

Green Waqf for Green Downstreaming: Developing a Productive Waqf Financing Model for Bioethanol Development and National Economic Resilience

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Abstract

Indonesia's energy vulnerability as a net importer of fuel oil risks weakening its national economic resilience. Transitioning towards energy independence through the green downstreaming of agricultural commodities into bioethanol is highly strategic but hampered by massive capital expenditure that burdens the State Budget (APBN). This research aims to formulate an innovative Green Waqf financing model as an independent alternative funding solution for bioethanol infrastructure development. The research utilizes a descriptive qualitative approach through library research and content analysis, designing an integration model using Hexahelix collaboration. The analysis outlines the financing framework, stakeholder roles, and feasibility evaluations based on SWOT, SMART, and Social Return on Investment (SROI). The results show that a Green Waqf portfolio, consisting of perpetual and temporary waqf, is capable of financing green downstreaming projects without burdening the national budget. The SROI evaluation demonstrates high feasibility, projecting a ratio of 1.64 in the first five years. This waqf-based bioethanol downstreaming model offers a novel approach to reducing gasoline import dependency, creating jobs, and strengthening national economic resilience sustainably.

Keywords: Bioethanol, Economic Resilience, Green Waqf

Abstrak

Kerentanan energi Indonesia sebagai negara net importer bahan bakar minyak (BBM) berisiko melemahkan ketahanan ekonomi nasional. Transisi menuju kemandirian energi melalui hilirisasi hijau (green downstreaming) komoditas agro menjadi bioetanol sangat strategis, namun terkendala tingginya kebutuhan pembiayaan yang membebani Anggaran Pendapatan dan Belanja Negara (APBN). Penelitian ini bertujuan merumuskan inovasi model pembiayaan Green Waqf (wakaf hijau produktif) sebagai alternatif pendanaan mandiri bagi pengembangan infrastruktur bioetanol. Metode yang digunakan adalah kualitatif deskriptif melalui library research

dan content analysis dengan merancang integrasi model berbasis kolaborasi Hexahelix. Analisis mencakup kerangka pembiayaan, peran pemangku kepentingan, serta evaluasi kelayakan menggunakan kerangka SWOT, SMART, dan Social Return on Investment (SROI). Hasil penelitian menunjukkan bahwa portofolio Green Waqf yang terdiri atas wakaf abadi dan temporer mampu membiayai proyek hilirisasi bioetanol tanpa menambah beban APBN. Evaluasi SROI menunjukkan proyek ini sangat layak dengan proyeksi rasio sebesar 1,64 dalam lima tahun pertama. Hilirisasi bioetanol berbasis wakaf menawarkan pendekatan baru yang berpotensi mengurangi ketergantungan impor, menjaga devisa, menciptakan lapangan kerja, dan memperkuat ketahanan ekonomi nasional berkelanjutan.

Kata Kunci: Bioetanol, Ketahanan Ekonomi, Wakaf Hijau

A. Introduction

In recent decades, global geopolitical dynamics and supply chain disruptions have driven severe imbalances in the global energy sector, significantly impacting developing countries with high energy consumption. For Indonesia, this global volatility highlights a critical national energy vulnerability given its entrenched position as a net importer of fuel oil. Domestic oil production has steadily declined to approximately 2.3 billion barrels of remaining reserves, a figure that contrasts sharply with the surging energy demands of a growing population of 283 million (U.S. Energy Information Administration, 2025).

The heaviest burden in Indonesia's trade deficit stems from an absolute dependence on imported gasoline. This structural reliance places the national economy at continuous risk of imported inflation and systemic macroeconomic instability. When global crude oil prices experience sudden spikes due to external geopolitical conflicts, the domestic fiscal burden for energy subsidies swells uncontrollably, eroding public purchasing power and threatening the country's economic resilience. Therefore, a strategic transition toward energy self-sufficiency is no longer an option, but a macroeconomic necessity.

