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GREEN FINANCE NEXUS: A SYSTEMATIC REVIEW OF CLIMATE CHANGE, ESG, DIGITALIZATION, AND ECONOMIC TRANSFORMATION

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RESEARCH ARTICLE

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Abstract

The green finance linkage among various interrelated themes of selected literatures based on green finance with ESG integration and sustainable economic transformation are reviewed systematically. The themes selected for the study include Climate Change, Environmental, Social, and Governance (ESG), Digitalization and Economic Transformation. The literature selection process for the study follows PRISMA 2020 protocol. The records identified for study include 413 articles from Scopus and other databases during the period of 2010-2026, after screening and eligibility assessment, which were refined to 48 relevant literatures as per the inclusion and exclusion criteria. The study focuses on core research themes such as climate change and environmental sustainability, regional and country-specific evidence, digitalization and technological integration, policy-regulation and institutional framework, financial instruments and green banking, green innovation and industrial transformation, ESG, governance and sustainable practices, and economic growth and sustainable development. The green finance transformation is accelerating the achievement of global SDGs (Sustainable Development Goals). The study concludes that the literatures over the period highlights the importance of green finance as a criterion for the sustainable development. Even then, the study evidenced that long -term literatures are not available and most of the literatures under study are covering last ten years. The review study suggests more in-depth research studies need to be conducted based on data, principles, local spread, digital access etc. using mixed methodologies like Econometrics, Network and Sentimental Analysis.

Keywords: *Green Finance; Climate Change; Environmental, Social, and Governance (ESG); Digitalization; Economic Transformation; Sustainability*

Introduction

The 21st century witnessed significant transformation and progression in the field of finance and investment. More focus has been shifted to sustainability perspective. The change initiated during the early period of 21st century. But after 2010 there was a tremendous change in the behaviour of finance and investment. By focusing on sustainability and environment friendly aspects, and joining hands with finance and investment options, the global economic system has accelerated its growth. Environment protection, Sustainability development, Climate changes, Scarce availability of natural resources, inequalities in society etc. forced governments and companies to approach finance and investment decision through sustainable value creation (Han et al., 2023, Shah et al., 2023 and Sun et al., 2025).

Initially the sustainability aspect was discusseda as a part of Corporate Social Responsibility of companies. Then this was shifted to Environmental, Social, and Governance (ESG). The environment considerations while choosing finance and investment options gave birth to the term 'Green Finance' (Ye & Tian, 2025). Green Finance is a financial system where smooth flow of fund to the field of environment - friendly Project is ensured. For e.g. Investment in novel ideas of power help to have pollution control, reduced carbon emissions etc. (Fahim, F., & Mahadi, B. (2022), Yeboah et al., 2025 and Chen et al., 2024).

After 2010 the green finance as an investment option showed its pace in growth. The Paris Accord of 2015, SDGs initiation of UN etc. placed the Green Finance as an essential Part of finance and investment globally. After that, Banks, other financial institutions included ESG aspects among their financial inclusion projects (Sun et al., 2025). While referring literatures, it is evident that, after 2016, the academic research studies in the field of Green Finance has been rapidly progressed. Studies in Green Bonds, ESG, Fintech innovation etc. developed. These studies show a ten times growth in research regarding green

finance, while comparing with the period of 2010-2015. And also, the research areas widened, and spread to econometrics, natural science, data analytics etc. At the same time the growth aspect of green finance also faces a number of challenges. Especially while comparing the economic- financial developments between developed- developing- underdeveloped countries, it is very evident that there exists lack of effective evaluation systems, lack availability of data etc. (Nhamo et al., 2010, Yan et al., 2023 and Pitaloka et al., 2024).

Latest studies in the field of green finance tries to establish relationship between green finance, sustainable leadership and urban renewal systems. Facilities provided by companies such as Green Cities have attracted global leader's environmental consciousness. This is clear evident that how the sustainability measures of cities influence corporate culture and investment pattern (Le et al., 2024). The growth of green finance to the latest stage is attained by passing through the various phases of evolution. The Financial system is now growing by joining hands with sustainable goals along with technology for a better future. (Ozili, 2022).

Statement of the Problem: The research studies in the field of green finance have grown significantly over the years. The research studies are scattered over a number of different themes, methodological approaches and regions. As this wider fragmentation makes it difficult to draw a complete knowledge about the role of green finance in sustainability goals, the themes of climate change, Environmental, Social, and Governance (ESG), digitalization, and economic transformation are focussed here using the method of systematic review of literature.

