

MAPPING THE LANDSCAPE OF DIGITAL GREEN WAQF: A SYSTEMATIC REVIEW OF TRENDS, CHALLENGES, AND OPPORTUNITIES

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Abstract

This study aims to map the evolving landscape of Digital Green Waqf through a Systematic Literature Review (SLR) guided by the PRISMA 2020 protocol. The concept of Digital Green Waqf reflects the integration of waqf, digital transformation, and environmental sustainability as an innovative instrument within the broader framework of Islamic social finance. Data were collected from five major international databases—Scopus, Web of Science, Google Scholar, EBSCOhost, and DOAJ—covering publications from 2010 to 2024. From an initial pool of 2,847 records, 87 studies met the inclusion criteria and were subsequently analyzed using thematic synthesis, content analysis, and bibliometric techniques with VOSviewer and Bibliometrix. The findings reveal a significant increase in scholarly attention to Digital Green Waqf since 2019, with the largest contributions originating from Malaysia, Indonesia, and the Middle East. Key trends identified in the literature include the digitalization of waqf platforms, the use of blockchain to enhance asset transparency, fintech-based waqf crowdfunding, the integration of green waqf for environmental financing, and alignment with the Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) frameworks. Major challenges include regulatory fragmentation, low levels of digital literacy, limited managerial capacity among nazhir (waqf managers), insufficient technological standardization, and the lack of reliable empirical data. At the same time, the review highlights substantial strategic opportunities, including stronger integration with the global Islamic finance ecosystem, support for energy transition and climate action, the adoption of artificial intelligence, South-South collaboration, and the development of global standards for green waqf. Based on these findings, the study proposes an integrative conceptual framework built upon three interconnected pillars: digital technology, maqasid al-shariah, and the global sustainability agenda. Overall, the results suggest that Digital Green Waqf has strong potential to emerge as an inclusive, transparent, and sustainable Islamic philanthropic instrument capable of addressing the socio-ecological challenges of the twenty-first century.

Keywords: Digital Green Waqf, digital waqf, environmental sustainability, Islamic social finance

Introduction

The rapid expansion of global Islamic finance has positioned waqf as a strategic instrument within the broader ecosystem of Islamic social finance across many regions of the world. Global Islamic financial assets were estimated to have exceeded USD 3.5 trillion in 2024, reflecting an average annual growth rate of approximately 10–15% over the past two decades—one of the fastest expansion rates in the history of modern finance. Among the various instruments of Islamic finance, waqf stands out as a mechanism of social redistribution that embodies both spiritual and economic significance for Muslim communities in more than 80 countries. Cross-country empirical studies demonstrate that effective waqf management can make substantial contributions to poverty alleviation, expanded access to education, and strengthened healthcare services for vulnerable populations. Within this context, a comprehensive examination of the digital green waqf landscape is essential to understand the potential and challenges associated with developing this innovative instrument in an era characterized by rapid transformation (Mohd Thas Thaker et al., 2021).

Waqf, as an Islamic philanthropic institution, has a long and distinguished history that can be traced back to the early Islamic civilization of the seventh century, when the Prophet Muhammad (peace be upon him) established the first waqf in Islamic history. Over the centuries, waqf institutions demonstrated remarkable resilience by financing essential public facilities such as mosques, madrasas, hospitals, and libraries that served as pillars of Islamic civilization across diverse regions. One of the most iconic examples is the waqf that supported Al-Azhar University in Cairo since the tenth century, which continues to operate today as a leading center of Islamic scholarship with more than a millennium of uninterrupted academic tradition. Historical evidence suggests that, at their peak, waqf assets accounted for between one-third and one-half of productive land in several parts of the Middle East and Mediterranean, illustrating their extraordinary contribution to economic welfare and social development. A deep understanding of these historical foundations is therefore indispensable for designing modern waqf models that preserve the philanthropic spirit of Islam while responding to twenty-first-century development needs (Çizakça, 2020).

Waqf has been widely recognized by economists and Muslim scholars as an Islamic social finance instrument with significant potential to address socioeconomic development challenges in countries with large and diverse Muslim populations. Empirical evidence from multiple jurisdictions indicates that productively managed waqf assets can generate sustainable income streams to finance social programs for vulnerable and underserved communities. Data from national waqf institutions further suggest that the global potential of cash waqf collection reaches billions of dollars annually, although actual mobilization remains far below this level due to structural, technical, regulatory, and sociocultural constraints. Because waqf supports education, healthcare, infrastructure, and economic empowerment, it is

highly relevant to the achievement of the United Nations Sustainable Development Goals (SDGs). Consequently, the development of innovative, adaptive, and responsive waqf models has become an urgent priority for scholars, practitioners, and policymakers alike (Hassan & Ashraf, 2019).

Despite its immense potential, traditional waqf institutions face serious systemic challenges that limit their capacity to contribute optimally to contemporary socioeconomic development. Commonly identified issues in the literature include weak governance structures, limited transparency in asset management, inadequate competencies among nazir (waqf managers), and minimal adoption of modern technologies in administration and reporting processes. Cases of mismanagement, misuse of assets, and even fund misappropriation in several countries have eroded public trust, thereby reducing willingness to donate and constraining resource mobilization. In addition, poor asset documentation and incomplete records have left many waqf properties neglected, unproductive, or entirely absent from official administrative systems, resulting in substantial unrealized social benefits. Comprehensive transformation encompassing regulation, governance, human capital development, and technological adoption is therefore essential if waqf institutions are to fulfill their religious and social missions effectively in the twenty-first century (Ab Rahman et al., 2020).

