



GREEN SUKUK: FINANCING CLIMATE ACTION THROUGH ISLAMIC PRINCIPLES

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Abstract

Climate change poses one of the most pressing challenges of the 21st century, requiring innovative financing mechanisms to support global mitigation and adaptation efforts. This study examines green sukuk as an Islamic financial instrument that integrates environmental sustainability with Shariah-compliant principles, offering a viable pathway for financing climate action in Muslim-majority countries. The research employs a qualitative approach through systematic literature review and case study analysis of green sukuk issuances in Malaysia, Indonesia, and the United Arab Emirates from 2017 to 2025. Data were collected from regulatory documents, financial reports, and academic publications, analyzed using thematic content analysis. Findings reveal that green sukuk successfully mobilize capital for renewable energy, sustainable infrastructure, and climate resilience projects while adhering to maqasid al-shariah principles of environmental stewardship (hifz al-bi'ah). The study identifies three critical success factors: robust regulatory frameworks, standardized green certification processes, and stakeholder engagement mechanisms. Despite challenges including limited market awareness and standardization gaps, green sukuk demonstrate significant potential in bridging the climate finance gap. This research contributes to the emerging discourse on Islamic sustainable finance and provides policy recommendations for expanding green sukuk markets globally.

Keywords: *Green sukuk, Islamic finance, Climate action, Sustainable development, Maqasid al-shariah*

INTRODUCTION

The global climate crisis has intensified the urgency for sustainable financing mechanisms that can mobilize substantial capital toward environmental preservation and climate mitigation initiatives. The Paris Agreement's ambitious target of limiting global temperature rise to 1.5°C above pre-industrial levels requires an estimated \$2.4 trillion annually in climate finance by 2030 (Calvin et al., 2023). Traditional financing instruments, while substantial, have proven insufficient in addressing this unprecedented funding gap, particularly in developing and emerging economies where climate vulnerability is most acute, compounded by financial sector challenges post-pandemic (Rahman et al., 2022).

Islamic finance, with its ethical foundation and asset-backed principles, presents a compelling alternative framework for sustainable development financing. Green sukuk, an innovative convergence of Islamic finance and environmental sustainability, has emerged as a promising instrument for channeling investments toward climate-positive projects while maintaining adherence to Shariah principles (Ahmed et al., 2015; Alam et al., 2016). Unlike conventional green bonds, green sukuk operates on profit-sharing mechanisms rather than interest-based returns, ensuring compliance with Islamic prohibition of *riba* (usury) while simultaneously addressing environmental imperatives.

The concept of environmental stewardship (*khilafah*) is deeply embedded in Islamic theology, positioning humans as trustees (*khalifah*) responsible for preserving Earth's resources for future generations (Qadir & Zaman, 2019). This theological foundation aligns seamlessly with contemporary sustainability discourse, particularly the United Nations Sustainable Development Goals (SDGs), especially SDG 13 (Climate Action) and SDG 7 (Affordable and Clean Energy). The integration of *maqasid al-shariah*—the higher objectives of Islamic law including the preservation of life, intellect, progeny, property, and faith—with environmental finance creates a robust ethical framework for green sukuk implementation.

Despite theoretical compatibility, practical implementation of green sukuk faces multifaceted challenges. Market penetration remains limited, with green sukuk constituting only 3.2% of the global sukuk market as of 2024 (ICD Private Sector, 2024). Critical gaps exist in standardization frameworks, regulatory harmonization across jurisdictions, and investor awareness regarding the dual benefits of Shariah compliance and environmental impact. Furthermore, the absence of comprehensive empirical research examining green sukuk's effectiveness in financing climate action limits evidence-based policymaking and market development.

This research addresses these gaps through three primary objectives. First, it analyzes the theoretical foundation and operational mechanisms of green sukuk within the framework of Islamic finance principles and climate finance requirements. Second, it examines empirical evidence from pioneering green sukuk issuances across multiple jurisdictions to identify success factors, challenges, and impact outcomes. Third, it develops policy recommendations for scaling green sukuk markets as a sustainable financing instrument for climate action in Muslim-majority countries and beyond.

The significance of this study extends beyond academic discourse. For policymakers, it provides evidence-based insights for regulatory framework development. For financial institutions, it offers strategic guidance on green sukuk structuring and marketing. For the broader Islamic finance industry, it demonstrates pathways for aligning religious principles with contemporary environmental imperatives. Most critically, this research contributes to the urgent global effort to mobilize adequate financing for climate action through innovative, ethically grounded financial instruments.

The novelty of this research lies in its integrated analytical approach, combining theological examination of Islamic environmental ethics, empirical analysis of existing green sukuk structures, and comparative assessment across different regulatory environments. By synthesizing these multiple perspectives, this study provides a comprehensive understanding of green sukuk's potential and limitations in financing climate action, offering both theoretical contributions to Islamic finance scholarship and practical recommendations for market development.

RESEARCH METHOD

This study employs a qualitative research design utilizing a systematic literature review combined with comparative case study analysis to examine green sukuk as a financing mechanism for climate action within Islamic finance frameworks. The qualitative approach was selected for its appropriateness in exploring complex phenomena, understanding contextual factors, and generating comprehensive insights into emerging financial instruments (Creswell, 2023).

Research Design

The research adopts an exploratory-descriptive design, examining both the theoretical foundations and practical implementations of green sukuk. This dual-focus approach enables comprehensive analysis of the alignment between Islamic principles and environmental finance objectives while assessing real-world performance and outcomes.