Scope of the Study: The systematic review study of literature on green finance within the thematic limit of climate change, ESG, digitalization, and economic transformation are considered here. For this purpose, bibliometric- empirical- review based literatures from peer- reviewed journals are focussed. The study summarises existing studies, extracts research gaps and also directs for future research options in green finance.

Objectives

1. To identify, review and classify the existing literatures on green finance in the areas of Climate Change, ESG, Digitalization, and Economic Transformation
2. To examine the methodological tools used in the studies and to assess them on the basis of environmental, social, and economic outcomes
3. To evaluate the assistance of green finance in economic transformation with reference to innovation, growth and sustainable development.

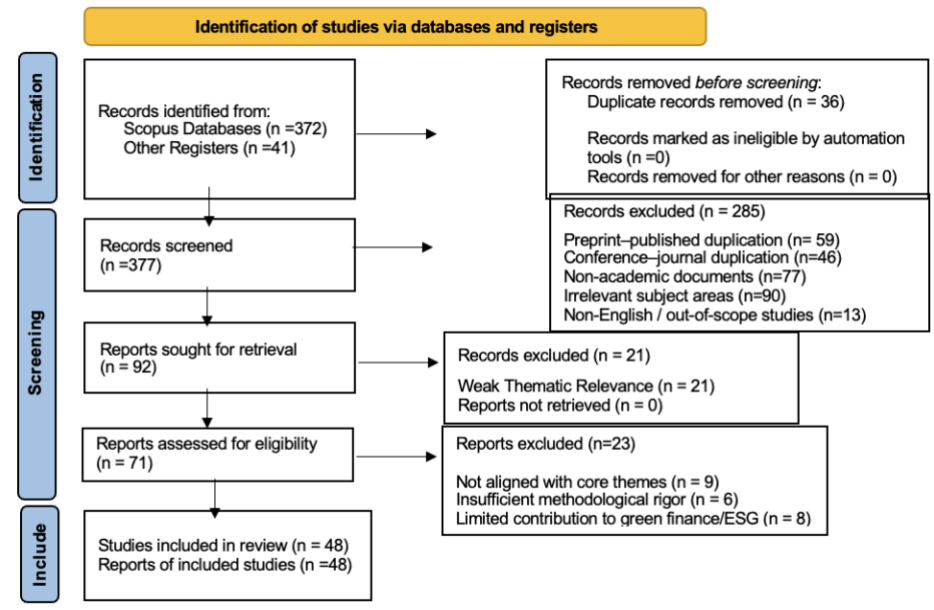
Research Questions

Q1. How does green finance contribute to climate change mitigation and environmental sustainability?
Q2. What is the role of ESG practices in shaping green finance outcomes?
Q3. How the digitalization is influencing the development and implementation of green finance?
Q4. In what ways does green finance support economic transformation and sustainable growth?
Q5. What are the key gaps and future research directions in green finance across these themes?

Methodology

The study is based on a sample of 48 peer- reviewed journal articles finalized after the process of identification- screening-eligibility assessment, on the basis of inclusion and exclusion criteria. This is a review study based on Systematic Literature Review methodology using PRISMA 2020 protocol in order to have a structured and transparent procedure. The integrated extraction of the literature is examined and analysed with a number of themes, methodologies, geographical base and key findings.

The Framework of the study used here is PRISMA2020, which follows the procedure of Identification-Screening-Eligibility-Inclusion. 413 Literatures regarding Green Finance (372 from Scopus database and 41 from other databases) extracted initially, the



Source: (Page et al., 2021)

Fig. 1: PRISMA 2020 Flow Chart

screening process reduced them to 92 (Exclusion criterion: Not in English, Without financial component and low academic quality) the process continued and again excluded 21 articles further (reduced to 71 full text articles) and finally excluded 23 full text articles and finalised to include 48 articles of green finance (inclusion criteria based on the themes of Climate Change, ESG, Digitalization, and Economic Transformation). The review study is conducted on the basis of the 48 selected literatures.

The selected literatures were coded based on key factors of themes, research methods, year, country and focus areas; and they are classified into categories of climate change, ESG, digitalization, and economic transformation.

