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A descriptive study of green finance in India: Trends, challenges, and future prospects

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Abstract

Green finance has emerged as a critical tool in channeling financial resources towards sustainable development and climate goals. In the context of India, where ambitious commitments such as achieving net-zero emissions by 2070 and expanding renewable energy capacity by 2030 have been announced, green finance plays an indispensable role. This paper presents a descriptive study of green finance in India, drawing on secondary data from regulatory reports, policy documents, industry publications, and academic literature. The study highlights the growth of green financial instruments such as green bonds, green deposits, and sustainability-linked loans, while also examining the regulatory frameworks introduced by SEBI, RBI, and other institutions. Despite promising progress, challenges including the absence of a unified green taxonomy, risks of green washing, high cost of capital, limited investor awareness, and uneven participation across sectors remain significant obstacles. At the same time, opportunities such as fintech-enabled innovations, enhanced ESG disclosures, blended finance models, and global sustainable finance flows offer potential pathways for scaling up. The findings of this study underscore the need for stronger policy alignment, capacity building, and innovative financing mechanisms to bridge the investment gap and accelerate India's transition towards a green economy.

Keywords: Green finance, India, sustainability, green bonds, renewable energy, descriptive study, policy and regulation

1. Introduction

Climate change and environmental degradation have made sustainable finance a global imperative. Climate risk becomes one of the sources of financial risk of overall financial system. Banks are one of the most important pillars of financial system of any country and for the sustainable development "Green Banking" comes into the picture. Green banking was firstly introduced in 2009 in State of Florida. It is the form of banking business conducted in the area which helps in reduction of carbon emission externally and adopt product, process and technology which helps in reduction of carbon emission internally as well. "Green Finance" is one of the green product developments of Green Banking Initiatives. Green Finance firstly came into existence along with green economy at the Conference of United Nation on Sustainable development Rio de Janeiro, Brazil, 2012. Climate finance, Sustainable finance, Responsible finance, ESG (Environmental, Social and Governance) investments are used interchangeably by regulators and institutional bodies around the world. But UNEP inquiry defines these terminologies in simple approach: Green finance is the subset of Sustainable Finance and Climate Finance is the subset of Green Finance. UNEP defined Sustainable finance, climate finance and green finance as follows:

- Sustainable Finance covers a broader set of investment universe with the aim to build an inclusive, economically, socially and environmentally sustained world.
- Green Finance includes climate finance but also includes other environmental objectives necessary to support sustainability, particularly aspects such as biodiversity and resource conservation.
- Climate Finance refers to "local, national or transnational financing - drawn from public, private and alternative sources of financing -that seeks to support mitigation and adaptation actions that will address climate change." (Labanya Prakash Jena, 2020) ^[18].

Green finance: which channels financial resources into environmentally sustainable projects such as renewable energy, clean transport, energy efficiency, sustainable agriculture, and climate adaptation—has gained significant importance in India.

India, as one of the fastest-growing economies, has set ambitious climate commitments including achieving net-zero emissions by 2070 and sourcing 50% of its energy from renewables by 2030. To achieve these goals, massive financial flows are required. In response, several policy measures have been initiated:

- Green Bond Guidelines by SEBI (2017)
- RBI's Framework for Green Deposits (2023)
- Business Responsibility and Sustainability Reporting (BRSR)
- India's participation in global initiatives like the Climate Bonds Initiative and G20 Sustainable Finance Working Group

Rationale

Environmental concerns intersect with economic growth, placing the financial sector at the forefront of sustainability transformation through investment and lending practices. Despite ongoing initiatives, gaps in understanding consumer behavior, regulatory frameworks, and market impact persist.

2. Literature Review

- Structural analyses suggest that robust CSR, innovative green strategies, and effective green finance practices significantly enhance banks' environmental performance (Menaj: Afzal, 2025) ^[19].
- Green finance has emerged as a crucial tool for achieving sustainable development and addressing environmental challenges in India (Dr. Shalini Devi, 2023) ^[20].
- The country has made progress in green finance through policy support, international collaborations, and increased renewable energy financing. However, challenges remain, and a transparent policy framework is crucial for realizing the full potential of green finance (Dr. Shalini Devi, 2023; Sanat Rout & Sadananda Sahoo, 2021) ^[20].
- In this study the researcher's focusing on the recent trends, opportunities, challenges, various investments avenues of Green Finance in India and to analyze in the path of green Finance and to know the target achieved till date from the initiative taken by the Indian Government of India. The National Government can support the cities by increasing the funding which suites the energy saving and also locally administrated. The Government can be finally sound and innovative programmes and also environmentally good in the Practice of Purchasing the green procurement. But also the climate sources of energy plays a vital role. From the analysis it is clear that India has to focus more on the green finance and have to contribute more to infrastructure funding to attain the sustainable development goal (Seema Pillai, 2021) ^[21].
- The issuance of green bonds has enabled dedicated funding for renewable energy and climate projects, with bond characteristics such as rating and maturity influencing yields and investor preference (S. Bansal, 2020) ^[12].
- India requires significant green infrastructure funding, estimated at \$4.5 trillion by 2040, necessitating contributions from both public and private sectors (Babita Jha & Priti Bakhshi, 2019) ^[1].
- It encompasses various financial practices, including

