IJMSRR
E- ISSN - 2349-6746
ISSN -2349-6738

IMPACT ON CURRENCY FLUCTUATION AND RENEWABLE ENERGY ON GREEN BOND MARKET IN INDIA DURING 2022 to 2025

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Abstract
Green bonds have become a central tool in the sustainable financing environment in India, where they are helping the country shift to a low-carbon, sustainable economy and support the financing of environmentally-friendly projects. In the Indian market, from 2022-2025, the green bond market has actively developed, and the main factor in this process was the active growth of renewable energy objects and the constant support of the government policy concerning the implementation of the net-zero concepts as of 2070. The development of the green bond market, however was tamed by the currency fluctuations with the most notable fluctuations being the Rhyme of the Indian Rupee with other major currencies in the world. This foreign exchange risk enhanced the cost of hedging, reduced foreign investor inflow and enhanced the coupon rates on INR-denominated bonds, although there are pricing advantages (greenium) that were enjoyed domestically This paper explains why currency fluctuation and the renewable energy development on the green bond market in India between 2022 and 2025 and explains both opportunities and challenges of sustainable finance.

Key Words: Green Bonds, Renewable energy, Sustainable finance.

Introduction
In times when the climate and environmental issues are at their raise, green bonds help investors align financial objectives with values of sustainability and have also played a crucial role in financing the transition towards a low-carbon economy. Green bonds are one of the strong tools to mobilize private capital toward environmental projects, supporting broader goals such as climate change mitigation and sustainable growth, with the added advantage of giving investors predictable income streams. During the year 2022-2025 there was high volatility in Indian Rupee as a result, a study is conducted to this know about the volatility.

Objective of the Study
1. To understand the concept of Green bonds, the factors affecting Green Market Bonds
2. To study the impact of Impact on currency fluctuation and renewable energy on the green bond market in India during 2022 to 2025.

Literature Review
Moro and Zaghini (2023) studied, by modeling, how exchange rate volatility impinges on green premia internationally and noted that emerging market economies with volatile currencies tend to have smaller greeniums. According to their model, foreign investors reduce investments in such economies due to higher risks, leading to lower greenium and higher financing costs of green projects.

According to the IMF (2025), green bonds issued in India are mainly dollar-denominated, and the local currency bond market accounts for only about 10%, mainly due to the concerns related to currency risks. This results in higher yields on the INR-denominated green bonds and cuts or eliminates the greenium they could otherwise achieve. The study pinpoints the fact that these bonds are less attractive due to the currency risk issue for international investors; consequently, this limits the greenium advantage.

A recent regional study by **Hyun et al. (2022)** shows that the greenium in certified bonds can amount to around 15-20 basis points in more stable markets but shrinks dramatically in India, for instance, due to currency risk and market inexperience, which lower investor willingness to accept lower yields.

Green Bonds

Green bonds are fixed-income instruments used to raise capital for projects that have an explicit positive environmental or climate benefit, including renewable energy, energy efficiency, and sustainable transportation. They work similar to traditional bonds, paying interest to investors and returning principal, but the key difference is the dedicated use of proceeds for "green" initiatives.

Characteristics of green bonds

1. **Purpose:** Funding those projects that result in a low-carbon, climate-resilient economy and restore environmental damage.
2. **Funding Categories:** Common projects include renewable energy, clean transportation, sustainable water management, energy efficiency, waste management, and conservation.
3. **Issuer Types:** These are issued by many entities such as governments, corporations, and international development banks.
4. **They Act Just Like Regular Bonds:** with credit ratings, marketability, and all that, but the money is used for projects that are environmentally friendly.
5. **Transparency:** Issuers are usually supposed to account for the utilization of the proceeds and disclose the environmental impact of the projects financed to ensure accountability.
6. **There Is, However, One Important Risk:** the so-called "greenwashing," where an entity could present a project as green while it is actually not. Regulatory bodies are promoting increased disclosure to help reduce that risk.

Factors Affecting Green Bond Market

1. **Government Policy and Regulatory Framework:** Policies like tax incentives, subsidies, and compulsory environmental disclosures support the issuance and investment in green bonds.
2. **Issuer Characteristics and Corporate Governance:** Firms that have more long-term debt, diverse boards in general, and particularly gender diversity, coupled with stronger environmental commitments, issue more green bonds.
3. **Market Demand and Investor Preferences:** Usually, it is the institutional investors, asset managers, and retail investors with sustainability goals that create the growing demand. Indeed, green bond pricing and issuance volume are strongly influenced by investor demand due to ESG criteria, sustainability mandates, and a preference for green investments.
4. **Credit Ratings and External Verification:** The creditworthiness of issuers, including third-party certification and verification of green bonds (such as through the Climate Bonds Initiative), impact bond pricing and investor confidence by reducing green washing risks.
5. **Macroeconomic Factors and Market Conditions:** The level of interest rates, inflation, economic stability, and wider conditions in the financial markets influence yields on and demand for green bonds. Economic shocks and volatility may impact risk appetites and investment flows.
6. **Project and Environmental Impact:** The type and foreseen impact of the financed projects-whether they are renewable energy, energy efficiency, etc.-will affect investor interest and perceived risk.

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In a nutshell, green bond markets depend on the following: regulatory environments, issuer profiles, investor demand that is aligned with ESG principles, creditworthiness with credible certification, and overall economic conditions.

