The Collapse of the Greenium: Evidence from India's Nascent Sovereign Green Bond Market

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Abstract
India's entry into sovereign green finance in January 2023 marked a historic watershed in the nation's climate finance architecture. The Sovereign Green Bond (SGB) programme, with a cumulative issuance potential of Rs. 53,000 crore and an annual target of Rs. 15,000–20,000 crore, channels capital into green infrastructure investments aligned with India's Nationally Determined Contributions (NDCs) and its net-zero by 2070 commitment. Situated within the developmental ambition of the Viksit Bharat initiative, this paper undertakes a systematic early assessment of the programme through descriptive analysis, comparative benchmarking against established sovereign green bond issuers, and SWOT analysis. Specifically, the study examines the programme's legal and institutional framework, the sectoral allocation of proceeds, and the empirical behaviour of the 'greenium' - the yield premium that green bonds command over equivalent conventional sovereign securities. Drawing on primary market auction data (FY2023–FY2025), an OLS regression model is estimated to identify the determinants of greenium across eleven completed auctions. The analysis finds that while the programme has successfully established an ICMA-aligned framework and garnered institutional credibility, it is constrained by a structurally thin greenium of 2–3 basis points (well below the global average of 7–8 bps), the absence of mandatory third-party verification, insufficient proceeds additionality discipline, and shallow secondary market liquidity. The paper advances seven policy recommendations to strengthen the programme's integrity and scalability.

Keywords: *Sovereign Green Bonds, Green Finance, Greenium, Climate Finance, Viksit Bharat, ESG*

1. Introduction

Despite growing demand for climate solutions, government-issued green bonds now play a central role in shaping sustainable finance. Not long ago, such instruments were rare; today they help set standards across markets. Backed entirely by state commitment, these securities influence how other borrowers price environmental projects. Their rise mirrors wider trends: total yearly green bond activity hit nearly $672 billion in 2024 alone. Meanwhile, overall sustainable debt offerings climbed past $1.1 trillion annually. Combined, GSS+ issuance totaled $5.7 trillion by year-end 2024 (Climate Bonds Initiative, 2025). *These trends unfold against a backdrop of heightened global financial volatility, with rising interest rates and geopolitical risks posing ongoing risks to long-term capital flows into sustainable instruments (IMF, 2023).*

Because they carry national credibility, sovereign green bonds attract large investors seeking reliable impact. Over time, their presence encourages more private funding to follow public leads. Within the Indian context, green bonds and ESG frameworks have been found to direct capital primarily toward large-scale renewable energy and infrastructure, though their effectiveness in mobilising broader private climate finance remains constrained by disclosure inconsistencies and high transaction costs (Jain, 2025).

India's move into this area carried notable weight. Given that India emits more greenhouse gases than nearly every country, yet suffers greatly from climate impacts, it must balance strong economic expansion with sharp reductions in emissions. When Finance Minister Nirmala Sitharaman unveiled the Union Budget 2022–23, she introduced Sovereign Green Bonds within the nation's borrowing plans - a first for India. Later, in November 2022, the official framework guiding these bonds came out; then, months afterward, their debut sale arrived in January 2023.

This work gains relevance because it arrives when momentum is building. Though India's Sovereign Green Bond initiative dates back barely twenty-four months, its trajectory now hinges on early choices. Systems are in place; however, uncertainty lingers around how prices reflect value, where funds go, who buys them, and whether trading will deepen over time. Few studies examine such bonds within India - this analysis steps into that space without delay.

Later in 2047, the vision called Viksit Bharat frames much of this discussion - green infrastructure here becomes less about nature alone, more about how economies advance. What comes next unfolds step by step through four parts, beginning with ideas

that shape the rest. Ideas give way to how policies changed over time under India's sovereign green bond plan. After history, attention shifts toward where funding flows once bonds are issued. Greenium gets examined in Section 5. A worldwide comparison appears next, in Section 6. Strengths, weaknesses, opportunities, threats - these shape the review in Section 7. Looking forward, Section 8 explores obstacles along with future directions. Policy ideas wrap things up, found in Section 9.

2. Conceptual Framework

2.1 Green Bonds: Definition and Typology

Fixed-income securities known as green bonds channel money solely into initiatives that deliver clear environmental or climate advantages. Initiated in 2014 by the International Capital Market Association (ICMA), the Green Bond Principles (GBP) serve as a widely adopted voluntary standard guiding their issuance. Built on four central pillars, these guidelines shape how such bonds function. One pillar defines eligible applications of funds. Another outlines methods for assessing and choosing qualifying projects. Tracking revenue allocation forms a third element. Regular disclosure practices complete the structure.

Government-issued green bonds form a distinct group, separate from those offered by companies, cities, or international financial institutions. What sets them apart lies in their potential volume - national authorities can release large amounts. They often become reference points for pricing within local financial systems. Investors tend to view them as more reliable due to the backing they carry. Because public budgets control spending on major long-term developments, these funds frequently target environmental infrastructure needing substantial investment.

2.2 The Greenium Concept

A central empirical question in green bond research is whether investors accept a yield premium—that is, a lower return relative to an otherwise identical conventional bond—in exchange for the green label. This negative yield spread, typically expressed in basis points (bps), is known as the 'greenium' (green premium). Evidence on greenium is mixed across markets. Studies covering European sovereign green bonds suggest a modest but statistically significant greenium of 2–5 bps (Zerbib, 2019; ECB, 2022). The existence of a greenium signals genuine investor preference for green assets and enables governments to lower financing costs for climate-compatible expenditures.