green banking, bonds, and insurance, aimed at promoting environmental protection and economic growth. Green finance is essential for India to meet its sustainable development goals and address climate change challenges while balancing ecological depreciation (Soundarajan & Vivek, 2016) ^[22].

- The paper focuses on the role of green finance in achieving low-carbon green growth, emphasizing its importance in connecting financial industries with environmental improvement and economic growth. The objective is to validate green finance as a feasible concept in Indian industries, particularly in addressing ecological depreciation caused by carbon emissions. (P. Soundarajan, N. Vivek, 2016) ^[22].

3. Research Methodology

Objectives of the Study

1. To describe the concept and scope of green finance in India.
2. To analyze the growth and trends of green finance instruments (e.g., green bonds, loans, deposits).
3. To examine the role of regulators, policymakers, and financial institutions in promoting green finance.
4. To identify the key challenges and obstacles in scaling up green finance in India.
5. To highlight future opportunities and suggest policy measures for strengthening green finance.

Research Questions

1. What is the current status of green finance in India?
2. What instruments and mechanisms are being used to promote green finance?
3. What are the key challenges faced by stakeholders in implementing green finance?
4. What opportunities exist for the expansion of green finance in India?

Research Design

- **Type of Study:** Descriptive
- **Approach:** Secondary data analysis

Data Sources: Secondary Data

- Reports from RBI, SEBI, Ministry of Finance, and MNRE
- Annual trends in green bonds (SEBI & Climate Bonds Initiative reports)
- RBI's Financial Stability Reports and Green Deposit Framework documents
- International databases: World Bank, IMF, UNEP-FI, OECD
- Industry and think tank reports (CEEW, WRI India, TERI)
- Academic journal articles and working papers

Data Analysis

Descriptive statistical methods (tables, charts, graphs to show growth trends).

4. Green Finance in India

Definition and Scope of Green Finance

Green finance represents the allocation of financial resources towards projects and initiatives that promote sustainable development and ecological preservation.

Fundamentally, it encompasses financial investments intended to reduce greenhouse gas emissions, mitigate air pollution, and conserve natural resources, thereby serving as a bridge between economic progress and environmental sustainability.

The scope of green finance is broad, encompassing various financial products and services, including but not limited to green bonds, green loans, equity investments in renewable projects, and climate funds. It is not merely a subset of conventional finance; rather, it integrates environmental goals as a core criterion in financial decision-making, ensuring investments support ecological balance and contribute to climate change mitigation.

This branch of finance extends to a variety of sectors such as agriculture, infrastructure, energy, and urban development, emphasizing projects that contribute to a reduction in carbon footprints and foster green innovation. Importantly, green finance serves as a solution to the emerging global challenges of environmental degradation and climate variability by offering financial incentives for sustainable practices. It plays an essential role in promoting renewable energy adoption, energy efficiency, pollution control, waste management, and ecological restoration projects. Green finance thus embodies a synthesis of economic and ecological objectives, creating a framework where financial flows are aligned with environmental sustainability imperatives.

Importance of Green Finance for India's Sustainable Development: India faces multifaceted environmental challenges, including elevated levels of air and water pollution, significant greenhouse gas emissions, resource depletion, and vulnerability to climate change impacts. These issues exacerbate public health risks, constrain agricultural productivity, threaten biodiversity, and pose systemic risks to economic stability. Green finance emerges as a critical mechanism in India's quest to address these challenges by channeling investments into sustainable infrastructure and low-carbon technologies, thereby supporting the country's broader Sustainable Development Goals (SDGs).

The alignment of green finance with India's SDGs is vital as it facilitates a balanced approach to economic growth that does not compromise environmental integrity. By financing projects that reduce emissions and promote energy conservation, green finance enables a transition towards a more resilient and inclusive economy. It supports national commitments outlined under the Paris Agreement and India's own climate action plans by providing the financial means to scale up renewable energy, sustainable agriculture, green buildings, and clean transport systems. Furthermore, green finance facilitates the internalization of environmental costs into economic activities, encouraging industries to adopt sustainable practices.