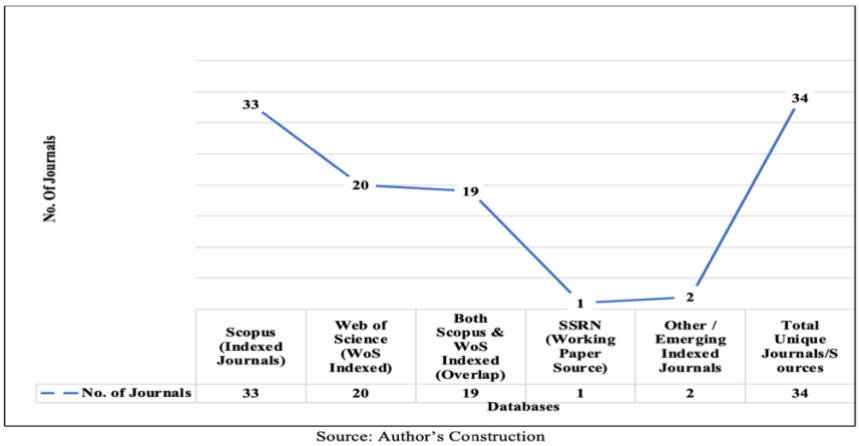
Table 1: Coding and Classification

Variable	Coding Category
Theme	Climate Change, ESG, Digitalization, Economic Transformation
Method	Econometric, Bibliometric, Review
Country	China, India, Other Global Countries etc.
Year	2010–2026
Focus	Environmental, Economic, Social

Source: Author's Construction

Table 2: Research Methodology Applied in Selected 48 Literatures

Research Method	Year of Publication (No. of Articles)								Total No. of Articles
	2010	2013	2015	2022	2023	2024	2025	2026	
Empirical / Econometric Analysis (Panel data, regression, causal models, etc.)	0	0	0	2	4	5	7	1	19
Survey-Based, Primary Data (Questionnaire, SME, firm-level studies)	0	1	1	0	2	2	1	0	7
Case Study Approach	0	0	0	0	0	1	0	0	1
Bibliometric Analysis	0	0	0	1	0	3	0	0	4
Systematic Literature Review (SLR), Review Papers	0	0	0	1	1	0	0	0	2
Conceptual, Theoretical, Policy Analysis	1	1	0	1	1	6	2	0	12
Mixed Methods (Empirical Conceptual, Policy, Institutional frameworks)	0	0	0	0	1	0	2	0	3
Total	1	2	1	5	9	17	12	1	48