To mitigate this vulnerability, the development of agro-based renewable energy presents a highly viable solution. Specifically, green downstreaming (*green hilirization*) that converts agricultural commodities into bioethanol serves as a strategic alternative to substitute fossil fuels. Indonesia possesses a profound comparative advantage in this sector due to its abundant biomass resources, such as sugarcane and cassava. The agricultural sector remains a fundamental pillar of national development, evidenced by its significant 14.35% contribution to the Gross Domestic

Product (GDP) in Q3 2025 (Ministry of Agriculture, 2025). Integrating raw agricultural materials into higher-value energy products through green downstreaming can simultaneously secure energy supply and stimulate the rural economy.

Bioethanol offers an eco-friendly combustion cycle that supports decarbonization and a circular economy, making it a pivotal component of the national energy transition. In practice, blending bioethanol with gasoline—through phased schemes like E20 (20% bioethanol) and E30 (30% bioethanol)—allows for a smooth infrastructural and mechanical adaptation. However, despite its tremendous potential, the realization of bioethanol downstreaming faces complex risks and structural barriers, primarily centralized around massive financing requirements.

Building commercial-scale green infrastructure and biorefineries requires highly capital-intensive investments (Capital Expenditure/CapEx). As highlighted during the Indonesia Sustainable Energy Week 2024, the scarcity of accessible financing remains the primary bottleneck in renewable energy development (Syarif, 2024). Relying predominantly on the State Revenue and Expenditure Budget (APBN) to fund this green transition is unfeasible and risks inflating the national fiscal burden. Furthermore, utilizing foreign debt to finance green infrastructure contradicts the ultimate goal of achieving independent economic resilience. Therefore, a novel, independent, and sustainable financing instrument is urgently required to break this investment deadlock.

As a solution to these financial constraints, Islamic social finance specifically the Green Waqf instrument emerges as a highly potent alternative. Green waqf integrates productive endowment management with environmental preservation and sustainability goals, aligning seamlessly with the principles of *maqashid sharia* (protection of religion, life, intellect, lineage, and property). Because waqf assets are perpetual in nature, they provide a stable, long-term, and zero-interest funding source that operates entirely independent of the APBN or state debt (Isnaeni & Pratomo, 2024). Transforming this traditional philanthropic concept into a modern ESG-compliant investment strategy holds the key to accelerating Indonesia's green downstreaming agenda.

Despite the theoretical promise of Islamic social finance, a systematic mapping of existing literature reveals a distinct research gap.

Previous studies have primarily approached these elements in isolation. Amanah et al. (2025) and Anam & Fauzi (2021) demonstrated the significant socio-economic benefits of Green Waqf for climate mitigation within the SDGs framework, yet their studies remained largely conceptual without targeting specific industrial CapEx. Conversely, Oetomo (2025) proved the technical and economic feasibility of a 100 KL/day bioethanol plant, but the study lacked a concrete alternative financing framework to overcome the initial investment barrier. Furthermore, Dinatha et al. (2024) highlighted the macro-regulatory urgency for energy self-sufficiency but did not integrate philanthropic funding solutions.

Currently, no comprehensive study has synergized productive waqf instruments specifically to solve the financing bottlenecks of bioethanol green downstreaming. This research aims to fill that exact gap by formulating an innovative Green Waqf financing model as an independent alternative funding solution for bioethanol infrastructure. By integrating Hexahelix collaboration and projecting the financial feasibility through Social Return on Investment (SROI), this study offers substantial novelty in utilizing Islamic philanthropic instruments to realize sustainable, debt-free national economic resilience.

B. Research Methods

This study employed a descriptive qualitative approach utilizing library research and documentary analysis to produce a valid conceptual model. The conceptual framework was built upon the PICOS (Problem, Intervention, Comparison, Outcome, and Study Design) model (Richardson et al., 1995) to ensure a systematic formulation of the financing intervention and expected outcomes. The data comprised secondary sources, including national and international scientific journals, energy balance reports (2023–2026), and waqf regulatory frameworks from the Indonesian Waqf Board (BWI).

