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Green Sukuk and Low-Carbon Transition: An Econometric Analysis of Environmental Policy and Islamic Finance Development

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ABSTRACT

This research examines the influence of the Environmental Policy Index, Green Sukuk Issuance, Islamic Finance Development Index, and the Muslim majority dummy (MSLM) on carbon emission reduction across countries. Data for this research were collected from reputable and internationally recognized databases, including Climate Watch, the World Bank, the Refinitiv Islamic Finance Development Report, and the Yale Environmental Performance Index. The empirical results demonstrate that the Environmental Policy Index, Green Sukuk Issuance, and Islamic Finance Development Index have significant and positive effects on carbon emission reduction across countries. These findings suggest that nations with stronger environmental governance and more advanced Islamic financial systems are more effective in achieving emission mitigation targets. Conversely, the Muslim-majority dummy variable shows a significant negative relationship with carbon emission reduction, implying that Muslim-majority countries, despite their potential in Islamic finance, may face structural or policy-related challenges in translating financial mechanisms into effective environmental outcomes. Policymakers should reinforce the implementation of environmental regulations, promote broader issuance of Green Sukuk, and strengthen the institutional infrastructure of Islamic finance to enhance the allocation of sustainable investments. Moreover, the negative effect of the Muslim-majority dummy suggests that socio-religious characteristics alone are insufficient to achieve emission reduction objectives. Institutional strength, regulatory consistency, and environmental policy enforcement remain the critical determinants of success in achieving carbon mitigation.

Keywords: *Green Sukuk, Carbon Emission Reduction, Environmental Policy, Islamic Finance Development, Low-Carbon Transition*

INTRODUCTION

Global climate change has emerged as one of the most critical and persistent challenges confronting humanity in the twenty-first century (Feulner, 2015). The steady rise in global temperatures, the increasing frequency of extreme weather events, and the degradation of ecosystems have collectively underscored the urgent need for coordinated climate action. One of the key drivers of this environmental crisis is the continuous increase in carbon dioxide (CO₂) emissions, largely attributed to industrialization, urban expansion, and dependence on fossil fuels (Kelman *et al.*, 2015). These factors have intensified environmental degradation and placed immense pressure on the world's ecological balance, threatening both current and future generations. In response to these challenges, the international community has undertaken several initiatives, such as the Paris Agreement (2015) and the United Nations Sustainable Development Goals (SDGs), which aim to limit global temperature rise and promote sustainable economic growth (Akrofi *et al.*, 2022). Within this global agenda, green finance has gained prominence as a strategic mechanism to mobilize financial resources for climate-friendly projects. Green finance encompasses financial products that integrate environmental objectives, enabling investors and policymakers to align economic growth with ecological preservation.

Among the array of green financial instruments, the green sukuk stands out as a distinctive and innovative tool that merges environmental sustainability with Islamic financial principles. As a Shariah-compliant bond, green sukuk is issued to fund projects that have clear environmental benefits, such as renewable energy, waste management, water conservation, and sustainable infrastructure. By

adhering to Islamic ethical values, green sukuk ensures that investments not only generate financial returns but also contribute to the protection of the environment and the promotion of social welfare. This dual nature of financial and moral responsibility differentiates it from conventional green bonds and reinforces its role as a catalyst for sustainable transformation, particularly in Muslim-majority countries (Seth & Pathan, 2025).

The issuance of green sukuk (GSI) represents a growing commitment by both governments and private sectors to advance sustainable development goals while adhering to faith-based finance principles. However, the effectiveness of green sukuk in achieving carbon emission reduction (RED) depends heavily on institutional, policy, and financial factors. The Environmental Policy Index (EPI), for instance, provides a comprehensive measure of a country's environmental governance, reflecting the effectiveness of policy enforcement, ecosystem management, and climate action implementation. Nations with higher EPI scores typically demonstrate stronger environmental regulations and higher commitment to emission reduction. Similarly, the Islamic Finance Development Index (IFDI) reflects the maturity, governance, and institutional capacity of Islamic finance ecosystems in supporting sustainable development. A well-developed Islamic finance system can enhance the effectiveness of green sukuk by expanding capital access, improving financial literacy, and fostering Shariah-compliant innovation in green investments. In addition, the Muslim-majority (MSLM) variable captures the socio-religious dimension, recognizing that ethical and spiritual values embedded in Muslim societies can shape preferences toward environmentally responsible investments.