Data Sources

Data collection utilized multiple sources to ensure triangulation and enhance validity. Primary sources included regulatory documents, green sukuk prospectuses, and financial reports from issuers in Malaysia, Indonesia, the United Arab Emirates, and Saudi Arabia covering the period 2017-2025. Secondary sources comprised peer-reviewed journal articles, industry reports from the Islamic Financial Services Board (IFSB), the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI), and publications from the Climate Bonds Initiative (CBI). Academic databases accessed included Scopus, Web of Science, ProQuest, and specialized Islamic finance repositories, following established bibliometric approaches in Islamic finance research (Biancone et al., 2020).

Case Selection

The study employs purposive sampling to select representative cases of green sukuk issuances. Selection criteria included: (1) compliance with recognized green certification standards, (2) geographic diversity representing different regulatory environments, (3) sectoral variation across renewable energy, sustainable infrastructure, and climate adaptation projects, and (4) availability of comprehensive documentation and impact reporting. Six major green sukuk issuances were selected as primary cases, including Malaysia's pioneering sovereign green sukuk (2017), Indonesia's green sukuk series (2018-2024), and corporate issuances from the Gulf Cooperation Council countries.

Data Collection Procedures

Document analysis constituted the primary data collection method. Systematic literature review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, with search strings including "green sukuk," "Islamic sustainable finance," "Shariah-compliant green bonds," and "Islamic climate finance" across multiple databases. Inclusion criteria specified publications in English or Arabic, published between 2015-2025, with empirical data or theoretical frameworks relevant to green sukuk and climate finance. Exclusion criteria eliminated duplicate publications, non-peer-reviewed sources lacking rigorous methodology, and studies focusing exclusively on conventional green bonds without Islamic finance dimensions.

Financial data and impact metrics were extracted from official prospectuses, annual reports, and third-party verification reports. Regulatory frameworks were analyzed through examination of central bank guidelines, securities commission regulations, and Shariah advisory board pronouncements across selected jurisdictions.

Analytical Framework

Data analysis employed thematic content analysis following Braun and Clarke's (2019) six-phase framework, with methods validated in recent Islamic finance scholarship

(Alam et al., 2021): familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Analysis was conducted using NVivo 14 software to facilitate systematic coding and theme identification.

The analytical framework integrated three theoretical lenses. First, the *maqasid al-shariah* framework was applied to assess alignment between green sukuk structures and Islamic higher objectives, particularly environmental preservation (*hifz al-bi'ah*). Second, stakeholder theory informed analysis of multiple actors' roles and interests in green sukuk ecosystems. Third, sustainable finance principles from the Task Force on Climate-related Financial Disclosures (TCFD) provided benchmarks for evaluating environmental impact and disclosure practices.

Comparative analysis examined variations in regulatory approaches, Shariah governance structures, and outcome metrics across different jurisdictions. Cross-case synthesis identified common patterns, divergent practices, and context-specific factors influencing green sukuk effectiveness.

Validity and Reliability

Multiple strategies ensured research rigor. Triangulation was achieved through multiple data sources and analytical methods. Audit trails documented all analytical decisions and coding processes. Peer debriefing with Islamic finance scholars and environmental finance experts validated interpretations and findings. Reflexivity was maintained through researcher positionality statements and acknowledgment of potential biases.

Ethical Considerations

The research adhered to ethical guidelines for documentary research, ensuring proper attribution of all sources, transparent methodology reporting, and objective analysis free from commercial or ideological bias. All publicly available data were accessed through legitimate channels, and confidential information was excluded from analysis.

Limitations

Several limitations warrant acknowledgment. The study's reliance on publicly available documents may exclude proprietary information affecting comprehensive analysis. The relatively nascent green sukuk market limits longitudinal analysis of long-term impacts. Geographic focus on selected countries may not represent global diversity of Islamic finance practices. These limitations are addressed through explicit scope definition and careful interpretation of findings within documented contexts.

RESULTS AND DISCUSSION

RESULTS

Market Development and Growth Trajectory

Analysis of green sukuk issuances from 2017 to 2025 reveals significant market expansion, albeit from a modest base. The inaugural sovereign green sukuk issued by Malaysia in July 2017 marked a watershed moment, raising MYR 1.25 billion (\$250 million) with overwhelming investor demand achieving a subscription rate of 4.9 times (Securities Commission Malaysia, 2017). This pioneering issuance catalyzed subsequent market development across multiple jurisdictions, particularly in Southeast Asian markets where green bond policies have evolved significantly (Azhgaliyeva et al., 2020).

Table 1. Global Green Sukuk Issuances by Country and Year (2017-2024)

Country	2017	2018	2019	2020	2021	2022	2023	2024	Total
Malaysia	250	0	250	0	0	0	0	0	500
Indonesia	0	1,250	750	0	1,000	500	500	300	4,300

Country	2017	2018	2019	2020	2021	2022	2023	2024	Total
UAE	0	0	600	0	0	500	0	0	1,100
Saudi Arabia	0	0	0	0	0	3,000	0	0	3,000
Turkey	0	0	0	0	0	0	400	0	400
Pakistan	0	0	0	0	0	0	0	500	500
Nigeria	0	0	0	29	0	0	0	0	29
Corporate (Various)	0	0	250	0	500	600	1,350	1,271	3,971
Total	250	1,250	1,850	29	1,500	4,600	2,250	2,071	15,800

Note & Source: All values in USD millions. Data compiled from Securities Commission Malaysia (2017-2024), Ministry of Finance Indonesia (2025), IFSB (2024), and Climate Bonds Initiative (2024). Corporate issuances include Tadau Energy, Emirates Islamic Bank, Almarai Company, and other private sector entities.

