

Green Finance as a Strategic Tool for Environmental Compliance and Sustainable Competitiveness

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Abstract. Research on green finance has largely treated environmental compliance and sustainable competitiveness as separate outcomes, while much of the firm-level evidence remains concentrated in China. This study integrates these strands by examining green finance as both a financing mechanism and a strategic governance tool. Using a documentary and systematic review design grounded in the Natural Resource-Based View, the study synthesised 20 unique empirical studies drawn from an auditable pool of 26 scholarly and policy sources. The evidence was assessed through narrative synthesis and descriptive percentage classification. For environmental compliance, 70.00% of the coded evidence reported positive effects, 20.00% mixed or conditional effects, and 10.00% limiting effects. For sustainable competitiveness, 66.67% reported positive effects, 25.00% mixed, delayed, or conditional effects, and 8.33% weak or inconsistent financial effects. Across the reviewed studies, green finance reduced financing constraints, supported green innovation and operational efficiency, strengthened reputation, and improved access to sustainability-oriented markets. Evidence from Nigeria, Ghana, South Africa, and other emerging economies also showed that outcomes depend on governance quality, digital capability, firm readiness, and institutional support. Overall, green finance is most effective when used as a governance and capability-building instrument rather than merely as a source of capital. Its benefits are strongest where targets are measurable, disclosure is credible, verification is reliable, and products are accessible to smaller firms. The study links these findings to SDGs 7, 8, 9, 12, and 13 and highlights their relevance for emerging-economy policy and firm strategy.

Keywords: Green finance, environmental compliance, sustainable competitiveness, green bonds, ESG, firms.

INTRODUCTION

Background to the Study

Green finance has become an important strategic response to the environmental and competitiveness challenges facing contemporary businesses. Climate change, resource constraints, pollution, and increasingly demanding disclosure requirements are making firms more accountable for their environmental

impacts and more attentive to regulatory and reporting expectations. Green finance can provide dedicated funding for projects and practices that reduce environmental harm, support cleaner production, improve resource efficiency, and strengthen environmental reporting. Corporate green bonds, for example, finance projects with climate objectives, and

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third-party certification can strengthen investor confidence in their environmental credibility (Flammer, 2021). Green finance therefore functions not only as a source of capital but also as a signalling and accountability mechanism.

The relevance of green finance is especially pronounced in developing economies, where firms may face tighter financing constraints, weaker environmental infrastructure, and limited technological capacity. In Nigeria, the Securities and Exchange Commission issued Green Bond Rules in 2018 to support financing for renewable energy, energy efficiency, sustainable water and waste management, climate adaptation, and related green projects (Securities and Exchange Commission Nigeria, 2018). The Nigerian Exchange Sustainability Disclosure Guidelines likewise encourage listed companies to report material environmental, social and governance information (Nigerian Exchange Group, 2019). Together, these frameworks strengthen the connection among regulation, sustainable finance, and corporate reporting.

Environmental compliance involves adherence to environmental laws, standards, permits, disclosure requirements, and voluntary certifications. It may require investment in pollution-control equipment, waste-management systems, emissions monitoring, environmental auditing, ISO 14001 certification, and sustainability reporting. Compliance with these requirements can be technically demanding and costly because it requires capital, specialist skills, and continuous monitoring. Green finance can ease these constraints by providing funding that is dedicated to or conditional on environmental improvement. Gao and Liu (2023) show that green credit policy can improve the environmental performance of high-polluting firms through credit discipline, while Li et al. (2024) show that green credit can improve ESG performance by stimulating green technological innovation.

Sustainable competitiveness is firms' ability to remain profitable, innovative, reputable, and environmentally responsible over the long term. Access to green finance can support competitive advantage by improving access to environmentally conscious markets, strengthening reputation, reducing regulatory risk, improving energy efficiency, and lowering financing constraints. Li and Lin (2024) found that green finance can improve the financial performance of environmentally responsible

firms by easing capital constraints and supporting green investment. However, the evidence is not uniformly positive. Auzepy et al. (2023) and Kim et al. (2025) caution that sustainability-linked finance may be ineffective when KPIs are weak, opaque, or poorly monitored.