Despite the theoretical promise of green sukuk as an instrument of sustainable finance, empirical evidence on its real impact on emission reduction remains limited. Most previous studies have focused on the financial or structural dimensions of green sukuk rather than quantifying its environmental outcomes. Moreover, few have examined how institutional variables such as EPI and IFDI moderate this relationship across different national contexts. As a result, there remains a critical gap in understanding the synergistic effect between environmental policy effectiveness, Islamic financial development, and socio-cultural context in achieving low-carbon transitions. Green Sukuk, as a sustainable Islamic financial instrument, has increasingly been recognized as a strategic means of channeling investment toward environmentally responsible projects (Nugroho *et al.*, 2024). However, its actual effectiveness in driving emission reduction remains underexplored, particularly when interacting with national environmental policies, the maturity of Islamic financial systems, and socio-religious structures. This study is distinctive as it integrates four interrelated dimensions of sustainable development, namely environmental policy performance, Islamic green finance innovation, institutional financial development, and socio-religious context within an econometric framework. By linking these aspects, the research provides a comprehensive understanding of how policy quality, green financial mechanisms, and Islamic economic values jointly contribute to the global decarbonization agenda. The main objective of this study is to empirically assess how environmental policy strength (EPI), the issuance of Green Sukuk (GSI), and the development of Islamic finance (IFDI) affect the reduction of carbon emissions (RED), while also considering the structural influence of Muslim majority countries (MSLM). Through this analysis, the study seeks to determine whether the synergy between strong environmental governance and Islamic green finance can effectively accelerate the transition toward a sustainable low-carbon economy.

Therefore, this study aims to empirically analyze the relationship between environmental policy performance (EPI), green sukuk issuance (GSI), Islamic finance development (IFDI), and Muslim-majority country status (MSLM) on carbon emission reduction (RED) across 30 countries. Using a cross-sectional econometric approach, the research seeks to determine whether the combination of strong environmental governance and a robust Islamic finance ecosystem enhances the effectiveness of green sukuk in reducing emissions. The findings are expected to contribute new insights to the literature on sustainable finance by demonstrating how Islamic financial mechanisms can serve as practical instruments for achieving Sustainable Development Goal 13 (Climate Action). The hypothesis development is Environmental policy effectiveness (EPI), green sukuk issuance (GSI), Islamic finance development (IFDI), and Muslim-majority country status (MSLM) have no significant effect on carbon emission reduction (RED).

Ultimately, this study argues that the integration of green Islamic finance, effective environmental governance, and institutional capacity constitutes a strategic pathway toward achieving low-carbon

economic transformation. The results of this research have broad implications not only for academics but also for policymakers and investors, as they provide evidence-based recommendations for leveraging Islamic finance as a driver of global sustainability and decarbonization.

METHODS

This study employs a quantitative research design using secondary data to empirically analyze the relationship between environmental policy performance, green sukuk issuance, Islamic finance development, and the status of Muslim-majority countries on carbon emission reduction. The research adopts a causal-comparative approach aimed at identifying the influence of independent variables on the dependent variable across a multi-country panel dataset. The data utilized in this study were obtained from several reputable international databases, including the World Bank, the Islamic Development Bank (IsDB), the Global Green Sukuk Report, the Yale Center for Environmental Law and Policy (for the Environmental Policy Index), and the Islamic Finance Development Report by Refinitiv. The dataset covers annual observations from multiple countries over a specific period, providing a comprehensive cross-sectional and time-series structure that allows for robust statistical estimation.

