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GREEN FINANCE FOR SDG ACCELERATION: A REVIEW OF SUSTAINABLE INVESTMENT, CLIMATE FINANCE, AND ENVIRONMENTAL GOVERNANCE

Neha Sharma
Assistant Professor (Guest Faculty), Department of BBE
Dr. Bhim Rao Ambedkar College, University of Delhi, Main Wazirabad Road,
Yamuna Vihar, North East district, Delhi - 110094

Abstract

Green finance is essentially about connecting the financial sector to sustainable development, especially in capital intensive sectors such as climate action, renewable energy, resilient infrastructure and responsible industry. The paper analyzes the contribution of green finance to the Sustainable Development Goals (SDGs) in the form of green bonds, sustainable banking, ESG investment, climate funds, green credit, carbon finance, and renewable energy financing. The literature is synthesized in terms of conceptual foundations, pathways to achieve the SDGs, institutional dimensions, sectoral relevance, barriers and opportunities and research gaps. The analysis shows that green finance can help to support SDG 7, SDG 9, SDG 11, SDG 12 and partially below the SD target for mobilizing resources for developing countries to close the financing gaps, while delivering global benefits through increases in low-carbon wealth and greater accountability of sustainable infrastructure provision. Sound taxonomy, clear disclosures, strong regulation and verification of impact assessment should have better access – including from weak economies – to strengthen its development. Therefore, green finance needs to be viewed along both lines – an environmental financing tool that underpins strategic development for climate-resilient growth.

Keywords: Green finance; Sustainable Development Goals; climate finance; green bonds; ESG investment; sustainable banking; SDG 13

1. Introduction

Green finance is increasingly becoming an important management tool in directing investment to activities that lead to environmental improvement, climate resilience, efficient use of resources and sustainable social welfare over time. Green bonds, sustainable banking, climate finance and ESG investment & renewable energy finance and carbon finance and green credit & responsible investment. Policy declarations have proved impossible for sustainable development, but the stakes have risen: it is the financial system that must be remade to move capital from carbon-intensive activities into clean energy, resilient infrastructure, sustainable production and inclusive growth. The SDGs are the normative framework for this transformation, in particular SDG 7 on affordable and clean energy; SDG 8 on decent work and economic growth; SDG 9 on industry and infrastructure; SDG 11 on sustainable cities; SDG 12 on responsible consumption & production; SDG 13 on climate action: SDG17. That means a fundamental decarbonization of energy, cities, industry and governance systems.

The scientific background of this assessment is framed by a new chasm opening between sustainability ambitions and the financing that is available. Its letters to the SDGs driving finance towards energy transition, adaptation, urban resilience and sustainable agriculture transport, water systems and circular economy models. Green finance is an approach for embedding the ecological value, transition risk and social responsibility into the capital allocation; it is in this environment that traditional finance has often been with its focus on short-term profit and therefore failed to take into account the environmental risk. Research on green bonds, green credit, renewable energy finance, and sustainable finance shows that when financial instruments are embedded in credible governance frameworks, they can help enable emission reductions, clean technology deployment, and improved environmental performance (Flammer 2021; Meo & Karim 2022; Sinha et al. 2018).

The problem is that green money has not led to the SDGs being achieved. Among the main obstacles hindering the developmental benefits of green financial markets are greenwashing, lack of transparency, fragmented taxonomies and ESG ratings, limited access for SMEs and developing countries in general and vague legislative landscapes. In many cases, bankable infrastructure projects in high-income countries can still attract flows of green capital funds, while adaptation (together with biodiversity and informal-sector sustainability, and local community resilience) remains under-financed. But the research also tells us that there

appears to be a decoupling of large increase in green finance supply and its credible, inclusive and measurable SDG effects (Bakhsh et al., 2024; Hafner et al. 2016).