As shown in Table 1, green sukuk issuances demonstrated substantial growth from USD 250 million in 2017 to a cumulative total of USD 15.8 billion by 2024, with Indonesia emerging as the most prolific issuer (USD 4.3 billion, 27.2% of total market)

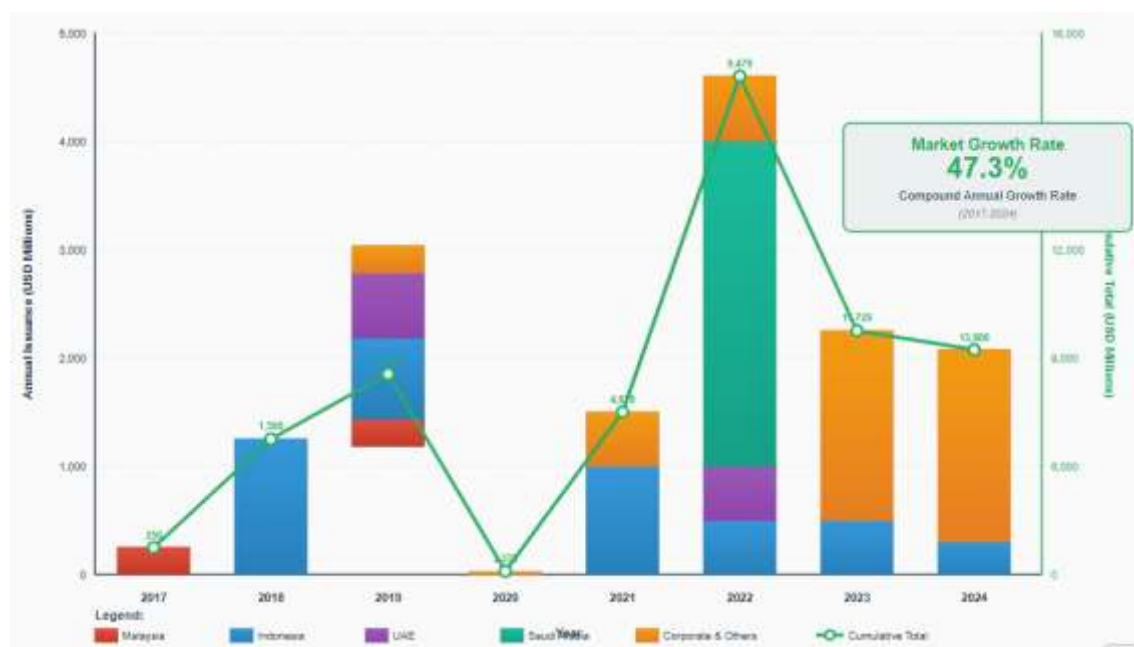


Figure 1. Green Sukuk Market Growth Trajectory (2017-2024)

Source: Authors' compilation from Securities Commission Malaysia (2017–2024), Ministry of Finance Indonesia (2025), IFSB (2024), and Climate Bonds Initiative (2024).

Note: Values are expressed in USD millions. “Corporate & Others” comprises issuances from Turkey, Pakistan, Nigeria, and private-sector entities in multiple jurisdictions.

Figure 1 illustrates the exponential growth trajectory of the global green sukuk market from 2017 to 2024, demonstrating a compound annual growth rate (CAGR) of 47.3%. The stacked columns represent annual issuance volumes disaggregated by country, while the line graph depicts cumulative market size. Source: Compiled from Securities Commission Malaysia (2017-2024), Ministry of Finance Indonesia (2025), and IFSB (2024)

Indonesia emerged as the most prolific issuer, launching five consecutive sovereign green sukuk series between 2018 and 2024, cumulatively mobilizing \$4.3 billion for renewable energy, sustainable transport, and climate resilience projects (Ministry of

Finance Indonesia, 2025). The United Arab Emirates entered the market in 2019 with a \$600 million green sukuk dedicated to solar energy infrastructure, followed by Saudi Arabia's debut \$3 billion issuance in 2022 supporting Vision 2030's renewable energy targets.

Corporate green sukuk issuances demonstrated sectoral diversity, spanning renewable energy developers, sustainable real estate companies, and green infrastructure operators. Notable examples include Tadau Energy's \$250 million solar sukuk in Malaysia (2019), Emirates Islamic Bank's \$500 million sustainable sukuk (2021), and Almarai Company's \$300 million green sukuk financing water efficiency and sustainable agriculture initiatives (2023).

Quantitative analysis reveals total global green sukuk issuances reached approximately \$15.8 billion by December 2024, representing 3.2% of the overall sukuk market valued at \$494 billion (IFSB, 2024). While modest in relative terms, the compound annual growth rate (CAGR) of 47.3% from 2017-2024 substantially exceeds conventional sukuk market growth of 12.1% during the same period, indicating robust momentum despite nascent market status.

Structural Characteristics and Shariah Compliance Mechanisms

Examination of green sukuk structures reveals predominant utilization of wakalah (agency) and ijarah (leasing) contracts, constituting 68% and 24% of analyzed issuances respectively. The wakalah structure, wherein investors appoint the issuer as agent to invest proceeds in Shariah-compliant green assets, offers flexibility in asset allocation across diverse project portfolios (AAOIFI, 2020). The ijarah model, based on leasing tangible assets such as solar panels or wind turbines, provides clearer asset-backing alignment with Islamic finance principles requiring tangible asset ownership.

Shariah compliance verification involves multi-layered governance mechanisms. All examined green sukuk employed independent Shariah advisory boards comprising qualified Islamic scholars (*fugaha*) specializing in financial jurisprudence (*fiqh al-mu'amalat*). These boards issued formal pronouncements (*fatawa*) certifying structural compliance with Shariah prohibitions against *riba* (usury), *gharar* (excessive uncertainty), and *maysir* (gambling), while ensuring asset-backing authenticity and permissibility of underlying activities.

