

Integrated Green-Fintech Framework for Value-Based Islamic Wealth Creation: Bridging Green Sukuk, Smart Contracts, and Maqasid al-Shariah

Zahirah Hamid Ghul^{1*}, Norhasimah Shaharuddin², Nik Rozila Nik Mohd Masdek², Muhammad Abd Hadi bin Abd Rahman², Norsaliza Abu Bakar², Heizal Hezry Omar²

¹Department of Economics and Finance, Universiti Teknologi MARA (UiTM), Malaysia

²Department of Economics and Finance, Universiti Teknologi MARA (UiTM), Malaysia

* Corresponding Author

DOI: <https://doi.org/10.47772/IJRISS.2026.100800722>

Received: 26 August 2026; Accepted: 31 August 2026; Published: 16 September 2026

ABSTRACT

The exponential expansion of Sustainable and Responsible Investment (SRI) alongside rapid advancements in distributed ledger technology (DLT) presents a transformative opportunity for Islamic Financial Institutions (IFIs). While Green Sukuk have emerged as vital Shariah-compliant debt instruments for financing sustainable infrastructure, systemic operational bottlenecks—specifically high administrative transaction fees, a deficit in real-time impact verification, and persistent risks of "greenwashing"—hinder market scalability. This paper proposes the Integrated Green-Fintech (IGF) Framework, an interdisciplinary theoretical and conceptual model combining blockchain smart contracts, Artificial Intelligence (AI), Internet of Things (IoT) data Oracles, and the foundational objectives of Maqasid al-Shariah (focusing on Hifz al-Mal and Hifz al-Biah). AI-processed environmental data into self-executing smart contracts can theoretically automate Sukuk profit disbursements based on verifiable ESG key performance indicators (KPIs), addressing governance fragmentation and advancing Value-Based Intermediation (VBI). Addressing critical peer-review observations, this revised paper clearly distinguishes between established empirical literature and hypothesized framework benefits. Furthermore, it provides an in-depth analysis of technical failure modes (Oracle security, smart contract bugs, IoT tamper-resistance), delineates continuous Shariah governance mechanisms, formulates testable empirical propositions, and addresses multi-jurisdictional legal enforceability across major Islamic finance hubs.

Keywords: Green Sukuk; Green Fintech; Smart Contracts; Maqasid al-Shariah; Impact Verification; Oracle Security; Continuous Shariah Governance; Value-Based Intermediation (VBI).

INTRODUCTION & BACKGROUND

Context

Islamic finance is fundamentally grounded in ethical risk-sharing, asset-backed transactions, and socio-economic justice, aligning naturally with contemporary Environmental, Social, and Governance (ESG) criteria. The fundamental prohibitions of exploitation (Riba), excessive uncertainty/ambiguity (Gharar), and harmful commercial activities (Haram) establish a robust moral foundation for sustainable finance (Chapra, 2000; Hassan et al., 2021). Across Southeast Asia and the Gulf Cooperation Council (GCC) region, Green Sukuk have emerged as flagship instruments to mobilize private capital for renewable energy installations, sustainable urban transport, water conservation, and climate adaptation projects (Delle Foglie & Keshminder, 2024; Endri et al., 2022; World Bank, 2024).

Problem Statement & Conceptual

Despite double-digit annual growth rates, the global Green Sukuk ecosystem faces three severe operational and structural bottlenecks that limit its potential:

- **The Impact Verification Deficit & Greenwashing Risks:** Traditional post-issuance environmental monitoring relies predominantly on periodic, manual, self-reported ESG audits. This creates severe information asymmetry, leaving investors vulnerable to "greenwashing"—where capital is raised under sustainable mandates but diverted or applied to projects with negligible real-world ecological impact (Jibo, 2025; Supriatno, 2026; Volz, 2022).
- **Prohibitive Administrative & Auditing Overhead:** Independent ESG rating agencies, third-party verifiers, and ongoing Shariah advisory reviews impose substantial operational overhead, increasing transaction costs by an estimated 15–30% relative to conventional debt instruments (Delle Foglie & Keshminder, 2024; OECD, 2023). These cost premiums disproportionately price out small-and-medium enterprise (SME) green issuers.
- **The Form vs. Substance Gap in Shariah Governance:** Contemporary Shariah governance structures predominantly focus on initial, ex-ante legal contract mechanics (ensuring strict compliance with commercial rules such as Ijarah or Murabahah) rather than continuous, ex-post socio-ecological impact (realizing the broader spirit of Maqasid al-Shariah) (Arrazi, 2025; Supriatno, 2026; Laldin & Furqani, 2018).

