

Systematic Literature Review on Digital Green Waqf: Innovations and Impacts for Sustainable Development

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Abstract

This study aims to analyze the development, innovation, impacts, and implementation challenges of Digital Green Waqf through a Systematic Literature Review (SLR) approach based on the PRISMA framework. The review examined 125 selected articles published between 2015 and 2024 across various international databases. The findings indicate that publications on Digital Green Waqf have grown significantly since 2019, with Malaysia and Indonesia emerging as the principal centers of innovation. The identified digital innovations include waqf crowdfunding, Islamic fintech, blockchain, smart contracts, waqf asset tokenization, the Internet of Things (IoT), big data, and artificial intelligence (AI). These technologies have demonstrably enhanced fundraising efficiency, asset management transparency, institutional accountability, and public participation across geographical boundaries. From a sustainable development perspective, Digital Green Waqf contributes meaningfully to the achievement of the Sustainable Development Goals (SDGs), particularly poverty alleviation, inequality reduction, clean energy, sustainable cities, and climate action. Innovative models such as solar waqf, forest waqf, waqf-based organic agriculture, and green infrastructure highlight the potential of waqf as a sustainable socio-environmental financing instrument. Nevertheless, its implementation continues to face several challenges, including unharmonized regulations, limited digital literacy among nazhir (waqf managers), inadequate infrastructure, and differing Shariah standards across countries. This study proposes the concept of the Integrated Digital Green Waqf Ecosystem (IDGWE), which integrates Shariah principles, digital technology, and environmental sustainability as a future development framework. With appropriate governance structures and supportive policy measures, Digital Green Waqf has the potential to become an innovative global solution for addressing poverty, inequality, and the climate crisis in the twenty-first century.

Keywords: Digital Waqf, Green Waqf, Sustainable Development, Islamic Financial Innovation

Introduction

Waqf is an Islamic philanthropic instrument with deep historical roots and has served as a central pillar of the Muslim socio-economic system for more than fourteen centuries. As a perpetual form of charitable endowment (*sadaqah jariyah*), waqf not only facilitates equitable wealth redistribution but also provides a strategic mechanism for sustainable community empowerment. Endowed assets cannot be exhausted, sold, or inherited; instead, they must be managed productively so that their benefits continue across generations. Globally, the potential value of waqf assets is estimated in the trillions of dollars, yet a substantial proportion remains underutilized due to managerial and regulatory constraints. Kahf (2003) emphasized that waqf possesses considerable potential as an instrument for poverty alleviation and economic redistribution, although this potential has not been fully realized in many Muslim-majority countries.

Historically, waqf institutions played a pivotal role in the development of Islamic civilization, financing mosques, madrasahs, hospitals, and public infrastructure across different regions of the world. During the height of the Ottoman Caliphate, waqf reportedly accounted for nearly three-quarters of all land within Islamic territories, illustrating its extensive socio-economic significance. Over time, waqf has undergone significant transformations in terms of form, object, and management mechanisms to respond to changing societal needs. The transition from land- and property-based waqf to cash waqf represents one of the most important innovations, as it broadened participation opportunities across all income groups. Mohsin (2013) argued that cash waqf was a transformative breakthrough that enabled lower- and middle-income communities to contribute to waqf activities more effectively.

Despite its enormous potential, conventional waqf management continues to face multiple challenges that hinder the optimization of its societal benefits. Key issues include weak governance structures, limited transparency and accountability among *nazhir* (waqf managers), and inadequate human resource capacity for the professional management of waqf assets. Furthermore, the absence of reliable and integrated record-keeping systems often results in undocumented assets, disputes, and misuse. Low levels of public trust in waqf institutions also constrain the mobilization of new endowment funds. Saad et al. (2017) comprehensively identified these structural problems and highlighted the need for innovative and technology-driven solutions.

The Fourth Industrial Revolution and accelerating digital transformation have created unprecedented opportunities for the modernization of Islamic financial institutions, including waqf. Digital technologies such as artificial intelligence, blockchain, big data analytics, and the Internet of Things (IoT) are increasingly being integrated into Islamic finance ecosystems to improve efficiency, transparency, and service outreach. In the context of waqf, digitalization enables more inclusive fundraising platforms, transparent asset management systems, and accountable

reporting mechanisms for stakeholders. The rapid growth of Islamic fintech demonstrates that technology can act as a catalyst for the broader expansion of Islamic finance. Hassan and Aliyu (2018) underscored the critical role of technology-based financial innovation in enhancing Islamic financial inclusion and public participation in Sharia-compliant financial instruments.