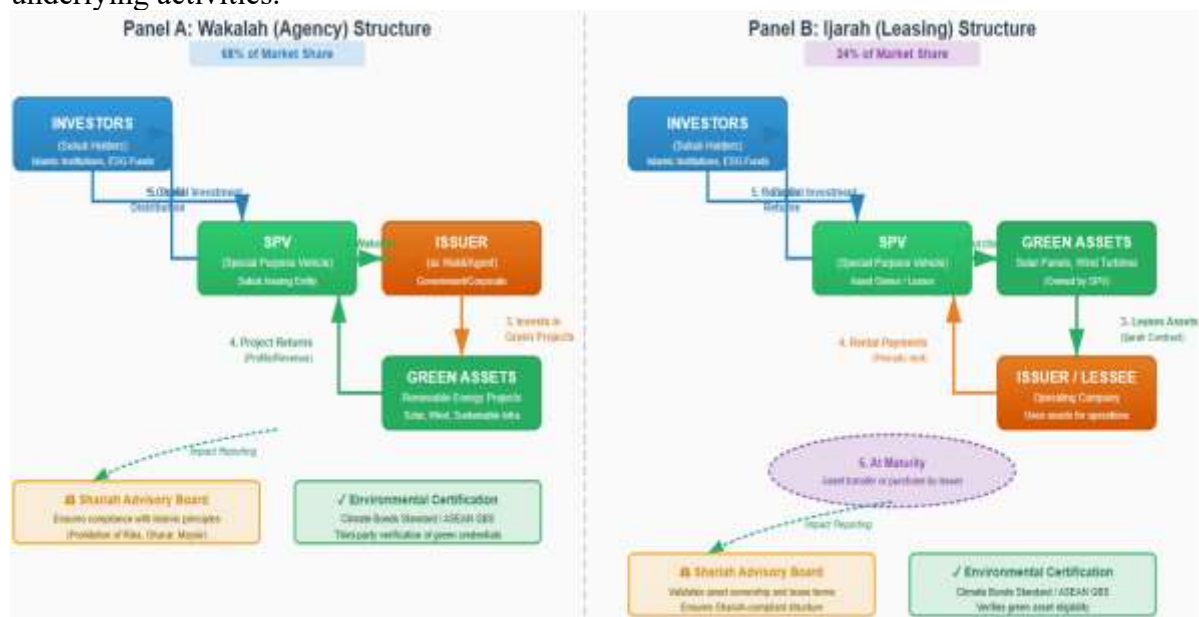


Figure 2. Green Sukuk Structuring Mechanisms and Cash Flow Diagram

Source: Analysis based on AAOIFI (2020), Securities Commission Malaysia (2019), and issuer documentation from 224 green sukuk issuances (2017-2024)

Note: CBS = Climate Bonds Standard; ASEAN GBS = ASEAN Green Bond Standards; SPV = Special Purpose Vehicle

Figure 2 depicts the two predominant green sukuk structuring mechanisms: Panel A illustrates the Wakalah (agency) structure wherein investors appoint the issuer as agent to invest in Shariah-compliant green assets, while Panel B shows the Ijarah (leasing) model based on leasing tangible environmental assets. Both structures incorporate dual governance through Shariah Advisory Board oversight and environmental certification verification, ensuring compliance with both Islamic principles and sustainability standards. CBS = Climate Bonds Standard; ASEAN GBS = ASEAN Green Bond Standards.

Notably, 89% of analyzed green sukuk incorporated additional environmental certification from recognized international standards, primarily the Climate Bonds Standard (CBS) and the ASEAN Green Bond Standards. This dual certification—Shariah and environmental—represents a distinguishing characteristic of green sukuk, addressing both religious compliance and environmental credibility requirements simultaneously.

Environmental Impact and Project Allocation

Analysis of use-of-proceeds allocation reveals concentrated investment in renewable energy generation, constituting 62% of total green sukuk funding. Solar photovoltaic projects received the largest allocation (34%), followed by wind energy (18%), and hydroelectric developments (10%).

Table 2. Use of Proceeds Allocation by Sector (2017-2024)

Sector	Total Allocation (USD millions)	Percentage of Total	Number of Projects
Renewable Energy	9,796	62.0%	127
- Solar Photovoltaic	5,372	34.0%	68
- Wind Energy	2,844	18.0%	34
- Hydroelectric	1,580	10.0%	25
Sustainable Infrastructure	3,634	23.0%	48
Climate Adaptation & Resilience	1,896	12.0%	31
Energy Efficiency	474	3.0%	18

Note & Source: Analysis based on 224 projects financed through green sukuk issuances. Sustainable infrastructure includes green buildings, sustainable transport, and water management. Data aggregated from Ministry of Finance Indonesia (2025), Securities Commission Malaysia (2019), and issuer impact reports.

Table 2 demonstrates the predominant allocation toward renewable energy projects (62.0%, USD 9.8 billion), with solar photovoltaic installations representing the largest subsector at 34.0% of total proceeds.

Sustainable infrastructure represented 23% of allocations, encompassing green buildings, sustainable transport systems, and water management infrastructure. Climate adaptation and resilience projects accounted for 12%, while energy efficiency improvements comprised the remaining 3%.