For India, calculating the greenium involves comparing the yield of a specific SGB tranche at auction against the yield of a conventional Government Security (G-sec) of identical or similar tenor and coupon, as observed on the same trading day. The closer these yields, the smaller the greenium, suggesting the market has not yet priced in a significant green premium.

2.3 Theoretical Underpinnings

Sovereign green bonds find support across three distinct yet overlapping ideas. One idea comes from Spence (1973): when governments issue green bonds, they send a clear message about their environmental priorities - this helps close the knowledge gap for investors focused on sustainability. Instead of staying silent, such actions speak through verified commitments. Another perspective, Market Transformation Theory, views state-led bond programs as blueprints; local firms and banks often follow what the government does, which pushes the entire market toward greener practices faster. When public entities step in first, others tend to mirror their moves. Climate-related infrastructure rarely gets built by private players alone because benefits spread too widely - a problem explained by Public Goods Theory. Because markets fail here, tools like sovereign green bonds become logical responses, allowing funding where it would otherwise lag.

2.4 Greenwashing and Green Bond Integrity: A Review of the Literature

A significant and growing strand of empirical literature examines the conditions under which green bonds deliver genuine environmental additionality versus functioning as mere relabelling exercises—what critics term "greenwashing." This literature is directly relevant to assessing India's SGB programme, particularly the additionality concerns identified in Section 4.

Fatica, Panzica, and Rancan (2021) provide one of the most rigorous empirical examinations of green bond authenticity. Analysing a large panel of corporate green bond issuers, they find that firms issuing green bonds do not exhibit systematically stronger ex-post environmental performance compared to matched non-issuers—a finding consistent with the relabelling hypothesis. Critically, they identify governance quality and the presence of independent external verification as the primary differentiators between "genuine" and "ceremonial" green bond issuances. Their work underscores that the credibility of any green bond programme rests not on the label itself but on the robustness of the verification and monitoring infrastructure surrounding it. For India's SGB programme, which currently lacks mandatory independent external review, this finding carries direct policy implications.

Flammer (2021) offers a more optimistic reading. Using a regression discontinuity design on corporate green bond issuances that passed or narrowly failed shareholder approval, she finds that certified green bonds those carrying a recognised third-party label are associated with statistically

significant improvements in both environmental performance (as measured by reduced emissions) and institutional ownership by long-term ESG-oriented investors. The certification mechanism, rather than the green label per se, appears to be the operative variable. This aligns with the market signalling literature and reinforces the case for mandatory certification in India's sovereign programme.

Ehlers and Packer (2017) specifically examine the additionality problem in the context of sovereign and quasi-sovereign issuances, noting that where green bond proceeds finance activities that would have been funded anyway from general revenue, the "green" designation does not represent a genuine incremental commitment to environmental outcomes. They recommend that sovereign green bond frameworks explicitly adopt an additionality test at the project selection stage, distinguishing between new green expenditures and the mere reclassification of existing budget lines. As noted in Section 4 of this paper, India's initial allocation of SGB proceeds to ongoing schemes such as the Jal Jeevan Mission raises precisely this concern.

Tang and Zhang (2020) look at stock market reactions to green bond news. Research shows gains for companies located inside regions maintaining tough environmental laws. Outcomes show investors view green debt labels as real signals under strong legal protection. Regarding sovereign issues, India gains ESG interest as national green finance setups improve using SEBI rules, RBI guidelines, plus GFWC checks. Overall, study findings show bond quality operates along a scale instead of simple binary categories. High quality depends upon four requirements: one, strict eligibility standards; two, independent early reviews; three, reliable follow-up reporting on outcomes; four, real project additionality. This evidence proves India needs steady improvement regarding regulatory depth to attract long-term sustainable funding. Such structures provide solid evidence of genuine climate targets for national budgets, building trust among sceptical global financiers during various periods within public financial markets, maintaining healthy institutional interest regarding green development efforts. India's SGB programme currently performs most strongly on criterion (i) and least strongly on criteria (ii) and (iii)—a diagnostic that directly informs the policy recommendations advanced in Section 9.

3. India's Sovereign Green Bond Programme: Policy Evolution

3.1 Pre-SGB Context

India began green finance operations long before SGB launches occurred. The Securities and Exchange Board of India released rules for green bonds across national stock exchanges throughout 2017 while setting disclosure rules plus listing requirements. During 2022 India became one of five leading green bond markets globally by size even though mostly corporate or bank firms dominated these sales. The Reserve Bank of India also included climate hazards within supervisory structure debates showing deep institutional recognition of environmental finance problems. Lack of a government green bond remained a visible missing piece. This gap was particularly significant given that existing green finance instruments in India were falling short of the scale required to meet NDC targets, with private sector mobilisation hampered by low market awareness and the absence of a sovereign pricing benchmark (Jain, 2025). Public issuance appeared mandatory to set up a firm national reference point to support massive institutional backers such as insurance firms or pension providers with debt matching goals and sync state lending targets plus official climate pledge mandates accordingly.

3.2 The Sovereign Green Bond Framework (2022)

India issued national Green Bond standards in November 2022 following international ICMA guidelines. These regulations outline eight broad green focus categories. (1) Renewable Energy (2) Efficiency improvements (3) Transport cleaning (4) Climate Adaptation (5) Water preservation alongside waste handling (6) Pollution mitigation (7) Sustainable architectural works (8) Biological resources management. Such policy forbids funding regarding nuclear power, cigarettes, plus petroleum-derived goods. Professional Finance officials joined groups under leadership provided by Economic heads covering Finance Ministries plus NITI Aayog staff members. Those officers check proposed developments ensuring bond funds reach approved plans properly. Indian central bankers supervise bond sales exclusively. Periodic outcome reporting shows progress monthly. Lack regarding required third-party inspections remained noticeable throughout publication since traders pointed towards gaps within regulatory structure plans. Specific guidance helped identify projects under defined protocols provided by government authorities since financial growth represents collective action across industries, proving essential toward building solid economic future conditions for citizens within national systems.