The concept of the green economy has emerged as an urgent global development paradigm in response to climate change, environmental degradation, and the depletion of natural resources. A green economy is commonly defined as an economic system that improves human well-being and social equity while significantly reducing environmental risks and ecological scarcity. These principles are highly compatible with the objectives of *maqashid syariah*, which emphasize the protection of life, intellect, lineage, wealth, and the environment (*hifzh al-bi'ah*). Integrating environmental sustainability into Islamic financial instruments is therefore both spiritually relevant and ecologically necessary. Alam et al. (2019) argued that Islamic finance has a strong philosophical foundation to lead the advancement of sustainable finance oriented toward environmental preservation.

The Sustainable Development Goals (SDGs), established by the United Nations in 2015, provide a global framework for building a more equitable, prosperous, and sustainable world by 2030. Of the 17 SDGs, *waqf* has the potential to contribute directly to at least 12 goals, including poverty reduction, food security, good health, quality education, and climate action. Several academic studies have identified strong synergies between *waqf* mechanisms and the SDG agenda, particularly in the context of inclusive and sustainable development financing. However, realizing this potential requires more comprehensive innovation in business models, institutional design, and technological integration. Iman and Mohammad (2017) identified several concrete pathways through which *waqf* institutions can become key actors in achieving global sustainable development targets.

The role of *waqf* as an instrument of sustainable development has gained increasing recognition among international scholars and policymakers in Muslim-majority countries. Productive *waqf*, when professionally managed, can generate stable revenues to finance social welfare, education, healthcare, and economic empowerment programs without relying on state budgets. Successful implementations in countries such as Malaysia, Kuwait, and Bangladesh demonstrate the remarkable potential of this instrument when supported by sound governance and innovation. Integrating *waqf* mechanisms with sustainability principles can create a philanthropic ecosystem that is more responsive to contemporary environmental and social challenges. Pitchay et al. (2018) empirically demonstrated that professionally managed productive *waqf* generates significantly greater socio-economic impacts than conventional *waqf* models.

The concept of Green *Waqf* represents a recent innovation that integrates environmental sustainability principles with Islamic philanthropic mechanisms. Green *Waqf* allows *waqf* assets to finance environmentally

friendly projects such as solar power generation, clean water systems, sustainable organic agriculture, and reforestation of degraded land. This concept not only offers alternative financing for environmental projects but also adds a spiritual and ethical dimension to the stewardship of the Earth as a trust from Allah SWT. The development of Green Waqf aligns with the expanding global green finance movement, including instruments such as green bonds, green sukuk, and green investment funds. Ali et al. (2021) examined the conceptual framework of Green Waqf and its potential to bridge Islamic finance, philanthropy, and sustainable environmental development.

Blockchain technology has emerged as one of the most promising solutions to address transparency and trust issues in waqf management. Its decentralized, immutable, and transparent characteristics make it particularly suitable for recording waqf transactions, tracking fund utilization, and verifying asset status in real time. Several blockchain-based waqf initiatives have already been introduced in countries such as Malaysia, Singapore, Indonesia, and Gulf states. The implementation of blockchain not only enhances the confidence of waqif (donors) but also facilitates auditing and regulatory oversight. Lahsasna and Hassan (2021) demonstrated how blockchain technology can revolutionize transparency and accountability in waqf governance while strengthening public trust.

Digital platforms for waqf fundraising have expanded rapidly over the past decade, largely driven by increasing internet penetration and smartphone adoption in Muslim-majority countries. Sharia-compliant crowdfunding and e-waqf platforms have successfully reached segments of society previously uninvolved in waqf activities, especially digitally literate younger generations. In Indonesia, platforms such as Dompot Dhuafa Digital, Kitabisa Wakaf, and other institutional initiatives have mobilized billions of rupiah through digital channels. Digital fundraising models also facilitate cross-border transactions, enabling Muslim diasporas to support projects in their home countries. Atan and Johari (2017) examined the effectiveness of digital platforms for waqf fundraising and identified key determinants of donor participation in the digital era.

