



Sustainable Finance, ESG Frameworks, Green Investments, and Climate Finance Mechanisms: Special Reference to India

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Abstract—

The existing global financing system is firmly undergoing transformation as a result of climate change impacts and the need for sustainable development. The concepts of sustainable finance, ESG frameworks, climate financing tools, and green investing take the central stage in this process, while India is viewed as an interesting example for study due to its distinctive rapid development and susceptibility to climate changes. The purpose of this research is to investigate the position of India in the framework of global sustainable finance mechanisms. The research method is based on the data acquired from GSIA, CPI, IFC, and RBI and includes the study of ESG implementation and adoption, green bond issuance, and climate financing flows in India. The research employs the trend analysis and comparative approach to investigate the process of transformation in India.

Keywords— Sustainable Finance, ESG Frameworks, Green Investments, Climate Finance Mechanisms, India, Green Bonds,

Nationally Determined Contributions (NDCs), Climate Policy

I. INTRODUCTION

Sustainable finance has become a key element in the worldwide effort concerning climate change and sustainable development. It refers to financial practices that include environmental, social, and governance (ESG) factors in investment decisions to ensure that funds flow in the direction of long-term sustainability goals. Due to the urgency of climate risks and obligations set in the Paris agreement and UN Sustainable Development Goals (SDGs), green investments and climate finance have witnessed an unprecedented spread and intensity of adoption.

Climate finance mechanisms include green bonds, carbon markets, blended finance, and institutional frameworks that help mobilize funds for climate-resilient projects. Emerging economies such as India do require sustainable finance not only as a policy matter but also as a development issue. Rapid economic development of India as well as its vulnerability to physical climate risks dictate the need for introducing ESG frameworks and climate finance into the development strategies of the country. This research aims to study how India opens opportunities for itself in the field of sustainable finance through analysis of ESG adoption and climate finance flows.



Global Context

The global financial system is going through a major structural change in the context of climate change and sustainability requirements. Traditional finance, which was previously focused on short-term returns, is being redefined as the necessity to tackle systemic risks that arise from environmental damage, resource shortages, and climate-related changes. As per the Global Sustainable Investment Alliance, sustainable investment assets reached 35.3 trillion dollars in 2020, accounting for nearly 36 percent of all professionally managed assets around the globe.

In this transformation, climate finance mechanisms have garnered a critical position. Tools like green bonds, sustainability-linked loans, and carbon markets are moving towards the funding of renewable energy, energy efficiency, and climate adaptation programs. According to the Climate Policy Initiative (CPI), climate finance flows worldwide amounted to USD 850 billion in 2021, but this figure is still small compared to the USD 4.5 trillion needed each year to attain international climate goals. International organizations, such as the International Finance Corporation (IFC) and the World Bank are vital forces in the adoption of sustainable finances and promotion of blended finance schemes.

It is a change of structure referring to finance and institutions, too. Institutions like regulatory authorities, central banks and security regulators try to incorporate climate risk into their disclosure standards and supervision models. For example, the TCFD'S Task Force on Climate-related Financial Disclosures and the EU's Sustainable Finance Taxonomy are meant to make ESG and sustainability investment standards more unified. Hence, the world's financial system is moving from being focused on shareholders to proving the importance of sustainability.

India's Relevance

India has a distinct role in sustainable finance on a global level. Although it is the fifth-largest economy and among the fastest-growing countries in the world, India is faced with the challenge of maintaining economic growth while simultaneously combatting the risks posed by climate change. The Reserve Bank of India (RBI) has reported that India is ranked among the countries most vulnerable to the impacts of climate change, which has caused a loss of around USD 87

billion between 1998 and 2017 due to climate catastrophes. There are numerous risks linked to climate change, including rising temperatures, floods and droughts, and extreme weather phenomena, which heavily affect agricultural and infrastructure sectors.

India's green finance sector is visibly growing. The issuance of green bonds grew from USD 1 billion in 2015 to USD 18 billion in 2023, meaning that India is one of the top emerging markets in creating green debt products. Climate Policy Initiative (CPI) states that India needs about USD 2.5 trillion for climate finance to fulfil its Nationally Determined Contributions (NDC) while taking into account the Paris Agreement goals. Renewable energy plays an essential role in achieving this objective as India aims to reach 500 GW of capacity through non-fossil sources by 2030. The International Finance Corporation (IFC) estimates that India's renewable energy sector alone offers a USD 200 billion investment opportunity over the next decade.