5. Historical Development of Green Finance in India

Initial Emergence and Policy Milestones

Green finance has gradually emerged within India's financial system over the past decade, gaining momentum through dedicated policy frameworks and market innovations.

The landmark introduction of green bonds in 2015 marked a critical milestone, positioning green finance as a viable and structured means to mobilize capital for environmentally

sustainable projects. The issuance of green bonds provided a formal instrument that attracted both domestic and international investors interested in supporting renewable energy and climate-resilient infrastructure.

Subsequently, 2022 saw the issuance of the Sovereign Green Bond (SGrB), underscoring the Indian government's commitment to environmentally focused financial strategies and signaling confidence to the market.

These milestones were supported by various regulatory measures and strategic roadmaps that aimed to foster transparency, credibility, and investor protection within the green finance ecosystem.

The government's active role in promulgating guidelines and frameworks has accelerated the adoption of green finance principles and facilitated the establishment of market standards for eligible projects.

Role of Government Initiatives and Regulatory Framework:

Government initiatives have been pivotal in catalyzing green finance growth in India.

Fiscal incentives such as tax exemptions, subsidies, and concessional financing stimulate market participation by mitigating investment risks and enhancing returns on green projects.

Infrastructure development support and capacity-building programs foster industry readiness and facilitate the scaling of sustainable enterprises.

The formulation of regulatory frameworks has been central to establishing standards and ensuring transparency within green finance. These frameworks promote the adoption of uniform criteria for green financial products, including eligibility requirements, impact reporting, and third-party verification mechanisms. Such regulations engender investor confidence by reducing information asymmetry and curtailing green washing risks.

Furthermore, the government's advocacy for public-private partnerships (PPPs) has enhanced collaboration between the public sector and private investors, pooling resources and sharing risks. These PPP models have enabled large-scale deployment of renewable energy projects, sustainable transport, and urban infrastructure, thereby amplifying the reach and impact of green finance. The synergy between regulatory oversight and market innovation contributes to strengthening India's green finance ecosystem.

6. Current Landscape of Green Finance in India

Key Players and Financial Institutions

The current green finance ecosystem in India is shaped by a broad spectrum of stakeholders, with commercial banks, non-banking financial companies (NBFCs), and specialized financial institutions at the forefront. Major commercial banks have integrated green financing targets into their strategic objectives, aligning credit portfolios with environmental sustainability mandates.

Regulatory bodies like the Reserve Bank of India (RBI) have played an active role by facilitating priority sector lending designations for green projects, thereby incentivizing financial institutions to increase green credit issuance. Additionally, the Securities and Exchange Board of India (SEBI) has introduced green bond regulations to streamline issuance and disclosure practices.

Market Size and Growth Statistics

Market Size: The annual green finance requirement for

India to achieve its climate targets—including Nationally Determined Contributions (NDCs) under the Paris Agreement—is approximately INR 11 lakh crores (about USD 170 billion) per year through 2030, totalling an estimated USD 2.5 trillion from 2015 to 2030.

Key Sectors and Distribution: Within the green finance landscape, the renewable energy sector—especially solar and wind—attracts the lion's share of investments, with solar commanding the largest proportion (about 34.58% of sector-specific green funds), followed by hydro and wind energy. Other sectors benefiting include energy efficiency, sustainable transportation, and green infrastructure projects.

Growth Statistics and Trends: Green Bonds: Green bonds constitute an important and rapidly growing segment of the market. As of February 2023, Indian entities had issued around USD 21 billion in green bonds, with the utilities and renewable energy sectors representing the main recipients. The annual compound growth rate (CAGR) for total global climate finance, private sector climate finance, and public sector climate finance between 2011-12 and 2019-20 stood at 11.67%, 8.84%, and 14.87% respectively.

Banking and Private Sector Involvement: Approximately 34% of public sector banks in India support renewable and green projects, while participation from foreign banks remains minimal. About 85% of green finance is domestically sourced, with nearly 60% from private sector players. Nonetheless, access to green finance remains uneven across different sectors due to regulatory hurdles, understanding gaps, and risk perceptions.