Reasons in Currency fluctuations and Its Effects on green bonds During 2022-2025

1. **Currency Mix:** A rupee volatility increased during the year 2022-2025, USD-denominated green bonds remained dominant (55%), INR at 44%, with emerging use of JPY and EUR
2. **Yield Differential:** Due to the volatility of the currency, the average coupon rates for USD-denominated green bonds were from 2.75–6%, while INR bonds ranged from 7.5–10%, reflecting currency risk and domestic market constraints.
3. **There Are Hedging Costs:** Rupee volatility in 2022-2025 increased hedging costs and deterred international investors who demand compensation through higher returns against currency risk.
4. **Market Reaction:** Sovereign green bonds had enjoyed a "greenium," or lower costs relative to conventional debt, but market illiquidity and ongoing rupee volatility quickly diminished this advantage.

Regulatory and Market Responses

1. **Liquidity and Indices:** Though the secondary market remains illiquid, policy steps towards more transparent disclosure (SEBI's BRSR Core, RBI's Green Deposit Framework, etc.) boosted investor confidence and increased transparency.
2. **Hedging Mechanisms:** Indian DFIs are looking into currency swaps and long-term contracts to hedge the risks of currency fluctuation for green bond investors.

Renewable Energy: The Principal Driver

1. **Renewable Allocation:** more than 60% of funds raised through green bonds since 2022 have been put towards energy sector projects, with a focus on renewable.
2. **Key Issuers:** Large Corporates and state-owned enterprises have issued bonds for utility-scale and rooftop solar, wind, biomass, and grid modernization.
3. **Policy Tailwinds:** Government programs like the Production Linked Incentive scheme accelerated project pipelines and bond issuances for renewable.

Green Bond Issuance in India till February 2024

Bar chart for understanding the decline in issuance of green bonds in India, from 2022-2023, is shown below, which indicates that there was a sharp increase in the year 2021-2022, thereafter it shows a decline, which is the result of currency fluctuations, impacting the green bond market in India.

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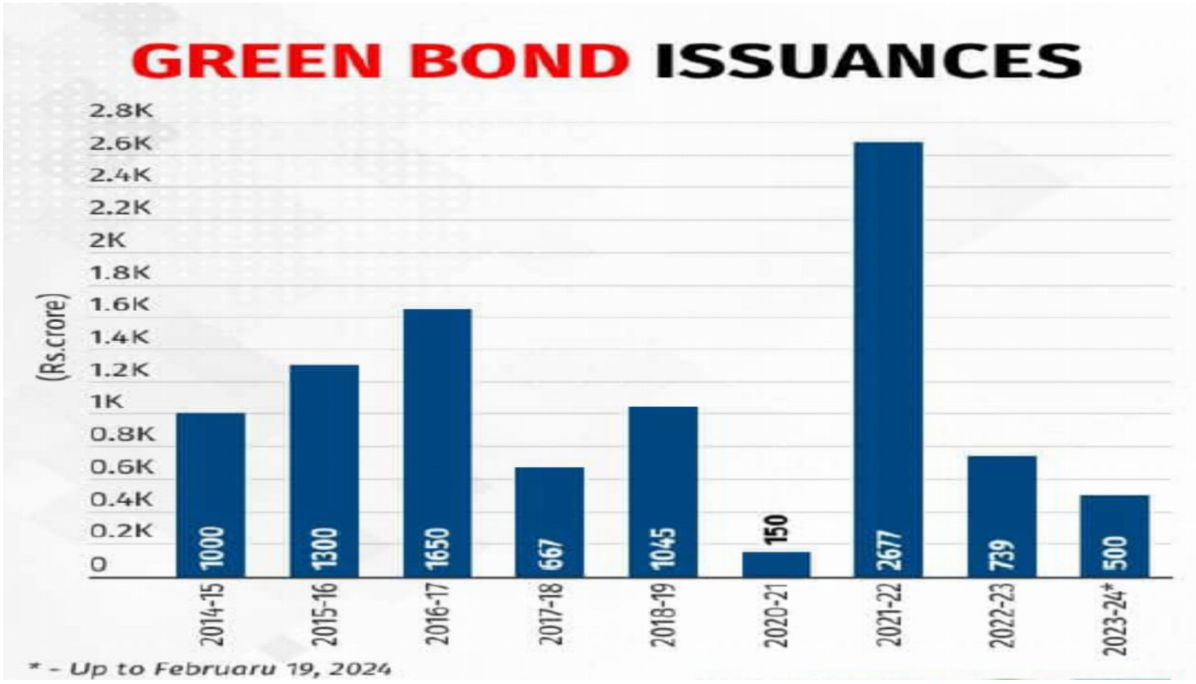

Thus, the chart clearly shows that there is a decline in the year 2020-2023 that further declined in the year 2023-2024, which was as a result of the influence of the external factors like currency risks, policy changes, and renewable energy project cycles.

Conclusion

The influence of currency fluctuation and renewable energy on green bond markets is multi-dimensional and significant, the study shows. While this sounds attractive, currency fluctuations, in particular exchange rate volatility, tend to raise the risks of green bonds denominated in local currencies, especially in emerging markets. The volatility increases the risk premium associated with green bonds, making them less appealing for foreign investors and culminating in higher financing costs for green projects. This sometimes is referred to as a "green sin" in which exchange rate instability and limited financial openness in emerging economies dampen the greenium (the yield difference that favours green bonds) and cut foreign investment in these bonds. Stable exchange rates, on the other hand, support the expansion of green bond markets by attracting more investments and reducing uncertainties. The study has helped in understanding the impact and the regulatory authorities have to take proper measures to see that investment in Green bonds are encouraged.

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