Conceptual Distinction: Established Evidence vs. Proposed Framework

In response to scholarly feedback regarding the empirical grounding of technological claims, this manuscript explicitly clarifies that while the literature establishes the existence of transaction cost premiums and verification deficits in current Green Sukuk markets (Delle Foglie & Keshminder, 2024; World Bank, 2024), the proposed efficiency gains, automated cost reductions, and greenwashing elimination under the Integrated Green-Fintech (IGF) framework represent theoretical expectations and conceptual propositions. To date, DLT- and AI-driven automated Green Sukuk frameworks remain largely in pilot stages or controlled regulatory sandboxes (e.g., BNM Digital Asset Sandbox, DFSA Regulatory Sandbox). Consequently, this paper presents the IGF model as a conceptual blueprint and formulates testable empirical propositions for future field verification.

Research Objectives

This paper aims to bridge these structural gaps by developing an Integrated Green-Fintech (IGF) framework. By linking AI-enhanced IoT edge sensors to smart contracts on permissioned blockchains, the framework establishes a conceptual, automated, impact-linked Green Sukuk architecture grounded in Maqasid al-Shariah, while comprehensively examining the technical, legal, and Shariah governance challenges required for real-world deployment.

EXPANDED LITERATURE REVIEW & THEORETICAL FOUNDATIONS

Green Sukuk and the Realization of Maqasid al-Shariah

Recent scholarship highlights a fundamental paradigm shift in Islamic finance from negative Shariah screening (merely avoiding Riba, Gharar, and Maysir) toward positive, outcome-oriented financial engineering grounded in Maqasid al-Shariah (the higher objectives of Islamic law) (Alan Nur & Herianingrum, 2023; Chapra, 2000; Laldin & Furqani, 2018). Traditional Islamic wealth management emphasizes Hifz al-Mal (Preservation of Wealth) primarily through property rights and legal validity. However, modern scholars argue that true wealth preservation is impossible without Hifz al-Biah (Protection of the Environment) and Hifz al-Nasl (Protection of Future Generations) (Izzati et al., 2025; Rafique & Raza, 2026).

Figure 1: Conceptual Alignment of Maqasid al-Shariah and Value-Based Intermediation

MAQASID AL-SHARIAH (Higher Objectives of Islamic Law)		
Hifz al-Mal (Preservation of Wealth & Economic Equity)	Hifz al-Biah (Protection & Preservation of Environment)	Hifz al-Nasl / Nafs (Protection of Generations & Human Life)
Directs, Governs & Operationalizes		
VALUE-BASED INTERMEDIATION (VBI) & SUSTAINABLE FINANCE		
(Realized via Integrated Green-Fintech Architectural Layers)		

Environmental Stewardship (Khilafah) as a Legal Imperative

Scholars emphasize that environmental preservation (Hifz al-Biah) is not merely a secondary ethical preference, but a mandatory legal imperative linked to safeguarding human life and generational equity (Izzati et al., 2025; Rafique & Raza, 2026). Green Sukuk serves as a practical vehicle to operationalize the Islamic principle of Khilafah (vicegerency/stewardship) by directing capital toward renewable energy infrastructure, carbon capture, and climate resilience (Endri et al., 2022; Hassan et al., 2021). However, achieving true stewardship requires verifiable impact rather than passive financial claims.

Divergence between Form and Substance

Although Green Sukuk constitutes approximately 10% of total global Sukuk issuances (World Bank, 2024), critical literature highlights a persistent gap between legal form and ethical substance. Supriatno (2026) and Arrazi (2025) observe that current market structures often treat green certification as a static, ex-ante marketing exercise. Once the Sukuk is issued, ongoing monitoring is lax, enabling issuers to meet financial yield targets while failing to deliver promised ecological benefits, thereby undermining the core purpose of Value-Based Intermediation (VBI) as framed by Bank Negara Malaysia (BNM, 2018).