The demand for modernization in waqf institutions has intensified as public expectations regarding accountability, transparency, and efficiency continue to rise in the age of information openness. Several Muslim-majority countries, including Indonesia, Malaysia, Saudi Arabia, and Bangladesh, have initiated significant structural reforms to revitalize waqf through regulatory renewal, institutional strengthening, and context-sensitive digital transformation. The concept of cash waqf, introduced as a legitimate contemporary juristic innovation, has broadened participation by enabling individuals beyond large property owners to contribute. More advanced products such as share waqf, takaful waqf, waqf sukuk, and digitally backed waqf assets have also emerged to diversify waqf portfolios while improving productivity and liquidity. Within this broader reform agenda, integrating environmental sustainability principles into waqf models has become an increasingly relevant and urgent frontier for systematic exploration (Laldin & Furqani, 2019).

The Fourth Industrial Revolution and the broader wave of digital transformation have fundamentally reshaped the global financial landscape, including the ecosystem of Islamic finance. Financial technology innovations have generated digital platforms for Shariah-compliant crowdfunding, mobile-based investment services, digital payment systems, and decentralized financial services supported by blockchain technology. The adoption of artificial intelligence, big data analytics, and cloud computing has significantly improved operational efficiency while extending access to Islamic financial services for previously underserved communities. Empirical studies indicate that digital transformation in Islamic finance not only improves

accessibility but also stimulates the emergence of more inclusive, efficient, and sustainable products and business models. This transformation creates a timely opportunity to examine how technological innovation can optimize the management, mobilization, and distribution of waqf resources on a global scale (Rabbani et al., 2021).

The rise of digital waqf as a new paradigm in contemporary waqf management reflects the interaction of two major forces: rapid digital adoption among Muslim societies and growing demand for fundraising mechanisms that are efficient, transparent, and easily accessible. Digital waqf platforms facilitate online cash waqf collection through mobile applications, dedicated websites, and integration with trusted digital payment systems. Pioneer countries such as Malaysia and Indonesia have successfully introduced digital waqf initiatives, demonstrating strong public enthusiasm for simpler, more transparent, and measurable forms of charitable participation. Technologies such as digital identity verification, cloud-based accounting, and real-time reporting have enhanced accountability toward increasingly tech-literate donors. Nevertheless, digital waqf implementation still faces technical, regulatory, literacy-related, and trust-based barriers that require systematic analysis to formulate adaptive and comprehensive development frameworks (Sulaiman et al., 2021).

Emerging disruptive technologies from the Industry 4.0 era possess substantial potential to transform the management, administration, investment, and benefit distribution of waqf assets across all levels of the ecosystem. Blockchain technology, for instance, offers promising solutions to longstanding transparency and data security challenges through immutable, decentralized, and auditable transaction records. Artificial intelligence and machine learning create opportunities to optimize asset allocation based on social needs data, forecast market trends for waqf investments, and detect early signs of inefficiency or misconduct. The Internet of Things (IoT) enables real-time monitoring of physical waqf assets, ranging from buildings and agricultural land to solar energy facilities, thereby improving utilization and maintenance. The synergistic integration of these technologies could create a waqf management system that is substantially more efficient, transparent, accountable, and socially impactful than conventional models that still dominate today (Fakhrunnas et al., 2022).

Digital crowdfunding platforms have emerged as one of the most effective and democratic mechanisms for broadening public participation in waqf, allowing individuals from different economic backgrounds to contribute according to their means. This innovative model combines time-tested Shariah principles with contemporary digital convenience, producing a more inclusive, interactive, and transparent waqf experience. Platforms operating globally—including GlobalSadaqah, Waqfworld, Kitabisa in Indonesia, and numerous regional initiatives across Southeast Asia, the Middle East, and Europe—have demonstrated the viability of crowdfunding for waqf fundraising at previously difficult scales. Studies on donor behavior

consistently show that transaction ease, transparent reporting of fund utilization, and authentic beneficiary testimonies are major drivers of participation. Furthermore, the ability of crowdfunding waqf to engage the global Muslim diaspora—spread across more than 100 countries and holding considerable wealth—remains a strategic opportunity that is still underexplored in academic research (Abdullah & Oseni, 2020).

Blockchain technology offers a transformative solution to one of the most persistent challenges in traditional waqf management: deficits in transparency, trust, and accountability that constrain ecosystem growth. Its inherent characteristics—decentralization, complete traceability, and data immutability—make it particularly suitable for digitally recording waqf ownership, documenting management transactions, and ensuring that waqf resources are utilized in accordance with donor intentions and Shariah requirements. Blockchain-based smart contracts further enable automated benefit distribution according to predefined criteria, reducing reliance on intermediaries and minimizing inefficiency and moral hazard risks. Pilot initiatives involving blockchain waqf have emerged in Malaysia, Indonesia, Bahrain, the United Arab Emirates, and Saudi Arabia, although most remain in early developmental stages. Initial findings are promising, yet they also reveal technical, regulatory, and digital literacy barriers that must be systematically addressed before large-scale adoption becomes feasible (Ahmad et al., 2021).

Climate change has become one of the greatest existential challenges confronting humanity in the twenty-first century, with its impacts felt disproportionately by vulnerable populations in developing countries, including many Muslim-majority nations. Recent reports from the Intergovernmental Panel on Climate Change (IPCC) indicate that uncontrolled global warming will generate severe economic losses, intensify the frequency and magnitude of natural disasters, threaten food security and water availability for billions of people, and widen inequalities between rich and poor countries. Economic sectors that depend heavily on natural resources—such as agriculture, fisheries, forestry, and tourism, which sustain large segments of Muslim populations in developing regions—are expected to face the most severe consequences. Effective climate action requires the mobilization of enormous financial resources, estimated in the trillions of dollars annually, to support the transition toward low-carbon economies and strengthen resilience against unavoidable climate impacts. In this urgent global context, innovative community-based financial instruments such as green waqf may play a complementary role in channeling Islamic philanthropic resources toward climate mitigation and adaptation initiatives in the most affected communities (Marwan et al., 2022).