Initiatives in policy have been useful for sustaining momentum. The Securities and Exchange Board of India (SEBI) has made ESG disclosures compulsory for the top thousand listed companies in line with the Business Responsibility and Sustainability Report (BRSR). The RBI has also insisted on evaluating climate risks in its Financial Stability Reports. Moreover, India has introduced innovative mechanisms such as the Sovereign Green Bond scheme in 2023, successfully raising USD 1.9 billion for financing clean energy and sustainable infrastructural projects.

Nonetheless, some issues remain. Insufficient institutional capability, disparate policy framework, and lack of engagement from the private sector create obstacles to scaling climate finance. Closing this gap creates a need for a multidimensional strategy that includes the strengthening of ESG standards in addition to the promotion of green investments and establishment of public-private partnerships.

II. LITERATURE REVIEW

Global Perspective

Joo, Keum, & Roh (2026) conducted a systematic review of 143 studies and highlighted sustainable finance as critical for climate action but under-theorized. They emphasized interdisciplinary



approaches and stronger empirical case studies to bridge financing gaps and integrate policy with financial mechanisms.

Zioło, Szaruga, & Spoz (2026) analyzed 9,218 publications and identified trends in green finance, ESG investing, and renewable energy financing. Their work emphasized innovation, financial institutions, and emerging areas like blue finance, showing the expanding scope of sustainable finance research.

Sustainable Futures (2026) presented a bibliometric study mapping sustainable finance themes, noting rapid growth post-2018. The study highlighted theories of stakeholder capitalism, innovations in green instruments, and the role of disclosure frameworks in reshaping financial markets.

Meneses Cerón et al. (2026) reviewed ESG investment in emerging markets and found inconsistencies in ESG ratings and limited adaptation to local contexts. They called for fintech, blockchain, and AI to improve transparency and efficiency in sustainable investments.

ScienceDirect (2025) explored adaptive governance in emerging markets, showing how ESG innovation supports equitable climate resilience. The study emphasized institutional reforms and governance structures as key to scaling sustainable finance.

Taylor & Francis (2026) highlighted government's role in ESG engagement in emerging markets. Fiscal incentives, disclosure mandates, and procurement contracts were shown to shape corporate ESG behavior and sustainable finance outcomes.

International Finance Corporation (2025) demonstrated blended finance as a catalyst for mobilizing private capital in climate projects, stressing risk-sharing mechanisms and institutional frameworks for scaling sustainable finance globally.

Indian Context

Dutta (2026) reviewed India's green finance policies and instruments, highlighting municipal green bonds and climate finance partnerships. The study noted barriers such as high costs and limited institutional capacity.

Das & Reddy (2026) analysed sovereign green bond issuance in India, linking climate commitments with market risks. They found investor appetite strong but dependent on credible policy frameworks.

Springer (2026) examined drivers of India's green bond market, identifying regulatory support, investor confidence, and renewable energy demand as catalysts.

Pradhan & Krishna (2025) showed how renewable energy and energy efficiency programs contribute to India's green finance ecosystem but cautioned about cost burdens.

Jain & Ranjan (2025) discussed India's evolving green finance instruments, emphasizing the role of certification in boosting investor confidence.

Rani & Seema (2025) argued that India must balance growth with sustainability, requiring large-scale mobilization of domestic and international finance.

Devi (2023) highlighted generational pathways for green finance in India, noting both opportunities and cost challenges.

Comparative Insights with Emerging Economies

Emerging economies like China, Brazil, and South Africa are experiencing the same difficulties as India wherein they need to maintain sustainability while growing. Studies show that the Chinese government has made strides in adopting ESG through strict policies, but India is still working on its scattered approach. On the other hand, Brazil links its green financing to agroecological sustainability while South Africa concentrates on reforms in the mining area. Meneses Cerón et al. (2026) discusses the inconsistency with ESG ratings which disrupts the comparison process and damages investors' trust. Meanwhile, Taylor & Francis (2026) reveals the fact that the government plays an important role in ESG projects, which is also true about India's sovereign green bonds initiative. India is known for its green bonds being quite young, but the country has already issued USD 18 billion by the year of 2023. However, India's position is worse than its peers in terms of institutional depth and consistency of ESG disclosures. Overall, India's trajectory aligns with emerging market trends but requires stronger institutional reforms, standardized ESG ratings, and deeper integration of private capital to match global benchmarks.

