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Integration of Blockchain and Blue Sukuk in the Development of a Sustainable Blue Economy from the Perspective of Maqasid Syariah

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ABSTRACT

The accelerating global emphasis on sustainable blue economy development necessitates innovative financial mechanisms aligning technological advancements with ethical frameworks. This study explores the integration of blockchain technology with blue sukuk Sharia compliant bonds dedicated to marine and coastal sustainability through the lens of maqasid syariah, the higher objectives of Islamic law. The aim is to systematically synthesize contemporary international literature (2021-2025) to uncover thematic patterns in governance, socio-environmental impact, and Sharia compliance of blockchain-enabled blue sukuk. A qualitative thematic literature review was conducted, analyzing over fifteen peer-reviewed articles and policy reports selected via purposive sampling based on relevance, recency, and accessibility. Data extraction and coding employed NVivo software with adherence to PRISMA guidelines, facilitating rigorous thematic analysis within an Islamic fintech context. Findings reveal blockchain's significant role in enhancing transparency and trust in blue sukuk issuance, coupled with strong alignment to maqasid syariah principles emphasizing environmental preservation and social welfare. Identified challenges include fragmented regulatory frameworks and inconsistent Sharia standardization, posing barriers to scalability and widespread adoption. Additionally, blue sukuk smart contracts demonstrate potential for inclusive financing, empowering coastal communities economically and ecologically. The study contributes theoretically by extending maqasid syariah's application to an emergent intersection of digital finance and blue economy sustainability and practically by highlighting policy imperatives for integrating technology, regulation, and ethics in Islamic finance. Future research should prioritize empirical validations, interoperability advancements, and capacity-building to enable robust, scalable Sharia-compliant blue finance solutions globally.

Keyword: : Blockchain, Blue sukuk, Maqasid syariah, Sustainable blue economy, Islamic fintec

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1. INTRODUCTION

The global blue economy faces critical challenges from marine degradation, overfishing, and climate change impacts, which threaten food security, biodiversity, and coastal livelihoods worldwide. Sustainable Development Goals (SDGs), particularly SDG 14 on life below water, underscore the urgency for innovative financing to support ocean conservation and resource management (Asrul Bastian Yunas et al., 2025). Islamic finance instruments like sukuk have emerged as ethical alternatives, aligning with global sustainability agendas by channeling funds to environmentally beneficial projects (Yanova & Komarudin, 2024).

In Indonesia, as an archipelagic nation with vast marine resources, the blue economy holds immense potential yet grapples with funding gaps for sustainable fisheries, coastal infrastructure, and ecosystem restoration (Yanova & Komarudin, 2024). Blue sukuk, a sharia-compliant bond tailored for marine projects, represents a local innovation pioneered by the government to finance initiatives like integrated fishing villages and sea toll infrastructure. Despite growth in sukuk issuance, integration with emerging technologies remains underexplored amid regulatory hurdles and limited stakeholder awareness (Diana, 2024).

Maqasid syariah encompassing preservation of faith, life, intellect, lineage, and wealth provides a holistic framework for sustainable development, emphasizing hifzh al-'alam (environmental protection) as a core objective (Diana, 2024). This perspective mandates ethical financing that promotes maslahah (public welfare) while prohibiting harm to natural resources. Blue sukuk aligns with these principles by funding sharia-compliant marine conservation, yet its synergy with modern tools demands deeper scrutiny (Latifah, 2024).

A notable research gap exists in the literature: while studies examine blockchain-green sukuk integration for coastal empowerment and blue sukuk's regulatory challenges separately, few address their combined application in blue economy development through a maqasid syariah lens. Existing works highlight blockchain's role in enhancing transparency and green sukuk's environmental focus but overlook sharia-objective alignment for marine-specific sustainability. This leaves untapped potential for a unified model in resource-constrained contexts like Indonesia (Nurul Izzati & Sanjayawati, 2021).

This study aims to explore the integration of blockchain technology with blue sukuk to foster a sustainable blue economy, evaluated against maqasid syariah principles. Specific objectives include analyzing blockchain's enhancement of sukuk transparency, assessing sharia compliance in marine financing, and proposing a framework for Indonesian implementation.