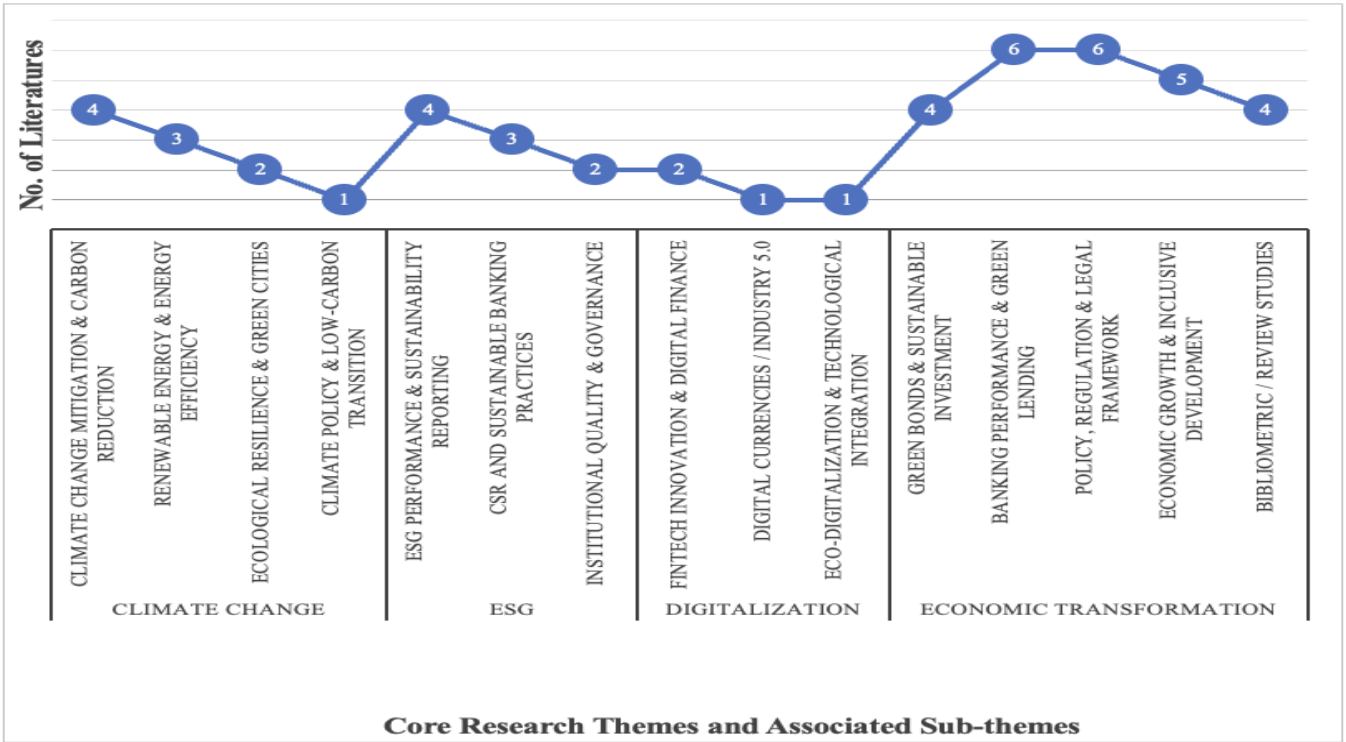
Source: Author's Construction

Fig 2: Journals used from various Databases

Table 3: Concept Category and Key Words used in 48 Literatures

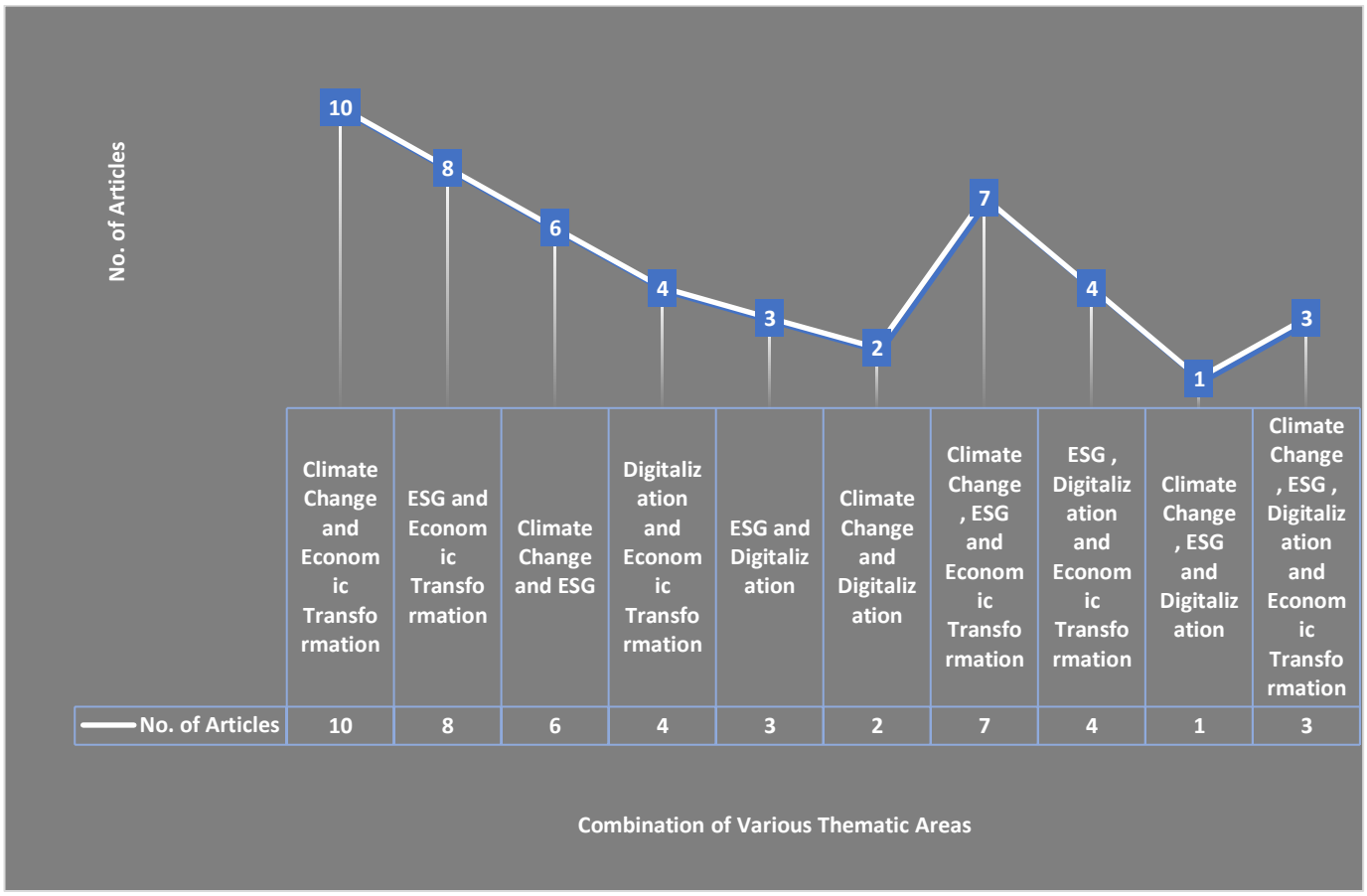
Category	Keywords
Core Concepts	Green Finance, Sustainable Finance, Climate Finance, Green Economy, Environmental Finance
Financial Instruments	Green Bonds, Green Credit, Green Lending, Green Investment, Green Banking, Carbon Finance
Policy & Governance	Environmental Policy, Climate Policy, Green Finance Policy, Institutional Quality, Regulatory Framework, ESG Governance
Sustainability & ESG	ESG (Environmental, Social, Governance), Sustainability Reporting, Corporate Social Responsibility (CSR), Environmental Performance
Environmental Outcomes	Carbon Emissions, CO_2 Reduction, Decarbonization, Climate Change Mitigation, Ecological Resilience
Energy & Innovation	Renewable Energy, Energy Efficiency, Green Innovation, Clean Technology, Low-Carbon Transition
Economic Outcomes	Economic Growth, Inclusive Growth, High-Quality Development, Financial Development, Export Resilience
Sectoral Applications	SMEs, Banking Sector, Industrial Sector, Agriculture, Aviation
Digitalization & Technology	FinTech, Digital Finance, Digital Currency, Eco-Digitalization, Industry 5.0
Methodological Keywords	Econometric Analysis, Panel Data, Regression Analysis, Bibliometric Analysis, Systematic Literature Review (SLR), PRISMA
Geographical Focus	China, India, OECD Countries, Developing Economies, Emerging Markets, Global
Thematic Areas	Climate Change, ESG Integration, Digital Transformation, Green Innovation, Sustainable Development Goals (SDGs)