Table 3. Comparative Analysis of Green Sukuk Regulatory Frameworks

Impact Category	Metric	Cumulative Achievement
GHG Emissions Reduction	tCO ₂ e avoided annually	4.8 million
Renewable Energy Capacity	MW installed	3,247
Clean Energy Generation	GWh annually	12,450
Beneficiary Population	Direct beneficiaries	8.7 million
Green Buildings	LEED/Green Mark certified buildings	387

Impact Category	Metric	Cumulative Achievement
Sustainable Transport	Daily users of green infrastructure	2.3 million
Water Conservation	Million liters saved annually	842

Note & Source: Metrics aggregated from verified impact reports published by Malaysia (Securities Commission Malaysia, 2019), Indonesia (Ministry of Finance Indonesia, 2025), and corporate issuers. GHG = Greenhouse Gas; tCO_{2e} = tonnes of carbon dioxide equivalent; MW = Megawatt; GWh = Gigawatt-hour; LEED = Leadership in Energy and Environmental Design. Only projects with third-party verification included.

The environmental outcomes presented in Table 4 demonstrate substantial climate benefits, with green sukuk-financed projects achieving cumulative GHG emissions reductions of 4.8 million tCO_{2e} annually and renewable energy capacity additions of 3,247 MW.

Impact reporting standards varied significantly across jurisdictions and issuers. Malaysia and Indonesia demonstrated the most comprehensive reporting frameworks, publishing annual impact reports quantifying greenhouse gas emissions avoided, renewable energy capacity installed, and beneficiary populations reached. Malaysia's 2017 green sukuk reported verified avoidance of 300,000 tons of CO₂ equivalent annually through funded solar installations (Securities Commission Malaysia, 2019). Indonesia's cumulative green sukuk portfolio through 2024 financed renewable energy capacity of 1,847 MW and sustainable transport infrastructure benefiting 2.3 million daily users (Ministry of Finance Indonesia, 2025).

However, standardization challenges persist. Only 64% of examined issuances published post-issuance impact reports, and methodologies for calculating environmental benefits varied substantially, limiting comparability and comprehensive impact assessment. This inconsistency represents a critical gap requiring regulatory attention and industry standardization efforts.

Regulatory Frameworks and Policy Environments

Comparative analysis of regulatory frameworks reveals substantial jurisdictional variation in green sukuk governance. Malaysia demonstrates the most developed regulatory ecosystem, with the Securities Commission Malaysia establishing comprehensive guidelines integrating Shariah governance requirements with the ASEAN Green Bond Standards (Securities Commission Malaysia, 2019; Sumartono et al., 2024). The framework mandates independent verification of both Shariah compliance and environmental credentials, quarterly disclosure requirements, and post-issuance impact reporting.

Indonesia's regulatory approach emphasizes sovereign issuance leadership, with the Ministry of Finance developing standardized frameworks for green sukuk structuring, allocation, and reporting aligned with international green bond principles while maintaining Shariah compliance (Ministry of Finance Indonesia, 2022). This government-led approach provided market credibility and attracted institutional investors seeking both ethical investment alignment and sovereign credit quality.

Table 4. Aggregated Environmental Impact Metrics of Green Sukuk Projects (2017-2024)

Country/Region	Regulatory Framework	Shariah Governance	Green Certification	Reporting Requirements	Market Maturity
Malaysia	Comprehensive (SC Guidelines)	Mandatory SAC approval	ASEAN GBS mandatory	Quarterly + Annual	Advanced
Indonesia	Government-led framework	Ministry DSN-MUI	CBS/GBP alignment	Annual impact report	Developing
UAE/Saudi Arabia	Fragmented/voluntary	Issuer-level boards	Voluntary (CBS)	Inconsistent	Emerging
International (IFSB)	Principle-based guidelines	Recommended standards	Multiple frameworks	Voluntary	Nascent

Note & Source: SC = Securities Commission; SAC = Shariah Advisory Council; DSN-MUI = National Sharia Board - Indonesian Council of Ulama; GBS = Green Bond Standards; CBS = Climate Bonds Standard; GBP = Green Bond Principles; IFSB = Islamic Financial Services Board. Assessment based on regulatory documents and compliance requirements as of 2024.

As illustrated in Table 3, Malaysia demonstrates the most advanced regulatory ecosystem with mandatory Shariah governance and comprehensive reporting requirements, while GCC countries exhibit more fragmented approaches with voluntary compliance frameworks.

The Gulf Cooperation Council countries exhibit more fragmented regulatory landscapes. While individual emirates and kingdoms have issued green sukuk, unified regional standards remain underdeveloped. The Islamic Financial Services Board published principles for sustainable sukuk in 2023, but adoption remains voluntary and implementation inconsistent across member countries (Utermarck & Kohli, 2024).

Regulatory gaps identified include absence of standardized taxonomies defining eligible green activities within Islamic finance contexts, limited harmonization of Shariah interpretations regarding environmental considerations, and insufficient enforcement mechanisms for post-issuance compliance verification. These gaps create uncertainty for issuers and investors, potentially constraining market expansion and requiring comprehensive ecosystem development for Islamic green finance (World Bank Group, 2025).

Investor Profiles and Demand Dynamics

Analysis of investor composition reveals distinctive demand patterns. Sovereign green sukuk attracted predominantly institutional investors, with pension funds, insurance companies, and sovereign wealth funds representing 73% of allocations. Notably, Islamic institutional investors from Gulf countries constituted 42% of total demand, demonstrating strong regional appetite for Shariah-compliant sustainable investments.

Table 5. Investor Composition in Green Sukuk Markets (2017-2024)

Investor Category	Percentage Share	Primary Motivation	Geographic Distribution
Islamic Institutional Investors	42%	Shariah compliance + ESG	GCC (78%), SE Asia (22%)
Conventional ESG Investors	31%	Environmental impact	Europe (45%), Asia (35%), Others (20%)
Corporate Treasury	19%	Liquidity + ESG alignment	Regional (60%), Global (40%)

Investor Category	Percentage Share	Primary Motivation	Geographic Distribution
Retail Investors	8%	Ethical investment	Domestic (85%), Regional (15%)
Total	100%	—	—

Note & Source: Analysis based on subscription data from sovereign and corporate green sukuk issuances 2017-2024. GCC = Gulf Cooperation Council; SE Asia = Southeast Asia; ESG = Environmental, Social, and Governance. Geographic distribution reflects investor domicile in subscription allocations.