Environmental waqf and renewable energy waqf constitute two important dimensions of Green Waqf that are receiving growing scholarly and professional attention. Several renewable energy waqf projects have been implemented successfully, including mosque-based solar panel installations funded through waqf in Malaysia, the United Kingdom, and parts of Europe. These models enable waqf assets to generate revenue from energy sales, which can then finance social and educational programs. Beyond renewable energy, environmental waqf also includes waqf forests, organic agricultural projects, and waqf-based water resource management. Hasan (2020) discussed various innovative environmental waqf models and analyzed their contributions to ecosystem preservation and community welfare.

The growth of the Islamic financial technology ecosystem has created a strong foundation for the expansion of digital waqf worldwide. Innovations

such as Sharia-compliant digital wallets, peer-to-peer financing, and Islamic payment platforms have opened new, efficient, and secure channels for waqf transactions. Integration between Islamic fintech and digital waqf platforms enables faster, simpler, and lower-cost endowment payments while improving user experience and encouraging greater donor participation. The continued development of Islamic fintech regulations across jurisdictions also provides the legal certainty required for digital waqf growth. Zulkhibri (2016) analyzed the development of fintech in Islamic finance and its implications for more adaptive waqf product innovation.

Good governance and transparency are essential prerequisites for the long-term success of digital waqf management. Governance standards for digital waqf institutions must comprehensively address risk management, Sharia compliance, financial reporting, and public disclosure. Regulations governing digital waqf remain diverse and insufficiently standardized internationally, creating regulatory gaps that may be exploited by irresponsible actors. The implementation of integrated Good Waqf Governance (GWG) principles supported by digital technologies can enhance public confidence and attract more donors. Abdullah (2018) proposed a comprehensive governance framework for waqf institutions that combines Sharia principles with modern technology-based governance standards.

The socio-economic impacts of digital waqf have become an increasingly important topic in Islamic finance literature. Numerous studies indicate that digitalization significantly increases the number of new donors, the total amount of waqf collected, and the efficiency of benefit distribution to recipients. Big data and analytics also allow waqf institutions to identify community needs more accurately and allocate resources more effectively. Digital waqf has further proven valuable in promoting financial inclusion, particularly among Muslim communities in remote areas previously excluded from formal financial systems. Ambrose et al. (2015) documented the positive effects of productive waqf programs on beneficiary welfare and poverty reduction.

Climate change represents one of the most pressing existential challenges of the twenty-first century, and Islamic financial instruments such as waqf can make meaningful contributions to mitigation and adaptation efforts. Green Waqf may finance reforestation programs, renewable energy infrastructure, and environmentally friendly technologies. The Islamic concept of *khalifah fi al-ardh* (human stewardship of the Earth) provides a strong theological basis for waqf institutions to participate in climate action. Integrating Sharia principles with sustainable finance frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) may position Green Waqf as an innovative climate finance instrument. Awang et al. (2021) reviewed the potential of waqf-based financing in supporting climate action agendas in developing Muslim-majority countries.

Green waqf product innovation continues to evolve through hybrid models combining waqf mechanisms with other green finance instruments

such as green sukuk, social bonds, and blended finance. Green Sukuk Waqf is among the most promising models, where waqf assets serve as underlying assets for sukuk issuance, with proceeds used to finance environmentally sustainable projects. Blended finance models that combine waqf funds with private investment and public grants are also being developed for large-scale Green Waqf projects. These innovations require adaptive regulatory and Sharia frameworks as well as strong institutional capacity among waqf managers. Riyaldi et al. (2022) explored various innovative Green Waqf models and analyzed their implementation opportunities and challenges in contemporary Islamic finance.

Regulatory and policy frameworks for digital waqf remain underdeveloped in many Muslim-majority countries, creating uncertainty that constrains ecosystem growth. Countries such as Malaysia, Indonesia, and the United Arab Emirates have taken proactive steps to regulate digital waqf, but cross-jurisdictional coordination remains limited. International standard-setting bodies such as AAOIFI and IFSB need to play a more active role in developing globally accepted standards for digital waqf. Regulatory ambiguity also impedes innovation in Green Waqf products involving more complex financial structures. Nooh et al. (2014) identified several regulatory gaps in modern waqf administration and recommended institutional reforms to foster a more dynamic ecosystem.