Islam, as a comprehensive way of life (deen), provides a strong theological foundation for environmental responsibility through core concepts such as khalifah (human stewardship of the earth), amanah (divine trust to preserve creation), mizan (balance and harmony in nature), and the

prohibition of causing corruption or destruction on earth (*fasad fil ardh*). The Qur'an explicitly instructs humankind not to spread damage on earth and emphasizes the human duty to maintain the ecological balance created by Allah. The objectives of Islamic law (*Maqasid al-Shariah*), which include the protection of life, intellect, lineage, wealth, and religion, may be interpreted in contemporary terms to encompass environmental sustainability as a prerequisite for safeguarding these five objectives over the long term. Various fatwas and resolutions issued by leading Islamic financial authorities, including the OIC Fiqh Academy and national Shariah councils, have increasingly recognized the environmental dimension of Islamic financial products and services. This convergence between Islamic ecological values and the urgency of the climate crisis creates a unique historical opportunity to develop green Islamic financial instruments capable of contributing meaningfully to global environmental solutions (Hasan & Asutay, 2021).

Green finance has rapidly evolved into one of the most dynamic and innovative segments of the global financial market over the past decade. This growth has been driven by rising awareness of the systemic risks posed by climate change and increasing investor demand for environmentally and socially responsible investment products. The global green bond market has surpassed USD 2 trillion in cumulative issuance, while related instruments such as green sukuk, sustainability-linked bonds, and blue bonds continue to diversify the sustainable finance landscape. Influential international initiatives—including the Paris Agreement, the Task Force on Climate-related Financial Disclosures (TCFD), the Principles for Responsible Investment (PRI), and the Glasgow Financial Alliance for Net Zero (GFANZ)—have accelerated the mainstream integration of ESG considerations into investment decision-making. Major multilateral institutions such as the World Bank, Asian Development Bank, and Islamic Development Bank (IsDB) have also become increasingly active in promoting green finance principles, including within Islamic finance ecosystems. These global developments create significant strategic opportunities for waqf instruments that integrate green finance principles to mobilize philanthropic capital for high-impact environmental solutions (Sachs et al., 2019).

The growing convergence between Islamic finance principles and modern Environmental, Social, and Governance (ESG) standards has attracted substantial attention from academics, practitioners, regulators, and institutional investors seeking ethical and purpose-driven investment alternatives. Many scholars argue that Shariah principles inherently embody ESG values, as the prohibitions against *riba* (usury), *maysir* (speculation), and *gharar* (excessive uncertainty) align closely with responsible governance and ethical finance. The explicit integration of ESG criteria into waqf asset management could significantly enhance the appeal of waqf among younger Muslim generations who are increasingly financially literate, sustainability-conscious, and motivated to align religious commitments with tangible global impact. Several leading waqf institutions in Malaysia, Saudi Arabia, and the

United Arab Emirates have begun incorporating ESG frameworks into their investment strategies, signaling an important positive trend. However, the development of ESG standards specifically tailored to Islamic finance, including waqf institutions, remains an underexplored area with considerable academic and practical relevance (Azmi et al., 2021).

Green waqf represents a conceptual innovation that systematically integrates environmental sustainability principles into the traditional framework of Islamic endowment. It creates a philanthropic mechanism that simultaneously fulfills religious devotion while contributing directly to solutions for the global environmental crisis. In operational terms, green waqf includes endowments specifically dedicated to environmentally beneficial projects such as renewable energy development (e.g., solar panels and wind turbines), forest conservation, biodiversity protection, sustainable water systems, organic agriculture, agroforestry, and environmental education and research. Its juristic foundation can be traced to established concepts such as waqf ala masalih al-Muslimin (waqf for the welfare of Muslims), which contemporary scholars interpret broadly to include environmental preservation for future generations. Innovative case studies from several countries—including forest waqf in Malaysia, organic agricultural waqf in Türkiye, and solar panel waqf initiatives in Gulf countries—demonstrate that green waqf is no longer merely theoretical, but increasingly practical and measurable. A systematic and comparative evaluation of these pioneering experiences is therefore urgently needed to build a robust and integrated body of knowledge for future expansion (Saiti et al., 2021).

Digital green waqf, as the synthesis of three mutually reinforcing domains—digitalization, environmental sustainability, and Islamic waqf—represents one of the most promising paradigms within the contemporary Islamic social finance ecosystem. The integration of advanced digital platforms with scientifically verified green waqf projects enables donors worldwide to support environmental initiatives whose impacts can be transparently tracked and reported through accessible digital dashboards. This model addresses multiple challenges simultaneously: from the waqf perspective, it enhances accessibility and trust; from the green finance perspective, it provides a perpetual philanthropic funding source free from interest burdens; and from the environmental perspective, it mobilizes substantial resources from global Muslim communities for practical ecological solutions. Several platforms in Malaysia, Singapore, the United Kingdom, and Gulf countries have begun incorporating green dimensions into their digital waqf offerings, although these efforts remain limited in scale and lack international standardization. Comprehensive mapping of the trends, challenges, and untapped opportunities in this emerging ecosystem forms the central motivation of the present study (Masyita & Ahmed, 2021).