Shariah Governance Fragmentation and Technical Auditing Limits

Shariah governance in Green Sukuk currently operates under a structural dualism. Traditional Shariah advisory boards excel in evaluating Islamic commercial law (Fiqh al-Mu'amalat)—ensuring that underlying contracts (e.g., Ijarah, Wakalah, Mudarabah) adhere to rules against interest and ambiguity (Arrazi, 2025; Hafssa & Oumaima, 2020). However, three major structural governance gaps persist:

- **Divergent Regional Fatawa:** Significant discrepancies exist between major regulatory regimes —such as Malaysia's Securities Commission (SC) and the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) in the GCC—regarding acceptable asset-use ratios, debt tradability, and restructuring mechanics (Delle Foglie & Keshminder, 2024; Hashim et al., 2023).
- **Technical ESG Auditing Deficit:** Shariah scholars typically lack specialized scientific capabilities to audit complex environmental engineering data (e.g., verifying carbon abatement curves, solar grid efficiencies, or methane capture metrics) (Arrazi, 2025; Supriatno, 2026). This creates institutional friction between Shariah advisory boards and third-party ESG rating agencies.
- **Static Ex-Ante Governance:** Traditional Shariah approval is granted prior to issuance based on prospectus documentation. There is no mechanism for dynamic, continuous Shariah oversight during the operational lifecycle of the Sukuk to verify if revenue streams remain aligned with Shariah-based impact criteria.

Blockchain, AI, and Smart Contracts in Islamic Finance

Distributed Ledger Technology (DLT) and Smart Contracts enable automated execution of complex financial arrangements without reliance on heavy centralized intermediaries (Hafssa & Oumaima, 2020; Rejeb, 2022; Muneeza et al., 2018). Tokenized "Smart Sukuk" can streamline issuance procedures, lower minimum investment thresholds for retail investors, and theoretically reduce settlement friction (Lahsasna et al., 2018; Rejeb, 2022). Furthermore, embedding AI and IoT data Oracles creates a bridge between physical environmental performance and digital financial settlement (Jibo, 2025; World Economic Forum, 2023).

Theoretical Framework & Synthesis

The proposed conceptual model synthesizes Stakeholder Theory (Freeman, 1984) and the Maqasid al-Shariah Framework (Chapra, 2000; Laldin & Furqani, 2018). Stakeholder Theory establishes that corporations owe fiduciary and ethical duties not only to equity shareholders but also to the environment and surrounding communities. Maqasid al-Shariah provides the normative religious foundation (Khilafah and Hifz al-Biah), converting passive ESG screening into active moral stewardship. The Integrated Green-Fintech Framework acts as the mediating operational mechanism that transforms these theoretical principles into verifiable real-world outcomes.

Figure 2: The Integrated Theoretical Architecture of the IGF Framework

STAKEHOLDER THEORY (Freeman, 1984)	MAQASID AL-SHARIAH (Chapra, 2000)
• Multi-stakeholder value creation • Broader ecological accountability • Corporate social legitimacy	• Protection of Wealth (Hifz al-Mal) • Environmental Preservation (Hifz al-Biah) • Generational Equity (Hifz al-Nasl)
<i>Mediating Operational Mechanism</i>	
INTEGRATED GREEN-FINTECH (IGF) MEDIATING PROCESS: 1. <i>Data Layer:</i> IoT Edge Sensors & AI Anomaly Filtering 2. <i>Oracle Layer:</i> Decentralized Proof-of-Authority Data Transmission 3. <i>Execution Layer:</i> Smart Contracts & Dynamic Impact-Linked Yields 4. <i>Redistribution Layer:</i> Automated Zakat & Micro-Waqf Allocations	
<i>Generates Proposed Outcomes (Subject to Institutional Moderation)</i>	
Governance & Economic Efficiency: • Mitigation of greenwashing risks • Potential administrative cost reductions • Automated trust & transparency	Socio-Ecological Outcomes: • Verifiable CO2 sequestration • Dynamic impact-linked profit sharing • Enhanced Value-Based Intermediation
Institutional Moderators: Regulatory Sandbox Readiness AAOIFI/IFSB Standardization Cross-Border Legal Enforceability Oracle Cybersecurity Standards	

Technical Architecture, Security & Governance Mechanisms

To address reviewer concerns regarding technical feasibility, cybersecurity, and system failures, this section details the four-stage digital architecture of the IGF model, incorporating robust fault-tolerance and security protocols.

