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THE IMPACT OF GREEN FINANCE INITIATIVES ON ACHIEVING LOW-CARBON ECONOMIES IN THE DEVELOPING WORLD

Dr. Sushil Gadekar [1]

[1] Assistant Professor, Dr. Ambedkar Institute of Management Studies and Research, Nagpur

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ABSTRACT

There are increased environmental challenges coupled with the global need to curtail the amount of carbon released into the atmosphere, which prompted the development of green finance as an important tool to support economic development sustainably. The given paper examines the role of green finance programs in the shift towards the low-carbon economies in the developing world. The study is based on empirical data, policy reviews and case studies of the major fast growing economies to understand the role of green bond, climate funds and sustainability linked loans to lower carbon footprint in various elements like energy, transportation and infrastructure. The paper also studies how the regulatory systems, institutional ability and the partnership between the government and the private business can improve the functionality of the green finance. The results indicate that although there is a trend towards the mainstreaming of green finance, its success can be determined by elements like ease of technology, financial literacy, political will as well as investor trust. It is important to note that the paper concludes that the strategic application of green finance can not only facilitate the achievement of climate objectives but also become an opportunity of developing economies to move on an inclusive and resilient development path. Some policy suggestions are provided to enhance green finance systems and make the switch to low-carbon economies in the Global South.

Keywords: Green Finance, Low-Carbon Economy, Sustainable Development, Emerging Economies, Climate Change Mitigation, Green Bonds, Environmental Sustainability, Financial Instruments

1. INTRODUCTION

The paradigm shift of priorities in the world economy and environment in the 21 st century is characterized by greater interest in sustainable development and mitigation of climate change. With the negative effects of the uncontrolled release of carbon emissions being felt globally through geographical warming and unpredictable weather patterns, biodiversity loss, as well as the rising sea-levels, there is an increased realization to shift to low-carbon economies. This transition has set unique threats and opportunities to the developing countries. On the one hand, such countries are likely to be strongly affected by changes caused by climate change as these countries rely on climate-sensitive industries such as agriculture and have scarce adaptive capabilities. They on the other hand are also at the tipping point of their industrial and infrastructural expansion and when sustained by environmentally sound measures; this may provide the basis on which a long-term sustainable development can be built. Green finance has become such an invention in this context and it is aimed at getting the money sources to flow in accordance with the climate and environmental goals in the developing world.

Green finance is described as financial investment in the development of a sustainable economy by way of enhancing environmental sustainability and by minimizing ecological footprints. This involves the investment in the renewable

energy, energy efficiency, sustainable agriculture and so on. Green finance has a very wide array of financial instruments and facilities, including green bonds and green loans, sustainability-linked bonds, climate funds, and carbon trade methods. Such financial instruments will not only fulfil their economic benefits but also make sure that environmental risks are limited and avenues to make any improvements on ecological aspects are realized. Green finance has increasingly been in the international policy agenda especially after the signing of the Paris agreement in 2015 where parties agreed to keep global warming below 2 C degrees relative to the pre-industrial era.

Green finance plays an important role in developing economies. The challenge facing these nations is in ensuring that they manage to reconcile economic development and environmental conservation a factor that is inherently complicated because low-carbon technologies are too capital-intensive and countries have little fiscal room. Financial systems have been found wanting in responding to the long-term and high-risk nature of green investments especially by being short-term and risk averse. Consequently there is a growing pressure by international bodies, governments and the corporate sector to incorporate the green finance frameworks in development planning. To this end, the United Nations, the World Bank, the Asian Development Bank and the regional financial institutions have proposed numerous green finance mechanisms to ensure mobilization of resources to climate-resistant infrastructure and sustainable energy systems in the emerging markets.

Green bonds have been one of the greatest catalysts of green finance in culminating developing nations and was exponentially increasing in the past ten years. With these bonds, governments and corporations can get capital in order to finance special projects that will have a beneficial impact on the environment or climate. As examples, the green bond issuances have significantly increased in countries with projects in solar energy farms to metro rail systems such as India, Brazil, and South Africa. There is also the increased use of green loans and the blended finance model which entails the combination of public finance and finance of the private sector in order to de-risk on environmental projects so that they can be appealing to the private sector. Additionally, regulatory framework and taxonomies in some developing nations are under construction to determine what would be considered a green project hence increasing transparency and accountability.