The research contributes globally by bridging Islamic finance with fintech for SDG-aligned ocean economies, offering a replicable model for Muslim-majority nations facing similar marine threats. Locally, it addresses Indonesia's blue sukuk barriers through sharia-centric innovation, promoting inclusive growth for coastal communities.

2. LITERATURE REVIEW

Blockchain and Blue Sukuk in Sustainable Blue Economy

Integration of blockchain and blue sukuk advances sustainable blue economy development by enhancing transparency, funding access, and Sharia compliance, aligning with maqasid syariah principles like environmental preservation (hifzh al-'alam) and community welfare (maslahah). Recent studies (2021-2025) emphasize blockchain's role in streamlining sukuk transactions via smart contracts, reducing fraud, and ensuring real-time fund tracking for marine projects. Blue sukuk, as Sharia-compliant bonds for ocean conservation, bridges Islamic finance with SDGs 14 (life below water), supporting Indonesia's blue economy roadmap (Dimyati, Moh. Imron Rosyadi, 2023).

Maqasid Syariah Perspective

Maqasid syariah frames blockchain-blue sukuk integration as fulfilling core objectives: protecting property (hifzh al-mal) through immutable ledgers, preserving life and environment, and promoting public benefit. Literature highlights alignment with zero-waste practices, resource efficiency, and inclusive growth in blue economy sectors like halal tourism and fisheries. Green sukuk variants extend this to climate mitigation, with Sharia boards ensuring ESG compliance via ijarah or mudarabah structures (Moh Lutfi, Fahrurrozi, 2025).

Key Studies (2021-2025)

Blockchain-green sukuk empowers coastal communities via transparent financing, addressing digital literacy gaps for inclusive blue growth (Asrul Bastian Yunas et al., 2025). Blue sukuk frameworks finance Indonesia's marine projects, modeling theory-of-change for poverty alleviation and climate resilience (Suryomurti et al., 2023). Smart sukuk on blockchain boosts MSME access, harmonizing with maqasid al-shariah for ethical, efficient Islamic finance (Dimyati, Moh. Imron Rosyadi, 2023). Cash waqf-linked sukuk supports halal blue economy, enhancing financial inclusion in OIC nations (Ishom et al., 2025). Sovereign blue sukuk issuance opportunities align fiqh al-bi'ah with SDGs, prioritizing marine protected areas (Rusydiana et al., 2023). Waqf-sukuk models defend SDG 14, integrating social finance for sustainable ocean ecology (Rusydiana et al., 2023). Islamic finance nexus with green-blue economies improves logistics in OIC countries via renewable investments (Suryomurti et al., 2023).

Challenges and Opportunities

Implementation faces hurdles like regulatory gaps, infrastructure limits, and Sharia standardization, yet offers scalability through phased digital adoption. Opportunities include waqf-blockchain hybrids for coastal empowerment and global blue finance leadership. Future research should quantify impacts via empirical models (Nia Kartika Putri, Ainul Mardiah, 2021).

3. METHOD

This study employed a qualitative approach using a systematic thematic literature review design. This approach enables an in-depth synthesis of recent literature to identify recurring patterns, research gaps, and a conceptual framework for integrating blockchain-based blue sukuk into a sustainable blue economy from the perspective of maqāṣid al-sharīʿah. A thematic literature review is particularly appropriate for an emerging interdisciplinary topic, especially within the 2021–2025 period, because it facilitates the development of a robust theoretical foundation without relying exclusively on primary empirical data. This approach is also consistent with methodological recommendations found in related Islamic finance studies.

Data Sources

The primary literature comprised more than 15 peer-reviewed international articles indexed in Scopus, Web of Science, and Google Scholar and published between 2021 and 2025. The literature search focused on combinations of keywords such as "blockchain," "sukuk," "blue economy," and "maqāṣid al-sharīʿah." Secondary sources included policy reports, such as the Bappenas Blue Economy Roadmap and the ICD Islamic Finance Report, as well as relevant conference proceedings.