Data processing was conducted using content analysis techniques through three stages: (1) data reduction by classifying structural barriers in bioethanol financing and productive waqf governance; (2) model conceptualization in the form of analytical narratives, stakeholder mapping, and cash flow frameworks; and (3) feasibility evaluations. To validate the proposed conceptual model, the study utilized four rigorous feasibility analysis instruments: SWOT-TOWS matrix for strategic positioning, SMART criteria for goal precision, and Social Return on

Investment (SROI) to quantify the projected socio-economic and environmental benefits against the initial investment.

C. Results and Discussion

1. The Potential of Bioethanol as a Green Downstreaming Process for the Economy

The potential of bioethanol as a green downstreaming industry offers an economic development model that not only serves as a decarbonization solution but also as a new engine of economic growth based on domestic strengths. Import substitution through bioethanol is crucial to prevent the widening gap between domestic gasoline supply and demand, which is projected to reach 28.2 million kiloliters per year by 2030 without biofuel supply (Ministry of Investment/BKPM, 2022). This reduction in imports will preserve the country's foreign exchange reserves with massive savings of up to USD 30.9 billion, alleviate pressure on the trade balance, and help stabilize Indonesia's exchange rate and balance of payments (Ministry of Investment/BKPM, 2022). The biofuel industry is estimated to contribute around 3.5% to Indonesia's total GDP growth (Djarmika et al., 2024), while this downstreaming directly boosts the added value of the agricultural sector, which already demonstrated a significant contribution of 14.35% to the national GDP in Q3 2025 (Ministry of Agriculture, 2025).

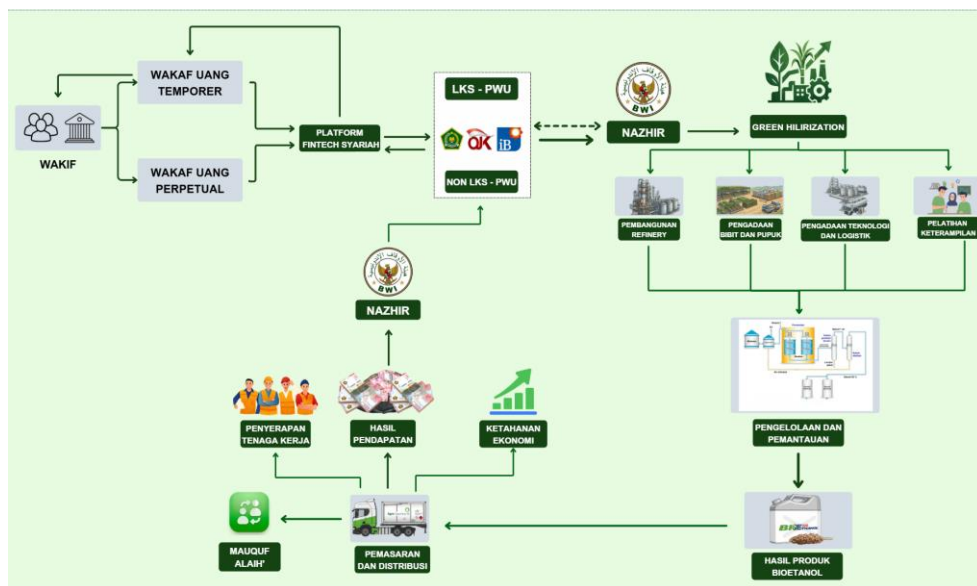
From a socio-economic perspective, the agriculture-based bioethanol industry creates a strong multiplier effect, particularly in boosting the rural economy. The construction of bioethanol processing facilities on cassava, corn, and sugarcane plantations will provide direct economic added value to local communities, with a projected employment of 7,849–7,894 workers (Ministry of Investment/BKPM, 2022). Net revenue from the bioethanol supply chain is projected to reach IDR 340 billion in 10 years (Wirawan et al., 2025). Guaranteed market absorption from mandatory government programs such as E10 will drive up raw material commodity prices at the farm level, significantly increasing the income of farmers and micro-businesses, ultimately strengthening the regional economy through the renewable energy ecosystem (Hasanah et al., 2025).