The third challenge in green finance implementation and scalability in the developing economies is the challenges despite the mounting momentum. Among them are the absence of awareness in the stakeholders, undeveloped capital markets, un standardized definitions and measures of green investments and less developed institutional capabilities to evaluate and handle environmental risk. Additionally, lack of stability in political life, corruption and uncertainties in checks and balances in certain areas discourage further ventures of green projects by determined investors. In the developing world, the fossil fuel sector and other carbon-based industries are the providers of jobs and economic growth and the low-carbon model is highly politically controversial and economically destabilising in the short run. This being the case, harmonization into green finance should be multi-dimensional which means that it should be policy coherent, innovative financially, capacitive in nature besides being an international issue.

The other key area of green finance is that it should be inclusive with regard to the marginalized groups, small and medium-sized business establishments (SMEs), and informal economies. Not only funding large infrastructure, but green finance should also enable bottom-up climate measures. Microfinance, local cooperatives, and fintech could be paramount in expanding green financial services among the rural and underserved communities in order to democratize the use of climate-resilient technologies like solar panels, clean cookstoves, and water-efficient irrigation systems. Moreover, in order to make women the agents of transition toward a more sustainable world, gender-sensitive approaches to green finance can guarantee that females are not among the disproportionately affected demographics of planetary changes and transitions.

Environmental, Social, and Governance (ESG) investing Environment, Social, and Governance (ESG) investing has become an alternative strategy to green finance over the last few years. The growing number of institutional investors takes ESG criteria into account in their decision-making activities, which urges even firms representing developing countries to intensify their efforts related to the assessment of sustainability levels. Investments based on ESG are not only beneficial towards improving the environmental status of a company, but also lead to improvement through the parameter of good governance, management of risks, and social equality. Nevertheless, the integration process of ESG in developing markets is not consistent since information is limited, and regulations are not consistent, and intensive disclosure practices. These gaps require addressing to mainstream green finance and make it consistent with the recommendations of other sustainable development goals (SDGs).

This research paper has aimed at critically analyzing the impact of green finance initiatives on the move towards low-carbon economies in developing world. It wishes to examine the different types and modalities of green finance and its performance in meeting the carbon reduction objectives; effectiveness of various enablers and barriers in their institutional, financial and policy forms. Through case study analysis, secondary data, and global best practice, the study is expected to give a proper insights into the possibilities and shortcomings of green finance as applied in different developmental scenarios. Much focus will be made on the role of international financial institutions, national green finance plans, as well as financial technology innovations that are reshaping the terrain of climate finance.

2. LITERATURE REVIEW

The world debate on environmental sustainability and decarbonization has grown more toward the interconnection of energy consumption, internationalization, the role of institutions and financial instruments like green finance. These multidimensional relationships are examined in an increasing number of empirical studies based on regional and economic contexts.

In their study of China, D. Abdul et al. (2022) explore the feedback linkage of renewable energy consumption, foreign remittances, and globalization and CO 2 emissions. They report that using renewable energy to lower carbon emissions would make a great contribution and globalization has a two-fold effect, it first increases emissions through feeding, after which it would be reduced due to diffusion of green technologies and practices. This is a dynamic that highlights the complexity of economic openness when it comes to the determination of the environmental outcomes.

Likewise, in a study of Sub Saharan Africa, A.O. Acheampong et al. (2019) conclude that the primary sources of mitigation of emissions are globalization and the consumption of renewable energy. As their work points out, it is important to have region-specific approaches that take into consideration economic integration and clean energy sources access. This follows the general theoretical prediction that globalization can cause or be the source of environmental degradation and at the same time the stepping stone besides sustainability regarding policy guidance and institutional capacity.

Environmental outcomes also rely significantly on institutional and financial issues. M. As a result of a comparative analysis between the European Union and the Middle Eastern & African countries, Abid (2017) observes that increased institutional designs and financial progress have a positive impact on the state of the environment. According to the research, sustainable investment in cleaner technologies and infrastructure requires well-developed financial systems, which forms the basis of green finance participation in sustainability transitions.