Restricting the review to publications from the most recent five-year period ensured the contemporary relevance of the literature, particularly in relation to post-pandemic developments and advances in blockchain technology. The inclusion of both academic publications and grey literature also strengthened source triangulation and helped reduce potential publication bias.

Sampling Technique

Purposive sampling was applied based on the following inclusion criteria: (1) articles published in English or Indonesian; (2) publications issued between 2021 and 2025; (3) studies relevant to blockchain, blue sukuk, the blue economy, or maqāṣid al-sharīʿah; and (4) publications with accessible full-text versions.

A total of 35 publications were initially identified. Following title, abstract, and full-text screening, 18 articles were selected for the final analysis. Purposive sampling was considered appropriate because a qualitative literature review prioritizes thematic relevance and analytical depth rather than statistical representativeness. This technique enabled comprehensive coverage of the principal themes while avoiding the inclusion of sources with limited relevance to the research objectives.

Data Collection Instrument

The primary data collection instrument was a structured data-extraction protocol developed in tabular form using Microsoft Excel and supported by a PRISMA flow diagram. The extraction table recorded information on the authors, year of publication, research methodology, key findings, relevance to maqāṣid al-sharīʿah, and identified research gaps.

NVivo software was used to facilitate initial coding, data organization, and keyword searches. The application of a standardized extraction protocol and PRISMA-based documentation enhanced the transparency and reproducibility of the review process. Meanwhile, NVivo supported the systematic management and coding of textual data, thereby reducing inconsistencies arising from entirely manual analysis, as commonly demonstrated in bibliometric and qualitative studies of Islamic finance.

Data Analysis

The data were analyzed using the six-stage thematic analysis framework developed by (Braun & Clarke, 2021): (1) familiarization with the data; (2) generation of initial codes; (3) searching for potential themes; (4) reviewing the themes; (5) defining and naming the themes; and (6) producing the final report.

The analysis generated three principal themes: technology–finance integration, alignment with maqāṣid al-sharīʿah, and implementation challenges. The credibility of the analysis was strengthened through cross-checking among the researchers.

Thematic analysis was selected because of its flexibility in examining heterogeneous textual data. It enabled the researchers to identify and interpret emerging patterns from a Sharia perspective while maintaining qualitative rigor. Compared with conventional content analysis, which tends to emphasize the description and frequency of textual categories, thematic analysis provides greater analytical depth in examining relationships, meanings, and conceptual patterns across the reviewed literature.

4. RESULT

Blockchain Enhances Transparency and Trust in Blue Sukuk

Coding revealed frequent mentions of blockchain's role in improving transparency and trustworthiness in blue sukuk issuance. One source noted, "Blockchain enables immutable record-keeping, reducing fraud risk and increasing investor confidence". This aligns with the theme of technological empowerment supporting Sharia compliance by safeguarding investor assets (hifzh al-mal).

Maqasid Syariah Drives Sustainable and Ethical Economic Outcomes

Many articles emphasized maqasid syariah principles guiding sustainable development. As an expert stated, "The integration of maqasid syariah with blue sukuk ensures that environmental preservation and community welfare are prioritized alongside financial returns". Thematic coding linked these values strongly with themes of environmental stewardship (hifzh al-bi'ah) and social justice (maslahah).

Challenges in Regulatory and Sharia Standardization

Data highlighted recurring challenges such as "lack of harmonized regulations and standardized Sharia governance frameworks pose significant obstacles to scaling blue sukuk on blockchain platforms". This theme illuminated the need for policy development and inter-institutional cooperation to align technology and religious compliance.

Opportunities for Inclusive Coastal Community Empowerment

Another prominent theme was the socio-economic benefits of blue sukuk supported by blockchain to empower coastal communities. A case study discussed how "smart contracts facilitate efficient fund disbursement to small-scale fishermen, fostering financial inclusion and sustainable livelihoods". This finding underscores the theme of inclusive growth and poverty alleviation in the blue economy sector.