Source: Author's Construction



Source: Author's Construction

Fig 3: Core Research Themes and Associated Sub-themes Distributed Among Selected Literatures



Source: Author's Construction

Fig 4: Combination of Various Thematic Areas Among the Selected Literatures

Thematic Interpretations and Theoretical Implications

The thematic analysis of selected literatures based on the themes of climate change, ESG, digitalization, and economic transformation highlights a strong inter-relationship between them, which reflects a positive shift toward sustainable financial systems. The core research themes from the selected literatures are analysed here along with their associated sub-themes.

Climate Change & Environmental Sustainability: The green finance through investments and policies gives clear evidence of reduced carbon emissions and achieving climate goals with an enhanced environment quality. (Ali et al. ,2024 and Chen et al., 2024). In developing economies, the environment taxes and FDI play a vital role in strengthening the outcomes of achieving climate resilience and decarbonization. In such a way the green finance assures as a key mechanism for the climate change mitigation (Yeboah et al., 2025). The green finance initiatives direct towards achieving the environmental outcomes through improved energy efficiency and environmental resilience (Wu et al., 2022 and Nepal et al., 2024). The credit risk is reduced by using green lending, and at the same time the carbon neutrality is also supported. The energy sustainability and environmental performance are positively contributed by the green finance (Sinha et al., 2023 and Umar et al., 2021).

ESG, Governance & Sustainable Practices: Corporates with green leadership are able to earn high ESG (Environment Social Governance) scores and more access to green funds. Policy, Governance and Digital Green Transformation: Digital Technologies enhances the transparency of ESG and green bond evaluation. Even then the challenges like data security are also existing there. The various research studies regarding green financing during the period of 2010-2015 (Ye & Tian, 2025; Appiah-Kubi et al., 2024; Chang & Yang, 2024 and Masrick Hasan et al., 2025). The research articles published on ESG evaluated how the performance of ESG measures impact on the company values with the help of techniques like Panel Regression and SEM. The studies showed high ESG scores with lower cost of capital and reduced market volatility'. Even then, there existed 'Green Washing' issues due to inconsistency in ESG rating standards. 'The international standards like ISSB were trying to solve these issues. Even after such measures there exist, the lack of international comparability (Dorry and Schulz, 2018). The Green finance, ESG aspects and corporate disclosure pattern are closely related with each other. The sustainable behaviour and digitalization practices improve the sustainability reporting in SMEs. The studies suggested that the ESG Standards are needed to be included under the preview of Executive Compensatory Board. There can visualize the growing significance of integration of ESG, accountability, transparency in sustainable finance. The green finance policies uplift the ESG performances (Appiah-Kubi et al., 2024, Asif et al., 2025 and Ye and Tian, 2025). Environmentally conscious leaders influence strategies and ESG performance of

companies They implements CSR in such a way that the strategies will result in environment- sustainability oriented organisational (green) practices (Appiah-Kubi et al., 2024 and Gazi et al., 2025).