2. Green Waqf Financing Model for Bioethanol

An innovative *sharia*-based financing model is urgently needed to address the funding challenges of the strategic bioethanol sector. This

study modifies the Green Waqf Framework by Ningsih et al. (2022) and the Indonesian Waqf Agency (UNDP et al., 2022), then integrates it with the Green Downstreaming concept in the bioethanol industry. In this scheme, waqf funds are not merely positioned as passive philanthropic instruments, but are instead optimized productively as the main catalyst for green industry funding.

Figure 1.
The Proposed Green Waqf Financing Model for Bioethanol



The Green Waqf for Green Downstreaming scheme consists of nine stages of fund flow mechanisms: (1) Wakif (individuals or institutions) distributes perpetual or temporary cash waqf to LKS-PWU directly or through a *sharia* fintech platform; (2) funds are collected by LKS-PWU (*Sharia* Financial Institutions Receiving Cash Waqf) or registered non-LKS-PWU *sharia* financial institutions; (3) LKS-PWU hands over management to *Nazhir* under the supervision of BWI; (4) The *Nazhir* distributes funds for the construction of a micro-scale bioethanol refinery, procurement of seeds and fertilizers, logistics technology and fleet, and human resource training; (5) management and monitoring of the manufacturing distillation process are carried out routinely; (6) the operational process produces ready-to-use renewable bioethanol products; (7) the bioethanol enters the marketing and distribution stage to the energy and transportation sectors; (8)

operational success creates three macro impacts: national economic resilience, employment, and commercial income; and (9) net cash flow is returned to the *Nazhir* of 10% for operational governance, 30% as a sinking fund, and 60% distributed as a social dividend to *Mauquf Alaihi*.

The stakeholder collaboration in this model is designed using a hexahelix approach, which integrates six strategic actors: (1) Academics (LPPM Perguruan Tinggi, WaCIDS, FoSSEI, BRIN) play a role in conducting research on fermentation and distillation technology innovations and providing a *fiqh* framework for the productive waqf model; (2) The government (Ministry of Energy and Mineral Resources, BKPM, Ministry of Agriculture, Bappenas) is tasked with drafting mandatory regulations for biofuel blends (E10/E20) and providing fiscal incentives; (3) The media builds public awareness of the benefits of Green Waqf and maintains transparency in fund management; (4) Communities (Farmer Groups) supply raw materials, become operational workers, and also act as *Mauquf Alaihi*; (5) Industry, especially Pertamina, provides processing technology and acts as the main buyer (offtaker) of bioethanol; and (6) Waqf Institutions (BWI, LKS-PWU, *Nazhir*) collect funds from waqif and ensure that all operations are carried out in accordance with *sharia* principles.

3. Feasibility Analysis and Implementation Strategy

This study uses four feasibility analysis instruments, especially SWOT-TOWS, SMART, and SROI analysis.

a. SWOT-TOWS Analysis

A SWOT analysis identified the key strengths of this model: the existence of Green Waqf instruments (perpetual and temporary) that provide zero-cost capital (CapEx), the availability of abundant biomass in rural areas, BWI governance that guarantees the legality and professionalism of *Nazhir*, a labor-intensive operational model that cuts the chain of middlemen, and the integration of *Sharia* fintech crowdfunding for transparent and massive fundraising. Weaknesses that need to be addressed include limited literacy in productive waqf among the community, the high initial investment costs of micro-scale refineries, the lack of certified *Nazhir* with dual expertise (*fiqh* and agro-energy management), the vulnerability of the supply chain to climate change, and distillation technology R&D capabilities that have not yet reached maximum commercial efficiency.

Externally, the greatest opportunities include geopolitical urgency (the risk of a Strait of Hormuz blockade), which is pushing the government to seek gasoline import substitutes; full support for the 2060 Net Zero Emission target; increasing corporate commitment to ESG standards as a source of CSR funding; the presence of research institutions such as BRIN, and strong domestic gasoline demand as a captive market for bioethanol. Threats that must be anticipated include potential conflicts over land use for food crops versus bioenergy, volatility in global oil prices, which could reduce bioethanol's competitiveness; market distortions due to fossil fuel subsidies; the acceleration of electric vehicles, which could threaten bioethanol's long-term relevance; and the risk of a public confidence crisis if *Nazhir* mismanages.

