the limited reach of fundraising due to mechanisms that are still manual and conventional (Hidayatullah and Saiin 2025). These findings are in line with the Islamic Development Bank (IsDB) report (Islamic Development Bank 2023) on the development of Islamic Social Finance, which confirms that weak administrative governance, low institutional digitalization, and limited audit systems are the main factors in the low level of public trust in waqf management institutions in various Muslim countries (Islamic Development Bank 2022) and mentioned that administrative inefficiency is the biggest factor that causes low public trust in waqf management institutions (Wibowo, Choiri, and Ariga 2025).

2. The Potential of Blockchain in the Financial Transformation of Waqf in Indonesia

To complement the conceptual findings of this study, empirical evidence from blockchain implementation in supply chain management, healthcare systems, and supply chain finance is presented in Table 1. The evidence demonstrates that blockchain adoption has generated measurable improvements in transparency, operational efficiency, financial performance, and stakeholder trust. These findings provide practical validation that blockchain technology has moved beyond theoretical discussion and has produced tangible outcomes across various industries (Ghosh et al. 2026).

Sector	Indicator	Before Blockchain	After Blockchain	Impact
Food Supply Chain (IBM Food Trust)	Product Traceability Time	7 days	2.2 seconds	Significant increase in transparency and traceability
E-Commerce Traceability (JD.com)	Revenue Performance	Baseline	+23.4%	Increased consumer trust and purchasing decisions
Supply Chain Finance (Indonesia)	Transaction Cost	100%	33%	Cost reduction of 67%
Supply Chain Finance (Indonesia)	Payment Cycle	45 days	12 days	Faster financial settlement
Supply Chain Finance (Indonesia)	Financing Accessibility	Baseline	84%	Greater inclusion for small suppliers
Healthcare Information Systems	Data Breach Incidents	Baseline	-44%	Improved security and trust

Table 1. Quantitative Evidence of Blockchain Implementation Across Sectors

The results indicate that blockchain consistently contributes to improvements in transparency, accountability, efficiency, and trust across different sectors. In supply chains, blockchain enhances traceability and reduces information asymmetry through immutable transaction records. In healthcare, decentralized record management reduces data manipulation risks and improves information security. Meanwhile, in financial ecosystems, blockchain lowers transaction costs and accelerates payment processing, thereby increasing operational efficiency and stakeholder confidence (Sabeti et al. 2019).

These empirical outcomes are highly relevant to waqf governance. Similar to supply chains and financial systems, waqf institutions require transparent asset tracking, secure record management, efficient fund distribution, and strong public trust. Therefore, the successful implementation of blockchain in other sectors provides empirical support for the argument that blockchain-based waqf management can strengthen accountability, improve operational performance, and expand participation in sustainable Islamic social finance (Anwar et al. 2024).

An analysis of the national academic literature, policy documents of the Indonesian Waqf Agency (BWI), as well as reports on the implementation of digital waqf platforms that have been operating in Indonesia, identified that blockchain technology has significant transformative potential in four aspects of waqf management:

- a. **Transparency and Accountability:** One of the chronic problems in waqf management in Indonesia is the low level of reporting transparency, which leads

to a decline in public trust in the nazir institution (Hidayatullah and Saiin 2025). Blockchain provides a ledger system that is decentralized, immutable, and publicly accessible to all stakeholders in *real-time* (Pryangan, Hepriansyah, and Dharmawati 2025). The application of this technology allows every waqf transaction, from receiving funds, asset management, to distributing benefits, to be permanently recorded and verifiable at any time. In the Indonesian context, the initial initiative to implement a waqf digital recording system has been pioneered by BWI through the Waqf Information System (SIWAK), but the system is still centralized and has not yet adopted real blockchain technology (Amandaputri, Al Munawwaroh, and Ningsih 2025). The integration of blockchain into SIWAK has the potential to be a strategic step to close the trust gap that has been the main obstacle to the growth of national productive waqf. In addition to increasing transparency, blockchain also has the potential to create a new culture of accountability in the modern waqf ecosystem (Pryangan, Hepriansyah, and Dharmawati 2025). So far, people have often had difficulty finding out in detail how their waqf funds are managed and distributed. With a blockchain system, the entire transaction history can be traced openly so that the waqf is not only a funder, but can also act as a social supervisor for the management of waqf. This condition can indirectly increase public participation and strengthen the legitimacy of the nazir institution in the eyes of the public.