Economic Growth & Sustainable Development: Green capital financialization influences environmental finance and sustainability (Sibanda, M., 2013). Studies regarding the emerging economies such as Ghana, demonstrates that the green financing facilitates to have an inclusive and sustainable economic growth (Frimpong Henneh and Awunyo-Vitor, 2026). In another study about the importance of knowledge networks and institutional quality in empowering the economic benefits suggests that the green finance promotes log-term environment- economic stability and development (Sun et al., 2025 and Han et al., 2023).

Green Innovation & Industrial Transformation: Green Finance- Technology - innovation related studies gained importance. The studies showed that models like System-GMM, QARDL enhanced the availability of R&D investments which is a symbol of green innovation. The comparison of OECD, BRICS countries indicates that the stimulation of financial activities in a sustainable manner is accelerating the shift towards the secular economy'. 'The Green innovation is working in two directions such as compliance driven and opportunity driven. Most of the studies are on China, EU etc. while the African, Latin American countries remained unexplored (Wu et al., 2022 and Chen et al., 2024). The green financial support helps the firms to invest in green technologies and other environment oriented innovative activities; thereby industrial restructuring is also facilitated (Huang, 2022 and Fu and Wang, 2024). The regulations and policy-driven initiatives of green finance, drives towards low-carbon industrial transitions and thereby it acts as a driving force of sustainability oriented technological advancement and industrial development (Daniya and Tang, 2024 and Fan et al., 2025).