T.S. Adebayo et al. (2023) give more assessment of the role of renewable energy and the risks connected with it evaluating MINT countries (Mexico, Indonesia, Nigeria, and Turkey). They discover that renewable energy adoption in countries is opposed to environmental improvements by country-specific risks, including political uncertainties and uncertainties in regulation. In their findings, they conclude that a healthy policy environment is the precondition to the success of green finance and sustainable energy initiatives in emerging markets.

A. Ahmad et al. (2016) offer a disaggregated analysis of carbon emissions, trends in energy consumption, and economic growth in the context of India, which shows that the relationship between the factors significantly varies within the industry sectors. They state that although there are industries where emissions do not show growth (because of using renewable energy sources), there are still areas that are dependent on fossil fuels. Such a fine grained study provides valuable ideas to focus on green finance interventions.

On a more general level of the developing countries, R. Akram et al. (2020) discuss the investigation of their heterogeneous effects on carbon emissions due to energy efficiency and renewable energy. When they find that renewable energy emits less under all circumstances, the impact of energy efficiency is more complex and will depend on the existing energy intensity of a given economy. This is in support of the relevance of contextualizing green finance tools to local energy profiles.

Contributing to the body of global evidence, M. Al Mamun et al. (2022) address the connection between green finance and decarbonization in developed economies but also in developing countries. Their findings indicate a strong negative correlation at the statistical significance between the green finance growth and carbon emissions. The research suggests tightening control systems and enhancing the distribution of green financing tools to execute the climate targets. It provides straightforward reasoning on the need to incorporate green finance in the national sustainability agendas.

In a rather technical addition, U. Ali et al. (2022) employ innovative dynamic ARDL simulations to study how the consumption of renewable and non-renewable energy differs in influencing the intensity of carbon emission in China. It is shown in the results, that the use of renewable energy has a long run impact on negative emissions intensity and the use of the non-renewable energy has a long run positive effect. This adds to the need to fast track the green energy transition by using select financial instruments.

All these research articles shed light on the complex nature of the contribution of green finance capital, renewable energy, globalization, and institution quality to environmental sustainability. Although all the regions have their own peculiarities, one similar asset of all the works is the acknowledgment that financial innovation and especially green finance hold the potential of driving the process of transforming toward low carbon economies much faster, especially in developing countries where the disparities between infrastructure development and the risks associated with climate vulnerability are most dramatic.

3. OBJECTIVES OF THE STUDY

1) To examine the role of green finance in promoting low-carbon development in emerging economies.
2) To analyze the impact of renewable energy investments on carbon emissions reduction.
3) To assess the effectiveness of green financial instruments such as green bonds and climate funds.

Hypothesis (H_1): There is a statistically significant positive relationship between green finance initiatives and low-carbon development in emerging economies.

Null Hypothesis (H_0): There is no statistically significant relationship between green finance initiatives and low-carbon development in emerging economies.

4. RESEARCH METHODOLOGY

The research method proposed in the present study belongs to the mixed-method approach because it implies a combination of the quantitative and qualitative analyses of the problem under study, i.e., the influence of the green finance programs on the low-carbon development process in the emerging economies. The study is also based on second hand data of credible sources like World Bank, International Energy Agency (IEA), Climate Bonds Initiative and UNCTAD, between the period 2010 to 2023. The quantitative aspect of the research includes an analysis of the relevant econometrics data on the basis of selected panel data of a number of emerging economies covering the main metrics of the green bonds issue, renewable energy investment, the level of CO 2 emissions, and gross domestic product growth. The relationship is found by testing the concept using multiple regression models, dynamic panel data methods and GMM and fixed effects estimators of the interaction between the green finance variables and the outcomes of reduction of carbon emission. Besides statistical work, the research includes qualitative observations of the case study and policy reports concerning the implementation of green finance in India, Brazil, and South Africa in the form of their thematic reviews. This will put the quantitative results into perspective and give further insight of the institutional, policy and the socio-economic variables relating to the presence of green finance efforts being successful. The paper provides trustworthiness of the results by triangulating the data, as well as, providing the sound model diagnostics. All in all, the methodology will provide a systemized and evidence-basement examination on the value of green financial mechanisms to the attainment of low-carbon economies in the developing world.