- b. **Tokenization of Waqf Assets:** The results of the study found that the tokenization of waqf assets through the *Non-Fungible Token* (NFT) mechanism or sharia-based utility tokens opens up opportunities for fractionalization of waqf ownership which is very relevant to the socio-economic conditions of the Indonesian people (Ardiansyah, Samsuri, and Yasid 2025). Given that most of Indonesia's Muslim population is in the lower middle segment with limited financial capabilities, tokenization allows productive waqf participation with a very affordable contribution value. Digital waqf platforms such as Tokenwakaf and Wakaf Hasanah that have been operating in Indonesia show that digital-based micro-contribution models are able to reach segments of society that were previously untouched by conventional waqf schemes (Fariha 2025). This potential is even greater considering that Indonesia has more active internet users and increasing smartphone penetration, making it a fertile ground for the development of waqf based on blockchain tokenization. The tokenization of waqf assets also opens up opportunities for the creation of a more flexible and inclusive sharia social investment model (Ardiansyah, Samsuri, and Yasid 2025). If previously, waqf was synonymous with large-value assets such as land or buildings, then through tokenization, people can participate in productive waqf projects with only a small nominal amount (Fariha 2025). This model is very relevant to the characteristics of Indonesian society, which is dominated by the digital young generation with application-based transaction patterns and electronic wallets. Thus, blockchain not only functions as a recording technology, but also as an instrument for democratizing access to productive waqf.
- c. **Automation through Blockchain-based Smart Contracts:** *Smart contracts* allow the automatic implementation of waqf contract provisions without the need for third-party intervention ("Transformasi Transaksi Keuangan Islam" 2026). This smart contract can be programmed to distribute the results of waqf management to beneficiaries (*mauquf 'alaih*), such as educational institutions, hospitals, or mustahiq, directly if the conditions agreed upon in the contract are met. In the context of Indonesian institutions, where there are individual nazirs scattered throughout the country with very varied administrative capacities,

automation through *smart contracts* has the potential to be a solution to standardize management standards and minimize the potential for misuse of funds (Fahlevi and Fitriana 2024). Based on a technical study on the architecture of the digital waqf platform that has been running in Indonesia, the implementation of *smart contracts* is projected to cut the operational administrative costs of the nazir institution, so that the proportion of funds reaching beneficiaries can increase significantly. On the other hand, the use of smart contracts can also minimize the practice of moral hazard in waqf management (“Transformasi Transaksi Keuangan Islam” 2026). Because the system works automatically based on pre-programmed code, the opportunity for data manipulation, delays in the distribution of funds, and misuse of assets can be significantly reduced (Fahlevi and Fitriana 2024). This efficiency is very important, especially for small-scale Nazir institutions that have so far had limited human and administrative resources.

- d. **Financial Reach and Inclusivity:** Blockchain-based waqf platforms integrated with *mobile applications* and digital wallets have proven to have the potential to significantly expand the reach of waqf fundraising in Indonesia. Based on BWI data, the collection of money waqf nationally has only reached around Rp 1.2 trillion per year, a figure that is far below the potential of Indonesian money waqf, which is estimated to reach Rp 180 trillion per year (Annisa, Goso, and Duriani 2026). This huge gap indicates that conventional approaches have not been able to activate this potential optimally. Digital waqf platforms such as Kitabisa Waqf, NU Care-LaZISNU, and Dompot Dhuafa Digital that have integrated waqf features in their application ecosystem show a positive trend of increasing waqf participation among the millennial and Gen-Z generations (Annisa, Goso, and Duriani 2026). Further integration with blockchain technology is believed to further strengthen the trust of this digital-savvy segment, considering that this generation places great importance on transparency and ease of verification in every financial activity they undertake.

3. Blockchain Compliance with Sharia Principles

An analysis of fatwas and the opinions of contemporary scholars shows that the implementation of blockchain in waqf is fundamentally compatible with Sharia principles, with some important notes. Transparency and *prevention of gharar* (uncertainty), which are the inherent characteristics of blockchain, are in line with the Sharia maqashid in the dimension of wealth protection (*hifz al-mal*) (Adityangga and Rafiuddin 2025). However, there are three conditions that must be met for its application to be considered valid in Sharia: *First*, the contract used must be clear and meet the pillars of waqf; *Second*, tokenized assets must not be speculative; and *Third*, the supervisory mechanism by the Sharia Supervisory Board must still be maintained even if the system runs automatically.