The 2030 Sustainable Development Agenda, with its 17 Sustainable Development Goals (SDGs), provides a highly relevant global framework for articulating and measuring the potential contribution of digital green waqf to

inclusive, equitable, and future-oriented development. Theoretical analyses indicate that waqf instruments are directly relevant to at least 13 of the 17 SDGs, ranging from poverty eradication (SDG 1) and zero hunger (SDG 2) to health (SDG 3), quality education (SDG 4), gender equality (SDG 5), affordable clean energy (SDG 7), and global partnerships (SDG 17). The environmental dimension of digital waqf is particularly aligned with SDG 7, SDG 11 (sustainable cities and communities), SDG 13 (climate action), SDG 14 (life below water), and SDG 15 (life on land). This alignment offers a standardized framework for impact measurement across platforms and countries. Developing indicators for digital green waqf that are fully aligned with the SDGs remains an important research priority for integrating waqf into the evolving architecture of global development finance (Zainuldin & Lui, 2020).

Southeast Asia, particularly Malaysia and Indonesia, has emerged as a global center of waqf innovation due to a unique combination of large Muslim populations, relatively advanced Islamic finance ecosystems, rapidly expanding digital infrastructure, and increasingly progressive regulatory support. Indonesia, home to the world's largest Muslim population of more than 230 million people, possesses immense waqf potential, with estimates of annual cash waqf reaching hundreds of trillions of rupiah, although actual mobilization remains far below this level. Malaysia, through initiatives led by state Islamic councils, Yayasan Wakaf Malaysia, and Islamic financial institutions such as Bank Islam Malaysia Berhad and Maybank Islamic, has demonstrated regional leadership in developing corporate waqf, waqf sukuk, and blockchain-based digital waqf models. At the same time, Southeast Asia is highly vulnerable to climate change impacts, including sea-level rise, extreme flooding, prolonged droughts, and degradation of coastal and tropical ecosystems. These conditions make the region an especially relevant and urgent context for developing green waqf solutions. Lessons from Southeast Asian innovation may therefore serve as valuable models for Muslim communities elsewhere (Othman et al., 2020).

Adequate, progressive, and enabling regulatory frameworks are essential prerequisites for the healthy growth of the digital green waqf ecosystem. However, in many Muslim-majority countries, existing regulations remain ill-prepared to accommodate the complexity and novelty of instruments that combine technological, environmental, and philanthropic dimensions. Waqf laws in many jurisdictions were enacted decades ago for very different socioeconomic contexts and often fail to recognize digital cash waqf, blockchain-based waqf tokens, virtual assets, or environmentally designated waqf requiring specific verification systems. Regulatory ambiguity concerning the legal status of digital waqf, Shariah and civil compliance requirements for crowdfunding platforms, and accounting standards for digital waqf assets creates uncertainty that discourages innovation, investment, and public trust. More forward-looking jurisdictions such as Bahrain, the United Arab Emirates, Malaysia, and Singapore have begun developing specialized regulations and regulatory sandboxes for Islamic

fintech, including digital waqf platforms. Nonetheless, cross-border harmonization remains limited and fragmented. Comparative regulatory studies are therefore crucial to support coherent and enabling policy development (Ibrahim et al., 2021).

Good governance is one of the most critical pillars of effective and trustworthy waqf management. However, governance challenges in the context of digital green waqf are far more complex than those faced by traditional waqf institutions and require multidimensional solutions. The competency requirements of nazir become significantly broader, as managers must understand not only waqf jurisprudence but also digital technologies, modern financial management, environmental standards, and risk governance. Accountability mechanisms for digital green waqf platforms must ensure that every contribution is used exactly as promised through real-time reporting systems, multilayer verification, independent audits, and transparent communication accessible to donors from diverse backgrounds. Potential conflicts of interest among stakeholders—including nazir, platform operators, beneficiaries, regulators, Shariah auditors, and environmental verifiers—necessitate clear governance structures and effective dispute-resolution mechanisms. The development of comprehensive and internationally relevant governance standards covering Shariah compliance, environmental integrity, cybersecurity, and social accountability is therefore an urgent research priority (Salleh & Ahmad, 2021).

Financial inclusion is among the most transformative dimensions of digital green waqf, given its potential to reach communities historically excluded from formal financial systems through increasingly accessible digital technologies. Expanding smartphone penetration and internet connectivity across developing Muslim countries provide the infrastructure needed for millions of previously unbanked Muslims to participate in digital waqf ecosystems conveniently and at low cost. With very low minimum contribution thresholds—sometimes equivalent to only a few cents through micro-waqf platforms—digital green waqf can empower lower-income groups to become active and meaningful donors. This transforms waqf from an instrument traditionally associated with wealthy asset owners into a genuinely inclusive philanthropic movement. Beyond fundraising, digital green waqf can also enhance beneficiary-side inclusion by extending social and environmental programs to remote, marginalized, and climate-vulnerable communities that have often been underserved. Nevertheless, future research must also critically examine the risk of a digital divide that may unintentionally deepen inequalities between technologically connected and disconnected communities (Nasution et al., 2020).

Social impact measurement in digital green waqf is both a complex methodological challenge and a critical requirement for building credibility, accountability, and public trust. Established frameworks from modern philanthropy and impact investing—such as Social Return on Investment (SROI), IRIS metrics, and GIIN standards—need careful adaptation to reflect

the distinctive jurisprudential, spiritual, and institutional characteristics of waqf. The environmental component of green waqf adds further complexity, requiring the measurement of avoided carbon emissions, land conservation, water savings, biodiversity protection, and improvements in community welfare. These indicators must be independently verified and transparently reported alongside conventional social metrics. Digital platform infrastructure offers important advantages through real-time data collection, intuitive impact visualization, and third-party verification supported by tamper-resistant blockchain records. Standardized methodologies specifically designed for digital green waqf are therefore essential for creating a credible, comparable, and continuously improving market across jurisdictions and platforms (Dusuki & Abdullah, 2021).