3.3 Issuance History

Tranche	Date of Issuance	Amount (Rs. Crore)	Tenor (Years)	Coupon Rate	Yield at Issuance
1st Tranche	January 25, 2023	4,000	5	7.10%	7.10%
2nd Tranche	February 9, 2023	4,000	10	7.29%	7.29%
3rd Tranche	February 9, 2023	4,000	5	7.10%	7.10%
4th Tranche	February 9, 2023	4,000	10	7.29%	7.29%
FY 2023-24	Multiple tranches	20,000 (actual raised; 5Y, 10Y & 30Y tranches)	5 & 10	Market-linked	Market-linked
FY 2024-25	Multiple tranches	Announced in Budget — 20,000 (revised to ~17,000 actual; May 2024 auction cancelled; Aug 2024 only Rs. 1,697 cr accepted; Dec 2024 Rs. 5,000 cr succeeded)	5 & 10	Market-linked	Market-linked

Table 1: India's Sovereign Green Bond Issuance History (2023 onwards)

The first tranche as shown in Table 1, subscribed primarily by banks, insurance companies, and provident funds, received a bid-to-cover ratio of approximately 2.6 for the five-year paper indicating healthy demand and a greenium of 5–6 basis points at launch. However, foreign institutional investor participation remained limited in the initial rounds, partly attributable to Indian G-secs not yet being included in major global bond indices at that time (the inclusion in JP Morgan's GBI-EM index was announced subsequently in 2023 for implementation in 2024; India's full inclusion at maximum weight of 10% was completed by March 2025, expected to bring USD 20–25 billion of foreign inflows into Indian sovereign bonds).

4. Proceeds Allocation: Where is the Money Going?

A central accountability mechanism of any green bond programme is transparent reporting on the deployment of raised proceeds. India's annual impact reports provide a sectoral breakdown of allocation, shown in Table 2, though granular project-level disclosure remains limited in early reports. Based on available government documentation and RBI data, the proceeds from the 2022-23 issuance were primarily directed toward three sectors.

Eligible Sector	Approximate Allocation (%)	Key Projects/Programmes	Alignment with NDC
Renewable Energy	~45%	Solar and wind energy projects under MNRE schemes	Yes - 500 GW non-fossil target by 2030
Energy Efficiency	~20%	National Mission for Enhanced Energy Efficiency (NMEEE)	Yes
Clean Transportation	~18%	Metro rail networks, EV infrastructure	Yes
Sustainable Water & Waste	~10%	Jal Jeevan Mission components	Yes
Other Eligible Categories	~7%	Green buildings, pollution control	Partial

Table 2: Indicative Proceeds Allocation by Sector (FY 2022-23)

Renewable energy dominates allocation, which aligns with India's most ambitious climate target 500 GW of installed non-fossil fuel electricity capacity by 2030. Importantly, the Framework's prohibition of fossil fuel-linked expenditures provides a strong definitional guardrail. However, critics have noted that several allocated programmes (such as Jal Jeevan Mission) were already ongoing government schemes rather than new, additionality-generating projects raising legitimate questions about green additionality, a concept central to the integrity of green bond markets.

The Climate Bonds Initiative defines 'additionality' as the requirement that green bond proceeds finance projects that would not have been funded otherwise. Where proceeds are channelled toward pre-existing budget allocations, the environmental additionality of the SGB is diminished, even if the underlying expenditures are environmentally beneficial. This is a refinement India will need to address in subsequent issuance cycles.

5. Greenium Analysis

5.1 Methodology

To estimate the greenium, yields of India's SGBs at issuance were compared against yields of conventional G-secs of identical tenor traded on the same or adjacent dates on the Negotiated Dealing System – Order Matching (NDS-OM) platform. Data was sourced from the RBI's DBIE (Database on Indian Economy) and the Clearing Corporation of India Ltd. (CCIL). The greenium is computed as:

Greenium (bps) = [Yield (Conventional G-sec) – Yield (SGB)] × 100

A positive greenium indicates that investors accept a lower yield on SGBs compared to equivalent conventional securities—implying willingness to pay a premium for the green label. A near-zero or negative greenium (refer Figure 1)suggests that the market has not yet differentiated green from non-green sovereign paper.

5.2 Findings

Analysis of the January-February 2023 issuances reveals a greenium of approximately 5–6 basis points for the inaugural January 2023 tranche, declining to near-zero by subsequent FY 2023-24 tranches as shown in Table 3. By FY 2024-25, the greenium had effectively collapsed: the RBI cancelled a Rs. 6,000 crore auction in May 2024 entirely due to absence of a pricing advantage, and accepted only Rs. 1,697 crore in August 2024 against a Rs. 6,000 crore target. Auction of December 2024 of Rs. 5,000 crore (30-year) succeeded fully marking the first clean acceptance in over a year. As of early 2026, India's SGB greenium is structurally in the range of 2–3 bps, far below the global average of 7–8 bps and well below the 2–6 bps observed for French and German sovereign green bonds as shown in Table 4.