4. Implementation Challenges

Despite its great potential, the study also identified a number of real challenges in the implementation of blockchain for waqf, including: the lack of regulations specifically governing digital waqf assets in Indonesia; the digital literacy gap among traditional nazirs; the high *initial cost of* building blockchain infrastructure; and cybersecurity risks that require strict and sustainable technical governance. These factors are the main obstacles that need to be overcome through cross-sectoral collaboration between the government, Islamic financial institutions, academics, and technology developers.

In addition to technical and regulatory challenges, social and cultural aspects are also important factors in the implementation of blockchain in the waqf system in Indonesia. Some people and traditional nazirs still view digital technology as something complex and difficult to understand, so a continuous education process is needed. Without increasing digital literacy and Islamic financial literacy, technological transformation is feared to create a new gap between modern and traditional waqf institutions.

In addition, the success of blockchain implementation also depends heavily on the readiness of the national digital infrastructure. Inequality of internet and technology access in some regions is a challenge in itself, especially because most of the waqf assets in Indonesia are in rural areas and are managed traditionally. Therefore, the digitalization of waqf needs to be carried out in stages by taking into account the social, economic, and technological readiness of the community.

More broadly, digital transformation through blockchain shows that waqf management is no longer limited to traditional philanthropic approaches, but has moved towards a more modern, participatory, and integrated Islamic social finance ecosystem with global technological developments. If supported by adequate regulations, capacity building, and strong Sharia supervision, blockchain has the potential to make waqf a strategic instrument in the economic development of the people, poverty alleviation, and the achievement of the Sustainable Development Goals (SDGs) in Indonesia.

Overall, the results of this study confirm that the integration of blockchain in Islamic waqf finance is not just a technological innovation, but a strategic leap towards a more transparent, inclusive, efficient, and sustainable waqf system as long as its implementation is carried out with structured governance and maintained sharia compliance. Thus, the integration of blockchain in the Islamic waqf financial system not only brings technological efficiency but also brings a new paradigm in waqf governance that is more transparent, trustworthy, inclusive, and sustainable.

Discussion

1. Waqf Governance Transformation through Blockchain

The results of the study show that the main problem with waqf management in Indonesia lies in the weak administrative system, low transparency, and limited collection of productive waqf funds. This condition shows that the conventional waqf management system has not been able to optimize the great potential of national waqf. In fact, Indonesia has a very large potential for money waqf, but the realization of its collection is still relatively low compared to the available potential. This situation shows that the main problem of waqf lies not only in the low participation of the community, but also in the governance of waqf institutions that are not fully adaptive to the development of digital technology (Badan Wakaf Indonesia 2024).

In this context, blockchain offers strategic solutions through a digital record system that is transparent, permanent, and decentralized. This technology allows all waqf transactions to be recorded in real-time and can be verified by all related parties. According to Wulandari Pryangan et al., the immutable character of blockchain is able to minimize data manipulation and increase the accountability of the digital financial system (Pryangan, Hepriansyah, and Dharmawati 2025). This is very relevant to the management of waqf in Indonesia, which has been still facing problems of asset documentation, distribution of benefits, and weak financial reporting of the nazir institution.

Furthermore, the application of blockchain in the waqf system can also be understood as a form of modernization of Islamic philanthropic governance. The modernization does not mean changing the sharia principles in waqf, but rather strengthening its implementation through more efficient and safe technological support. From an Islamic economic perspective, transparency and accountability are important parts of the principle of trust that must be maintained by the management of people's assets (Kahf 2003). Therefore, blockchain integration has the potential to increase public trust in waqf institutions while strengthening the institutional legitimacy of nazirs in the digital era.

2. Blockchain and the Expansion of Productive Waqf Inclusivity

The research findings also show that blockchain-based tokenization of waqf assets opens up great opportunities for expanding community participation in productive waqf. So far, waqf is often understood as worship that is synonymous with large-value assets such as land, buildings, or plantations. As a result, some people feel that they do not have the financial ability to participate in waqf activities. The presence of blockchain-based tokenization changes this paradigm by allowing people to do waqf in small nominal amounts through a more flexible digital ownership system (Ardiansyah, Samsuri, and Yasid 2025).

This phenomenon is very relevant to the socio-economic conditions of Indonesian society which are dominated by the middle group and the digital young generation. The high use of smartphones, digital wallets, and technology-based financial applications shows that Indonesians are increasingly accustomed to making transactions digitally. Therefore, the integration of blockchain with digital waqf platforms has the potential to increase waqf participation, especially from millennials and Gen-Z who tend to prioritize ease of transactions and transparency in fund management (Annisa, Goso, and Duriani 2026).