This paper integrates firm-level evidence on the links among green finance, environmental compliance, and sustainable competitiveness. It addresses two related gaps: prior studies tend to examine environmental and financial outcomes separately, and limited attention is given to how finance-based compliance mechanisms can be converted into firm-level competitive capabilities. Accordingly, the study asks how green finance facilitates environmental compliance and how it contributes to sustainable competitiveness.

Statement of the Problem

Many firms face financial and technical constraints while environmental regulation and sustainability disclosure requirements become more demanding. Compliance may require clean technologies, environmental management systems, monitoring equipment, certification, waste treatment, and sustainability reporting. These investments can be especially burdensome in developing economies, where green financial markets and environmental data systems are less mature. Firms that cannot meet these requirements may face regulatory penalties, reputational damage, higher operating costs, loss of market access, and declining investor confidence.

Green finance has therefore been promoted in several forms as a potential solution, yet its effectiveness remains context-dependent. Some studies report positive effects of green bonds, green credit, and sustainability-linked loans on environmental performance, ESG disclosure, innovation, and firm value. Other studies find mixed outcomes where greenwashing risks, transaction costs, weak monitoring, or limited access for smaller firms reduce the benefits. The research challenge is therefore to determine the conditions under which green finance supports both environmental compliance and sustainable competitiveness. This study addresses that challenge by synthesising current evidence across the two outcomes.

Objectives of the Study

The main objective of the study is to review the literature on green finance as a

strategic tool for environmental compliance and sustainable competitiveness of firms. Specifically, the study seeks to:

- examine how green finance instruments facilitate environmental compliance in firms.
- assess how green finance instruments facilitate sustainable competitiveness of firms.

Research Questions

The following research questions guided the study:

1. How do green finance instruments facilitate environmental compliance in firms?
2. How do green finance instruments facilitate the sustainable competitiveness of firms?

Significance of the Study

The study is relevant to managers because it shows how green finance can be used strategically beyond project financing, including for environmental management systems, certification, pollution-control technologies, and sustainability reporting. It also has implications for regulators because it demonstrates how financial instruments can reinforce environmental governance when financing is linked to disclosure, monitoring, and credible verification. Investors and financial institutions can use the findings to assess how green finance may reduce environmental risk while supporting firm competitiveness. For scholars, the study integrates two closely related areas of inquiry: environmental compliance and sustainable competitiveness.

The study also links green finance to the Sustainable Development Goals (SDGs). Renewable energy and cleaner production support SDG 7; inclusive firm growth supports SDG 8; innovation and resilient industrial systems support SDG 9; resource-efficient production and credible reporting support SDG 12; and climate-related investment and emissions reduction support SDG 13.

Scope of the Study

The study is a literature review of green finance, environmental compliance, and sustainable competitiveness at the firm level. It focuses mainly on empirical and policy literature published during 2019–2026 and covers green bonds, sustainability-linked loans, green credit lines, ESG equity funds, carbon credits, and green guarantees. The emphasis is on how firms

can use these instruments to meet environmental requirements without undermining long-term competitiveness, with attention to Nigeria and other jurisdictions.

REVIEW OF RELATED LITERATURE

Conceptual Review

Green Finance

Green finance refers to finance mobilised and allocated to activities that generate environmental benefits or mitigate environmental harm. It includes financial instruments, policies, and investment mechanisms supporting renewable energy, climate adaptation, sustainable agriculture, environmental innovation, sustainable waste management, low-carbon transport, and cleaner production. Flammer (2021) describes corporate green bonds as debt instruments whose proceeds are allocated to projects with climate objectives. In Nigeria, the Green Bond Rules identify eligible areas including renewable energy, clean transportation, sustainable water management, climate adaptation, energy efficiency, sustainable waste management, and sustainable land use (Securities and Exchange Commission Nigeria, 2018).