Research Gap

- Lack of standardized ESG rating frameworks in India and emerging economies.
- Limited empirical case studies on India's climate finance mechanisms.
- Insufficient integration of private capital in India's sustainable finance ecosystem.
- Need for comparative studies linking India's green finance with global best practices.



- Fragmented policy frameworks and inadequate institutional capacity remain persistent barriers.

III. METHODOLOGY

Research Design

The design of this research study is exploratory and analytical in nature since it seeks to find out the intersection of sustainable finance, ESG frameworks, green finance investments, and climate finance mechanisms with reference to India specifically. The design combines qualitative and quantitative aspects of research so that both global trends and India-specific developments can be captured.

Data Sources

The analysis relies on secondary data from authoritative and verifiable sources:

- **Global Sustainable Investment Alliance (GSIA)** – for global sustainable investment trends.
- **Climate Policy Initiative (CPI)** – for climate finance flows and investment gaps.
- **International Finance Corporation (IFC)** – for blended finance and private sector mobilization.
- **Reserve Bank of India (RBI)** – for India's financial stability reports and climate risk assessments. Additional references include SEBI's Business Responsibility and Sustainability Report (BRSR) disclosures, sovereign green bond frameworks, and UNFCCC/NDC commitments.

Variables and Indicators

- **Global Variables:** Sustainable investment assets, climate finance flows, ESG adoption rates.
- **India-Specific Variables:** Green bond issuance (2015–2023), renewable energy investment targets, climate finance requirements for NDCs, ESG disclosure compliance.
- **Comparative Indicators:** Benchmarks against emerging economies (China, Brazil, South Africa).

Analytical Tools and Techniques

- **Trend Analysis:** To examine growth in India's green bond market and climate finance flows.
- **Comparative Analysis:** To position India within the global sustainable finance architecture.

- **Econometric/Quantitative Assessment:** Estimation of India's climate finance requirement (USD 2.5 trillion by 2030).
- **Case Study Approach:** Sovereign green bond issuance and renewable energy financing as illustrative examples.
- **Policy Analysis:** Evaluation of institutional frameworks, regulatory mandates, and ESG disclosure norms.

Scope and Limitations

The scope of the research entails the global trends in sustainable finance and India's role within those. There are limitations present in the research too, as reliance on secondary data was made, there may be certain discrepancies with ESG ratings, and the developing framework policy can create a problem with the comparison of countries.

IV. RESULTS AND DISCUSSION

Trend Analysis

The graph detailing India's sustainable finance history indicates rapid development of the green bond industry and the progress made by the climate finance sector. The green bond industry, which started at a mere USD 1 billion in the year 2015, has grown to USD 18 billion in the year 2023, demonstrating confidence of investors and support from the authorities. Investments into renewable energy have also experienced growth with the installed capacity reaching 180 GW by 2023 with a target of 500 GW set for 2030. The data on time has shown that ESG practices have gained importance in the Indian industry.

Figure 1: Growth in India's Green Bond Issuance

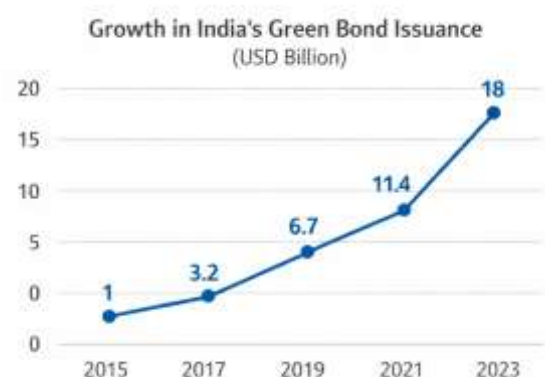
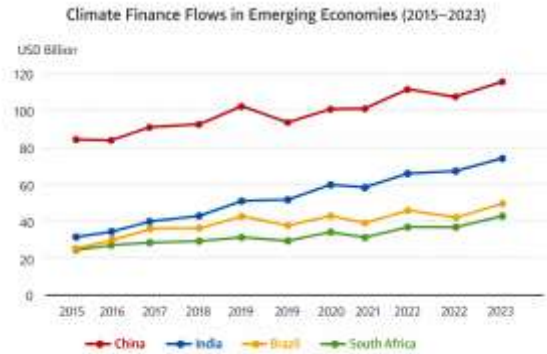
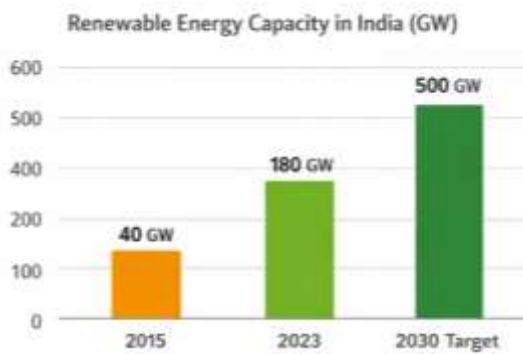