This article provides a comprehensive review of the role of green finance in achieving the SDGs, addressing issues such as basic concepts, financial instruments; the pathways from green financial intermediation to SDG progress; institutional architecture and sectoral treatment; implementation challenges and strategic agenda for future research. The review should be useful for policy makers as it clarifies the case for taxonomies, disclosure systems and blended finance. For financial institutions as it highlights operational responsibilities of sustainable lending and investment. For investors, as constructive guidance on opportunities with risks to their credibility. For corporations, since integrates green finance with transition strategy and sustainability assessment. For researchers since identifies knowledge gaps related to impact measurement, inclusion and governance.

2. Conceptual Understanding of Green Finance

Green finance comprises of some elements like mobilization, allocation and control of capital for eco-friendly activities. Sustainable financing is much broader than green finance, which is focused only on climate, energy, pollution management, biodiversity and resource efficiency. It is also different from climate finance for mitigation and adaptation and ESG, which tracks corporate behaviour on environmental, social and governance parameters. In practice, these categories are not mutually exclusive, as SDG-aligned capital is increasingly combining environmental targets with social safeguards and governance accountability. The concept of green finance is based on the literature that views green as a link between environmental protection and incentives in financial markets (Ozili, 2022; Wang & Zhi, 2016).

Green finance turns charity into a core capital market activity. The first focus was environmental financing and public climate funds. Lately, green bonds, green credit Standards and carbon finance, ESG funds, and sustainability-linked loans have emerged to address the newer advances in the market. global climate pledges, increased attention of central banks on climate related financial risk and increased investor demand for credible sustainable assets (Dikau et al 2021; Zhang et al 2019) have supported this change. Green finance and its representation for sustainable development are presented in Table 1.

Table 1. Major Green Finance Instruments and Their Sustainable Development Contributions

Green finance instrument	Description	Main users	SDG linkage	Expected sustainability outcome
Green bonds	Debt securities earmarked for eligible green projects	Governments, corporations, banks	SDG 7, 9, 11, 13	Lower-cost capital for clean infrastructure
Sustainability-linked loans	Loans with pricing tied to sustainability targets	Firms, utilities, infrastructure operators	SDG 8, 12, 13	Incentives for measurable transition performance
Climate funds	Public or blended funds for mitigation and adaptation	MDBs, governments, project developers	SDG 13, 17	Risk-sharing for climate-resilient investment
Green credit	Bank lending guided by environmental criteria	Commercial banks, SMEs, industries	SDG 9, 12, 13	Credit shift away from polluting activities
ESG investment	Portfolio allocation using ESG criteria	Asset managers, pension funds	SDG 8, 12, 13	Capital discipline through sustainability screening

Green finance instrument	Description	Main users	SDG linkage	Expected sustainability outcome
Carbon markets	Trading of emissions allowances or credits	High-emitting sectors, regulators	SDG 12, 13	Carbon pricing and emissions reduction incentives
Green banking	Bank products and risk policies aligned with sustainability	Banks, households, firms	SDG 7, 8, 13	Mainstreaming sustainability in financial intermediation
Renewable energy finance	Equity, debt, and blended capital for clean energy	Utilities, developers, investors	SDG 7, 9, 13	Expansion of renewable generation and grid assets

The basic idea behind green finance is that financial intermediation can alter the relative cost of Sustainable compared to Unsustainable operations. Green bonds and the financing of renewable energy projects alleviate some specific financial constraints to clean initiatives, whereas ESG investing promotes business transparency, transition planning, and the integration of issues such as environmental risk into banking decisions. But clarity of conception is important as non-specific definitions allow traditional initiatives to be re-packaged as green ones. The conceptual framework of the review (see Fig 1) relates green finance instruments to capital mobilization, investment in clean technologies, environmental protection and inclusive growth and attainment of the Sustainable Development Goals (SDGs).