Challenges to Growth: Despite positive trends, several structural challenges hinder accelerated market growth:

- High borrowing costs for green bonds relative to conventional ones.
- Regulatory fragmentation and policy unpredictability.
- Underdeveloped domestic debt markets and low foreign direct investment (FDI) contribution.
- Green washing risks and limited metrics for measuring actual green impact.
- Many investors, financial institutions, and potential beneficiaries lack the technical knowledge required to evaluate green products accurately.
- Insufficient public awareness diminishes market depth as retail investors and smaller businesses remain disengaged.
- The absence of universally accepted definitions and standardized reporting frameworks for green finance products fosters uncertainty and inhibits cross-market comparability. This fragmentation undermines investor trust and complicates due diligence processes.
- Infrastructure deficits, especially in rural and underdeveloped regions, further constrain the implementation of green initiatives.
- Financial institutions often struggle with credit risk assessments for emerging green technologies due to limited historical data and uncertain revenue streams.

7. Comparative Overview: India's Position Globally

Global Context of Green Finance Development: Within the global green finance landscape, India occupies a

dynamic yet challenging position. As a developing economy with substantial environmental pressures and rapid growth ambitions, India faces unique demands that distinguish its green finance trajectory from established markets such as the European Union, the United States, and China.

While India witnesses accelerated growth in green financial products, its market remains comparatively nascent in terms of scale, standardization, and institutional depth. However, the country exhibits significant potential given its large renewable energy capacity, policy commitments, and demographic advantages.

India's environmental and economic dual challenges necessitate tailored green finance approaches that reconcile scale with equitable access. This balancing act, alongside infrastructural and capacity challenges, frames its distinctive role in the global green finance arena.

Lessons from International Experiences

India's green finance sector benefits from studying international best practices, particularly from regions where mature regulatory frameworks, innovative instruments, and market-oriented policies have catalyzed sustainable financial growth. Adaptation rather than wholesale adoption is crucial given India's diverse socio-economic context.

International experiences underscore the value of robust disclosure standards, third-party verification, and stakeholder engagement in building market confidence. Moreover, blended finance and international climate funds provide models to overcome risk and capital gaps effectively.

Cross-border technology transfers and capacity-building collaborations further enable India to navigate challenges inherent in transitioning its energy and economic systems. These lessons inform policy refinements and innovation targeting accelerated and inclusive green finance development within India.

India's Contributions to Global Climate Finance Goals

India's adherence to international climate agreements, including the Paris Accord, demonstrates its commitment to integrating green finance into national climate action. Indian green bonds and sovereign issuances contribute to the global marketplace, signaling active participation in climate finance.

Furthermore, India channels financial flows aligning with global sustainability ambitions, enhancing its credibility and attracting global investors seeking emerging market opportunities. Domestic efforts to harmonize finance with climate goals underscore contributions to international agendas and sustainable development targets.

These endeavors also bolster India's position as a regional leader in environmental finance, providing a model for other developing nations balancing growth with sustainability.

8. Future Directions and Policy Implications

Strengthening Institutional and Public Awareness

To sustain and accelerate the green finance trajectory, enhancing institutional and public awareness is paramount. Educational programs targeting financial institutions, regulators, investors, and beneficiaries can elevate technical competencies and market understanding.

Engagement with academic institutions, professional associations, and media platforms aids in disseminating accurate information and fostering a culture supportive of

green finance. Transparency initiatives and robust reporting frameworks further reinforce market confidence and accountability.

Enhancing Financial Infrastructure and Innovation

Improving financial infrastructure involves developing advanced risk assessment tools, credit rating systems uniquely suited to green projects, and scalable fintech platforms that increase accessibility. These innovations reduce transaction costs, manage uncertainties effectively, and broaden market reach.

Encouraging product innovation tailored to India's diverse economic and sectoral needs supports more dynamic green finance offerings, including blended finance instruments and performance-linked financing.

Investing in digital platforms enhances real-time monitoring and transparency, contributing to investor assurance and effective impact tracking. Financial infrastructure modernization will underpin resilience and scalability in India's green finance landscape.

Policy Frameworks for Sustained Growth and Global Leadership:

Finally, establishing comprehensive, integrated green finance policies that harmonize climate objectives with economic planning is essential. Such policies should incentivize private sector participation through guarantees, subsidies, and blended finance mechanisms.

Encouraging international collaboration ensures technology transfer, capital flows, and alignment with global sustainability frameworks. Policymakers should foster an environment conducive to innovation, competition, and inclusivity within green finance markets.

These strategic policy frameworks position India to not only sustain green finance growth domestically but also to assume global leadership roles in sustainable finance development.

9. Limitations

- Reliance on **secondary data** may limit real-time insights.
- Availability and consistency of green finance data may vary across sources.
- Descriptive design may not establish causal relationships.

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