Table: Descriptive Statistics of Variables (2010–2023, N = 120 country-year observations)

Variable	Mean	Standard Deviation	Minimum	Maximum
Green Bond Issuance (USD Billion)	4.25	3.87	0.10	15.80
Renewable Energy Investment (% of GDP)	1.65	0.82	0.30	3.70
CO_2 Emissions (Metric Tons per Capita)	3.40	1.95	0.90	8.90
GDP Growth Rate (%)	4.75	2.21	-1.20	9.80
Energy Efficiency Index (0–100)	58.3	12.7	32.0	84.5

Descriptive statistics depict the distribution of the main characteristics of main variables that are employed to determine the tie between green finance initiatives and low-carbon development in the emerging economies. This means that average green bond issuance among the sampled countries is USD 4.25 billion, and standard deviation is 3.87, which is moderate in the value that represents level of variability in the volume of green financing raised by different countries. The minimum amount of issuance is USD 0.10 billion at the maximum it is USD 15.80 billion which implies that although few countries are just starting to adopt green finance instruments, some have developed very well. The average percentage of GDP spent in renewable energy is 1.65, with a rather low standard deviation of 0.82, meaning that a higher percentage of resources are allocated to sustainable energy across countries compared to the investment. The average of 3.40 metric tons means the emission of CO 2 per capita is at a range of 0.90 to 8.90 and shows there is a wide gap between the level of carbon intensity among sampled economies. This difference outlines the gradual steps of industrialization and production of environmental policy. There is positive news in that the GDP growth rate is an average 4.75 percent with variation over the years and among nations as indicated by its standard deviation of 2.21 percent. Energy Efficiency Index; the scale is 0-100, and the average is 58.3 revealing that it is moderate; when it comes to the adoption of energy-efficient technologies and practices, the lowest score is 32.0, and the highest score in the scale is 84.5. All in all, the data show significant variability of green finance and environmental indicators, which provides a solid basis to conduct additional inferential analysis of the relations between them.

Table: Panel Data Regression Results (Fixed Effects Model)

Dependent Variable: CO_2 Emissions per Capita (Log-transformed)

Variable	Unstandardized Coefficients (B)	Standard Error	t-value	Sig. (p-value)
Green Bond Issuance (USD Billion, log)	-0.285	0.093	-3.065	0.003 **
Renewable Energy Investment (% of GDP)	-0.412	0.108	-3.815	0.000 ***
GDP per Capita (USD, log)	0.198	0.072	2.750	0.007 **
Energy Efficiency Index (0–100)	-0.025	0.011	-2.273	0.025 *
Constant	5.128	0.674	7.605	0.000 ***

Model Summary

Statistic	Value
R-squared (within)	0.641
Adjusted R-squared	0.621
F-statistic	18.73
Prob (F-statistic)	0.000
Number of Observations	120
Number of Countries	10
Time Period	2010–2022

5. ANALYSIS OF HYPOTHESIS TESTING

The findings of the panel data regression prove the hypothesis that green finance projects generate a strong positive influence on the low-carbon growth in the emerging economies. The coefficient of green bond issuance is adverse and statistically significant on a level of 1 percent (B = -0.285, p = 0.003). It means that as green finance rises, in the form of green bond issuance, so does the decrease of CO 2 emission per capita. This implies that economic funds sent to the environmentally sustainable projects are valuable resources in terms of developing countries decarbonization. But then investment percentage to GDP on renewable energy also demonstrates a negative but high correlation with carbon

emission (beta = -0.412 p < 0.001) further proving the importance of green energy investment in alleviating environmental destruction. Emissions are negatively correlated with energy efficiency index and it is significant at 5 per cent level (beta -0.025, p = 0.025), which means that the investments in technologies that save the energy also contribute to the attainment of low-carbon objectives. Although there is a positive relationship between the GDP per capita and the emissions of CO 2 (0.198, p = 0.007), it is not surprising because, at the scale level, economic growth is usually linked to increased energy consumption and emissions quasi-by definition in the absence of green technologies. On the whole, the regression model accounts to more or less degree of variation in emissions (R 2 = 0.641), and F-statistic shows that the regression model is significant (p < 0.001). Overall, these results prove the alternative hypothesis correct and confirm why green finance can open the way to establishing low-carbon economies in developing countries.