Green finance differs from conventional finance because it attaches an explicit environmental purpose, along with related accountability and disclosure requirements, to the financing process. A green or sustainability-linked loan may incorporate commitments to reduce emissions, waste, or other sustainability indicators, whereas a conventional loan is primarily assessed on creditworthiness and repayment capacity. Auzepy et al. (2023) define sustainability-linked loans as facilities whose terms are linked to sustainability KPIs, while Gao and Liu (2023) show how green credit can influence firm behaviour through credit allocation and environmental-risk screening. In this study, green finance is therefore treated as a strategic financial approach that can support environmental compliance and sustainable competitiveness.

Green Finance Instruments

Green finance instruments channel capital toward environmentally responsible activities. This study considers green bonds, sustainability-linked loans, green credit lines, ESG equity funds, carbon credits, and green guarantees. Green bonds are debt instruments whose proceeds are allocated to projects with environmental benefits. Sustainability-linked

loans may finance general corporate purposes, but their pricing or other terms depend on achieving agreed sustainability targets. Banks can provide dedicated green credit lines for environmentally beneficial projects, while ESG funds allocate equity capital to firms that meet specified sustainability criteria. Carbon credits create a market for verified emissions reductions, and green guarantees reduce lender risk on eligible green projects.

These instruments are significant because they connect financing conditions to environmental behaviour. Green bonds normally require proceeds to be directed to eligible environmental projects and often involve environmental reporting. Sustainability-linked loan pricing can depend on KPIs such as greenhouse-gas reductions, renewable-energy use, or ESG performance. Green credit lines and guarantees can reduce financing barriers to cleaner technologies, while ESG funds can increase pressure for stronger disclosure and environmental controls. Nigeria's sustainable banking and capital-market frameworks further link finance, environmental risk management, and disclosure (Central Bank of Nigeria, 2012; Securities and Exchange Commission Nigeria, 2021). International evidence likewise indicates that well-designed green finance instruments can support innovation, disclosure, and environmental performance.

Environmental Compliance

Environmental compliance refers to firms' adherence to environmental laws, regulations, standards, permits, reporting requirements, and voluntary environmental management systems. These may include national environmental laws, waste-disposal requirements, emissions limits, climate-disclosure rules, ESG reporting guidelines, ISO 14001 systems, and sector-specific permits. Compliance extends beyond avoiding penalties; it also requires internal processes to measure environmental impacts, report sustainability information, prevent pollution, and demonstrate responsible corporate behaviour. This broader understanding is reflected in the Nigerian Exchange Sustainability Disclosure Guidelines and the SEC Sustainable Finance Principles (Nigerian Exchange Group, 2019; Securities and Exchange Commission Nigeria, 2021).

Environmental compliance can require substantial expenditure on monitoring systems, cleaner-production technologies, waste-treatment facilities, emissions measurement,

staff training, auditing, and certification. The costs are often immediate, while many benefits emerge over a longer period. Green finance can help close this financing gap by supporting compliance-related investment. Li et al. (2024) show that green credit guidelines can improve environmental performance through environmental and social risk assessment in credit management. Sun and Hao (2025) further show that third-party certification strengthens the environmental credibility of green bonds and reduces greenwashing risk, highlighting the importance of monitoring and verification.

Sustainable Competitiveness

Sustainable competitiveness is the capacity of a firm to remain profitable, innovative, trusted by stakeholders, and competitive in its markets without compromising long-term environmental responsibility. It goes beyond short-term price or output competition. A firm may perform well in the short run yet remain vulnerable to regulatory sanctions, inefficient resource use, reputational damage, or climate-related risk. Key dimensions of sustainable competitiveness therefore include financial performance, resource efficiency, green innovation, market legitimacy, environmental reputation, and resilience.