Waqf institutions worldwide increasingly recognize the importance of aligning their programs and investments with the SDGs to enhance relevance and social impact. Impact investing approaches within waqf, which measure social and environmental outcomes alongside financial returns, are being adopted by more innovative waqf managers. The development of Social Return on Investment (SROI) and other waqf-specific impact metrics is essential for demonstrating waqf's added value in sustainable development. Transparent and standardized impact reporting can also improve collaboration between waqf institutions, governments, international organizations, and private sector actors. Shukor et al. (2019) presented a comprehensive framework for measuring social impact in waqf institutions and explained how robust reporting enhances legitimacy and accountability.

Global trends indicate rapid growth in digital waqf, with Southeast Asia—particularly Malaysia and Indonesia—emerging as major innovation hubs. Malaysia has developed a relatively advanced digital waqf ecosystem through initiatives led by JAWHAR and state waqf institutions. Indonesia, home to the world's largest Muslim population, possesses immense waqf potential and has begun developing digital waqf infrastructure through the Indonesian Waqf Board (BWI) and technology partners. Middle Eastern countries such as Saudi Arabia, the United Arab Emirates, and Kuwait are also actively innovating through blockchain- and AI-based waqf platforms. Ibrahim and Amir (2014) documented developments in productive waqf across Muslim countries and identified success factors relevant to digital waqf expansion.

Low levels of digital literacy among some Muslim communities present a significant challenge to the inclusive growth of digital waqf. Existing digital divides between urban and rural populations, age groups, and developed and developing countries may limit participation. Systematic digital literacy programs integrated with Islamic financial education are therefore necessary to ensure equitable access to digital waqf benefits. User-friendly platforms available in multiple local languages are likewise critical to expanding participation. Wibowo et al. (2021) analyzed the relationship between digital literacy, technological trust, and Muslim communities' willingness to participate in fintech-based waqf platforms.

The integration of Environmental, Social, and Governance (ESG) principles with waqf introduces a new dimension of responsible and sustainable Islamic finance. Green Waqf inherently reflects strong ESG characteristics: the environmental dimension through eco-friendly projects, the social dimension through philanthropic objectives, and the governance dimension through Sharia oversight and accountability. Institutional investors and pension funds increasingly attentive to ESG criteria may view Green Waqf as an attractive vehicle for sustainable investment portfolios. Developing waqf-specific ESG standards that incorporate Sharia perspectives has become an urgent priority for the Islamic finance industry. Ahmad et al. (2022) explored the synergy between ESG principles and Islamic financial instruments, including waqf, while highlighting opportunities for sustainable waqf product development.

Waqf for green infrastructure is among the most innovative applications of Green Waqf, with potentially substantial environmental and social benefits. Waqf-based green infrastructure may include urban parks, green corridors, rainwater management systems, green buildings, and other environmentally friendly public facilities. In several cities, strategically located waqf land has begun to be utilized for urban green infrastructure that improves environmental quality while enhancing residents' quality of life. Waqf financing models for green infrastructure can also be integrated with Public-Private Partnership (PPP) schemes to maximize scale and impact. Johari et al. (2019) discussed innovative models for utilizing waqf assets in infrastructure development that generate positive environmental outcomes and contribute to sustainable development goals.

Systematic Literature Review (SLR) offers a rigorous, transparent, and replicable research method for synthesizing knowledge from relevant academic literature. In the context of Digital Green Waqf, SLR is particularly appropriate because the topic is inherently interdisciplinary, spanning Islamic economics, sustainable finance, information technology, and environmental studies. The use of strict SLR protocols, including the PRISMA framework, ensures that the identification, screening, evaluation, and synthesis of literature are conducted objectively and comprehensively. SLR also enables researchers to identify existing knowledge gaps and formulate more focused future research agendas. Moher et al. (2009) established widely

accepted reporting standards for systematic reviews that continue to guide scholars across disciplines.

Existing literature reveals several important research gaps in the study of Digital Green Waqf. First, no systematic review has comprehensively mapped the global development of digital innovation within the Green Waqf ecosystem. Second, the long-term impacts of Digital Green Waqf implementation on multiple sustainability dimensions remain underexplored empirically and methodologically. Third, holistic conceptual frameworks integrating the digital, environmental, and waqf dimensions remain limited. Huda et al. (2020) identified several research gaps in digital waqf studies and recommended priority research agendas to address these deficiencies.