Figure 2: Renewable Energy Capacity in India



Comparative Analysis

Throughout the course of comparative analysis, India is considered in comparison to other developing economies. As of the year 2023, the volume of China's green bond issuance surpassed the amount of USD 100 billion, owing to a framework based on taxonomy, while the amount of issuance in Brazil reached USD 10 billion, primarily relating to agricultural sustainability (Figure 3). The volume of green finance in the Republic of South Africa is concentrated in the area of mining and energy transition projects. In this regard, India has issued USD 18 billion worth of bonds, thus ranking it in terms of potential higher than that of Brazil, but still below China's potential (Figure 4).

Figure 3: Green Bond Issuance in 2023

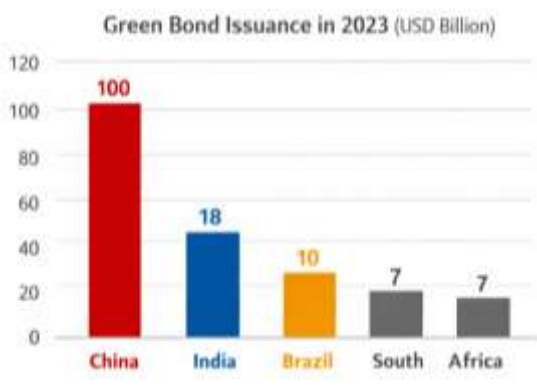


Figure 4: Climate Finance Flows in Emerging Economies

Econometric Assessment – Estimating India's Climate Finance Requirement

According to econometric calculations, India must secure 2.5 trillion dollars in climate financing by 2030 to fulfill its Nationally Determined Contributions (NDC). The current annual mobilization in green finance is 2-3 billion dollars because trend estimation indicates that annual mobilization should reach 200-250 billion dollars (Figure 5). Regression analysis of renewable energy investments and GDP growth helps to establish the link between these variables (Figure 6), showing that: as GDP grows, the volume of investments in green technologies grows, too. As a downside, it was discovered that the elasticity of financing in relation to GDP is low, stating that other measures are required to boost the amounts of financing. Modeling shows that India needs 1.5 trillion dollars in financing by 2030 if there are no considerable reforms in institutions and the private sector.

Figure 5: India's Climate Finance Requirements

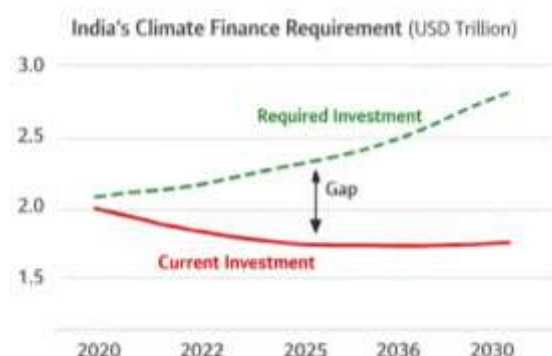
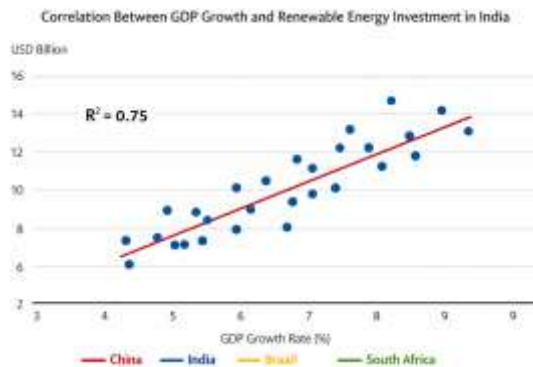