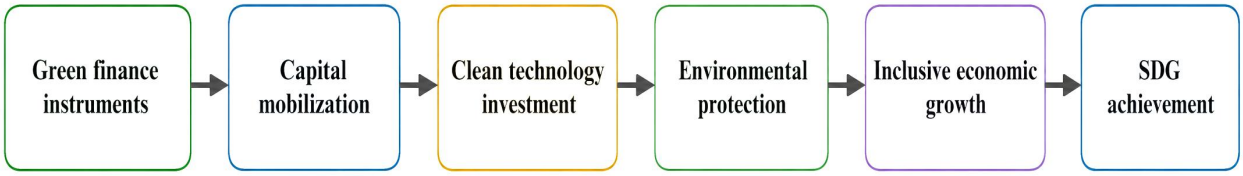

Figure 1. Conceptual Framework Linking Green Finance and Sustainable Development Goals

3. Green Finance and SDG Achievement Pathways

Green finance helps achieve the SDGs in many ways. The second is the clean energy path, supported by finance for renewables, green bonds and concessional climate funds for solar, wind, storage, grid modernization and energy-efficiency projects. This solution delivers carbon reductions to SDG 13, while providing immediate support for SDG 7 delivery. Nevertheless, empirical studies have shown that the features of green finance (i.e. in the Energy governance transform, investment and policy) alleviate the transition to renewable energy and environmental performance associated with green financing.

Second is the road to infrastructure and innovation. Innovation, Infrastructure and Industry Build resilient infrastructure, foster inclusive and sustainable industrialization and encourage innovation You are trained on data till Oct 2023 Green finance could remove barriers for funding for a low-carbon manufacturing, deployment of clean technology smart grids, resource-efficient and green total factor productivity. Evidence from China and other developing country contexts shows that green finance can promote efficiency gains and reduction in carbon intensity especially when used in combination with innovation incentives or non-fossil energy use (Ren et al., 2020; Lee & Lee, 2022).

The third is the urban and circular economy path. Every sustainable city will require smart investment in: From electrified public transit to climate-adaptive water infrastructure, green buildings and emissions-free waste treatment. In particular, green bonds: they offer the long-term financing that infrastructure investments require. Green bonds act as a signaling device for corporate and governmental issuers of the investor's appetite for sustainability, funded by projects with measurable environmental impacts (Banga, 2019; Zerbib, 2019). Fourthly, the road to an inclusive development model. Green financing can contribute to SDG 8

through employment creation, improving access to energy, enhancing the participation of micro, small and medium-sized enterprises in clean value chains, and reducing vulnerability to climate shocks. Inclusion, however, is not automatic. Developing economies need blended finance, local currency instruments, and institutional capacity to avoid exclusion from global green capital markets. Evidence from development suggests the need to judge green finance by environmental performance rather than issuance volume (Bakry et al., 2023).

Fifth avenue is about governance and partnership. Goal 17 Partnership with governments, banks, development agencies and investors, companies & organizations public policy reduces the risks, private finance then flows in, international organizations set the standards, offer guarantees and spread know-how. Table 2 maps selected SDGs to green financing channels and their sectoral uses with available estimates of benefits and indicators associated with benefit realization.

Table 2. Green Finance Contribution to Selected Sustainable Development Goals

SDG	Green finance mechanism	Sectoral application	Expected impact	Example indicators
SDG 7: Clean energy	Renewable energy finance, green bonds	Solar, wind, storage, grids	Higher clean energy access	Renewable capacity, energy intensity
SDG 8: Decent work and growth	Green SME credit, ESG lending	Green enterprises, clean services	Green jobs and resilient growth	Green employment, SME lending
SDG 9: Industry and infrastructure	Green credit, transition finance	Low-carbon industry, smart infrastructure	Cleaner industrial upgrading	Green patents, emissions intensity
SDG 11: Sustainable cities	Municipal green bonds, PPP finance	Transport, buildings, water systems	Urban resilience and lower pollution	Public transport share, building efficiency
SDG 12: Responsible production	Sustainability-linked loans, circular finance	Resource efficiency, recycling	Reduced waste and material intensity	Recycling rate, resource productivity
SDG 13: Climate action	Climate funds, carbon finance	Mitigation and adaptation	Lower emissions and higher resilience	CO2 intensity, adaptation finance
SDG 17: Partnerships	Blended finance, MDB guarantees	Cross-border project finance	Mobilized private capital	Private capital mobilized, co-financing ratio