Recommended TOWS strategies include: (1) S-O: campaigning for "Foreign Exchange Saving Waqf" through Islamic fintech to mobilize funds amidst the geopolitical energy crisis; (2) S-T: leveraging the advantages of interest-free waqf capital to maintain competitive bioethanol production costs when global crude oil prices plummet; (3) W-O: utilizing ESG-based corporate philanthropic funds to subsidize the initial investment costs of micro refineries; and (4) W-T: limiting the proportion of temporary waqf to a maximum of 40% of the total pool in the initial stage to mitigate the risk of default.

b. SMART Analysis

Table 1.
SMART Analysis

No	Aspects	Description
1	Specific	Developing a productive waqf integration model through a Green Waqf scheme as a strategic instrument to drive hilirization development in the bioethanol industry, thereby realizing a sustainable renewable energy system and strengthening national economic resilience.
2	Measurable	The targets are to increase the utilization of productive waqf by 30% and bioethanol production by 20%, as well as to raise the income of beneficiary communities by 15%–20% within a period of 1–2 years.
3	Achievable	The combination of government regulatory support for fuel substitution development, the availability of bioethanol processing infrastructure, collaboration

		within the agricultural commodity sector, and the involvement of <i>nazhir</i> (waqf managers) and technology providers makes this model a realistic one to implement.
4	Relevant	This model aligns with efforts to strengthen national economic resilience and meet the demand for alternative fuels, while also supporting the realization of a sustainable economy through the use of <i>Sharia</i> -based instruments.
5	Time Bound	The implementation of this model is designed to span 20 months. The initial phase (Months 1–8) focuses on participatory diagnosis, stakeholder consolidation, and technical planning. The second phase (Months 9–16) involves executing the infrastructure and community empowerment. The final phase (Months 17–20) focuses on impact evaluation and refining the model for scalability.

c. SROI Analysis

The feasibility evaluation of the Green Waqf financing model is measured using the Social Return on Investment (SROI) approach which projects the ratio of benefit value (value creation) covering economic, social, and environmental aspects compared to the total initial capital investment. This projection is based on the assumption of a 5-year project life, a total initial investment (CapEx) of IDR 8,000,000,000, and a 5% discount rate as a representation of the long-term BI-Rate. The overall benefit value is quantified through three pillars: (1) economic benefits, the projected net profit from bioethanol sales of IDR 1.5 billion/year, based on a production capacity of 600,000 liters/year with a margin of IDR 2,500/liter (COGS of IDR 8,000/liter, selling price of IDR 10,500/liter); (2) social benefits of creation of 25 jobs with the UMR standard (estimated IDR 900 million/year) and improvement in the welfare of 100 partner farmers (surplus of IDR 300 million/year), resulting in a valuation of IDR 1.2 billion/year; and (3) environmental and macroeconomic benefits, a proxy for foreign exchange savings due to imported gasoline substitution and carbon emission reductions, amounting to IDR 800 million/year. The maximum total benefit at 100% capacity reaches IDR 3.5 billion/year.

The benefit projections are arranged progressively based on a five-year operational assumption (2027–2031): IDR 2 billion in the

first year (57% utilization), IDR 2.8 billion in the second year (80% utilization), and a stable IDR 3.5 billion from the third to the fifth year (100% utilization). Based on the Net Present Value (NPV) calculation with a 5% discount rate (reflecting the long-term BI-Rate), the accumulated Total Present Value of Benefits over the 2027–2031 period reaches IDR 13,089,676,283, with the following breakdown:

Year 1 (2027) = IDR 1,904,761,904;

Year 2 (2028) = IDR 2,539,682,539;

Year 3 (2029) = IDR 3,023,431,595;

Year 4 (2030) = IDR 2,879,458,662;

Year 5 (2031) = IDR 2,742,341,583.