Figure 3: Four-Layer Technical Architecture of the IGF Model

Layer	Technical Components	Security & Validation Protocol
1. Asset Tokenization Layer	Permissioned DLT (Hyperledger Besu / Ethereum Enterprise), ERC-3643 / Shariah-compliant token standard.	Multi-signature wallet governance, identity verification (KYC/AML), smart contract legal wrappers.

2. Data & Oracle Verification Layer	IoT edge sensors (solar meters, airflow sensors), Decentralized Oracles (Chainlink PoA), AI Anomaly Filters.	Cryptographic hardware security modules (HSM), Isolation Forest / LSTM AI algorithms for data outlier detection, multi- node consensus.
3. Smart Contract Execution Layer	Self-executing smart contracts managing <i>Wakalah / Ijarah</i> profit distributions and impact adjustments.	Formal verification math proofs, automated circuit breakers (emergency pauses), multi- sig Shariah override keys.
4. Automated Redistribution Layer	Smart contract routing of excess profit / Zakat obligations to verified micro-Waqf / green funds.	On-chain audit logs, immutable transaction records, automated tax/Zakat receipt issuing.

Asset Tokenization & Legal Framework

Tangible green assets (e.g., a 50MW solar photovoltaic plant) are fractionalized into digital Sukuk tokens on a permissioned, enterprise-grade blockchain ledger. Tokenization lowers barriers to entry for retail investors while preserving asset-backed or asset-based Shariah structures (such as *Ijarah* or *Mudarabah*). Each token represents an undivided beneficial ownership interest in the underlying green asset or yield-generating lease.

IoT Sensors, AI Data Cleaning & Oracle Security

A critical weakness in automated financial systems is the "garbage-in, garbage-out" risk, alongside physical sensor tampering or malicious cyber-attacks on Oracles. The IGF framework addresses these vulnerabilities through a multi-tiered security and data validation protocol:

- **IoT Edge Cryptography & Hardware Security:** Physical sensors deployed at project sites (e.g., smart solar meters) are equipped with Hardware Security Modules (HSM) and cryptographic private keys. Data captured at the edge is signed at the hardware level before transmission, preventing man-in-the-middle tampering.
- **AI Data Cleansing & Anomaly Detection:** Before transmitting physical metrics to the blockchain, an ensemble Machine Learning model (e.g., Isolation Forest combined with Long Short-Term Memory [LSTM] neural networks) processes raw IoT telemetry. The AI cleanses noise, detects sensor malfunctions, and flags anomalous spikes (e.g., artificially inflated solar output readings) relative to historical baseline data and localized satellite weather feeds.
- **Decentralized Oracle Networks (DONs):** Rather than relying on a single centralized Oracle, the framework utilizes a Proof-of-Authority (PoA) Decentralized Oracle Network (e.g., Chainlink architecture). Multiple independent validator nodes aggregate sensor metrics and cross-reference them with external data feeds (e.g., European Space Agency satellite irradiance logs). Consensus must be reached across 75% of Oracle nodes before data is committed to the smart contract.

Smart Contract Governance, Vulnerabilities & Emergency Breakers

Smart contracts automatically calculate and disburse profit yields based on verified ESG metrics. If a green project exceeds its carbon abatement targets, an impact bonus yield is released to investors. Conversely, underperformance triggers yield reductions or redirects funds to corrective maintenance.

To mitigate risks associated with smart contract code vulnerabilities, logic bugs, or unintended execution outcomes, the IGF framework incorporates strict technical governance controls:

- **Formal Verification & Security Audits:** All smart contract code must undergo mathematically rigorous formal verification to prove logic correctness, alongside dual independent cybersecurity audits prior to mainnet deployment.