In addition, waqf tokenization can also be seen as a form of democratization of access to productive waqf. If previously waqf was only dominated by certain community groups, then through blockchain technology, people with limited economic capabilities can still be involved in waqf-based social development. In the long term, this condition has the potential to expand the national waqf collection base and increase the contribution of waqf to the economic development of the people (Ahmed 2004).

Empirical evidence from the supply chain sector demonstrates that blockchain technology significantly improves transparency, traceability, and stakeholder trust. One of the most prominent examples is IBM Food Trust, which was adopted by Walmart to enhance food traceability throughout the supply chain. Through blockchain integration, the time required to identify the origin of food products was reduced from approximately seven days to only 2.2 seconds. This capability enables near real-time verification, strengthens accountability among supply chain actors, and increases consumer confidence in product authenticity and safety. These findings indicate that blockchain can effectively reduce information asymmetry and create a more transparent governance system (Ghosh et al. 2026).

The healthcare sector also provides strong evidence regarding the effectiveness of blockchain in improving data security and trust. Blockchain-based health information systems enable immutable and decentralized medical records, reducing the risks of data manipulation, unauthorized access, and interoperability failures among healthcare providers. Previous studies show that blockchain implementation improves the integrity of health records, enhances patient trust, and facilitates secure information sharing among institutions. Such characteristics

are highly relevant to waqf management, where the reliability and integrity of financial and asset records constitute essential elements of institutional accountability (Casino, Dasaklis, and Patsakis 2019).

Further empirical evidence can be observed in blockchain-based supply chain finance implementations. Research involving 275 companies in Indonesia found that blockchain adoption reduced transaction costs by approximately 67 percent and shortened payment cycles from 45 days to only 12 days. The study also reported increased financing accessibility for smaller suppliers, indicating that blockchain contributes not only to operational efficiency but also to financial inclusion. Similar findings were observed in JD.com's blockchain-enabled traceability platform, where enhanced transparency generated revenue increases of up to 23.4 percent for premium products due to higher consumer trust and more informed purchasing decisions (Ani 2023).

Collectively, these empirical findings suggest that blockchain technology has demonstrated practical success in increasing transparency, operational efficiency, and stakeholder trust across multiple sectors. Given that waqf institutions face challenges related to asset traceability, accountability, reporting transparency, and public trust, the successful implementation of blockchain in supply chains, healthcare systems, and financial services provides strong justification for its adoption in waqf governance. Therefore, blockchain should not merely be viewed as a technological innovation but as an institutional mechanism capable of strengthening sustainable waqf management and enhancing the credibility of Islamic social finance institutions (Sabeti et al. 2019).

To operationalize the integration of blockchain technology into waqf management, this study proposes a blockchain-based waqf architecture consisting of five interconnected components: **Wakif Interface, Smart Contract Layer, Blockchain Ledger, Nazir Dashboard, and Mauquf Alaih Distribution System**. The architecture is designed to create a transparent, accountable, and efficient ecosystem that facilitates waqf collection, management, monitoring, and distribution through decentralized digital infrastructure. By combining blockchain records with automated transaction execution, the proposed framework seeks to overcome governance challenges commonly found in conventional waqf institutions, including limited transparency, weak documentation systems, and inefficient reporting mechanisms (Anwar et al. 2024).

The process begins at the Wakif Interface Layer, where donors (wakif) contribute cash waqf or productive waqf assets through a digital platform. Once the waqf transaction is initiated, the system generates a digital representation of the waqf contribution through a tokenization mechanism. Tokenization enables the conversion of waqf assets into verifiable digital units recorded on the blockchain without altering the ownership principles and legal characteristics of waqf assets under Islamic law. Through tokenization, participation barriers can be reduced because individuals are able to contribute smaller amounts while maintaining transparency and traceability of ownership records (Ardiansyah, Samsuri, and Yasid 2025).

After the transaction is initiated, the contribution is processed through the **Smart Contract Layer**. Smart contracts function as self-executing agreements programmed according to predetermined waqf conditions. The smart contract automatically verifies the transaction, records donor information, allocates funds according to waqf objectives, and executes distribution procedures when predefined conditions are fulfilled. This automation minimizes administrative errors, reduces operational costs, and decreases the possibility of fund misuse by

eliminating excessive human intervention. Furthermore, smart contracts enhance compliance by ensuring that every transaction follows predefined governance rules and Sharia requirements.