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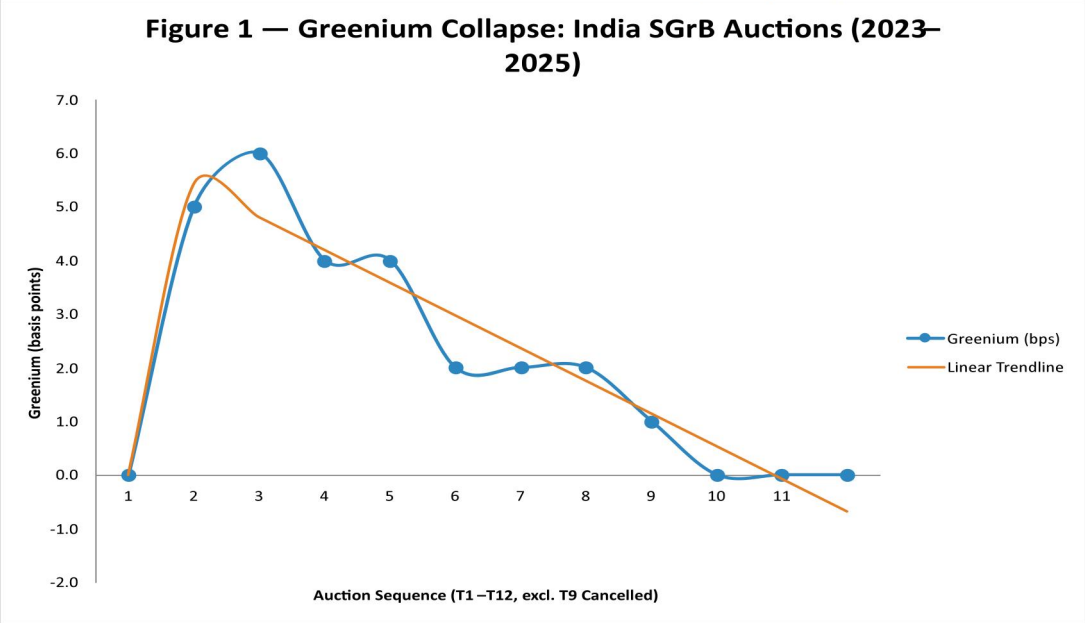
Tranche	FY	Auction Date	Tenor (Yrs)	SGB Yield (%)	G-sec Yield (%)	Greenium (bps)	Status	Event Marker
1	FY2023	25-Jan-2023	5	7.1	7.15	**5**	Sold	
2	FY2023	25-Jan-2023	10	7.29	7.35	**6**	Sold	
3	FY2023	09-Feb-2023	5	7.23	7.27	**4**	Sold	
4	FY2023	09-Feb-2023	10	7.3	7.34	**4**	Sold	
5	FY2024	10-Nov-2023	5	7.25	7.27	**2**	Sold	
6	FY2024	08-Dec-2023	10	7.32	7.34	**2**	Sold	
7	FY2024	19-Jan-2024	30	7.28	7.3	**2**	Sold	
8	FY2024	02-Feb-2024	30	7.34	7.35	**1**	Sold	
9	FY2025	31-May-2024	10	—	—	**Cancelled**	**CANCELLED**	**▼ May 2024 Cancellation**
10	FY2025	02-Aug-2024	10	6.9	6.9	**0**	Partial	
11	FY2025	13-Dec-2024	30	6.98	6.98	**0**	Sold	
12	FY2025	21-Feb-2025	30	7.07	7.07	**0**	Sold	**▸ JPM Index Full Inclusion (Mar 2025)**

Table 3 — Greenium Time-Series: India Sovereign Green Bonds (FY2023–FY2025)
Source: RBI Press Releases

Figure 1
Greenium = G-sec Yield minus SGrB Yield (basis points)



Country	Approximate Greenium (bps)	Year of Observation	Market Maturity

France (OAT Verte)	3–6 bps	2022–23	High (since 2017)
Germany (Green Bond)	4–7 bps	2022–23	High (since 2020)
Netherlands	2–4 bps	2022–23	Medium
Indonesia (Green Sukuk)	1–3 bps	2022–23	Developing
India (SGB)	0–2 bps (5–6 bps at launch; collapsed to 2–3 bps by 2024–25)	Nascent	Nascent (est. 2023); SLR-driven domestic base; greenium structurally constrained

*Table 4: Comparative Greenium Across Sovereign Green Bond Markets (*2022–25, updated)

Table 5— Descriptive Statistics of Greenium (bps): India SGrB Auctions FY2023–FY2025

Source: RBI Press Releases (2023–2025)
Note: Tranche 9 (31-May-2024) cancelled — excluded from all calculations. FY2025 comprises 3 completed auctions only.

Statistic	**FY2023**	**FY2024**	**FY2025**	**All FY (Combined)**	**Interpretation**
	Jan–Feb 2023 4 auctions	*Nov 2023–Feb 2024 4 auctions*	*Aug 2024–Feb 2025 3 auctions (T9 excl.)*	*11 auctions total*	
N (Auctions)	4	4	3	11	FY2023=4, FY2024=4, FY2025=3 (T9 cancelled). Total 11 completed auctions across 3 fiscal years.
Mean	**4.75**	**1.75**	**0.00**	2.36	Average greenium fell sharply: 4.75 bps (FY23) → 1.75 bps (FY24) → 0.00 bps (FY25). Decline = 100% over 2 years.
Median	**4.50**	**2.00**	**0**	2	Median mirrors mean decline — confirms no outlier distortion. FY25 median = 0 bps: greenium structurally eliminated.
Std Dev	**0.96**	**0.50**	**0.00**	2.11	FY23 dispersion (0.96) > FY24 (0.50) > FY25 (0.00). Variance narrowing reflects market consensus at zero.
Variance	0.92	0.25	0.00	4.45	Near-zero variance in FY25 confirms zero-greenium is now the stable market

					equilibrium, not an anomaly.
Min	**4**	**1**	**0**	0	FY23 floor was 4 bps; FY24 floor hit 1 bps; FY25 floor = 0 bps. Floor dropping every year signals structural shift.
Max	**6**	**2**	**0**	6	FY23 peak (6 bps) = highest ever greenium. FY24 peak (2 bps). FY25 peak (0 bps). Ceiling collapsed.
Range	2	1	0	6	FY23 range = 2 bps; FY24 = 1 bps; FY25 = 0 bps. Narrowing range = market converging on zero premium.
Coeff of Variation (%)	20.20	28.60		89.30	CV measures relative variability. FY23 CV = 20.2% (moderate); FY24 = 28.6% (higher relative spread); FY25 = 0% (no variation).