Future Directions and Scalability

Several sources pointed towards future potential, stating "advancements in blockchain interoperability and growing interest in green finance could drive widespread adoption of blue sukuk aligned with SDG 14". Thematic analysis suggested optimism about scaling digital Islamic finance instruments integrated with environmental objectives under maqasid syariah ethics.

5. DISCUSSION

Findings on blockchain's transparency enhancements in blue sukuk diverge from earlier sukuk-blockchain studies focused solely on general Islamic finance, such as those emphasizing cost reduction without environmental linkage. Unlike Abduh (2021) on sukuk tokenization challenges, this review critically reveals maqasid syariah as a binding mechanism for blue economy specifics, where smart contracts enforce hifzh al-bi'ah beyond mere hifzh al-mal. Regulatory hurdles identified here echo but extend ICCTF's blue finance guidelines (2022), critiquing their overemphasis on issuance mechanics while underplaying Sharia standardization gaps in digital contexts.

This thematic synthesis introduces novelty by intersecting blockchain, blue sukuk, and maqasid syariah specifically for sustainable blue economy a triad underexplored compared to green sukuk parallels. Prior works like Tazkia Institute's maqasid-blue sukuk analysis (Diana, 2024) remain conceptual; this review critically advances by coding real integration barriers (e.g., interoperability for coastal funds), exposing a scalability paradox absent in optimistic Islamic finance narratives. Critically, it challenges the assumption of seamless tech-Sharia fusion, highlighting digital literacy deficits in coastal settings overlooked by urban-centric blockchain literature (Lestari et al., 2025).

Theoretically, findings refine maqasid syariah as a dynamic framework, extending Al-Najjar's smart sukuk model to blue contexts via thematic linkages of maslahah with SDG 14. This contributes a hybrid lens critiquing static Sharia interpretations, proposing adaptive fiqh al-bi'ah for blockchain era finance contrasting rigid compliance views in waqf-sukuk studies (Ashfaq & Wolters, 2018). By mapping themes to hifzh pillars, the review builds a conceptual matrix for future Islamic fintech, addressing gaps in bibliometric blockchain-Islam reviews that ignore blue economy nuances (Kamali, 2019).

Globally, these insights position OIC nations as blue economy leaders, critiquing Western green bonds' secular limits by offering Sharia-aligned alternatives scalable via blockchain interoperability. For Indonesia's roadmap, findings urge policy reforms beyond Bappenas prototypes, emphasizing cross-border Sharia harmonization to rival EU blue finance initiatives. Critically, without addressing standardization, adoption risks fragmenting global Islamic capital markets, underscoring urgency for empirical pilots in fisheries and halal marine sectors (Harahap et al., 2023).

6. CONCLUSION

The findings demonstrate that the integration of blockchain technology and blue sukuk presents a transformative opportunity for advancing a sustainable blue economy aligned with maqasid syariah principles. Key themes reveal blockchain’s ability to enhance transparency, trust, and financial inclusion in blue sukuk issuance, while maqasid syariah ensures that environmental preservation and social welfare remain central objectives. Challenges persist around regulatory frameworks and Sharia standardization, highlighting critical barriers to scaling these digital Islamic finance instruments for ocean sustainability.

Theoretically, this study contributes by extending the application of maqasid syariah to the intersection of emerging fintech and blue economy finance, emphasizing adaptive Islamic jurisprudence (fiqh al-bi’ah) that responds to technological innovation and socio-environmental imperatives. Practically, it provides policy-relevant insights for OIC countries and emerging markets aiming to harmonize Sharia compliance with sustainable development goals, encouraging blockchain-enabled sukuk models that empower coastal communities through smart contract automation and inclusive financing mechanisms.

For future research, empirical investigations are recommended to validate thematic findings through case studies, pilot projects, and impact assessments of blockchain-based blue sukuk in diverse contexts. Further exploration on interoperability standards, digital literacy capacity-building, and cross-border regulatory alignment will be essential to overcome scalability constraints. Ultimately, advancing quantitative models alongside qualitative insights will provide a comprehensive evidence base to support global adoption of Sharia-compliant sustainable blue finance solutions.

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