The significance of research on Digital Green Waqf is substantial from both academic and practical perspectives, given its transformative potential to address sustainable development challenges in Muslim-majority countries. Academically, this field contributes to the development of new theories and conceptual frameworks integrating Islamic finance, digital technology, and environmental economics within a coherent paradigm. Practically, research findings are expected to provide evidence-based recommendations for policymakers, waqf managers, and Islamic fintech innovators seeking to build more effective Digital Green Waqf ecosystems. At the global level, such research may position Islamic waqf as a relevant and competitive alternative financial instrument within the international sustainable finance agenda. Mukhlisin et al. (2021) emphasized the urgency of developing a comprehensive research framework for Digital Green Waqf as a meaningful contribution of Islamic finance to inclusive and sustainable development for humanity.

Methods

This study employed a Systematic Literature Review (SLR) approach guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. The SLR approach was selected because it enables the systematic, transparent, and replicable identification, evaluation, and synthesis of empirical evidence from relevant literature on Digital Green Waqf. Through this method, the study sought to map the development of environmentally oriented digital waqf innovations, identify their contributions to sustainable development, and reveal research gaps that warrant further investigation. The review was conducted comprehensively by integrating perspectives from Islamic jurisprudence, digital technology, and environmental sustainability. This study was structured around three principal research questions. First, what forms of digital technological innovation have been implemented in the management and development of green waqf? Second, how does the implementation of digital green waqf contribute to the achievement of the Sustainable Development Goals (SDGs)? Third, what challenges, barriers, and opportunities exist in developing the global digital green waqf ecosystem?

To ensure the relevance and quality of the sources included, explicit inclusion and exclusion criteria were established prior to the literature search process. Included studies comprised publications issued between 2015 and 2024, written in English or Indonesian, and presented as journal articles, conference proceedings, books, or institutional reports. The primary focus of each publication had to relate to digital waqf, green waqf, Islamic fintech, or the SDGs. In addition, studies were required to be available in full-text form and to employ a clearly stated methodology, whether qualitative, quantitative, or mixed methods. Conversely, the review excluded publications released before 2015, non-academic documents such as blogs and opinion pieces, theses or dissertations, articles without full-text access, and studies lacking methodological clarity or discussing only conventional waqf without digital or environmental dimensions.

The literature search was conducted across nine internationally recognized academic databases: Scopus, Web of Science (WoS), Google Scholar, JSTOR, ProQuest, EBSCOhost, SSRN, ResearchGate, and the IIUM Repository. Search strings were developed using Boolean operators such as AND, OR, and NOT. Keyword combinations included terms such as digital waqf, e-waqf, online waqf, waqf fintech, green waqf, sustainable waqf, blockchain waqf, crowdfunding waqf, smart contract waqf, as well as impact-related terms such as waqf sustainability and waqf development. The literature selection process followed the four principal stages of PRISMA. During the identification stage, 1,847 records were retrieved from all databases, with an additional 73 records identified through snowballing techniques, resulting in a total of 1,920 records. During the screening stage, 412 duplicate records were removed using Mendeley Reference Manager, leaving 1,508 records for further review. Title and abstract screening subsequently led to the exclusion of 1,142 records due to irrelevance. During the eligibility stage, 366 full-text articles were assessed against the inclusion and exclusion criteria by two independent reviewers. Inter-reviewer agreement was measured using Cohen's Kappa, yielding a value of $\kappa = 0.82$, which indicates strong agreement. A further 241 articles were excluded because they did not meet methodological standards or lacked specific relevance. At the final included stage, 125 studies satisfied all criteria and were retained for the final analysis.

The quality of the selected literature was assessed using Critical Appraisal Tools adapted from the CASP (Critical Appraisal Skills Programme) and the Mixed Methods Appraisal Tool (MMAT). Each article was evaluated based on eight indicators: clarity of research objectives, appropriateness of research design, data validity, analytical rigor, relevance to the digital green waqf context, scholarly contribution, acknowledgement of study limitations, and publication reputation. Each indicator was scored on a scale of 0–2, producing a maximum possible score of 16. Articles scoring below 10 were excluded from the final analysis.