Figure 2 illustrates how policy support enables green financial products, mobilizes public and private investment, finances sustainable projects, and produces measurable SDG outcomes. This pathway is circular rather than linear because impact evidence should feed back into policy design, investor confidence, and product innovation.

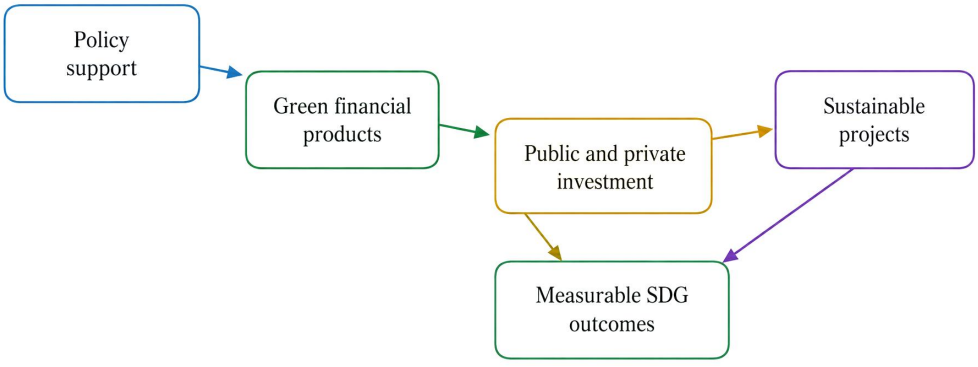

Figure 2. SDG Achievement Pathway through Green Finance Mobilization

4. Role of Financial Institutions, Markets, and Policy Frameworks

Green finance is not something that can be done by one financial actor but a multi-institutional system. Banks are still at the center of the system, determining the price and availability of credit to families, businesses, governments and infrastructure developers. Sustainable banking means taking environmental risk into account when evaluating loans, eliminating polluting businesses and offering funding products linked to energy efficiency, renewable energy and less toxic manufacturing. Physical risk (through impacts from extremes), transition risk, stranded asset and the implications for credit-quality degradation – Central Banks and financial regulators are increasingly of the opinion that climate risk may affect stability. These are not meant to replace climate policy and climate action, but only to make sure that financial supervision, transparency and risk assessment are aware of significant environmental risk (Dikau & Volz, 2021).

Scaling up Green Finance Instruments Green finance by capital markets, by green bonds, by ESG funds, by sustainability-linked bonds, by transition financings instruments. Green bonds are particularly important for connecting long term investors with project pipelines in renewable energy, transit, water and buildings. Research shows that pro-environmental investors are behind the pricing and market integration of green bonds and provide diversification benefits, but their credibility depends on certification, reporting and external assessment (Reboredo, 2018; Tolliver et al., 2020). If the project involves high political, currency or technical risk national governments will resort to development financing institutions and multilateral development banks. Guarantees, concessional loans, first-loss capital and technical assistance could leverage the private financing that would not otherwise enter early-stage green markets.

Ultimately, it is the policy architecture that will determine whether green finance is transformative or symbolic. Green taxonomies restrict the activities that can be considered, disclosure rules enhance comparability, sustainability reporting standards reduce information asymmetries and climate-risk assessment protects against hidden exposures. Blended finance and public-private partnerships help to bridge the bankability gap for adaptation, nature-based solutions and resilience at the community level. The main institutional responsibilities in the development of green finance are listed in Table 3.