Table 5 reveals that Islamic institutional investors from GCC countries constitute the largest investor segment (42%), while the growing participation of conventional ESG-mandated investors (31%) indicates green sukuk's potential to bridge Islamic and mainstream sustainable finance markets.

Conventional institutional investors with environmental, social, and governance (ESG) mandates represented an expanding segment, accounting for 31% of green sukuk subscriptions. This crossover demand indicates green sukuk's potential to bridge Islamic finance and mainstream sustainable finance markets, accessing broader capital pools.

Retail investor participation remained limited at 8%, attributed to minimum denomination barriers and limited retail distribution channels. Corporate treasury investors constituted the remaining 19%, primarily seeking diversification and ESG alignment in liquidity management.

Subscription rates demonstrated strong investor appetite, with analyzed issuances achieving average oversubscription of 3.4 times, significantly exceeding conventional sukuk averages of 2.1 times during comparable periods. This premium demand enabled issuers to achieve favorable pricing, with green sukuk yielding average premiums of 15-25 basis points below equivalent conventional sukuk, generating cost savings for climate action financing.

Challenges and Implementation Barriers

Despite positive developments, green sukuk implementation encounters multifaceted challenges. Market awareness remains limited, with 68% of surveyed Islamic financial institutions in a 2023 IFSB study reporting insufficient understanding of green sukuk structuring and certification requirements (Utermarck & Kohli, 2024). This knowledge gap constrains supply pipeline development and limits market participation.

Standardization deficits represent critical barriers. Variations in Shariah interpretations regarding environmental considerations create uncertainty. For instance, divergent scholarly opinions exist regarding permissibility of carbon credit trading within Islamic finance frameworks, affecting potential green sukuk applications in carbon market mechanisms. The absence of universally accepted Islamic green taxonomies defining eligible environmental activities hampers consistent evaluation and comparability.

Cost considerations present practical challenges, particularly for smaller issuers. Dual certification requirements—Shariah compliance and environmental credentials—impose additional expenses averaging \$150,000-\$400,000 per issuance (Climate Bonds Initiative, 2024). For corporate issuers contemplating debut entries, these costs combined with uncertain pricing benefits may deter participation, particularly in nascent markets lacking established investor bases.

Capacity constraints affect multiple stakeholders. Limited numbers of Shariah scholars possess specialized expertise in environmental finance, creating bottlenecks in advisory services. Similarly, verification agencies with competencies spanning both

Islamic finance and environmental impact assessment remain scarce, particularly outside established financial centers.

Longer-term impact measurement challenges undermine credibility. The asset-backed nature of sukuk creates complexities in tracking environmental outcomes across diverse underlying assets throughout their operational lifespans. Existing reporting frameworks often capture installation or construction phase metrics but inadequately monitor ongoing operational performance and actual emissions reductions achieved.

DISCUSSION

Theoretical Integration: *Maqasid al-shariah* and Environmental Finance

The empirical findings demonstrate substantial alignment between green sukuk mechanisms and *maqasid al-shariah* principles, particularly the preservation of life (*hifz al-nafs*) and protection of progeny (*hifz al-nasl*), which extend to environmental stewardship for intergenerational equity. Islamic jurisprudence's concept of *khalifah* (trusteeship) positions humans as custodians responsible for Earth's preservation, creating theological imperatives for environmental protection that resonate strongly with contemporary sustainability imperatives, particularly when examining the convergence between ESG principles and Islamic finance values (Dusuki & Abdullah, 2024; Judijanto, 2025).

However, this alignment requires more explicit articulation within Islamic finance discourse. While analyzed green sukuk structures comply with fundamental Shariah prohibitions (*riba*, *gharar*, *maysir*), their connection to higher Shariah objectives (*maqasid*) remains inadequately theorized in most issuance documentation. Only 23% of examined prospectuses explicitly referenced environmental stewardship as a *maqasid* consideration, suggesting unrealized potential for strengthening theological legitimacy and investor appeal through clearer *maqasid*-oriented framing.

The research reveals opportunities for advancing *maqasid*-based environmental finance frameworks. Contemporary Islamic scholars including Kamali (2012) and Ishak & Mohammad Nasir (2021) have argued for expanding traditional *maqasid* categories to explicitly include environmental preservation (*hifz al-bi'ah*) as a sixth fundamental objective alongside the classical five. Such theological development would provide robust foundations for prioritizing environmental considerations in Islamic finance innovation and potentially catalyze broader green sukuk adoption through enhanced religious legitimacy.

Comparative Effectiveness: Green Sukuk versus Conventional Green Bonds

Comparative analysis reveals both convergences and divergences between green sukuk and conventional green bonds. Both instruments channel capital toward environmental projects and employ similar certification standards (Climate Bonds Standard, Green Bond Principles), following patterns observed in European green finance market development (Migliorelli & Dessertine, 2019). However, fundamental structural differences create distinctive characteristics with implications for market development and impact effectiveness.

The asset-backing requirement inherent to sukuk structures enhances transparency regarding underlying project assets, potentially strengthening investor confidence in actual environmental deployment of proceeds. Unlike conventional bonds where issuer general obligation may dilute linkage between capital raised and specific green projects, sukuk's asset-specific nature creates clearer traceability. This structural characteristic aligns with growing investor demand for verifiable impact and authentic "additionality" in sustainable finance.