Bibliometric assessments of waqf scholarship over the past two decades reveal a positive and encouraging trajectory, marked by substantial growth in the quantity, quality, and diversity of academic publications examining modernization, innovation, and optimization of waqf in various national and regional contexts. Comprehensive analyses of publications indexed in Scopus and Web of Science show that themes such as cash waqf, corporate waqf, waqf governance, productive waqf, and more recently digital waqf have become dominant areas of inquiry. However, studies that specifically examine the synergistic intersection of waqf, digital transformation, and environmental sustainability—namely digital green waqf—remain scarce and fragmented. This body of literature has not yet matured into a coherent and structured knowledge domain capable of guiding future research and practice. The absence of a comprehensive systematic review therefore represents a serious academic gap, especially as practical developments are progressing faster than theoretical understanding. The present study seeks to address this gap through a rigorous, evidence-based synthesis of the relevant literature (Hassan et al., 2022).

Accurately identifying and mapping research gaps in the digital green waqf literature is one of the most important contributions this study seeks to make to the fields of Islamic finance, environmental sustainability, and digital philanthropy. Several significant gaps can be preliminarily identified: first, the lack of an integrated conceptual framework that holistically connects digitalization, green principles, and waqf within a single coherent model; second, the limited number of empirical quantitative studies using primary data from active digital green waqf platforms to assess effectiveness, efficiency, and measurable impact. Additional gaps include the absence of internationally recognized standards for environmental reporting, verification, and auditing of green waqf projects, as well as limited empirical understanding of the psychological, social, cultural, and technological factors influencing donor participation across different contexts. Geographic and methodological imbalances are also evident, as existing studies focus heavily on Malaysia and Gulf countries, while the substantial potential of Indonesia, Bangladesh, Pakistan, Nigeria, and West Africa remains underrepresented.

This systematic review aims to provide a comprehensive, evidence-based, and impact-oriented research roadmap to address these foundational gaps in a structured manner (Pitchay et al., 2021).

This study emerges at a historically significant moment when three transformative forces—the unstoppable digital revolution, the escalating global climate crisis, and the continued rise of Islamic finance—are converging to create unprecedented opportunities for the development of innovative, inclusive, and high-impact waqf instruments. By employing a rigorous systematic review approach guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, this study offers a comprehensive, transparent, methodologically robust, and reproducible synthesis of the international literature on digital green waqf. The novelty and originality of this research lie in four principal contributions: (1) providing the first dedicated systematic review that comprehensively maps the digital green waqf research landscape; (2) systematically identifying key trends, structural challenges, and strategic opportunities; (3) developing a new integrative analytical framework linking the digital, green, and waqf dimensions; and (4) proposing a future research agenda grounded in practical needs and societal impact. The theoretical and practical implications are extensive, offering guidance for regulators designing enabling policies, practitioners developing viable platform models, and Muslim communities seeking to optimize waqf as a values-based instrument for addressing climate challenges. Accordingly, this study aspires to become a foundational and high-impact academic reference for advancing a more effective, inclusive, and sustainable digital green waqf ecosystem in the twenty-first century (Shafi'i & Salleh, 2022).

Methods

This study employed a Systematic Literature Review (SLR) approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 protocol. This approach was selected because it provides a comprehensive, systematic, and transparent framework for examining the development of research in the field of Digital Green Waqf, including the identification of major research trends, existing challenges, and future opportunities. SLR is an evidence-based research method that integrates findings from multiple primary studies in a rigorous and transparent manner. Through this method, selection bias can be substantially minimized, resulting in a more objective synthesis of the literature. In the context of digital waqf and environmental sustainability, this approach enables a holistic mapping of the research landscape and supports the formulation of evidence-based recommendations.

The data sources were obtained through a systematic search of five reputable international academic databases: Scopus, Web of Science (WoS), Google Scholar, EBSCOhost, and the Directory of Open Access Journals (DOAJ). These databases were selected due to their multidisciplinary coverage, strong indexing quality, and ability to capture both international

and regional publications. The search period was limited to studies published between January 2010 and December 2024, considering that the rapid development of Islamic financial digitalization and the concept of green waqf accelerated after 2010 alongside the growing adoption of financial technology (fintech) across many Muslim-majority countries.

The literature search strategy employed iterative combinations of keywords using Boolean operators (AND, OR, NOT). Keywords were organized into three major clusters: the waqf cluster (waqf, wakaf, awqaf, Islamic endowment), the digital and technology cluster (digital waqf, fintech waqf, blockchain waqf, crowdfunding waqf, e-waqf), and the green and sustainability cluster (green waqf, waqf sustainability, environmental waqf, eco-waqf, climate waqf, SDGs waqf). In addition, broader combinations such as digital green waqf, green waqf digital, and sustainable digital waqf were also used to improve the relevance and comprehensiveness of the search results.

Article selection was conducted based on predefined inclusion and exclusion criteria. Included studies were those discussing digital waqf, green waqf, or the intersection between the two; published as journal articles, conference proceedings, book chapters, or reports issued by reputable institutions; written in Indonesian, English, Arabic, or Malay; published during the period 2010–2024; available in full-text form; and demonstrating sound academic quality with clear methodological procedures. Conversely, studies were excluded if they did not address waqf, consisted only of editorials or opinion pieces, lacked full-text availability, were published before 2010, or had not undergone a peer-review process.

The study selection process followed the four stages of the PRISMA 2020 flow diagram: identification, screening, eligibility, and inclusion. During the identification stage, a total of 2,847 records were retrieved from the five databases and supplementary sources. After duplicate removal using reference management software such as Mendeley and Zotero, the number was reduced to 1,923 documents. Title and abstract screening resulted in 487 relevant studies, which were subsequently assessed for full-text eligibility, leaving 143 articles. Following the strict application of all eligibility criteria, 87 studies were ultimately included in the final synthesis. To ensure the reliability of the selection process, two independent reviewers were involved, and inter-rater agreement was assessed using Cohen's Kappa coefficient ($\kappa = 0.82$), indicating a very high level of agreement.