Table 3. Institutional Roles in Green Finance Development

Institution	Role in green finance	Policy tool or financial mechanism	Contribution to SDGs	Key challenge
Commercial banks	Allocate credit and screen environmental risk	Green lending, green mortgages, exclusion lists	Mainstreams sustainability in lending	Short-term profitability pressure
Central banks/regulators	Integrate climate risk into supervision	Stress testing, disclosure rules, prudential guidance	Protects financial stability and SDG 13	Mandate and data limitations
Development finance institutions	De-risk early-stage green projects	Guarantees, concessional loans, blended finance	Mobilizes private capital for SDG 17	Project pipeline and governance constraints
Institutional investors	Scale sustainable capital allocation	ESG funds, green bonds, stewardship	Supports long-term SDG investment	ESG rating divergence
Stock exchanges	Promote transparency and market standards	ESG reporting guidance, green bond segments	Improves disclosure and investor access	Compliance cost for smaller issuers
Insurance companies	Price physical and transition risk	Climate-risk insurance, resilience finance	Supports adaptation and resilience	Affordability and risk modelling gaps
Multilateral organizations	Coordinate standards and global cooperation	Taxonomy support, technical assistance	Strengthens cross-border SDG partnerships	Uneven country capacity

The institutional lesson is that financial innovation must be embedded in public accountability. Green finance works best where banks, regulators, investors, and development institutions share consistent definitions,

reliable data, and transparent reporting requirements. Without such alignment, capital may flow toward projects that are easy to label but weak in environmental additionality.

5. Green Finance Instruments and Sectoral Applications

How green funding is allocated among sectors will be key to its impact on the SDGs. The most mature space: solar, wind, storage and grid assets can drive material earnings and carbon reductions. Common instruments in this domain are green bonds, project financing and concessional debt, and Sustainable transport focuses on municipal finance, public-private partnerships and transition loans for street smart electric mobility (e-mobility), train systems and charging infrastructure. Green buildings need mortgages, construction loans and certification-based funding that promotes energy efficiency and climate responsive design.

They include waste management, water management, sustainable agriculture, circular economy and climate adaptation. Cash flows of this indirect, diffuse or public policy dependent nature are inherently more difficult from a financial point of view. Financing for waste and circular economy initiatives through the issuance of green credit and infrastructure bonds becomes possible when the earnings from recycling or the savings due to landfilling or producer responsibility programs are visible. Private investors do not fully appreciate the benefits of averted losses, gains to public health and improvements in resilience and thus, mixed financing is required for adaptation projects (e.g. water). This will require support for sustainable agriculture for soil conservation, water efficiency and low emission production, as well as green finance, crop resilience finance, climate insurance and supply chain investment.

Sectoral funding must therefore decarbonize, increase the productive use of resources, create green jobs, increase resilience and modernize development infrastructure. Figure 3 shows the sectoral application model form, which features green financing connecting interconnected SDG relevant sectors chains to a unified goal of onward people–planet transformation.