Data analysis was conducted through three complementary approaches. First, bibliometric analysis was performed using VOSviewer and R-bibliometrix to map author collaboration networks, annual publication trends, geographical distribution of studies, and patterns of co-citation and keyword co-occurrence. Second, thematic analysis followed the six-step procedure proposed by Braun and Clarke (2006): data familiarization, initial coding, theme searching, theme reviewing, theme defining, and reporting. The coding process was supported by NVivo 12 software. Third, content analysis was undertaken using both deductive and inductive approaches to extract quantitative and qualitative information, including types of digital innovation, affected sustainability dimensions, forms of impact generated, and the geographical and institutional contexts of implementation.

As a foundation for interpreting the findings, the study employed an integrated analytical framework combining three major perspectives. First, Maqashid al-Shariah was used as the philosophical basis for waqf governance and management. Second, the Technology Acceptance Model (TAM) and Rogers' Diffusion of Innovation Theory (2003) were applied to explain the adoption of digital technologies within the waqf ecosystem. Third, the SDGs framework, particularly Goals 1, 3, 7, 11, 13, and 17, was utilized as a benchmark for assessing the contribution of digital green waqf to sustainable development.

Results and Discussion

The analysis of the 125 selected articles indicates that research on Digital Green Waqf experienced substantial growth throughout the 2015–2024 period. In the early stage, between 2015 and 2018, the number of publications remained relatively low, averaging only 4–7 articles annually. During this period, the dominant themes focused on the conceptualization of digital waqf, Islamic legal foundations, and early discussions on the use of technology in waqf management. However, beginning in 2019, publication output increased considerably, driven by the rapid expansion of the global Islamic fintech ecosystem and growing attention to the Sustainable Development Goals (SDGs) agenda. Publication activity reached its peak in 2022 and 2023, suggesting that the COVID-19 pandemic served as an important catalyst in accelerating the digitalization of Islamic social finance sectors, including waqf.

From a geographical perspective, studies on Digital Green Waqf originated from 38 countries. Malaysia ranked first as the leading contributor, followed by Indonesia, Saudi Arabia, and Bangladesh. The dominance of Malaysia and Indonesia indicates that both countries have become major global hubs of digital waqf innovation. This leadership has been supported by progressive regulatory frameworks, strong Islamic banking ecosystems, and institutional backing from national waqf authorities. Non-Muslim majority countries such as the United Kingdom, the United States, and Australia also made significant contributions through comparative studies and the

development of Islamic social finance models within broader global contexts. In terms of research methodology, the reviewed articles were dominated by qualitative approaches, including case studies, interviews, and content analysis. Quantitative studies ranked second, followed by mixed methods, conceptual papers, and bibliometric analyses. These findings suggest that the field of Digital Green Waqf remains in a developmental stage, in which conceptual exploration, implementation models, and field-based case studies are still more prevalent than large-scale statistical model testing.

One of the most prominent findings of this review is the emergence of diverse digital innovations within the green waqf ecosystem. The most widely discussed innovation was crowdfunding platforms and waqf fintech models, appearing in more than half of the reviewed articles. These platforms enable the public to participate in waqf through digital micro-donations without geographical constraints. Examples include MyWakaf in Malaysia, the digital platform of the Indonesian Waqf Board (BWI), and various Islamic banking super-applications. The presence of these platforms has significantly increased participation among younger generations, as waqf contributions have become easier, faster, and more transparent.

Another major innovation is the application of blockchain technology and smart contracts in waqf governance. Blockchain is widely regarded as a solution to longstanding challenges in waqf management, particularly in relation to transparency, data security, and accountability. Through decentralized record-keeping systems, waqf assets can be monitored by the public in real time. Smart contracts further allow waqf returns to be distributed automatically in accordance with Shariah principles. Within the green waqf context, this technology is especially important for ensuring that proceeds from environmental investments, such as solar energy projects or waqf forests, are allocated efficiently and transparently.

The review also identified the rise of waqf asset tokenization. Under this approach, waqf assets such as land, buildings, or productive property are converted into blockchain-based digital tokens that can be fractionally owned. This system opens participation opportunities to a broader segment of society, including small-scale investors, while simultaneously improving the liquidity of waqf assets that have historically remained passive or underutilized. In the context of green waqf, tokenization can be applied to waqf forests, organic agricultural land, and renewable energy projects.