- **Automated Circuit Breakers & Emergency Pause:** Smart contracts are embedded with automated circuit breakers that freeze execution if parameter inputs exceed predefined variance limits (e.g., a sudden 500% spike in reported energy output).
- **Fallback Arbitration & Human-in-the-Loop Override:** In the event of system errors, hardware failure, or Oracle consensus breakdown, execution halts automatically and transfers control to a joint Technical-Shariah Arbitration Committee. This ensures that automated systems never execute incorrect financial distributions without recourse.
- **Automated Wealth Redistribution (Zakat & Micro-Waqf)**

In accordance with Hifz al-Mal and income redistribution principles, the smart contract platform includes an optional, automated Zakat calculation module. Subject to investor preference, annual Zakat liabilities on Sukuk yields (2.5% of net realized return) are automatically calculated and routed directly to accredited micro-Waqf institutions or community-level green projects (e.g., off-grid rural solar electrification), establishing a closed-loop socio-ecological wealth ecosystem.

Continuous Shariah Governance & Legal Multi-Jurisdictional Enforceability

Operationalizing Continuous (Ex-Post) Shariah Oversight

A central contribution of the IGF Framework is replacing static ex-ante paper fatwas with dynamic, continuous Shariah governance. Under this operational model:

- **Digital Shariah Compliance Rulesets:** Shariah parameters (e.g., maximum allowable non-permissible revenue ratios, debt-to-asset thresholds, and environmental impact benchmarks) are translated into machine-readable code parameters within the smart contract.
- **The Real-Time Shariah Dashboard:** Shariah advisory board members access a dedicated monitoring dashboard powered by immutable blockchain logs. This provides real-time visibility into asset utilization, revenue generation, and environmental KPI fulfillment.
- **Ex-Post Compliance Auditing & Dynamic Sanctions:** If an underlying asset violates Shariah conditions during operation (e.g., unapproved business diversification or severe environmental degradation failing Hifz al-Biah), the smart contract automatically flags the non-compliance, suspends profit distribution, and initiates a mandatory 30-day rectification protocol monitored by the Shariah board.

Authority, Liability, and Responsibility Allocation

A critical governance question concerns legal liability when automated systems fail or produce incorrect outcomes. The IGF framework establishes a clear hierarchy of responsibility:

Table 1: Governance Responsibility & Legal Liability Matrix

System Level / Component	Primary Responsible Authority Liability & Remediation Mechanism	
Shariah Compliance & Fatwa Validation	Central Bank / National Shariah Advisory Council & Issuer Shariah Board	Shariah Board retains sole authority over Islamic legal interpretations. Code parameters must be signed off by the board via multi-sig keys.
Data Accuracy & Sensor Integrity	IoT Infrastructure Provider / Project Engineering Operator	Contractual liability backed by performance bonds; physical hardware warranties and regular calibration requirements.

Oracle Security & Consensus	Decentralized Oracle Network Operators	Slashing conditions: Node operators stake tokens that are forfeited (slashed) in cases of malicious or incorrect data reporting.
Smart Contract Code Integrity	Lead Software Architecture Firm& Audit Firm	Professional indemnity insurance; mandatory bug bounty programs and formal verification sign-off.

Legal and Regulatory Enforceability Across Jurisdictions

The cross-border execution of blockchain-based Smart Green Sukuk presents complex legal challenges across different legal traditions:

- **Common Law Jurisdictions** (e.g., Malaysia, DIFC, ADGM): These jurisdictions generally recognize smart contracts as legally binding agreements under standard contract law, provided basic elements (offer, acceptance, consideration) are met. Equity courts in Malaysia have shown willingness to enforce digital asset rights, making them highly receptive to DLT Sukuk structures (Hashim et al., 2023).
- **Civil Law & Traditional Shariah Jurisdictions** (e.g., Saudi Arabia, UAE onshore, Indonesia): Civil law systems require explicit statutory recognition of digital signatures, tokenized property rights, and automated ledger entries. Recent legislative updates—such as Saudi Arabia's Capital Market Authority (CMA) Financial Technology Law and UAE's VARA framework—provide emerging legal pathways, though full court enforceability of automated smart contract liquidations remains untested in judicial trials.
- **Conflict of Laws & Dispute Resolution**: To resolve cross-border jurisdictional conflicts, all tokenized Green Sukuk issued under the IGF framework must incorporate an explicit "Legal Wrapper" contract designating a preferred arbitration seat (e.g., Asian International Arbitration Centre [AIAC] or DIFC Courts) with express jurisdiction over smart contract code disputes.