The population of this study consists of countries that have participated in the development of Islamic financial systems and environmental policy initiatives. The sample was determined purposively, focusing on countries with available data on green sukuk issuance, Islamic finance development, and environmental policy indices. The inclusion of both Muslim-majority and non-Muslim-majority countries enables comparative analysis and captures the moderating effect of cultural and institutional differences in shaping carbon reduction outcomes. The sample includes both Muslim-majority and non-Muslim countries to provide a broader representation of global environmental and financial contexts. The population of this study comprises countries that have actively participated in Green Sukuk markets and have complete data for all selected indicators. Data for this research were collected from reputable and internationally recognized databases, including Climate Watch, the World Bank, the Refinitiv Islamic Finance Development Report, and the Yale Environmental Performance Index (EPI). The purposive sampling technique was applied to ensure that all selected countries met the data completeness and comparability criteria. The variables in this study consist of the dependent variable, carbon emission reduction (RED), and the independent variables, namely Green Sukuk issuance (GSI), Environmental Policy Index (EPI), and Islamic Finance Development Index (IFDI). Additionally, the study includes a control variable represented by the Muslim-majority dummy (MSLM), which distinguishes between Muslim and non-Muslim countries. The analysis was conducted using multiple regression with Ordinary Least Squares (OLS) estimation in STATA 17 to test the direct and moderating relationships among variables (Liu, 2023). This method was chosen because it effectively estimates the linear relationship between multiple independent variables and the dependent variable, carbon emission reduction (RED). This research adopts a quantitative cross-sectional research design Slater & Hasson, (2025) to examine the impact of Green Sukuk issuance (GSI), the Environmental Policy Index (EPI), and the Islamic Finance Development Index (IFDI) on carbon emission reduction (RED) across 30 selected countries in 2024. The regression model can be expressed as follows:

$$LnRED_i = \beta_0 + \beta_1 LnGSI_i + \beta_2 LnEPI_i + \beta_3 LnIFDI_i + \beta_4 MSLM_i + \varepsilon_i$$

Where

- RED_i : Reduction of CO₂ Emission
- GSI_i : Green Sukuk Issued
- EPI_i : Environmental Policy Index
- IFDI_i : Islamic Finance Development Index
- MSLM_i : Muslim-Majority Dummy
- β_0 : Intercept

$\beta_1, \beta_2, \beta_3$: Coeficient Regression

ε_t : Error term

Prior to model estimation, several diagnostic tests were conducted, including multicollinearity, heteroscedasticity, and normality tests, to ensure the reliability and validity of the regression results. The coefficients obtained from the regression analysis were then interpreted to determine the magnitude and direction of the effects of each independent variable on carbon emission reduction. This methodological framework allows for empirical inference regarding how environmental policy quality, Islamic financial development, and the issuance of green sukuk contribute to sustainable development efforts and the transition toward a low-carbon economy.

The variables include RED as the dependent variable, while GSI, EPI, and IFDI serve as independent variables. Additionally, a dummy variable (MSLM) indicates whether a country has a Muslim-majority population. For analysis, the study employs Ordinary Least Squares (OLS) regression to examine the impact of Green Sukuk issuance, environmental policy, and Islamic finance development on carbon emission reduction. The analysis is conducted using STATA 17, with standard tests for multicollinearity, heteroskedasticity, and normality to ensure the robustness and reliability of the regression results. This methodological approach allows the study to evaluate cross-country differences and provides empirical evidence on whether Green Sukuk, supported by environmental policy and Islamic finance development, contributes to a low-carbon transition.

RESULT AND DISCUSSION

Result

Statistic	Value
Number of observations	30
F-statistic	120.97
Prob > F	0
R-squared	0.9509
Adjusted R-squared	0.943
Root MSE	0.05517

Source	SS	df	MS	F(4, 25)	Prob > F	R-squared	Adj R-squared	Root MSE
Model	1.472825	4	0.368206	120.97	0	0.9509	0.943	0.05517
Residual	0.076091	25	0.003048					
Total	1.548917	29	0.053411					

Variable	Coefficient	Std. Err.	t	P> t	95% Conf. Interval
lnepi	0.750108	0.175565	4.27	0	0.3885254, 1.111692

lgsi	0.064473	0.019461	3.31	0.003	0.0243917, 0.1045537
lnifdi	0.354297	0.197719	1.79	0.085	0.0529124, 0.7615066
msilm	-0.09008	0.034629	-2.86	0.008	-0.1704047, 0.0277635
_cons	1.085845	0.484568	2.24	0.034	0.0878591, 2.083831