The methodological quality of the selected studies was assessed using the Mixed Methods Appraisal Tool (MMAT) version 2018, which is suitable for evaluating quantitative, qualitative, and mixed-methods research. Each article was assessed across five dimensions: clarity of the research question, appropriateness of the research design, reliability of data collection, validity of data analysis, and relevance of the findings. Studies with low methodological quality scores (below 40%) were excluded from the synthesis to maintain the overall validity and robustness of the review findings.

The final stage involved data extraction and synthesis. Data were extracted using a standardized form covering author names and year of publication, country or study region, thematic focus, research methodology, key findings, and policy recommendations. The collected data were then analyzed using thematic synthesis and content analysis to identify recurring patterns, dominant themes, and interrelationships among studies through both inductive and deductive approaches. In addition, bibliometric analysis was conducted using VOSviewer and Bibliometrix (R-package) to map author collaboration networks, co-citation patterns, and thematic clusters within the emerging field of Digital Green Waqf.

Results and Discussion

General Profile of the Included Literature

From the total of 87 articles included in this review, several broad patterns can be identified. The majority of studies, amounting to 62.1%, were published during the 2019–2024 period, reflecting a significant acceleration of academic interest in Digital Green Waqf. This increase became particularly visible after the COVID-19 pandemic, when digital transformation and sustainable finance gained stronger global attention. The rapid growth of publications during this period suggests that researchers increasingly view waqf as a strategic instrument that can be integrated with technological innovation and environmental sustainability objectives.

In terms of geographical contribution, the highest number of studies originated from Malaysia (28.7%), followed by Indonesia (24.1%), Saudi Arabia (11.5%), Bangladesh (9.2%), and Pakistan (8.1%). These findings indicate that research on digital waqf and green waqf remains largely concentrated in Southeast Asia and the Middle East, regions where Islamic social finance institutions are more established and where waqf reforms have received stronger policy support. Malaysia and Indonesia, in particular, appear to play leading roles due to their active development of Islamic fintech ecosystems and progressive waqf governance frameworks.

When examined by publication period, only six studies were published between 2010 and 2014, with the dominant focus on traditional waqf practices and early digitalization initiatives. During 2015–2018, the number of publications increased to 27 articles, with research attention shifting toward fintech applications and crowdfunding-based waqf models. The 2019–2021 period recorded the highest output with 31 articles, where blockchain technology and green finance became the central themes. Meanwhile, from 2022 to 2024, 23 studies were published, emphasizing the alignment of waqf with Sustainable Development Goals (SDGs), Environmental, Social, and Governance (ESG) principles, as well as regulatory frameworks. Overall, these trends demonstrate an evolution of the literature from conventional waqf management toward more innovative, technology-driven, and sustainability-oriented models.

Major Trends in Digital Green Waqf

a. Digitalization of Waqf Infrastructure

The first major trend identified was the rapid digitalization of waqf management infrastructure. Numerous studies reported that the adoption of web-based and mobile application platforms significantly expanded the reach of waqf fundraising activities. In Indonesia, platforms such as online waqf portals managed by national institutions and Islamic fintech providers have successfully mobilized productive waqf funds far beyond the capacity of conventional collection methods. More than 73% of the reviewed articles identified digital transformation as a key driver of waqf mobilization. In particular, studies from Malaysia found that the digitalization of e-waqf platforms significantly increased participation among Millennials and Generation Z, with average annual growth of 34% since 2018.

b. Integration of Blockchain Technology in Waqf

The second prominent theme was the integration of blockchain technology as a mechanism to enhance transparency and accountability in waqf asset management. Blockchain offers immutable ledger systems that directly address public trust concerns toward nazhir (waqf managers). Several blockchain-waqf pilot projects have been reported in Malaysia, the United Arab Emirates, and Bahrain. Blockchain-based smart contracts were also found to automate benefit distribution to verified beneficiaries in real time, reduce transaction costs, and accelerate administrative processes. Empirical evidence from the UAE showed that blockchain-based waqf governance reduced administrative costs by up to 42% and increased public trust by 58%.

c. Crowdfunding Waqf and Islamic Fintech

Crowdfunding waqf was the most frequently discussed digital modality, appearing in 54.0% of all reviewed articles. Crowdfunding platforms enable cash waqf contributions in small denominations, thereby increasing accessibility for middle- and lower-income communities. Evidence from Bangladesh showed that waqf crowdfunding integrated with mobile banking platforms successfully raised the equivalent of USD 2.4 million in a single three-month campaign cycle. The rapidly growing Islamic fintech ecosystems in Indonesia and Malaysia have further stimulated innovation in digital waqf products, including Waqf-Linked Sukuk, equity waqf, and digitally tokenized waqf assets, although the latter remains largely at the stage of academic and regulatory debate.

d. Green Waqf and Environmental Sustainability

The intersection between waqf and environmental sustainability—commonly termed green waqf—was quantitatively smaller but growing exponentially. Only 18 studies (20.7%) explicitly discussed green waqf during 2010–2020, but this figure rose sharply to 31 studies (35.6%) during 2021–2024, reflecting increasing scholarly awareness of waqf's potential in

financing climate solutions. Green waqf was defined in diverse ways across the literature, but generally refers to the utilization of waqf assets for environmentally oriented purposes, such as green land development, waqf forests, renewable energy projects, sustainable infrastructure, and financing for climate adaptation and mitigation initiatives aligned with maqasid al-shariah, particularly environmental preservation (hifz al-bi'ah).

e. Alignment of Digital Green Waqf with the SDGs and ESG

Another emerging trend was the effort to align Digital Green Waqf frameworks with the United Nations Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) principles. The literature indicates that waqf is inherently relevant to at least 10 of the 17 SDGs, especially SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals). Several scholars from the Middle East have proposed ESG-based waqf governance frameworks that provide operational guidance for integrating sustainability principles into waqf asset investment and management.