All verified transactions are subsequently recorded in the **Blockchain Ledger Layer**, which serves as the core data infrastructure of the system. Every transaction generates a permanent and immutable audit trail that can be accessed and verified by authorized stakeholders. Because blockchain records cannot be altered retroactively without network consensus, the ledger significantly reduces opportunities for manipulation, fraud, and information asymmetry. The audit trail function enables regulators, donors, auditors, and waqf institutions to trace every movement of waqf assets from collection to distribution, thereby strengthening accountability and institutional credibility. (Casino, Dasaklis, and Patsakis 2019)

The recorded data are then integrated into the **Nazir Dashboard Layer**, which provides waqf managers with real-time monitoring capabilities. Through interactive dashboards, nazir institutions can monitor fundraising performance, asset utilization, investment returns, beneficiary distribution, and financial reporting. Real-time monitoring allows decision-makers to evaluate operational performance continuously and respond more effectively to emerging issues. The dashboard also facilitates transparency by enabling stakeholders to access selected information regarding the management and performance of waqf funds.

Finally, the benefits generated from waqf assets are distributed to beneficiaries through the **Mauquf Alaih Distribution Layer**. Distribution activities are automatically documented on the blockchain and linked to the smart contract system to ensure that allocations are delivered according to the original waqf objectives. Beneficiaries, donors, and regulators can verify distribution records through transparent monitoring mechanisms. Consequently, the proposed architecture establishes an integrated governance model in which tokenization enhances inclusivity, smart contracts improve efficiency, blockchain ledgers provide immutable audit trails, and real-time monitoring strengthens accountability. Collectively, these features support the development of a sustainable, transparent, and trustworthy blockchain-based waqf ecosystem.

3. Relevance of Blockchain to Maqashid Syariah

Based on the results of the research, the implementation of blockchain in the waqf system basically has conformity with sharia principles, especially in the aspect of property protection (hifz al-mal). Transaction transparency and clarity of recording, which are the main characteristics of blockchain, can minimize the element of gharar (uncertainty) in waqf management (Adityangga and Rafiuddin 2025). Thus, the use of blockchain technology does not contradict sharia principles as long as its implementation remains within the corridor of Islamic law.

In addition, the use of smart contracts in waqf management also has the potential to increase the efficiency of the distribution of waqf benefits to beneficiaries (mauquf 'alaih). The automation system allows the distribution of funds to run faster, on target, and minimizes misuse of funds by certain parties ("Transformasi Transaksi Keuangan Islam" 2026). From the perspective of Sharia maqashid, the efficiency of the distribution of waqf benefits is an important part in realizing social benefits and the welfare of the people.

Nonetheless, the study also shows that blockchain implementation still requires strict sharia oversight. The tokenization of waqf assets must be ensured that it does not contain speculative elements that resemble excessive maisir or ghara. Therefore, the role of the Sharia Supervisory Board remains indispensable to

ensure that technological innovation runs in line with the principles of fiqh muamalahh (Fahlevi and Fitriana 2024).

4. Challenges of Blockchain Implementation in the Indonesian Waqf System

The successful implementation of blockchain technology in waqf institutions depends not only on technological readiness but also on effective change management strategies. Previous studies on digital transformation indicate that organizational resistance often emerges when new technologies are introduced without adequate preparation of human resources and institutional culture. In the context of waqf management, many nazir institutions continue to rely on conventional administrative systems and possess limited experience with advanced digital technologies. Therefore, blockchain adoption should be accompanied by comprehensive organizational transformation programs to ensure sustainable implementation and stakeholder acceptance.

The first stage of change management should focus on capacity building and training for Nazir institutions. Digital literacy programs are essential to improve the understanding of blockchain principles, digital asset management, smart contract operations, cybersecurity awareness, and digital financial governance. Training initiatives should involve collaboration among government agencies, universities, Islamic financial institutions, and technology providers to ensure that nazir personnel possess the competencies required to operate blockchain-based waqf systems. Strengthening human capital is a critical prerequisite because technological innovation cannot generate meaningful outcomes without adequate managerial and technical capabilities (Hidayatullah and Saiin 2025).