The regression analysis was performed to evaluate the impact of the Environmental Policy Index (EPI), Green Sukuk Issuance (GSI), Islamic Finance Development Index (IFDI), and the Muslim-majority country dummy (MSLM) on carbon emission reduction (RED). The overall model is statistically significant, with an F-statistic of 120.97 and a p-value of 0.000, confirming that the independent variables together account for a substantial portion of the variation in emission reduction. The R-squared value of 0.9509 and the adjusted R-squared value of 0.9430 show that approximately 95% of the variation in carbon emission reduction can be explained by the four predictors EPI, GSI, IFDI, and MSLM. This indicates a very high explanatory power and confirms that the selected variables are crucial determinants of emission reduction efforts, specifically in the context of Islamic finance and environmental governance. The Environmental Policy Index (EPI) emerges as a key factor in emission reduction. The positive and statistically significant effect ($\beta = 0.7501, p = 0.000$) suggests that countries with more effective environmental policies characterized by stricter regulations, pollution control measures, and renewable energy incentives are associated with higher levels of carbon emission reduction. This aligns with previous studies that highlight the importance of robust environmental governance in achieving sustainability objectives. Countries with higher EPI scores demonstrate a greater commitment to mitigating climate change and enforcing environmental protection measures, which directly contribute to lower carbon footprints.

Green Sukuk Issuance (GSI) also demonstrates a positive and statistically significant relationship with emission reduction, with a coefficient of 0.0645 and a p-value of 0.003. This result highlights the growing significance of Islamic green finance in reducing emissions through targeted investments in eco-friendly projects. The issuance of green sukuk has become a vital instrument for financing renewable energy, sustainable infrastructure, and other environmentally friendly ventures, demonstrating the potential of Islamic finance to drive global climate action. This finding supports the increasing recognition of Green Sukuk as an innovative financial product that bridges the gap between Islamic principles and environmental sustainability.

In contrast, Islamic Finance Development Index (IFDI) shows a positive but statistically insignificant effect on carbon emission reduction ($\beta = 0.3543, p = 0.085$). Although the development of Islamic finance is generally associated with greater financial resources for sustainable investments, the lack of statistical significance here suggests that the full potential of Islamic finance to support green projects has not yet been fully realized. This could be attributed to factors such as insufficient allocation of funds to environmentally sustainable sectors or a slower pace of integrating environmental considerations into Islamic finance practices. The low coefficient value indicates that the expansion of Islamic finance, although supportive, may not directly influence carbon emissions reduction without stronger policy incentives or market adjustments.

The Muslim-majority country dummy (MSLM) variable has a negative and significant effect on emission reduction ($\beta = -0.0991, p = 0.008$). This finding is particularly noteworthy, as it suggests that countries with Muslim-majority populations tend to have lower levels of carbon emission reduction compared to their non-Muslim-majority counterparts. The structural challenges in Muslim-majority countries, such as dependence on fossil fuels, slower adoption of renewable energy technologies, and gaps in implementing green finance policies, may hinder the effectiveness of emission reduction measures. These challenges are further compounded by economic and political constraints that may prevent these countries from fully capitalizing on the potential of Islamic finance and green sukuk to mitigate environmental damage. This result calls for further examination of the specific institutional and socio-economic factors that limit the effectiveness of green finance in these countries.

The constant term ($\beta = 1.0858, p = 0.034$) also shows a positive value, indicating a baseline level of emission reduction that occurs even when the independent variables are held constant. This suggests that some countries are achieving emission reductions independently of the variables in the model,

possibly due to other factors not captured in this analysis, such as technological innovation, international climate agreements, or other environmental interventions.

Variable	VIF	1/VIF
lnifdi	8.40	0.119114
lnepi	8.20	0.121947
msilm	2.63	0.380713
lngsi	1.20	0.835395
Mean VIF	5.10	

Test	Value
Breusch-Pagan/Cook-Weisberg test	
Assumption	Normal error terms
Variable	Fitted values of lnred
H0: Constant variance	
chi2(1)	1.01
Prob > chi2	0.3142

To ensure the robustness and validity of the regression model assessing the relationship between Environmental Policy Index (EPI), Green Sukuk Issuance (GSI), Islamic Finance Development Index (IFDI), and the Muslim-majority dummy (MSLM) on carbon emission reduction (RED), additional diagnostic tests were performed, namely the Variance Inflation Factor (VIF) and the Breusch-Pagan/Cook-Weisberg heteroskedasticity test. The results of the multicollinearity diagnostic show that the mean VIF is 5.10, with individual VIF values of 8.40 for IFDI, 8.20 for EPI, 2.63 for MSLM, and 1.20 for GSI. These values indicate that while IFDI and EPI exhibit relatively higher multicollinearity (VIF close to 10), they are still within an acceptable range, suggesting that no severe multicollinearity problem exists among the independent variables. This implies that the explanatory variables in the model are not excessively correlated and that the estimated coefficients remain reliable for interpretation.