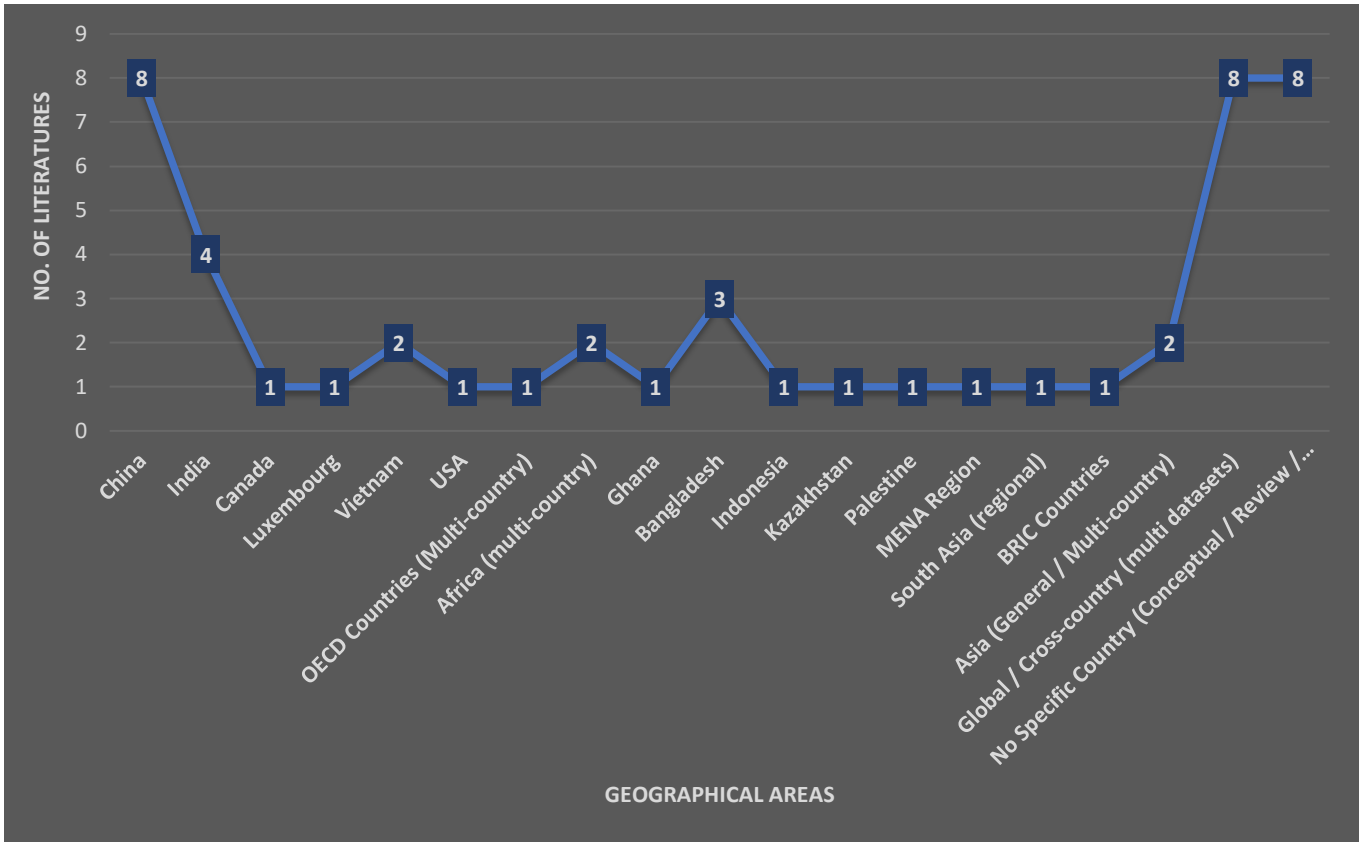
Financial Instruments & Green Banking: The green bonds have become important financial instrument for environment friendly financing options. 'The initial thematic studies analysed the possibilities for Green Bond in Sustainability Investments, then the studies progressed on pricing strategies using the econometric models like ARDL, VAR, VECM. The difference in interest rates of green bonds, the investors are ready to spend on environment friendly bonds at a reduced rate. The green bonds reduce Carbon emissions and increase liquidity on investment portfolios (Liu et al., 2025). Even then the lack of data to analyse the effectiveness of issue of Green Bonds still exists there. Most of the researchers suggest instruments like sustainability- linked bonds in order to enhance the effectiveness of investment. The green financial instruments like green bonds plays a vital role in mobilizing capital. Recently there can found more focus on the growth and importance of green bond markets in emerging economies like India (Bansal et al., 2023 and Prakash and Sethi, 2021). The green bonds are emerging as a productive tool for sustainable project investments and are also attracting more eco-conscious investors. The investors' sentiments are influencing the green bond investments (Kumar et al., 2025). During the period 2010-2015 Banking Sector started to Concentrate on Environment Responsibility aspects. The regulatory framework and policy aspects of green banking confirm the relevance of sustainable financial banking practices (Thi Thanh Tu, T., & Thi Hoang Yen, T., 2015). Major footsteps such as Environment Risk Assessment credit evaluation measures were initiated from countries like India, Malesia, Bangladesh. The initial studies during this period were based on qualitative and survey methods.' These initiatives resulted in establishment of Corporate Banking reflection, even then the direct impact on the increment in profit margin had remained low. The studies based on econometric models during 2013-2020 showed that the green policies were influencing performances of borrowed funds and energy efficiency effectively (Hancock, J., & Scott, B., 2013 Tu et al., 2016 and Uwuigbe, et al., 2022). By the year 2025 the green banking is growing like a strong pillar for a regulated sustainable financing sector by focusing on CSR and green lending practices. There can be seen the evidences of the influence of the same on banking operations and financial outcomes for instance the green lending promotes sustainable-financial performances (Mirza et al., 2023 and Habib and Khan, 2025). The banks adopting green finance-oriented practices not only enhance the environmental and financial outcomes but also achieve sustainability goals and profitability with an integration of CSR (Siddik et al.,2022 and Gazi et al., 2025).

Policy, Regulation & Institutional Framework: The interventions on the part of Government and Central Banks are resulting in the establishment of Green Finance as a system. 'The technological applications like FinTech, AI, Blockchain, Big Data Analytics are increasing transparency and efficiency in Green Credit and Carbon Trading. The Digital Financing results in reduced financial costs and increased financial inclusion, even then there exist challenges like cyber risks and unequal access. Studies indicate that, in order to avoid double counting unified policy formulation common taxonomy for green activities (Sun et al., 2025, Tsindeliani et al., 2023, Saryal, 2024 and Khoffash & Awwad 2024). The institutional quality can influence the green financing positively towards the sustainable development. The regulatory assistance and focus on governance with a environmental orientation can also support the effectiveness of green finance (Sun et al., 2025). The policy and legal aspects frame the green finance implementation. The desired sustainable outcomes can be achieved by well-designed policies and institutions (Saryal, 2024 and Tsindeliani et al., 2023). Co-operation among academic researchers, industrialists and policymakers is essential in order to ensure development of Green Finance in future. This will help to strengthen the data-driven sustainability, technological integration and global policy co-ordination (Han et al., 2023, Yan et al., 2023).