Challenges within the Digital Green Waqf Ecosystem

a. Regulatory and Legal Framework Challenges

Regulatory fragmentation was identified as the most significant barrier, appearing in 78.2% of the reviewed studies. The absence of harmonized standards for digital waqf across jurisdictions creates legal uncertainty that hinders innovation and cross-border investment. In Indonesia, overlapping frameworks between Islamic jurisprudence (fiqh al-waqf) and technical regulations issued by financial and waqf authorities often slow technological adoption. The legal status of digital waqf assets, including tokenized assets or NFT-based waqf, remains unresolved in most jurisdictions. Only the UAE and Bahrain have issued preliminary regulatory guidance concerning digital assets within Islamic finance, although not specifically for waqf.

b. Digital Literacy and Inclusiveness

The digital literacy gap across generations and between urban and rural areas constitutes a structural challenge. Surveys cited in multiple studies showed that in rural Indonesia and Bangladesh, more than 60% of potential donors lacked adequate access to digital banking services, directly limiting their participation in Digital Green Waqf platforms. This challenge is compounded by relatively low levels of digital trust toward online religious financial transactions in some Muslim communities.

c. Governance and Accountability of Nazhir

The human resource capacity of waqf institutions remains limited in managing digital and green waqf assets. Many traditional nazhir lack the

technical competencies required to operate digital platforms, understand blockchain systems, or integrate ESG criteria into investment decisions. Research from Malaysia found that fewer than 20% of nazhir possessed basic knowledge of blockchain technology, although 67% expressed willingness to learn.

d. Standardization and Technological Interoperability

The lack of internationally agreed technical standards for digital waqf platforms limits interoperability across systems. Each country—and often each institution—tends to develop its own technological solution, resulting in fragmented digital silos that undermine collaboration and cross-border fundraising potential. This challenge becomes more complex in green waqf initiatives that require integration with sustainability reporting systems and international environmental verification standards.

e. Lack of Data and Research Ecosystem

Limited availability of standardized empirical data on digital waqf performance and the environmental impact of green waqf remains a recurring methodological challenge. Many waqf institutions still lack transparent and standardized reporting systems, making cross-country and cross-institutional comparisons difficult. This also constrains the development of a strong evidence base for policy advocacy.

Strategic Opportunities in Digital Green Waqf

a. Synergy with the Global Islamic Finance Ecosystem

Digital Green Waqf presents substantial opportunities for integration into the rapidly expanding global Islamic finance ecosystem. Global Islamic financial assets were projected to exceed USD 5 trillion by 2025. Instruments such as Green Sukuk, Waqf-Linked Sukuk, and sustainability finance based on maqasid al-shariah provide a strong bridge between halal investment and planetary sustainability agendas. Malaysia and Indonesia have already introduced regulatory measures supporting such synergies.

b. Climate Finance and Energy Transition Potential

Green waqf offers unique potential as an alternative climate finance mechanism for developing Muslim-majority countries that often face constraints in accessing conventional climate finance channels. Waqf forests, solar waqf, and clean water waqf projects have emerged as innovative models. For example, a renewable-energy waqf initiative in Bangladesh reportedly operated 240 communal solar panels supplying electricity to 1,200 low-income households without grid access.

c. Role of Artificial Intelligence and Big Data

The integration of artificial intelligence (AI) and big data analytics into digital waqf platforms offers transformative opportunities for optimizing asset

allocation, forecasting demand, detecting fraud, and personalizing donor experiences. Recent studies have also proposed AI-driven impact assessment models capable of measuring the environmental and social outcomes of green waqf assets in real time, thereby improving accountability and attractiveness to ESG-oriented institutional investors.

d. South–South Collaboration and Knowledge Transfer

Developing countries with large Muslim populations—such as Indonesia, Malaysia, Bangladesh, Nigeria, and Pakistan—have unique opportunities to develop and share Digital Green Waqf models suited to their local contexts, distinct from green finance models historically dominated by Western perspectives. South–South collaboration in research, regulation, and technological implementation can accelerate mutual learning and innovation.

e. Development of Global Green Waqf Standards

There is significant potential to establish integrated global standards for Digital Green Waqf under the coordination of institutions such as AAOIFI, IFSB, and the Organisation of Islamic Cooperation (OIC). Such standards could cover definitions of green waqf assets, environmental impact verification mechanisms, digital reporting requirements, and adaptive governance frameworks.

Bibliometric Analysis and Research Mapping

The bibliometric analysis conducted using VOSviewer revealed five major thematic clusters within the co-citation network of the included studies, illustrating the intellectual structure and research directions in the field of Digital Green Waqf. These clusters demonstrate that the literature has developed into several interconnected domains combining Islamic social finance, technological innovation, sustainability, and governance perspectives.

The first cluster, Digital Waqf and Fintech, focuses on the use of digital platforms, crowdfunding systems, and Islamic financial technology to modernize waqf collection and distribution mechanisms. This theme is primarily driven by contributions from Malaysia, Indonesia, and Bangladesh, where fintech ecosystems and digital Islamic finance have expanded rapidly. Studies in this cluster emphasize accessibility, efficiency, and wider public participation in waqf donations.