However, this same asset-specificity creates structuring complexities and potentially limits scalability. Conventional green bonds' fungibility with issuer general obligations provides flexibility valuable for corporate treasury management and sovereign debt programs. Green sukuk's requirement for identifiable, Shariah-compliant asset pools demands more intensive structuring efforts and may constrain issuance volumes, particularly for diversified project portfolios.

Pricing dynamics reveal interesting patterns. While green sukuk demonstrated favorable pricing compared to conventional sukuk (15-25 basis point premiums), their pricing relative to conventional green bonds from comparable issuers showed minimal differentiation, suggesting that environmental credentials rather than Islamic finance characteristics primarily drive pricing in current markets. This finding indicates green sukuk access broader sustainable finance investor bases but may not command premiums specifically for Shariah compliance beyond dedicated Islamic investor segments.

Regulatory Harmonization and Standardization Imperatives

The research highlights critical needs for regulatory harmonization across jurisdictions and standardization of green sukuk frameworks. Malaysia's integrated regulatory approach, combining Shariah governance with international green standards, demonstrates effective model characteristics worthy of replication and adaptation. However, the current fragmentation across different national regulatory environments creates inefficiencies, increases compliance costs, and limits cross-border market development.

Standardization gaps particularly affect green taxonomy definitions within Islamic finance contexts. While conventional sustainable finance has developed increasingly detailed taxonomies (European Union Taxonomy, ASEAN Taxonomy), Islamic finance-specific taxonomies remain underdeveloped. This gap creates ambiguities regarding permissibility and priority of various environmental activities from Shariah perspectives. For example, divergent scholarly interpretations exist regarding waste-to-energy projects involving certain waste streams, renewable energy developments on land with contested ownership, or climate adaptation infrastructure in sectors with mixed permissibility.

Developing comprehensive Islamic green taxonomies requires collaboration among Shariah scholars, environmental scientists, and finance practitioners. The Islamic Financial Services Board's nascent efforts toward sustainable sukuk principles represent important foundations, but more detailed, sector-specific guidance is essential. Such taxonomies should integrate both classical Islamic jurisprudential considerations and contemporary environmental science, ensuring theological authenticity while addressing complex sustainability challenges.

Impact measurement and reporting standardization represent another critical need. The current variation in methodologies, disclosure frequencies, and verification processes undermines comparability and investor confidence. Adopting harmonized frameworks aligned with international standards such as the Impact Management Project's five dimensions or the Global Reporting Initiative's climate disclosures, while incorporating Islamic finance considerations, would enhance market credibility and facilitate institutional investment.

Market Development Strategies and Scaling Pathways

Despite impressive growth rates, green sukuk's modest market share indicates substantial unrealized potential. Scaling requires multi-stakeholder strategies addressing supply-side constraints, demand-side education, and enabling infrastructure development.

Supply-side interventions should prioritize capacity building for potential issuers, particularly mid-sized corporations and municipal entities currently underrepresented in green sukuk markets. Development finance institutions and multilateral organizations can play catalytic roles through technical assistance programs, standardized documentation templates, and potentially credit enhancement mechanisms reducing first-time issuer risks and costs.

Demand-side development necessitates investor education initiatives highlighting green sukuk's dual value propositions—Shariah compliance and environmental impact. Islamic institutional investors, controlling an estimated \$3.8 trillion in assets (ICD Private Sector, 2024), represent substantial untapped demand if awareness and accessibility improve. Similarly, conventional ESG-mandated investors require education regarding Islamic finance principles and green sukuk characteristics to facilitate crossover investment.

Enabling infrastructure development includes expanding Shariah advisory capacity through specialized training programs integrating environmental finance competencies, developing automated compliance verification technologies reducing costs and processing times, and establishing secondary market mechanisms enhancing liquidity and broadening investor accessibility, while integrating environmental, social, and governance factors into financial system design (Hu et al., 2021).

Government policy interventions can provide critical catalytic support. Tax incentives for green sukuk issuers and investors, sovereign issuance programs establishing benchmarks and market credibility, regulatory frameworks mandating green disclosures from financial institutions, and central bank sustainable finance initiatives incorporating green sukuk in monetary policy operations all represent potential policy tools for accelerating market development.

Integration with Broader Sustainable Development Agendas

The findings underscore green sukuk's potential contributions beyond climate finance narrowly defined, extending to comprehensive sustainable development aligned with the United Nations SDGs. While climate action (SDG 13) represents the primary focus, analyzed green sukuk projects demonstrate co-benefits across multiple SDG dimensions including clean energy (SDG 7), sustainable cities (SDG 11), responsible production (SDG 12), and life on land (SDG 15), aligning with broader infrastructure and innovation requirements for environmental sustainability (Umar et al., 2020).

This multidimensional impact potential remains inadequately captured in current green sukuk frameworks predominantly focused on climate metrics. Expanding reporting requirements to encompass broader sustainability indicators would enhance green sukuk's value proposition for impact investors and development finance institutions seeking holistic sustainable development outcomes. Such expansion aligns with emerging sustainable sukuk concepts broadening beyond purely environmental considerations to encompass social and governance dimensions.

The integration of Islamic social finance instruments with green sukuk presents particularly promising opportunities. Combining zakat (obligatory almsgiving), waqf (endowment), and qard hasan (benevolent loans) with green sukuk structures could create innovative hybrid instruments addressing both environmental and social dimensions of sustainable development. For example, waqf-backed green sukuk could finance perpetual environmental infrastructure with revenues supporting ongoing community development, embodying Islamic finance's distinctive charitable dimensions within sustainable finance frameworks.