Digitalization & Technological Integration: The Green Finance which was existed as a concentrated aspect on CSR during initial stage has now transformed to a sustainable financial base with the support of AI, Fintech, ESG and Analytics. It was evidenced that the Urban infrastructure systems like digital mobility systems are also found to be influential in the case of Corporate Governance and Environment Leadership (Le et al., 2024). The real green transition is possible only when institutions and society include sustainability as an integral part of financial and leadership level globally. The policy-financial-technology integration is the only fact which enhances Green Finance environment friendly and profitable. Green Finance is not only a

concept, but a Scientific - authoritative development path which protect financial and eco systems together. The digital currencies assist the green finance decision making in Industry 5.0. The intersection of digital transformation and green finance is clearly evident. The fintech and eco-digitalization lead to environment sustainability. The innovations and technological advancements improve the efficiency, accessibility and impact of green financial practices (Nanda et al., 2025, Yan et al., 2023, and Zhang, 2023).

Regional & Country-Specific Evidence: While considering the geographical variations, the country like China shows improvements towards the outward FDI and eco-resilience. Countries such as Kazakhstan, India, Africa and Ghana exhibit that the economic conditions, regional policies and institutional frameworks are playing an important role in the effectiveness of green finance, even then the impact varies across the geographical regions (Le et al., 2024, Liu and Fang, 2024, Hermala et al., 2024).



Source: Author's Construction

Fig 5: Geographical Distribution of the Selected Literatures

Consolidated Findings and Discussion

The summarized analysis of the various studies shows the Green Financing influence on Environment Quality, Innovation and sustainability finance. Green Credit Policies reduces industrial pollution. The Combination of ESG and stability of market induces investors' confidence level/ belief green bonds diversify and create long term benefits to investment portfolios. Digital Finance like AI, Fintech, Block chain strengthens evidence analysis and monitoring. There exists some kind of inequalities also. The most of the studies in the area are focused on Asian and European Countries. The comparative studies based on various region are found to be low in number. The studies lack the foundations of consolidated principle. Even then there exists a large number of studies in experiential basis lacks a principal structure. The latest studies give the evidences for transformation of Green Financing as a major connecting factor into Global Sustainable Development goals. There exist the lack of standardized data systems and cross boarder unified leadership, which form constraints in the way of realizing the true potential of Green Financing. The policy makers should promote inclusive digital infrastructure and unified global ESG reporting. Mixed methodologies comprising of Artificial Intelligence (AI), Machine Learning, Econometrics, Qualitative Policy Analysis etc. should be applied in future research.

Gaps identified

Principle based consolidation of research in the field of Green Finance is needed. The efforts to consolidate Stakeholder Theory, Institutional Theory and Behavioural Finance together are seem to be a few. Indifference in ESG sores and lack of institutional level environmental and sustainable data influences the comparative analysis negatively. Regional inequalities exist in the field of research regarding Green Financing. While comparing to studies all over the world, there can find a limited number of studies

which are covering the regions like Africa and Latin America.It is evidenced that there is non- availability of long term past data. The data collected and analysed are mostly falling into the last ten-year period. The impact verification studies which analyse the matters like how the economic transactions impact on the real environmental results are found to be low. The developing countries are having very low potential in accepting and facilitating the basic infrastructure for green-fintech solutions.

Future Directions

The studies on green financing during the period of 2010 to 2026 shows the following research suggestions that the evaluation of ESG-Fintech integration can be performed by developing Multi- Country Comparative data sets. The micro- level firm-based studies have to be increased, especially in the field of Green Innovation Acceptance. Carbon Finance Research of developing Nations has to be strengthened. Impact Measurement framework needs to be formulated, in order to measure the real effectiveness of Green Finance. The inter-relationship between 'policy, leadership and finance' are to be evaluated by using Mixed methodologies like Econometrics, Network and Sentiment Analysis. In an overall summarized view of the literatures during the period shows that the Green Financing has become an important criterion for sustainable development. Even then, in-depth research is essential in the field of data, principles, local spread, digital access etc. regarding the sustainability and green financing.

Conclusion

During the period from 2010 to 2026 Green Financing has become a system of structural sustainable development from a merely financial concept. While Initial studies on Green Financing were concentrated on Corporate Social Responsibility and environmental awareness, later on the studies developed into the practical evaluation in effectiveness of policy changes and technological innovations. The technological advancements (e.g. AI) lead into digitalization of financial transactions.

The evidences witnessed from the studies clarifies that the Green Financing measures directs to capital investment in the environmentally friendly projects, encourages eco -innovation and reduces risk factor in economic development strategy. The focus areas of selected literatures bring integrated and comprehensive understanding of green finance through environmental, social, technological, and economic dimensions. These interconnected themes on sustainability aspects are directing towards the realisation of key research trends, gaps and future directions.

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