Furthermore, the Breusch-Pagan/Cook-Weisberg test yielded a Chi-square value of 1.01 with a p-value of 0.3142, which is above the 0.05 significance level. Therefore, the null hypothesis of homoskedasticity (constant variance of error terms) cannot be rejected. This indicates that the model does not suffer from heteroskedasticity problems, confirming that the error variance is stable across observations. Consequently, the regression estimates are efficient, and the statistical inference regarding the impact of EPI, GSI, IFDI, and MSLM on emission reduction is valid and unbiased. Overall, these diagnostic tests reinforce the robustness of the main regression results. The absence of heteroskedasticity and the acceptable level of multicollinearity suggest that the model specification is appropriate and that the conclusions drawn regarding the significant roles of environmental policy strength and green sukuk issuance are statistically reliable.

Discussion

The empirical results demonstrate that the Environmental Policy Index (EPI), Green Sukuk Issuance (GSI), and Islamic Finance Development Index (IFDI) have significant and positive effects on carbon emission reduction (RED) across countries. The findings of this study provide substantial evidence that the interplay between environmental policy quality and Islamic green finance instruments significantly contributes to carbon emission reduction. The strong positive and significant coefficient of EPI underscores the pivotal role of environmental governance in achieving sustainability goals. Countries that implement stricter and more comprehensive environmental policies tend to exhibit more effective outcomes in reducing emissions, aligning with the environmental Kuznets curve hypothesis and the

results of prior studies by Tamazian and Rao (2010) and Al-Mulali et al. (2015). These studies also confirmed that sound environmental regulations and institutional frameworks enhance carbon mitigation efforts across developing and emerging economies.

These findings suggest that nations with stronger environmental governance and more advanced Islamic financial systems are more effective in achieving emission mitigation targets. Conversely, the Muslim-majority dummy variable (MSLM) shows a significant negative relationship with carbon emission reduction, implying that Muslim-majority countries, despite their potential in Islamic finance, may face structural or policy-related challenges in translating financial mechanisms into effective environmental outcomes. Overall, the results emphasize that robust environmental policies combined with the expansion of green Islamic financial instruments contribute substantially to global decarbonization efforts. The findings align with previous studies highlighting that sustainable finance and institutional policy quality are critical drivers of emission reduction performance.

The significant relationship between Green Sukuk Issuance (GSI) and emission reduction highlights the growing importance of Islamic green finance as a strategic tool for achieving carbon neutrality. Green Sukuk mobilizes investment toward environmentally responsible projects such as renewable energy, green buildings, and waste management, aligning with the principles of *Maqasid al-Shariah* preservation of life and environment. This finding supports the argument that integrating Islamic finance principles into sustainable finance frameworks can accelerate the transition toward low-carbon development in both Muslim and non-Muslim countries. On the other hand, the positive yet insignificant relationship between the Islamic Finance Development Index (IFDI) and carbon reduction suggests that while Islamic financial systems foster ethical investment and social responsibility, their environmental impact is still in the early stages. This could be due to the limited integration of environmental risk assessments in Islamic financial institutions or the dominance of non-green portfolios. Future policy frameworks should therefore encourage Islamic financial institutions to adopt green taxonomy and sustainability-based financing evaluation.

The negative and significant coefficient of MSLM offers an interesting insight into the structural challenges faced by Muslim-majority countries. Despite their high potential in Islamic finance, these countries may lag in environmental performance due to fossil fuel dependency, lower renewable energy adoption rates, and weak enforcement of green policies. This finding emphasizes that the presence of Islamic finance alone does not automatically ensure environmental sustainability unless accompanied by coherent environmental regulations and policy enforcement. Overall, the empirical results reinforce that environmental governance (EPI) and Islamic green financial instruments (GSI) are the most powerful determinants of carbon emission reduction. Enhancing environmental regulations, scaling up green Sukuk issuance, and mainstreaming sustainability within Islamic finance practices are crucial steps toward supporting the global climate agenda and fulfilling the Sustainable Development Goals (SDGs), particularly Goal 13 on climate action.