Research Propositions (For Future Empirical Testing)

To transition the IGF Framework from conceptualization to empirical validation, we formulate four testable propositions designed for future empirical testing in regulatory sandboxes or pilot implementations:

Proposition 1 (P1): Administrative Cost Reduction

"The integration of AI-driven IoT Oracles and smart contract automation into Green Sukuk structures significantly reduces ex-post third-party ESG auditing and administrative overhead costs (measured as a percentage of total issuance value) compared to conventional manual Green Sukuk reporting frameworks."

Proposition 2 (P2): Mitigation of Greenwashing & Enhancement of Investor Trust

"Automated, tamper-resistant environmental data feeds embedded directly into smart contract payout mechanics significantly reduce perceived greenwashing risks and increase retail and institutional investor participation in Shariah-compliant SRI instruments."

Proposition 3 (P3): Realization of Maqasid al-Shariah (Substance over Form)

"Adopting continuous ex-post smart contract Shariah governance bridges the 'form versus substance' gap by measurably improving Hifz al-Biah outcomes (e.g., verified metric tons of CO2 abated per dollar invested) relative to static ex-ante certified Green Sukuk."

Proposition 4 (P4): Regulatory Moderation Effect

"The degree of jurisdiction-specific regulatory sandbox readiness and legal framework clarity positively moderates the relationship between Green-Fintech adoption and overall Green Sukuk issuance efficiency."

Policy, Governance, And Practical Implications

For Financial Regulators & Standardization Bodies (BNM, SC, AAOIFI, IFSB)

Regulators must move beyond passive observation to establish active testing environments. Standard-setting bodies like AAOIFI and IFSB should collaborate with fintech engineers to establish standardized technical guidelines for "Smart Shariah Governance." Guidelines are urgently needed to define acceptable Oracle architecture, smart contract audit requirements, and standardized machine-readable fatwa protocols.

For Islamic Banks, Capital Market Issuers & SMEs

The IGF framework democratizes access to green capital markets. By automating post-issuance compliance and lowering fixed administrative costs, small-and-medium green enterprises (e.g., community solar developers, organic agriculture co-ops) can issue fractionalized micro-Sukuk, fostering inclusive economic growth aligned with VBI objectives.

For ESG Investors & Sustainability Ratings Agencies

Investors gain access to real-time, tamper-resistant impact data, dramatically reducing information asymmetry. ESG rating agencies will transition from periodic retroactive report-writing to providing real-time data analytics and continuous algorithmic validation services.

CONCLUSION & FUTURE RESEARCH AGENDA

This study establishes a comprehensive conceptual bridge between Islamic social finance, sustainable capital markets, and advanced financial technology. By addressing critical scholarly feedback, the paper clearly delineates between empirical realities and theoretical expectations, provides an in-depth technical examination of Oracle security and smart contract fault-tolerance, details an operational model for continuous Shariah governance, and formulates testable empirical propositions. The IGF framework demonstrates that embedding DLT, AI, and IoT into Green Sukuk structures can transform static financial vehicles into dynamic, impact-driven instruments that directly advance the core objectives of Maqasid al-Shariah.

Future research should focus on three key directions: (1) conducting empirical pilot testing using permissioned blockchain testnets (e.g., Hyperledger Besu) simulated with real-world solar telemetry; (2) performing comparative empirical cost-benefit analyses comparing traditional vs. tokenized Green Sukuk issuances within regulatory sandboxes; and (3) analyzing legal precedents regarding smart contract dispute resolution across contrasting common law and civil law Islamic finance jurisdictions.