The second cluster, Blockchain and Smart Contracts, highlights the application of blockchain technology for waqf asset tokenization, transaction transparency, and automated governance through smart contracts. Major contributions in this area come from the United Arab Emirates, Bahrain, and Saudi Arabia. Research within this cluster often argues that blockchain can improve trust, reduce administrative inefficiencies, and strengthen accountability in waqf management institutions.

The third cluster, Green Finance and ESG, centers on the integration of waqf with green sukuk, Environmental, Social, and Governance (ESG) principles, and sustainable investment frameworks. Malaysia, the United Kingdom, and Pakistan emerged as the leading contributors in this theme. The literature suggests that waqf can serve as an innovative instrument for financing renewable energy, climate resilience, and environmentally responsible development projects.

The fourth cluster, SDGs and Social Impact, examines the role of waqf in supporting the Sustainable Development Goals (SDGs), particularly in poverty alleviation, education, healthcare, and environmental protection. Indonesia, Nigeria, and Bangladesh were identified as major contributors. Studies in this cluster highlight waqf as a socially inclusive financing tool capable of generating long-term developmental impact.

The fifth cluster, Regulation and Governance, addresses legal frameworks, nazhir accountability, institutional governance, and compliance standards such as those promoted by AAOIFI. This cluster is strongly associated with Malaysia, Saudi Arabia, and Egypt. Research findings indicate that effective regulation and professional governance remain critical prerequisites for scaling digital and green waqf initiatives.

Overall, the bibliometric mapping shows that Digital Green Waqf research has become increasingly multidisciplinary, integrating finance, law, technology, and sustainability studies. It also indicates a shift from traditional philanthropic discussions toward more strategic and innovation-based approaches that respond to contemporary economic and environmental challenges.

Synthesis Discussion: Toward a Conceptual Framework of Digital Green Waqf

Based on the thematic synthesis of the 87 analyzed studies, this review proposes an integrative conceptual framework of Digital Green Waqf built upon three interconnected pillars: (1) Digital Technology as an enabler (blockchain, AI, fintech, IoT); (2) Islamic principles and maqasid al-shariah as the normative foundation (hifz al-mal, hifz al-nafs, hifz al-bi'ah); and (3) Global sustainability agendas (SDGs and ESG) as the impact orientation. This framework emphasizes that Digital Green Waqf is not merely a financial instrument, but a broader ecosystem integrating Islamic values of trust (amanah), justice, and sustainability with advanced digital capabilities and international sustainability standards. Its successful implementation requires a multi-stakeholder approach involving waqf institutions, governments, private sector actors, academics, and beneficiary communities.

This review also identified several important literature gaps: (1) a lack of longitudinal empirical studies examining the long-term environmental impacts of green waqf; (2) limited cross-country comparative studies using standardized methodologies; and (3) the absence of evaluation models integrating spiritual (ongoing charity reward), social, and ecological

dimensions simultaneously. This integrated approach may be conceptualized as the Triple Bottom Line plus Spiritual (3BL+S) framework.

Conclusion

This systematic review successfully mapped the research landscape of Digital Green Waqf through the analysis of 87 academic studies that met methodological quality standards. Several major conclusions can be drawn. First, Digital Green Waqf is experiencing rapid academic and practical growth, particularly since 2019. The digitalization of waqf through fintech, blockchain, and AI has empirically enhanced fund mobilization, transparency, and operational efficiency. The integration of green dimensions into digital waqf ecosystems opens new pathways for waqf as a sustainable financing instrument relevant to the global climate crisis. Second, the dominant trends in the literature include the digitalization of waqf platforms, blockchain adoption for asset accountability, fintech-based crowdfunding waqf, the emergence of green waqf in response to the SDGs, and the incorporation of ESG frameworks into waqf governance. These findings confirm that digital waqf is no longer merely a local phenomenon, but a growing global academic and policy agenda. Third, the major challenges facing the ecosystem include fragmented regulations across jurisdictions, digital literacy gaps among target communities, limited managerial capacity of nazhir, insufficient technological and reporting standardization, and a lack of reliable empirical data. These interconnected challenges require coordinated policy responses at both national and international levels. Fourth, strategic opportunities include synergy with the global Islamic finance ecosystem, potential as an alternative climate finance mechanism for developing Muslim-majority countries, AI and big data integration for impact optimization, South–South collaboration for institutional innovation, and the development of global green waqf standards under bodies such as AAOIFI and IFSB. Fifth, this study proposes an integrative Digital Green Waqf framework linking digital technology, maqasid al-shariah, and global sustainability agendas (SDGs and ESG). This framework offers both normative and operational guidance for future policymaking, institutional innovation, and research agendas. The proposed Triple Bottom Line plus Spiritual (3BL+S) concept provides a holistic evaluation model that uniquely captures the spiritual value of perpetual charity (sadaqah jariyah) absent in conventional financial instruments.

Policy Implications

Based on the findings, this study recommends several policy priorities: (1) harmonization of digital waqf regulations through OIC and ASEAN forums; (2) development of digital waqf literacy curricula for nazhir and communities; (3) establishment of international certification and standardization bodies for green waqf; (4) allocation of research and development (R&D) budgets for digital waqf by Muslim-majority governments; and (5) facilitation of public–

private-academic partnerships for inclusive and sustainable Digital Green Waqf platforms.

Future Research Agenda

Future research should address the identified gaps through: (1) longitudinal studies measuring the environmental impacts of green waqf; (2) comparative cross-country studies on digital waqf governance models; (3) development and validation of spiritual-social-ecological impact measurement tools based on the 3BL+S framework; and (4) in-depth case studies examining the successes and failures of blockchain implementation in waqf management across diverse institutional and regulatory contexts.

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