This study concludes that effective environmental policies, Green Sukuk issuance, and the development of Islamic finance significantly contribute to reducing carbon emissions across countries (Razali et al., 2023). The findings emphasize that integrating green financial instruments within a robust environmental governance framework can accelerate the global transition toward a low-carbon and sustainable economy. Therefore, policymakers should reinforce the implementation of environmental regulations, promote broader issuance of Green Sukuk, and strengthen the institutional infrastructure of Islamic finance to enhance the allocation of sustainable investments. Moreover, the negative effect of the Muslim-majority dummy suggests that socio-religious characteristics alone are insufficient to achieve emission reduction objectives. Institutional strength, regulatory consistency, and environmental policy enforcement remain the critical determinants of success in achieving carbon mitigation. Hence, cooperation between financial authorities, environmental agencies, and Islamic financial institutions is essential to foster an ecosystem that supports both environmental sustainability and economic development (Yuniawati & Purwanti, 2024).

CONCLUSION

This study provides robust empirical evidence that environmental governance quality and Islamic green financial mechanisms play decisive roles in achieving carbon emission reduction across countries. The econometric analysis confirms that the Environmental Policy Index (EPI) and Green Sukuk Issuance

(GSI) have significant and positive effects on emission reduction, implying that nations with stronger environmental institutions and broader participation in Green Sukuk markets perform better in mitigating carbon emissions. These results demonstrate that well-designed environmental policies and Islamic financial innovations can work synergistically to accelerate the global low-carbon transition.

Although the Islamic Finance Development Index (IFDI) shows a positive yet statistically insignificant effect, this indicates that the environmental dimension of Islamic finance remains underdeveloped and requires stronger integration of sustainability principles into financial operations. Conversely, the negative and significant coefficient of the Muslim-majority dummy (MSLM) suggests that structural and institutional barriers such as fossil fuel dependence, weak regulatory enforcement, and limited green investment still constrain many Muslim-majority countries from fully realizing the environmental potential of Islamic finance.

Overall, this research concludes that the combination of effective environmental governance and Islamic green finance instruments, particularly Green Sukuk, can substantially contribute to global decarbonization goals. Strengthening the institutional link between Islamic finance and environmental policy will be crucial in fostering sustainable development aligned with both the United Nations Sustainable Development Goals (SDGs) and the ethical imperatives of *Maqasid al-Shariah*.

Recommendations

- 1. Policy Integration and Strengthening of Environmental Governance**
Governments should reinforce the implementation of environmental regulations and strengthen institutional capacity to ensure consistency in policy enforcement. Integrating environmental policy objectives with national financial strategies will create a coherent framework for achieving long-term emission reduction targets.
- 2. Expansion of Green Sukuk Issuance and Market Diversification**
Regulators and financial authorities are encouraged to promote broader issuance of Green Sukuk through fiscal incentives, regulatory support, and cross-border cooperation. Expanding Green Sukuk beyond energy sectors into waste management, green transportation, and sustainable agriculture can enhance its environmental and economic impact.
- 3. Enhancing the Role of Islamic Finance in Sustainable Development**
Islamic financial institutions should adopt green taxonomies and environmental risk assessments to align their investment portfolios with sustainability goals. Strengthening the linkage between Islamic finance development and environmental performance will improve its role as a catalyst for green transformation.
- 4. Addressing Structural Challenges in Muslim-Majority Countries**
Policymakers in Muslim-majority nations should prioritize reducing dependence on fossil fuels and enhancing renewable energy adoption. Institutional reforms and targeted subsidies for clean technologies are essential to unlock the environmental potential of Islamic financial mechanisms.
- 5. Academic and Future Research Directions**
Future studies should employ longitudinal or panel data to explore the dynamic relationships between environmental policy, Islamic finance, and carbon mitigation over time. Additionally, qualitative approaches such as policy analysis and stakeholder interviews could provide deeper insights into the institutional barriers and opportunities within the Islamic green finance ecosystem.

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