The SROI ratio is calculated as follows:

$SROI = \text{Total Presents of Benefits} / \text{Total Investment (CapEx)}$

$SROI = \text{Rp}13,089,676,283 / \text{Rp}8,000,000,000 = 1.636 \approx 1.64.$

Referring to the social investment feasibility parameters that set the break-even limit at 1, the ratio of 1.64 proves that this waqf-based bioethanol hilirization project is highly feasible, every Rp1 of Green Waqf funds invested generates a social, economic, and environmental return of Rp1.64.

d. Implementation Strategy of The Conceptual Model

The implementation of this conceptual framework requires a phased integration approach involving all hexahelix stakeholders. The stages are structured into four progressive phases spanning 20 months: (1) Stakeholder Consolidation & Policy Design (Months 1–4): establishing formal agreements between BWI, research institutions, and the government to formulate standard operating procedures for the green downstreaming waqf model, alongside securing government commitment for mandatory biofuel blending (E10/E20); (2) Fundraising & Fintech Integration (Months 5–8): mobilizing perpetual and temporary cash waqf through LKS-PWU and Sharia crowdfunding platforms, strategically targeting ESG-based corporate CSR funds; (3) Infrastructure Execution (Months 9–16): executing the CapEx disbursement by Nazhir for constructing micro-scale bioethanol refineries, procuring technology, and establishing operational frameworks with local communities; and (4) Evaluation & Impact Measurement (Months 17–20): evaluating the program's effectiveness through SROI and

financial indicators to refine risk mitigation and pave the way for model replication in other agro-industrial centers nationwide.

The impact assessment of this model is verified across three dimensions. First, the impact on SDGs: the model contributes to SDG 7 (clean and affordable energy) through access to bioethanol, SDG 8 (decent work and economic growth) through agro-industrial employment, and SDG 9 (industry, innovation, and infrastructure) through sustainable bioethanol facilities. Second, the impact on Maqashid Syariah: the model includes *Hifz Al-Mal* (maintaining waqf assets to be productive and generate stable income), *Hifdz Al-Biah* (reducing pollution and maintaining ecosystem balance), and *Hifdz Al-Nasl* (improving future generation welfare through eco-friendly energy and economic empowerment).

Third, comprehensive risk mitigation and institutional governance must be established to protect the waqf assets and ensure operational sustainability. To separate the philanthropic waqf funds from high-risk operational capital, the Nazhir cannot operate the refinery directly. Instead, the Nazhir must establish a Special Purpose Vehicle (SPV), an independent, professionally managed corporate entity to act as the business entity and professional operator of the refinery. The refinery assets remain under the ownership of the Nazhir on behalf of the waqf, while the operational capital is channeled to the SPV through a *Mudharabah* (profit-sharing) or *Ijarah* (leasing) contract.

To safeguard the perpetual waqf principal, funds are strictly converted into fixed, insured physical assets (the biorefinery) and a dedicated contingency reserve. For temporary waqf, the maturity and return mechanism of the principal is secured by accumulating a mandatory 30% *sharia sinking fund* deducted from the annual net profits of the SPV. In terms of loss governance, operational cost overruns caused by managerial negligence are the full liability of the SPV operator. However, systemic risks or *force majeure* losses are mitigated through the contingency reserve and contract farming agreements to lock raw material prices. The complete operational and risk ecosystem is detailed in the Governance Matrix (Table 2)