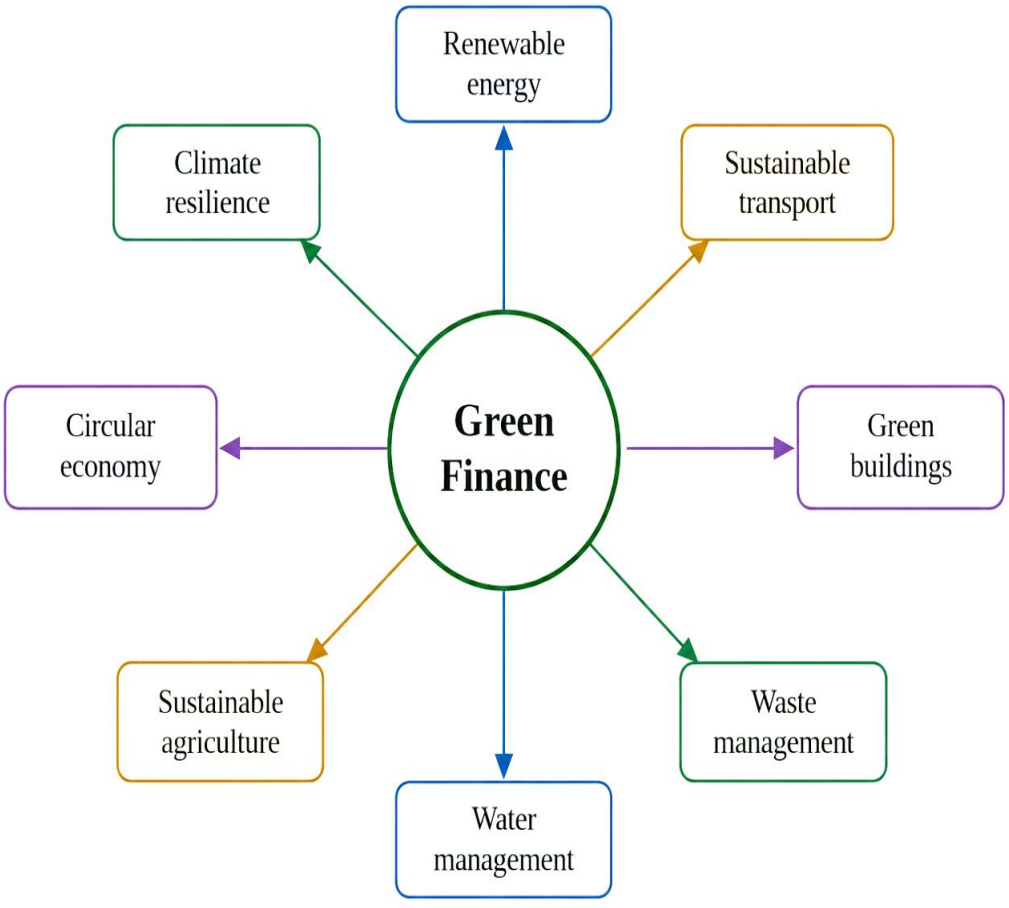

Figure 3. Sectoral Application Model of Green Finance for SDG Implementation

The diversity of these sectors shows why a single instrument cannot achieve all SDG outcomes. Marketable infrastructure may be financed through bonds and loans, while adaptation, inclusion, and rural transformation need blended finance, public guarantees, and local financial intermediation. Table 4 synthesizes the sectoral applications of green finance and their expected sustainability outcomes.

Table 4. Sectoral Applications of Green Finance and Expected Sustainability Outcomes

Sector	Green finance instrument	Sustainability objective	SDG relevance	Measurable outcome
Renewable energy	Project finance, green bonds	Clean generation and storage	SDG 7, 13	MW installed, emissions avoided
Sustainable transport	Municipal bonds, PPP finance	Low-emission mobility	SDG 9, 11, 13	EV adoption, modal shift
Green buildings	Green mortgages, construction loans	Energy-efficient built environment	SDG 11, 12	Energy use per square metre
Waste management	Green credit, infrastructure bonds	Recycling and pollution control	SDG 11, 12	Waste diverted from landfill
Water management	Blended finance, resilience funds	Water efficiency and access	SDG 6, 11, 13	Leakage reduction, treatment capacity
Sustainable agriculture	Green credit, climate insurance	Low-emission resilient farming	SDG 2, 12, 13	Water productivity, soil health
Circular economy	Sustainability-linked loans	Material reuse and product redesign	SDG 9, 12	Material recovery rate
Climate adaptation	Climate funds, guarantees	Resilience to climate shocks	SDG 11, 13, 17	Avoided losses, resilience index

6. Challenges and Barriers in Green Finance Implementation

The idea of green finance is picking up steam, but barriers stop it from fulfilling its potential to deliver on the SDGs. The biggest challenge is greenwashing – marketing financial products as sustainable without robust proof of environmental additionality. This is made more difficult by the lack of common taxonomies, reporting at different levels and the absence of verification. If greenwashing is rampant and investors can't tell the real from the fake, the price of sustainable capital will go up.