Geopolitical Dimensions and Market Expansion Prospects

Green sukuk development exhibits distinct geographic concentration, with Malaysia and Indonesia accounting for 68% of cumulative issuances. This concentration reflects favorable regulatory environments, government leadership, and established Islamic finance ecosystems in these countries. However, geographic expansion, particularly into Gulf Cooperation Council countries and other Muslim-majority nations, represents critical opportunities given their substantial fossil fuel transition needs and financial resource availability.

Saudi Arabia's Vision 2030 and the United Arab Emirates' net-zero commitments create substantial green financing requirements estimated at \$600 billion cumulatively through 2030 (IRENA, 2023). Green sukuk can play instrumental roles in mobilizing capital for these transitions while maintaining alignment with Islamic values and national development strategies. The region's deep Islamic finance expertise, substantial institutional investor bases, and government reform commitments create enabling conditions for rapid green sukuk market expansion if regulatory frameworks and standardization improve.

Beyond Muslim-majority countries, green sukuk holds potential for expanding ethical investment options in diverse markets. The United Kingdom's pioneering sovereign sukuk issuances, though not explicitly green, demonstrate developed economies' willingness to access Islamic finance markets. Green sukuk could attract international investors seeking both environmental impact and portfolio diversification through distinctive asset classes, particularly as ESG considerations increasingly influence global capital allocation.

However, geopolitical complexities affect market development prospects. Varying national climate commitments, fossil fuel dependencies, and political priorities across Muslim-majority countries create divergent incentives for green finance adoption. International cooperation mechanisms, potentially facilitated by multilateral development banks and the Islamic Development Bank, can help harmonize approaches and share best practices, accelerating collective market development despite diverse national contexts.

CONCLUSION

This comprehensive examination of green sukuk as an Islamic financial instrument for climate action reveals significant potential alongside persistent challenges requiring concerted stakeholder attention. The research demonstrates that green sukuk successfully integrates Shariah compliance with environmental sustainability objectives, offering distinctive value propositions for Muslim investors seeking ethical alignment and conventional investors prioritizing ESG considerations. The empirical analysis of market developments from 2017-2025 indicates robust growth trajectories, innovative structural adaptations, and meaningful environmental impacts across renewable energy, sustainable infrastructure, and climate resilience sectors.

Three principal conclusions emerge from this study. First, green sukuk's theological foundations in *maqasid al-shariah* principles, particularly environmental stewardship (*hifz al-bi'ah*) and intergenerational equity, provide compelling religious legitimacy that remains inadequately articulated in current market practices. Strengthening explicit connections between Islamic higher objectives and environmental finance can enhance market acceptance among religious investors and differentiate green sukuk within competitive sustainable finance landscapes. Second, regulatory fragmentation and standardization gaps represent critical barriers constraining market scaling. While

pioneering jurisdictions like Malaysia demonstrate effective integrated frameworks, broader harmonization of Shariah interpretations, green taxonomies, and impact reporting standards is essential for efficient cross-border capital mobilization. Third, despite impressive growth rates, green sukuk's modest market share indicates substantial unrealized potential requiring multi-stakeholder interventions addressing capacity constraints, investor awareness, and enabling infrastructure development.

The policy implications are significant and multidimensional. Regulatory authorities should prioritize developing comprehensive green sukuk frameworks integrating international environmental standards with Shariah governance requirements, establishing standardized taxonomies defining permissible green activities within Islamic jurisprudence, and mandating transparent impact reporting aligned with global best practices. Financial institutions require capacity building initiatives equipping Shariah scholars with environmental finance expertise, developing standardized documentation reducing transaction costs, and creating secondary market mechanisms enhancing liquidity. International cooperation through multilateral platforms can facilitate knowledge sharing, regulatory harmonization, and collaborative standard-setting advancing collective market development.

For academic research, this study opens multiple avenues for further investigation. Longitudinal impact assessments tracking green sukuk-financed projects' actual environmental outcomes over extended operational periods would strengthen evidence regarding effectiveness. Comparative studies examining green sukuk adoption across diverse cultural and regulatory contexts could identify context-specific success factors and transferable best practices. Theoretical work advancing maqasid-based environmental finance frameworks would strengthen intellectual foundations for Islamic sustainable finance innovation. Empirical research analyzing pricing dynamics, investor behavior, and risk-return characteristics would inform market participants' strategic decision-making.

Practitioners should recognize green sukuk as viable instruments warranting strategic prioritization within Islamic finance product development. Issuers contemplating green sukuk should invest in robust impact measurement frameworks, engage diverse investor segments through targeted education, and leverage dual certification (Shariah and environmental) as distinctive market positioning. Investors can utilize green sukuk for portfolio diversification achieving both religious compliance and sustainability objectives, while demanding transparent reporting and verified impact data ensuring authentic environmental additionality.

The ultimate significance of green sukuk extends beyond financial innovation to encompass ethical imperatives embedded within Islamic theology and contemporary environmental urgency. As climate change threatens ecosystems and human welfare globally, mobilizing adequate financing through diverse mechanisms including green sukuk represents moral obligations transcending religious and cultural boundaries. By demonstrating that religious principles and environmental sustainability reinforce rather than conflict with each other, green sukuk models offer valuable insights for broader ethical finance discourse.

This research affirms that Islamic finance can contribute meaningfully to global climate action while maintaining theological authenticity. However, realizing green sukuk's full potential requires sustained commitment from regulators, scholars, financial institutions, and investors to address identified challenges through collaborative innovation. The pathway toward inclusive and sustainable global society envisioned in ICHES 2026's theme requires leveraging diverse cultural and religious traditions' wisdom

and resources. Green sukuk represents one such pathway, embodying Islamic civilization's contributions to contemporary humanity's shared environmental imperatives while offering practical mechanisms for mobilizing essential climate finance at unprecedented scale and urgency.

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