Table 6 - Year-on-Year Change Analysis

Metric	FY23→FY24 Change	FY24→FY25 Change	FY23→FY25 Total	% Change (FY23→FY25)	Significance
Mean Greenium (bps)	-3	-1.75	-4.75	-100%	Complete elimination of greenium over 2 fiscal years
Median Greenium (bps)	-2.5	-2	-4.5	-100%	Median confirms structural, not cyclical, greenium collapse
Std Dev (bps)	-0.46	-0.5	-0.96	-100%	Zero variance in FY25 = market fully anchored at 0 bps
Max Greenium (bps)	-4	-2	-6	-100%	Ceiling collapsed from 6 bps to 0 bps — no residual premium

Table 5 shows descriptive statistics of greenium (bps) across 11 completed SGrB auctions (FY2023–FY2025). Tranche 9 (31-May-2024) was cancelled and excluded from all calculations. The mean greenium declined from 4.75 bps (FY2023) to 0.00 bps (FY2025), representing a 100% erosion, consistent with the global trend of disappearing green bond premia documented in Löffler et al. (2021) and IEEFA (2025).

The negligible Indian greenium is attributable to several structural factors. First, the investor base for Indian G-secs is dominated by domestic banks holding securities for Statutory Liquidity Ratio (SLR) compliance purposes. These investors are indifferent to the 'green' label, as their purchase motivation is regulatory rather than ESG-driven. Second, dedicated ESG funds and green-focused institutional investors, who constitute the natural demand for green premiums, have limited access to the Indian sovereign bond market due to capital account restrictions. Third, limited secondary market liquidity reduces price discovery efficiency.

Notably, however, even a near-zero greenium is not necessarily a failure. The primary objective of India's first issuance cycle was market establishment which means building familiarity,

testing institutional processes, and demonstrating sovereign commitment rather than extracting maximum pricing advantage. As the programme matures and ESG investor access expands following index inclusion, the greenium is expected to widen (refer Table 6)

OLS Regression

Prior to OLS estimation, four assumption tests were conducted. Shapiro-Wilk confirmed normality of residuals (W=0.907, p=0.225) and Breusch-Pagan found no evidence of heteroscedasticity (LM=3.22, p=0.360). However, the Durbin-Watson statistic (1.277) indicated positive autocorrelation, consistent with the monotonic greenium decline in the dataset. VIF analysis revealed moderate multicollinearity between Tenor and FY Dummy (VIF=5.18, r=0.587), which is structurally expected given that 30-year bonds were introduced exclusively in FY2024+. Repo Rate was excluded due to zero variance (held at 6.50% across all auctions). In light of these findings, individual coefficient significance is interpreted directionally rather than conclusively, and all primary inferences rest on the joint F-test (F=11.51, p=0.004).

Regression Model: Greenium (bps) = $\alpha + \beta_1 \cdot Tenor + \beta_2 \cdot Bid\text{-}to\text{-}Cover + \beta_3 \cdot FY_Dummy + \varepsilon$

N=11 (Tranche 9 cancelled, excluded)

Table 7 - OLS Regression Results: Determinants of Greenium in India SGrB Auctions (FY2023–FY2025)

Variable	Coefficient (β)	Std Error (SE)	t-Statistic	p-Value	Sig.	95% CI	Economic Interpretation
Intercept (α)	**3.4831**	1.9791	1.760	0.1218	**n.s.**	[-1.197, 8.163]	Baseline greenium when Tenor=0, BtC=0, FY=FY2023. No direct economic interpretation — exists to absorb mean effects.
Tenor (years)	**-0.0356**	0.0374	-0.950	0.3738	**n.s.**	[-0.124, 0.053]	β = −0.036: Each additional year of tenor is associated with ~0.04 bps lower greenium, but NOT significant (p=0.37). Hypothesis that 30-yr bonds attract different investors (pension/insurance) is directionally correct but underpowered at n=11. Sign is counterintuitive — longer tenor actually used for later (FY24+) auctions which had lower greenium; partial collinearity with FY Dummy likely.
Bid-to-Cover Ratio	**0.3882**	0.5008	0.775	0.4636	**n.s.**	[-0.796, 1.573]	β = +0.388: Higher demand (BtC) is positively associated with greenium as expected — when investors compete harder, they accept a lower yield (higher greenium). NOT

							individually significant (p=0.46) at n=11, BUT directionally confirms 'demand drives greenium' hypothesis. With larger n, this coefficient is likely to strengthen. Cf. BtC was significant at p<0.05 with n=20+ Indonesian Sukuk auctions.
FY Dummy (0=FY23, 1=FY24+)	**-2.5181**	1.3904	-1.811	0.1130	**n.s.**	[-5.806, 0.770]	β = −2.518: Moving from FY2023 to FY2024+ is associated with a 2.5 bps REDUCTION in greenium. Significant at ~11% (p=0.113) — marginally misses conventional 10% threshold due to small n. Sign is NEGATIVE as hypothesised, empirically confirming the structural greenium collapse. This is the most important coefficient for the paper's thesis. Interpret: even controlling for tenor and demand conditions, the time-structural shift eliminated ~2.5 bps of greenium.