The second problem is that access is not equal. Emerging countries usually have higher sovereign risk, more volatile currencies, less attractive project pipelines and less technical capacity for certification and reporting. These risks crowding investment into high carbon infrastructure and major industrialized economies or major corporations, but neglecting local firms, towns and adaptation programmes. Transaction costs are also high, often excluding small scale enterprises due to expensive upfront certification and monitoring and legal structure costs that do not make it feasible for smaller projects. These constraints run counter to the ideal of achieving SDGs inclusively.

A third challenge is the lack of data on climate risk, and how that risk is measured. Investors require clear information on emissions, resilience, technology performance and social protections. Many initiatives are implemented without a baseline, impact indicators or even a long-term monitoring method defined. Uncertainty over clean energy policies also causes investment hurdles. Price and types of state subsidies, as well as rules on carbon pricing and green taxonomy, change frequently. The main barriers and strategic actions for the effective improvement of the SDG effectiveness of green finance are shown in Table 5.

Table 5. Key Barriers to Green Finance and Strategic Responses

Barrier	Explanation	Affected stakeholders	Implication for SDGs	Recommended response
Greenwashing	Sustainability claims lack evidence or additionality	Investors, regulators, citizens	Weakens trust and misallocates capital	External review and enforceable disclosure
Lack of common taxonomy	Different definitions of eligible green activity	Issuers, banks, investors	Reduces comparability	National taxonomies aligned with global principles
Weak disclosure systems	Incomplete ESG and impact reporting	Companies, asset managers	Limits accountability	Mandatory climate and sustainability reporting
Limited access for developing economies	Higher risk and weaker project pipelines	Governments, SMEs, communities	Unequal SDG finance distribution	Blended finance and technical assistance
High transaction costs	Certification and monitoring are expensive	Small issuers, local projects	Excludes small-scale sustainability projects	Aggregation platforms and simplified standards
Insufficient climate-risk data	Poor emissions and resilience data	Banks, insurers, regulators	Weak risk pricing and planning	Open climate data and stress testing
Policy uncertainty	Unstable regulations and incentives	Investors, project developers	Delays long-term green investment	Stable policy roadmaps
Low investor awareness	Limited understanding of green products	Retail investors, pension savers	Restricts demand for green assets	Financial literacy and product transparency
Measurement difficulty	Outcomes are hard to verify over time	Auditors, issuers, beneficiaries	Weak SDG impact evidence	Standardized KPIs and digital monitoring
Unequal capital distribution	Finance flows to bankable sectors only	Rural areas, adaptation projects	Leaves vulnerable groups behind	Inclusive green finance mandates

These barriers show that green finance cannot be evaluated only by the volume of capital issued or invested. Its real value lies in environmental integrity, distributional fairness, and measurable contribution to SDG outcomes. Therefore, the governance of green finance must be as important as the quantity of finance mobilized.

7. Future Research Directions and Strategic Framework

Future research on green finance and SDGs has to go beyond descriptive expansion of green markets towards inclusive analysis of causal impact, distributional implications and implementation quality. More empirical work is needed to understand the extent to which green bonds, green credit, and ESG investment and climate funds deliver additional carbon abatement, resilience improvements and equitable economic outcomes. Research on low- and middle-income countries is most imperative because these economies have the largest SDG investment gaps but typically will receive least amount of private directed green investment. Studies on local-currency-denominated green bonds, blended finance mechanisms with locally based intermediaries,

community-based green banking, and institutional setting (or are attractive to investors with a credible long-term horizon).