Another emerging development is the integration of the Internet of Things (IoT), Big Data, and Artificial Intelligence (AI). These technologies are used to monitor environmental waqf assets in real time, such as the productivity of solar panels, the water quality of waqf wells, or the carbon levels of waqf forests. The data collected are subsequently analyzed using machine learning tools to improve management efficiency. This demonstrates that green waqf is gradually evolving into a modern philanthropic model driven by data and intelligent technologies.

From the perspective of sustainable development, this study shows that Digital Green Waqf contributes meaningfully to at least 11 of the 17 SDGs. The strongest impacts were found in SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities). The digitalization of waqf accelerates the mobilization and distribution of social funds to vulnerable groups, enhances the operational efficiency of nazhir (waqf managers), and expands donor bases to the global Muslim diaspora. For example, a productive agriculture-based digital waqf program in Bangladesh successfully increased the income of thousands of poor households through agricultural support and digital market access.

Significant contributions were also identified in SDG 7 (Affordable and Clean Energy) through the Solar Waqf or energy waqf model. Under this model, waqf funds are used to build solar power facilities for low-income communities. In addition to providing affordable electricity, the model contributes to reducing carbon emissions. This demonstrates that waqf functions not only as a social instrument but also as a viable mechanism for supporting the clean energy transition.

With respect to SDG 13 (Climate Action), green waqf contributes through forest conservation, renewable energy financing, and the development of climate-resilient infrastructure. The Forest Waqf model allows waqf land to be managed as conservation areas capable of generating carbon credits in voluntary markets. Consequently, waqf assets remain economically productive without sacrificing their ecological functions. Additional contributions were observed in SDG 11 (Sustainable Cities and Communities) through the concept of Urban Green Waqf, which utilizes urban waqf assets according to green building and smart city principles.

Despite its considerable potential, the implementation of Digital Green Waqf continues to face several challenges. The primary obstacle concerns regulatory and legal issues, particularly the absence of clear legal frameworks governing waqf asset tokenization, smart contracts, and cross-border digital platforms. Furthermore, low digital literacy among traditional nazhir and segments of society remains a serious constraint. Many waqf managers still lack adequate technological competencies. Another challenge is the limited availability of digital infrastructure in rural areas, despite the fact that such communities are among those most in need of productive waqf benefits. Inconsistent fatwas and Shariah standards across countries also create uncertainty for platform developers and investors.

Based on the synthesis of the literature, five critical success factors for implementing Digital Green Waqf were identified: progressive government regulation, multi-stakeholder partnerships between waqf institutions and technology firms, blockchain-based transparency, digital literacy programs for nazhir and the wider public, and integration with broader Islamic social finance ecosystems such as digital zakat, digital infaq, and green sukuk.

From a theoretical perspective, this study proposes the concept of the Integrated Digital Green Waqf Ecosystem (IDGWE) as a new framework combining three core dimensions: the Shariah dimension, the digital

dimension, and the environmental sustainability dimension. This framework extends the Islamic social finance literature, which has often discussed these aspects separately. The study also confirms the relevance of Diffusion of Innovation Theory, demonstrating that perceived usefulness, compatibility with Islamic values, and observability are among the key determinants of digital waqf adoption.

Conclusion

Based on the systematic review of 125 articles, it can be concluded that Digital Green Waqf is a strategic innovation with the potential to transform waqf from a traditional philanthropic instrument into a modern, inclusive, and impact-oriented Islamic social finance system. Innovations such as crowdfunding, blockchain, tokenization, IoT, and AI have created significant opportunities to improve the efficiency, accountability, and transparency of waqf management. In addition, Digital Green Waqf has demonstrated tangible contributions to the achievement of multiple Sustainable Development Goals, particularly poverty alleviation, clean energy, reduced inequalities, sustainable urban development, and climate action. The integration of environmental dimensions into digital waqf should not be viewed as a supplementary feature; rather, it functions as a catalyst that strengthens the broader socio-economic impact of waqf. Nevertheless, this substantial potential can only be fully realized through the development of a strong enabling ecosystem, including harmonized regulations, enhanced managerial capacity among nazhir, improved digital infrastructure, and globally recognized Shariah standards. With appropriate policy direction and institutional support, Digital Green Waqf has the potential to become one of the most innovative solutions emerging from the Muslim world to address poverty, inequality, and the climate crisis in the twenty-first century.

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