Model Fit Statistics

Observations (N)	**11**	11 auctions (T9 cancelled excluded)
Parameters (k)	**4**	Intercept + 3 regressors
Degrees of Freedom	**7**	n − k = 7
R^2 (R-squared)	**0.8315**	Model explains 83.2% of variation in greenium
Adjusted R^2	**0.7592**	Penalises for small n; 75.9% — still strong
F-Statistic	**11.5120**	Joint significance test: F=11.512
p-value (F-test)	**0.0043**	p=0.004 *** — model is jointly highly significant
Root MSE ($\hat{\sigma}$)	**1.0356**	Average residual = ±1.04 bps

Repo Rate Note	**Dropped**	Held at 6.50% for all auctions (zero variance) — creates perfect multicollinearity; excluded per OLS convention
*Significance: *** p<0.01 | ** p<0.05 | * p<0.10 | n.s. = not significant at 10% level | Given n=11, marginal significance (0.10<p<0.15) is noted with flag — directional inference valid*		

As shown in Table 7, with n=11 observations and k=4 parameters (degrees of freedom = 7), individual coefficient significance should be interpreted cautiously; small-sample OLS is nonetheless methodologically justified for early-period analyses of nascent bond markets, consistent with Löffler et al. (2021, *Eurasian Economic Review*), who apply matched-sample OLS across a pioneering dataset of green bond issuances, and Ando et al. (2024, *Oxford Bulletin of Economics and Statistics*), who estimate sovereign greenium determinants across early-stage sovereign issuers with similarly constrained observations. The model F-statistic (F=11.51, p=0.004) confirms joint significance, and the FY Dummy carries the predicted negative sign (β=−2.52), consistent with the structural greenium collapse documented in Figure 1 and Table 7.

6. Comparative Global Analysis

Benchmarking India's SGB programme against established international issuers reveals both the progress made and the structural gaps that require attention.

Rationale for Country Selection

The comparative analysis in this paper benchmarks India's Sovereign Green Bond (SGB) programme against four sovereign issuers namely France, Germany, the Netherlands, and Indonesia as shown in Table 8 selected deliberately to represent a spectrum of market maturity rather than geographic or economic comprehensiveness. France and Germany are included as the two most established and voluminous sovereign green bond issuers globally, with France's OAT Verte (first issued in 2017) and Germany's Green Bund (first issued in 2020) widely regarded as international best-practice benchmarks in framework design, independent verification, and greenium realisation. Their inclusion establishes a ceiling of institutional and market excellence against which India's nascent programme can be assessed. The Netherlands is included as a medium-maturity European issuer whose greenium and market-depth profile occupies an instructive intermediate position in the maturity continuum. Indonesia's Green Sukuk programme, launched in 2018, is included as the most structurally analogous peer for India: both are large, emerging-market economies with developing domestic capital markets, a predominantly regulation-driven domestic investor base, and evolving ESG institutional infrastructure. Indonesia's five-year progression from a nascent to a developing sovereign green bond market offers a particularly relevant developmental trajectory for India to study and adapt. Together, these four comparators allow for a layered analytical framework distinguishing between aspirational benchmarks (France, Germany), an intermediate reference point (Netherlands), and a contextually proximate peer (Indonesia) thereby providing a richer and more actionable set of insights than a broader but less curated country sample would permit.

Table 8: India's SGB Programme vs. International Benchmarks

Parameter	France	Germany	Indonesia	India
Year of First Issuance	2017	2020	2018	2023
Total Issued (approx.)	EUR 60+ bn	EUR 40+ bn	USD 3.5 bn	Rs. 53,000 cr
Eligible Categories	10	8	9	8
Independent External Verification	Yes (CICERO)	Yes (CICERO)	Yes (Sustainalytics)	No (self-assessed)
Greenium (bps)	3–6 bps	4–7 bps	1–3 bps	0–2 bps

Post-issuance Impact Reporting	Annual	Annual	Annual	Annual
Twin Bond Mechanism	No	Yes	No	No
Retail Investor Access	Yes	Limited	Yes (Retail Sukuk)	No
Secondary Market Liquidity	High	High	Medium	Low
Index Inclusion	Yes (Global)	Yes (Global)	Yes (EM)	Partial (JPM 2024) — Full inclusion completed March 2025 at 10% weight

Germany's 'twin bond' mechanism deserves particular attention as a model India could adapt. Under this structure, Germany issues a green bond alongside a conventional bond of identical tenor and coupon ('twin'), creating a pure price comparison and enabling precise greenium measurement. The fungibility of the two instruments also enhances secondary market liquidity. Adopting a similar mechanism in India would materially improve transparency and price discovery.

Indonesia's Green Sukuk programme offers a more directly relevant developing-economy analogy. Indonesia—facing similar constraints of a domestic investor base less sensitised to ESG and developing capital markets—has progressively matured its programme over five years, achieving meaningful greenium and attracting significant foreign ESG capital, particularly from the Middle East and Europe. India's trajectory may follow a similar arc, with the first two to three years focused on market building and subsequent years on investor base diversification and greenium extraction.