Academia and practitioners need frameworks to translate financial inputs into project outputs, environmental outcomes, or impacts at the Sustainable Development Goal (SDG) level. In particular, AI climate-risk analytics could boost risk assessment or geospatial-grounded monitoring and portfolio stress testing app (Muganyi et al., 2021; Nenavath, 2022), while blockchain-based verification and fintech-powered green finance could improve traceability of green bond continues (carbon markets) and sustainability-linked financing (Muganyi et al., 2021; Nenavath, 2022). But for all their promise, tech tools can also result in data exclusion, bias and algorithmic opacity — and dependence on unconfirmed indicators if not slickly managed.

Future research should also consider greenwashing, the convergence of taxonomies, just transition finance, biodiversity finance and the interaction of sustainable financial legislation with real sector decarbonization. A comprehensive strategic framework the results direct our mind towards an integrated strategic framework where green policy governance, financial innovation & institutional involvement, sectoral green investment and effect assessment jointly facilitate SDG acceleration as shown in Figure 4. The rationale says that green finance works well when financial flows are linked to verifiable governance, equitable access and measurable development gains.

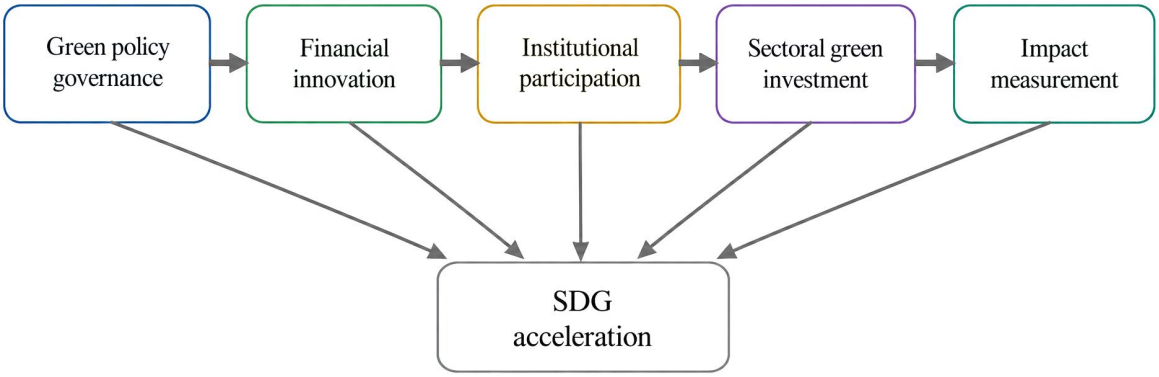

Figure 4. Integrated Strategic Framework for Green Finance and SDG Achievement

8. Conclusion

Green finance is vital to fast-track the achievement of the SDGs by mobilizing funds for projects that are environmentally sustainable and socially responsible. The research also finds that green bonds, sustainable banking, ESG investment and climate finance can also support clean energy, climate action, sustainable infrastructure, circular economy. Its greatest contribution is in turning sustainability goals into investable assets, and in aligning capital allocation with long-term value exposure to environmental risk. But green funding doesn't have to be a transformational process. it works particularly well when it is supported by robust legislative frameworks, transparency in disclosure and institutional engagement, reliability in the measurement of impact and avoidance of greenwashing. Without robust taxonomies and measurable outcomes, green finance runs the risk of becoming a reputational label rather than a development instrument (OECD, 2020). If we do not rollout inclusive design, green capital will also not be delivered to emerging economies, small businesses, adaptation or vulnerable people. The main message is that green finance is not to be seen as just a way of financing the environment, but as a blueprint of development architecture. Such improvement could enhance economic resilience, climate security and sustainable development through the application of a broad range of evidence-based legislation, institutional capability, technology validation and public-private partnerships. Financial institutions need to be greener, more transparent, more inclusive and accountable for measurable social and environmental impacts if the SDGs are to be realized.

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