REFERENCES

1. Alan Nur, R., & Herianingrum, S. (2023). Maqasid Al-Shariah and Green Finance: A Theoretical Framework on Islamic Finance with Sustainable Development Goals for a Greener Future. *Journal of Islamic Economics and Sustainable Finance*, 3(2), 112–128.
2. Arrazi, M. F. (2025). Maqasid al-Shariah and sustainable finance: Analyzing the impact of green sukuk allocation in Indonesia. *Muslim Business and Economics Review*, 4(1), 89–107.
3. Bank Negara Malaysia (BNM). (2018). Value-based Intermediation: Strengthening the Roles and Impact of Islamic Finance. Kuala Lumpur: Bank Negara Malaysia.
4. Chapra, M. U. (2000). The Islamic vision of development in the light of Maqasid al-Shariah. London: International Institute of Islamic Thought (IIIT).
5. Delle Foglie, A., & Keshminder, J. S. (2024). Green sukuk – Malaysia surviving the bumpy road: Performance, challenges and structural bottlenecks. *Qualitative Research in Financial Markets*, 16(1), 76–98.
6. Endri, E., Syafrida, I., & Rasyid, A. (2022). Green Sukuk and sustainable development goals: Evidence from Islamic capital markets. *Journal of Environmental Accounting and Management*, 10(3), 245–259.
7. Freeman, R. E. (1984). Strategic management: A stakeholder approach. Boston: Pitman.

8. Hafssa, R., & Oumaima, B. (2020). Smart contracts and blockchain technology in Islamic finance: Opportunities and Shariah compliance challenges. *International Journal of Islamic and Middle Eastern Finance and Management*, 13(4), 589–605.
9. Hashim, F., Hassan, M. K., & Abdullah, S. (2023). Legal and regulatory framework for digital Sukuk and fintech integration: A comparative analysis of Malaysia and UAE. *Journal of Financial Regulation and Compliance*, 31(3), 310–332.
10. Hassan, M. K., Rashid, M., & Aliyu, S. (2021). Sustainable finance and Islamic banking: A Maqasid al-Shariah perspective. *International Journal of Sustainable Development & World Ecology*, 28(5), 412–427.
11. Izzati, A. N., Tumuyu, S. S., & Wardhana, Y. M. A. (2025). Reconceptualizing green sukuk through Maqashid al-Shariah for advancing sustainable development goals. *Journal of Islamic Economics Lariba*, 11(2), 1833–1862.
12. Jibo, U. M. (2025). Green Fintech and blockchain integration in Islamic banking: Enhancing transparency and sustainability. *Journal of Financial Technology and Shariah Governance*, 7(1), 45–62.
13. Lahsasna, A., Hassan, M. K., & Ahmad, R. (2018). *Blockchain technology and smart sukuk: Innovation and transformation in Islamic capital markets*. London: Routledge.
14. Laldin, M. A., & Furqani, H. (2018). Innovation and size in Islamic finance: A Maqasid al-Shariah perspective. *Humanomics*, 34(1), 78–86.
15. Muneeza, A., Arshad, N. A., & Arifin, A. T. (2018). The application of blockchain technology in crowdfunding: Towards financial inclusion via Islamic finance. *International Journal of Management and Applied Research*, 5(2), 82–99.
16. OECD. (2023). *ESG Investing and Climate Transition in Developing Countries: Regulatory and Market Bottlenecks*. Paris: OECD Publishing.
17. Rafique, M. O., & Raza, K. M. (2026). Islamic Green Finance: A marriage of ethics and environmental responsibility in light of Maqasid al-Shari'ah. In E. Smolo & M. O. Rafique (Eds.), *Islamic Green Finance* (pp. 3–20). London: Routledge.
18. Rejeb, A. (2022). Blockchain technology in Islamic finance: A systematic review and future research agenda. *Technology in Society*, 68, 101847.
19. Supriatno, E. (2026). Green Sukuk and sustainable development: An Islamic finance and environmental governance perspective. *Journal of Oeconomia Syariah et Civitas*, 2(2), 101–118.
20. Volz, U. (2022). Fostering Sustainable Finance in Emerging Markets: Challenges and Policy Options. *Journal of Sustainable Finance & Investment*, 12(3), 645–667.
21. World Bank. (2024). *Global Sukuk Market Report: Green and Sustainable Finance Development*. Washington, DC: World Bank Group.
22. World Economic Forum (WEF). (2023). *Harnessing Artificial Intelligence and IoT for Climate Action and Sustainable Capital Markets*. Geneva: World Economic Forum.