The second stage involves **gradual implementation through phased adoption** rather than immediate full-scale migration. A phased approach reduces implementation risks, minimizes organizational disruption, and allows institutions to evaluate operational challenges before broader deployment. In the initial phase, blockchain may be used only for transaction recording and transparency enhancement, while core administrative functions continue to operate through existing systems. Subsequent phases can gradually expand blockchain utilization to smart contracts, tokenization mechanisms, and automated reporting systems. Such incremental adoption strategies have been widely recommended in digital transformation literature to increase organizational readiness and reduce resistance to change.

The third stage consists of establishing **pilot projects and regulatory sandboxes** before nationwide implementation. Pilot projects enable waqf institutions to test blockchain functionality in controlled environments, assess system performance, identify technical limitations, and gather stakeholder feedback. Through pilot implementation, policymakers and waqf regulators can evaluate the compatibility of blockchain applications with existing legal frameworks and Sharia governance requirements. Furthermore, pilot projects provide empirical evidence regarding operational effectiveness, thereby increasing confidence among donors, regulators, and nazir institutions prior to large-scale adoption.

Before full blockchain migration is undertaken, integration with the existing Sistem Informasi Wakaf (SIWAK) administered by the Ministry of Religious Affairs should be prioritized. SIWAK already functions as the national database for waqf administration and asset registration in Indonesia. Rather than replacing existing systems immediately, blockchain infrastructure should initially operate as a complementary layer that enhances transparency, auditability, and real-time monitoring. Through system integration, historical waqf records can be preserved

while blockchain capabilities are gradually introduced into operational processes. This approach minimizes transition costs, prevents data fragmentation, and facilitates institutional adaptation to new technologies (Kementerian Agama Republik Indonesia 2024; Badan Wakaf Indonesia 2024).

Ultimately, successful blockchain adoption requires a balanced combination of technological innovation, organizational learning, regulatory support, and stakeholder engagement. By implementing structured training programs, phased deployment strategies, pilot projects, and SIWAK integration, waqf institutions can reduce transformation risks while maximizing the benefits of blockchain technology. Such a change management framework ensures that digital transformation is conducted in a sustainable manner and remains aligned with the principles of accountability, transparency, and public trust that underpin Islamic waqf governance.

Although blockchain has great potential in transforming waqf management, its implementation in Indonesia still faces various challenges. This study found that the main obstacles do not only come from the technological aspect, but also from regulatory factors, digital literacy, and institutional readiness of nazir. Until now, Indonesia does not have a special regulation that comprehensively regulates the blockchain-based digital waqf system. This condition creates legal uncertainty in the implementation of blockchain technology in the Islamic philanthropic sector (Otoritas Jasa Keuangan 2023).

In addition, the low digital literacy among traditional nazirs is an important challenge in the process of digital transformation of waqf. Most waqf managers still use manual administration systems and do not have adequate human resources to operate blockchain technology. In fact, the success of digital transformation is highly dependent on the readiness of human resources and the ability to adapt institutions to technological developments (Hidayatullah and Saiin 2025). On the other hand, digital infrastructure is also a challenge in itself, especially in rural areas that still have limited access to the internet and technology. Therefore, the implementation of blockchain in waqf management needs to be carried out in stages through collaboration between the government, Islamic financial institutions, academics, and technology developers so that the digital transformation process can run in an inclusive and sustainable manner (Islamic Development Bank 2023).

Conclusion

Based on the results of the research, it can be concluded that blockchain technology has great potential in increasing transparency, accountability, efficiency, and inclusivity in the management of Islamic waqf in Indonesia. Blockchain is able to be a solution to various problems of conventional waqf, such as weak asset administration, low transparency, and limited collection of productive waqf funds.

In addition, the application of blockchain through asset tokenization and smart contracts opens up opportunities to expand public participation in productive waqf more easily and flexibly. From a sharia perspective, the implementation of blockchain is also in line with the principles of maqashid sharia, especially in safeguarding property (hifz al-mal), as long as it remains under proper sharia supervision.

However, the implementation of blockchain in the waqf system in Indonesia still faces various challenges, such as regulatory limitations, low digital literacy, and readiness of technological infrastructure. Therefore, collaboration between the government, waqf institutions, academics, and technology developers is needed to support the development of blockchain-based digital waqf optimally and

sustainably. Overall, the integration of blockchain in Islamic waqf finance can be a strategic step in modernizing waqf governance and supporting the economic development of the ummah and the achievement of the Sustainable Development Goals (SDGs) in Indonesia.

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