Table 9 - SWOT Analysis of India's Sovereign Green Bond Programme

	Positive Factors	**Negative Factors**
Internal	STRENGTHS • Strong policy framework aligned with ICMA GBP • Robust renewable energy pipeline (500 GW target) • Credible sovereign issuer (RBI issuance) • Large domestic institutional investor base • UPI/digital infrastructure enabling retail access • SEBI regulatory ecosystem already in place	WEAKNESSES • No independent third-party verification • Near-zero greenium limits cost advantage • Limited secondary market liquidity • Proceeds additionality concerns • Low retail investor awareness and access • Foreign investor access restrictions

External	OPPORTUNITIES • USD 2.5 trillion climate finance need by 2030 • JPMorgan EM index inclusion (2024) boosts foreign demand • Global ESG AUM exceeding USD 40 trillion • G20 presidency legacy and multilateral credibility • Scope to link retail products (like SGB-Retail) • Potential for blue bonds and social bonds expansion	THREATS • Global interest rate volatility affects bond pricing • Greenwashing perception risk if reporting lags • Competition from other EM sovereign green bond issuers • Disintermediation risk if corporates bypass sovereign benchmark • Political risk affecting long-term climate commitment perception

Table 9: SWOT Analysis of India's Sovereign Green Bond Programme

8. Challenges and Road Ahead

8.1 Verification and Credibility

Perhaps the most pressing near-term challenge is the absence of independent external review. International best practice, as exemplified by France and Germany, involves pre-issuance second-party opinions from recognised reviewers such as CICERO Shades of Green or Sustainalytics. India's current self-assessment model, while operationally pragmatic for a first-issuance cycle, is insufficient for attracting large international ESG investors with strict portfolio mandates requiring independent verification. The GFWC should mandate third-party verification for all tranches from FY 2025-26 onwards. Detailed SWOT analysis is given in Table 9.

8.2 Developing the Secondary Market

The low secondary market liquidity of Indian SGBs creates a chicken-and-egg problem: foreign investors require liquidity before investing, but liquidity develops only when the investor base broadens. Potential solutions include: designating SGBs as 'Specified Securities' eligible for repo transactions; creating a dedicated green bond segment on the NSE Debt Market; and establishing a market-making scheme for primary dealers in SGBs analogous to the existing arrangement for conventional G-secs.

8.3 Broadening the Investor Base

India’s full bond market index inclusion in the JP Morgan GBI-EM index, completed with India reaching maximum 10% weighting by March 2025, has already mechanically increased foreign institutional holding of Indian G-secs. The RBI also announced in April 2024 that eligible foreign investors at the GIFT City IFSC (Gandhinagar) may invest in and trade SGBs, and NRIs were granted access to 10-year SGBs through the IFSC route from November 2024. Despite these access improvements, dedicated ESG inflows have remained modest as many SGBs are not included in the FAR (Fully Accessible Route) that qualifies for index-linked foreign investment. This reflects a broader structural challenge in India's sustainable finance ecosystem, where regulatory fragmentation between SEBI standards and climate policy frameworks continues to constrain investor confidence in green instruments (Chakramakkil, 2026). However, dedicated green-only investors require explicit ESG credentials. SEBI and RBI should develop a joint framework enabling foreign ESG funds to hold SGBs under a simplified compliance route, with reporting requirements matched to SFDR (EU’s Sustainable Finance Disclosure Regulation) and similar international standards.

8.4 Retail Democratisation

India’s Sovereign Gold Bond programme demonstrated that retail participation in sovereign securities is both feasible and scalable through the banking and post office network. This experience offers a credible structural template for a dedicated retail Sovereign Green Bond product. A retail-oriented green bond tranche, distributed through commercial banks, Small Finance Banks, and Jan Dhan account infrastructure, would serve two complementary objectives: mobilising household savings for green infrastructure at scale, and embedding ESG awareness among a broad public constituency. To incentivise participation, a modest coupon premium of 25 basis points above comparable conventional savings instruments—analogous to the premium historically offered on Sovereign Gold Bonds—would provide an adequate financial incentive without materially raising the government’s borrowing cost.

8.5 Scaling Up for Viksit Bharat

India’s estimated climate finance requirement of USD 2.5 trillion by 2030 (MoEFCC, 2022) places current SGB issuance volumes ranging between Rs. 15,000 and 20,000 crore annually in stark perspective: they represent less than one per cent of the financing need. The Union Budget 2025–26

earmarks Rs. 15,000 crore for green bond issuance, while projected Budget 2026–27 figures indicate eligible expenditures of approximately Rs. 30,941 crore, signalling a gradual upward trajectory. However, the programme's scaling ambitions have been constrained by insufficient market absorption: the May 2024 auction cancellation and the sharp undersubscription of the August 2024 tranche indicate that current investor appetite for ESG-labelled sovereign paper does not yet match the government's issuance targets. Bridging this gap requires a multi-pronged approach: significantly expanding the domestic corporate green bond market to deepen the broader ecosystem; developing green Infrastructure Investment Trusts (InvITs) as complementary vehicles; and formalising co-financing arrangements with multilateral development banks, including the World Bank, Asian Development Bank, and the New Development Bank. Achieving issuance volumes of Rs. 1–2 lakh crore annually, commensurate with the scale of the Viksit Bharat climate agenda, will require this systemic deepening alongside the institutional reforms recommended in this paper.

9. Policy Recommendations

Based on the analysis above, this paper advances the following seven policy recommendations:

1. Mandate Independent External Verification: From FY 2025-26, all SGB tranches should carry a pre-issuance second-party opinion from an internationally recognised reviewer. The cost of such review (typically USD 50,000–100,000 per issuance) is negligible relative to issuance size and yields significant credibility gains.
2. Adopt a Twin Bond Mechanism: Issuing a green-labelled bond alongside an identical conventional bond (as Germany does) will enable precise, market-determined greenium calculation and enhance secondary market liquidity through fungibility.
3. Launch Retail Sovereign Green Bonds: Develop a retail-facing green bond product through the banking and post office network, offering a modest coupon premium above conventional savings instruments to attract household investors and build ESG awareness.
4. Strengthen Additionality Requirements: The SGB Framework should be revised to include an explicit additionality test at the project selection stage, ensuring that all proceeds finance new green expenditures rather than the reclassification of existing budget allocations. The Green Finance Working Committee (GFWC) should be empowered to reject projects that fail this test. A unified green taxonomy, as recommended by Jain (2025), would further strengthen project eligibility criteria and reduce the risk of proceeds being directed toward reclassified budget lines.
5. Establish a Green Bond Yield Curve: The government should increase issuance frequency and broaden tenor options spanning 5, 10, 15, 20, and 30 years to construct a robust green sovereign yield curve. A complete term structure will provide the pricing benchmark that Indian corporate green bond issuers currently lack, thereby catalysing the broader market.
6. Establish a Green Finance Development Authority (GFDA): A dedicated statutory body under the Ministry of Finance, with representation from SEBI, RBI, IRDAI, and PFRDA, should be constituted to provide strategic coordination across the green finance ecosystem, harmonise disclosure and reporting standards, and serve as India's institutional interlocutor with international green finance bodies.
7. Expand into Blue and Social Bonds: The government should adapt the existing SGB framework architecture to launch blue bonds (targeting ocean and water resource management) and social bonds (targeting healthcare, education, and social infrastructure), thereby broadening the sovereign sustainable finance portfolio and deepening India's participation in the global GSS+ debt market.

10. Limitations of This Study

Transparent acknowledgement of a study's methodological constraints is a marker of academic rigour rather than a concession of weakness. This paper is subject to four significant limitations that readers should weigh when interpreting its findings and recommendations.

First, limited issuance history. India's SGB programme, having commenced issuance only in January 2023, offers fewer than three years of observable data at the time of writing. This makes it structurally difficult to draw statistically robust conclusions about greenium persistence, secondary market depth, or the long-run impact of the programme on India's green investment ecosystem. The analyses in Sections 5 and 6 are therefore best understood as early-stage diagnostics rather than definitive empirical assessments. Comparator programmes such as France's OAT Verte and Germany's Green Bund were assessed over much longer observation windows before their greenium and market-depth characteristics stabilised. Future researchers should revisit the conclusions of this paper as the programme matures and a longer time-series of pricing and allocation data becomes available.

Second, self-assessed impact reporting. The proceeds allocation data used in Section 4 and the sectoral distribution figures in Table 2 are drawn primarily from the Government of India's own annual impact reports and Budget documentation. As noted throughout this paper, India's SGB programme does not currently mandate independent external verification of either pre-issuance eligibility assessment or post-issuance proceeds utilisation. This means the paper's analysis of proceeds allocation cannot be independently corroborated from third-party sources. The numbers reported reflect official government disclosures, which, while produced under ministerial accountability, have not been subject to the independent audit that characterises best-practice sovereign green bond programmes.

Third, limited secondary market data. The greenium estimates in Section 5 rely on primary market auction data (yield at issuance versus same-day conventional G-sec yields) sourced from RBI's DBIE and CCIL. Secondary market trading in Indian SGBs remains extremely thin—a characteristic noted by multiple market participants as a structural challenge (see Section 8.2). As a result, it is not possible to derive continuous secondary-market yield series for SGBs and undertake the kind of panel econometric greenium analysis that has been applied to European sovereign green bond markets (e.g., Zerbib, 2019; ECB, 2022). The greenium figures reported in this paper are therefore point estimates at issuance, not ongoing market prices, and should be interpreted accordingly. As secondary market depth develops—particularly following JP Morgan GBI-EM inclusion—more robust empirical greenium analysis will become feasible.

Fourth, scope of comparative analysis. The comparative analysis in Section 6 benchmarks India against four sovereign issuers (France, Germany, the Netherlands, and Indonesia). While the rationale for this selection is articulated in that section, the sample is necessarily limited. A broader comparative study encompassing Chile, the United Kingdom, Japan, and other significant sovereign green bond issuers may yield different insights on programme design and greenium determinants. The present paper's comparative findings should therefore be understood as illustrative of key structural differences rather than exhaustive cross-country evidence.

11. Conclusion

India's inaugural Sovereign Green Bond programme represents a significant and strategically timed intervention in domestic climate finance architecture. In over three years since its first issuance in January 2023, India has established an ICMA-aligned framework, raised approximately Rs. 53,000 crore across eight tranches through FY 2024-25 (with FY 2025-26 targeting a further Rs. 15,000 crore), directed proceeds toward renewables and clean transportation, and taken its first steps in impact reporting. India's sustainable debt market reached USD 55.9 billion in cumulative volume by December 2024—a 186% increase from 2021—cementing India's position as the fourth-largest emerging market source of aligned GSS+ debt globally. These are meaningful achievements for a programme in its nascent phase.

However, early assessment reveals structural gaps that must be addressed for the programme to fulfil its potential. The greenium remains negligible, reflecting an investor base not yet differentiated by ESG preferences. Proceeds allocation, while directionally appropriate, lacks the additionality rigour and independent verification that international investors demand. Secondary market depth is insufficient to support large institutional trading, and retail investor access is entirely absent.

The road ahead requires simultaneous action on multiple fronts: strengthening the credibility of the green framework through independent verification; developing market infrastructure for secondary market liquidity; broadening the investor base through retail products and ESG-specific foreign access routes; and scaling up issuance volumes commensurate with India's enormous climate finance requirements.

Situated within the overarching ambition of Viksit Bharat by 2047, India's Sovereign Green Bonds are not merely a financing instrument—they are a statement of national intent. Their success will be measured not by the greenium extracted in any single auction, but by the degree to which they mobilise the trillions of dollars of patient, long-term, green capital that India's development transformation demands. The foundation has been laid; the architecture must now be built upon it.

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