Table 2.
Green Waqf Governance Matrix for Bioethanol Downstreaming

Stakeholders	Sharia Contract	Assets/Funds Controlled	Decision Rights	Risk & Loss Governance	Supervision	Cash Flow Mechanism
Wakif	<i>Wakalah</i> (to Nazhir)	Relinquishes ownership of cash waqf	Chooses waqf type (Perpetual or Temporary)	Bears no financial loss risk after handover.	Receives periodic transparent reporting.	Inflow of Cash Waqf (Perpetual or Temporary).
Nazhir	<i>Wakalah</i> (from Wakif), <i>Mudharabah</i> (to SPV)	Waqf Principal, Fixed Assets (Refinery), Reserve Funds	Strategic investment, asset allocation, dividend distribution	Bears capital loss only in cases of systemic force majeure, mitigated by reserve funds.	Regulated by Indonesian Waqf Board (BWI) & DPS.	Receives Wakalah fee (max 10%); Distributes to Mauquf Alaih (60%).
Special Purpose Vehicle (Operator)	<i>Mudharabah</i> (from Nazhir), <i>Bai'</i> (to Offtaker)	Operational Capital, Finished Bioethanol Inventory	Daily operations, HR management, supply chain execution	Bears liability for cost overruns and losses resulting from managerial negligence.	Monitored by Nazhir & Independent Auditors.	Receives profit share; allocates 30% to sinking fund.
Mauquf Alaih' (Farmers/Community)	<i>Tabarru'</i> (Social Dividend)	Social empowerment funds, CSR	None (Passive Beneficiary)	Vulnerable to supply chain climate risks.	Evaluated through SROI social impact metrics.	Receives 60% of net profits allocated by Nazhir.
Pertamina (Offtaker)	<i>Bai' Al-Tawrid</i> (Continuous Supply Contract)	Purchased Bioethanol	Quality control and volume procurement	Bears market/regulatory risk if global oil prices fluctuate.	Ministry of Energy and Mineral Resources (ESDM).	Outflow for bioethanol purchase.

Overall, the proposed Green Waqf for Green Downstreaming model demonstrates an integrated framework that connects productive waqf financing, agricultural-based bioethanol development, community empowerment, and national economic resilience within a Sharia-compliant governance structure. The SWOT-TOWS, SMART, and SROI analyses indicate that the model has identifiable strategic opportunities, measurable implementation targets, and a projected positive social and economic value under the assumptions specified in this study. Nevertheless, these feasibility results should be interpreted as a conceptual and scenario-based assessment rather than as evidence of proven commercial viability, since the model has not yet been implemented and the financial and social returns depend on assumptions regarding production capacity, bioethanol prices, raw

material availability, policy support, and operational performance. Therefore, the proposed governance and implementation framework serves as a foundation for subsequent pilot projects, regulatory alignment, and empirical validation, particularly through real-world implementation and stakeholder-based evaluation. In this context, Green Waqf can be positioned not merely as a philanthropic financing instrument, but as a potential Islamic social finance mechanism for supporting sustainable downstreaming, strengthening rural economic value chains, and contributing to long-term national economic resilience.

D. Conclusion

The Green Waqf for Green Downstreaming model in bioethanol development offers a strategic solution to strengthen national economic resilience amidst global geopolitical dynamics. Through this model, productive waqf (Islamic endowment) instruments are optimized as a source of independent funding capable of overcoming the investment cost barriers associated with green hilirization projects, without burdening the state budget or increasing national debt. Analysis demonstrates that this waqf-based bioethanol downstreaming initiative is both financially and socially viable, with a projected Social Return on Investment (SROI) ratio of 1.64, meaning that every IDR 1 invested generates IDR 1.64 in social, economic, and environmental value. Implementing this hexahelix model not only succeeds in substituting imported gasoline to conserve foreign exchange reserves but also actively fosters an inclusive economy by creating rural employment, enhancing value-added in the agricultural sector, and utilizing eco-friendly renewable energy. Thus, integrating renewable energy systems with Islamic social finance serves as a fundamental pillar in achieving energy sovereignty and economic self-reliance for Indonesia, making the nation resilient against external shocks.

To scale up this model, government policy commitment is required in the form of mandatory energy mix regulations and fiscal incentives for green downstreaming initiatives funded by religious social funds. The Indonesian Waqf Board (BWI) and *Nazhir* (waqf managers) are encouraged to intensify educational campaigns on productive waqf to mobilize public awareness, particularly among the youth regarding environmental conservation. Academics and future researchers are advised to design

regional-scale pilot projects to empirically validate the model in the field and to conduct further research into the development of green downstreaming based on Islamic social finance.

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