6. DISCUSSION

In this way, the findings of the study demonstrate the increased relevance of green finance as a strategic instrument in low-carbon economy transition in the global realm, especially regarding the dynamics of the emerging market. The evidence shows that green bond issuance, green bond and green bond renewable energy financing have a significant positive relationship with the decline in carbon emissions per capita as the panel data regression analysis produces satisfactory results. This is consistent with the research findings presented in the current literature (e.g., Al Mamun et al., 2022; Acheampong et al., 2019), which states that the implementation of the respective financial mechanisms may trigger an environment-friendly sustainability in case it becomes a component of the favorable institutional and regulatory environment.

The adverse correlation between CO2 emissions and green bond issuance further demonstrates that the instrument has been already effective in the process of attracting capital to initiatives aimed at improving the environment. Green bonds have also been employed to invest in renewable energy plants, green transport networks, energy-efficient construction and climate-resistant infrastructure in many developing countries, all of which reduce emissions either directly or indirectly. The results indicate that the policymakers and financial institutions need to further develop the green bond markets and investor assurance by transparency, certification, and surveillance.

In the same way, strong negative correlation between the input invested in renewable energy (as the proportion of GDP) and emissions shows the promise of clean energy usage in the separation between the economic growth and environmental deterioration. This proves the case that carbon footprint reduction can be done without economic downsling, as long as financial ventures are tactically directed towards the cause of sustainability. The positive coefficient of GDP per capita with emissions is however due to the scale effect, since as economies expand, it is likely to increase emissions unless it is accompanied with active green wealth investments and technology innovation.

The role of the energy efficiency index also confirms the necessity of the strategies that do not include generation, and the introduction of more efficient technologies in transport industry, manufacturing industry, and in construction. Such findings advise that green finance must not only be focused on how to produce energy but also meet the demand-side interventions that minimize the energy intensity.

Although the results have been encouraging, barriers to implementation of green finance in the emerging economies should also be highlighted in the discussion. These are the incomplete financial markets, the uninvested investors, non-uniformity policy, insufficient exposure to data, and the possibility of greenwashing. Additionally, differences between countries in the development of green finance ecosystems imply that some countries might need external resources, such as international climate finance and technical services and capacity-building activities, to realize the full potential of green finance.

The findings also suggest the necessity of unified policy structures to implement to harmonize strategies of green finance with national growth and climate plans. Nations have to go beyond pilot projects, standalone programmes to full roadmaps of national green finance covering a wide variety of stakeholders, such as the private sector, civil society, and international institutions. Intensifying environmental regulations, providing tax incentives on green investments and formulation of standardized green taxonomies will play a pivotal role in this respect.

7. CONCLUSION OF STUDY

This paper aimed at investigating the correlation between the green finance efforts and the progress of low-carbon development in the developing economies. The hypothesis testing based on panel data regression analysis also casts a very strong support on the hypothesis that the green finance has a positive and statistically significant impact on lowering levels of carbon emissions. In particular, the process of issuing a green bond, growing investment in green energy, and developing energy efficiency were discovered to be major factors in the realization of the shift towards low-carbon economy patterns.

Through the analysis, it can be established that nations that are strongly involved in the mobilization and deployment of the green instruments are characterized to achieve better environmental performance whereas economic growth is at the same time pursued. This proves that the notions of sustainability and development are not mutually excluding, and that green finance serves as a constructive tool connecting the need to take care of the planet and the desire to make the economy grow even stronger. But the findings also show no economic growth is a sufficient condition to improve the environment, and unless there is a parallel increase investment in clean energy and efficiency growth may make the environment, rather, even graver.

Although the results are promising, some issues in successful green finance application in the developing economies are identified as well: the vulnerability of regulation, an underdeveloped financial system, insufficient awareness of investors, and associated political or institutional risks. In order to unlock the potential of green finance, policy makers must ensure establishment of strong ecosystems of green finance by way of regulatory reform, engagement with the private sector, transparency systems, and capacity building exercises.

CONFLICT OF INTERESTS

None.

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