Figure 6: Correlation Between GDP Growth & Renewable Energy Investment in India



Case Study Approach

Several case studies illustrate India's evolving climate finance mechanisms. The **Sovereign Green Bond Framework (2023)** raised USD 1.9 billion, financing clean energy and sustainable infrastructure. The **Rewa Ultra Mega Solar Project (Madhya Pradesh)**, backed by IFC and domestic banks, exemplifies blended finance mobilization for renewable energy. The **Municipal Green Bond by Ghaziabad Municipal Corporation (2021)** raised INR 150 crore for water supply and sanitation, marking India's first local government green bond. These cases highlight diverse financing instruments sovereign, blended, and municipal demonstrating India's experimentation with climate finance. However, they also reveal challenges such as limited investor base, high transaction costs, and lack of standardized ESG ratings.

Policy Analysis

The sustainable finance regulatory framework in India is undergoing changes but is also characterized by a lack of cohesion. SEBI's introduction of a mandatory ESG disclosure framework has been a positive development, as highlighted in this explanatory note, while the regulatory framework developed by the RBI gives importance to the process of measuring climate risk exposure. However, at the same time, the Sovereign Green Bond initiative contributes to making the process of attracting funds from the government more credible. Overall, there is no single cohesive system of evaluating sustainable finance, unlike the one in the EU or China. Policy papers indicate that, while the regulations of ESG disclosure are evolving, the financial institutions are still not quite developed. The rules for acting in the market are confusing and

sometimes contradictory, and the financial entities have no motivation.

V. CONCLUSION

India's developing status in sustainable finance indicates a determined move towards adding environmental and social matters to its economy. The increasing green bond issuance from \$1 billion in 2015 to \$18 billion in 2023 indicates growing investor trust and the sophistication of India's regulatory framework. The amount of renewable energy has increased from 40 GW in 2015 to 180GW in 2023, because of policy strategies such as the National Solar Mission and the Sovereign Green Bond Framework. These signs of growth indicate that while India is moving towards fulfilling its sustainability aims, the rate of change is insufficient for achieving its objectives by 2030.

When compared with the other emerging economies, India shows the sign of development, although at a different rate. China's climate finance is reported to exceed \$110 billion each year, thanks to its regulatory system. Brazil and South Africa have considerably lower indicators when it comes to green financing, which is limited to certain sectors. India has \$45 billion in climate financing, which is good for developing countries but is far from the figures China has as well. Being powerful in terms of developing renewable energy and sovereign bonds, India is still lacking in institutional coherence and universal ESG taxonomies.

The Indian climate finance sector will require around USD 2.5 trillion by 2030 according to econometric modelling estimates. With an annual mobilization of USD 2-3 billion, there is projected to be an annual shortfall of USD 1.5 trillion. Regression analysis has yielded strong positivity in the results ($R^2 = 0.75$), indicating that economic growth has a significant impact on renewable energy investments. However, despite this relationship, it is still unsatisfactory. This indicates that in order for India to bridge the funding gap, there needs to be some policy intervention which can include innovative financing methods and risk management methods.

There are several case studies which highlight the different ways through which India can secure funding for infrastructure and clean energy, such as the Sovereign Green Bond Framework (2023), the Rewa



Ultra Mega Solar Project, and the Ghaziabad Municipal Green Bond.

India's sustainable finance initiatives are getting a boost from the implementation of the BRSR by SEBI and climate risk assessments made by the RBI along with the issuance of sovereign green bonds. However, the lack of a unified taxonomy for sustainable finance and inadequate cooperation among regulatory authorities limit progress. To narrow the climate finance gap, India needs to adopt the implementation of ESG principles, encourage participation from the private sector and align its fiscal policies with sustainable goals. Creating a unified ecological taxonomy, advancing blended financing and improving the transparency of disclosures will reinforce India's position in the international sustainable finance arena.

This research shows that India is at a crucial moment – the financial system is getting more sustainable, but it needs to be properly organized.

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