Green finance can support sustainable competitiveness by reducing financing barriers, enabling clean-technology investment, lowering energy and waste costs, improving disclosure quality, and strengthening stakeholder trust. Li and Lin (2024) found that green finance improves the financial performance of environmentally responsible firms, while Flammer (2021) showed that credible green bond issuance can strengthen market perceptions. These benefits are not automatic: poorly designed instruments can encourage symbolic compliance, impose high transaction costs, or create greenwashing risks. Credible monitoring and firm-level implementation capability are therefore essential.

Green Finance and Environmental Compliance

Green finance and environmental compliance are closely connected because many environmental obligations require investment in technology, systems, and specialised knowledge. Firms may need environmental audits, ISO 14001 certification, production-facility upgrades, pollution-control equipment, emissions monitoring, and related compliance infrastructure. Green bonds and green credit lines can provide dedicated funding for such

eligible projects and thereby reduce the financing burden associated with environmental compliance.

Conditionality, disclosure, and monitoring can further strengthen the compliance role of green finance. Lenders and investors may require borrowers to set environmental targets, produce impact reports, obtain third-party verification, or maintain environmental management systems. Auzepy et al. (2023) and Kim et al. (2025) show that KPI quality and transparency are central to the effectiveness of sustainability-linked lending. Green finance is therefore more likely to improve compliance when targets are measurable, reporting is credible, and verification is independent. Without these safeguards, the instrument may create greenwashing risk rather than meaningful behavioural change.

Green Finance and Sustainable Competitiveness

Green finance can become a source of strategic advantage when it supports green technology, energy-saving facilities, innovation, and environmental reporting systems. These investments can reduce operating costs, improve product quality, strengthen brand reputation, and attract sustainability-oriented investors. Gao and Liu (2023) show that green credit can improve ESG performance through green technological innovation, while Lei et al. (2025) find that green finance can ease financing constraints and increase research-and-development investment.

Green finance can also help firms reduce environmental-risk exposure and strengthen their competitive position. Strong environmental practices may reduce regulatory penalties, litigation risk, operational disruption, and reputational loss. However, competitiveness effects can vary with firm size, sector, ownership structure, and regulatory pressure. Liao and Zhou (2024), for example, show that green credit policy can create different innovation outcomes across polluting firms. The strategic value of green finance is therefore greatest when financing translates into measurable environmental and market outcomes.

Theoretical Framework

Natural Resource-Based View

The Natural Resource-Based View (NRBV), developed by Hart (1995) as an extension of the Resource-Based View, provides the theoretical foundation for this study. It proposes that firms can achieve competitive advantage by reducing environmental impacts, responding to ecological constraints, and developing environmentally oriented capabilities. Hart (1995) identifies pollution prevention, product stewardship, and sustainable development as strategic capabilities that can support long-term advantage. From this perspective, green finance is not merely a source of funds; it can also support the development of firm-level environmental capabilities.

The NRBV suggests that environmental strategies can improve efficiency, innovation, reputation, and market positioning. Russo and Fouts (1997) linked stronger environmental performance to profitability, while later sustainability research emphasises that valuable environmental resources become strategically important when they are embedded in organisational routines and are difficult to imitate. The theory nevertheless has limits: environmental investment does not automatically produce competitive advantage, particularly where regulation is weak, consumers do not reward green attributes, or smaller firms face disproportionate costs. Auzepy et al. (2023) and Kim et al. (2025) likewise show that sustainable finance may underperform when targets are poorly defined, or disclosure is weak.

The study is grounded in the NRBV because it explicitly links environmental compliance with sustainable competitiveness. Green finance can support pollution-reduction facilities, environmental standards, green innovation, and sustainability disclosure. When firms convert these investments into durable environmental capabilities, compliance can become a source of efficiency, legitimacy, innovation, and competitive advantage. The NRBV therefore provides an appropriate lens for interpreting the firm-level implications of green finance.

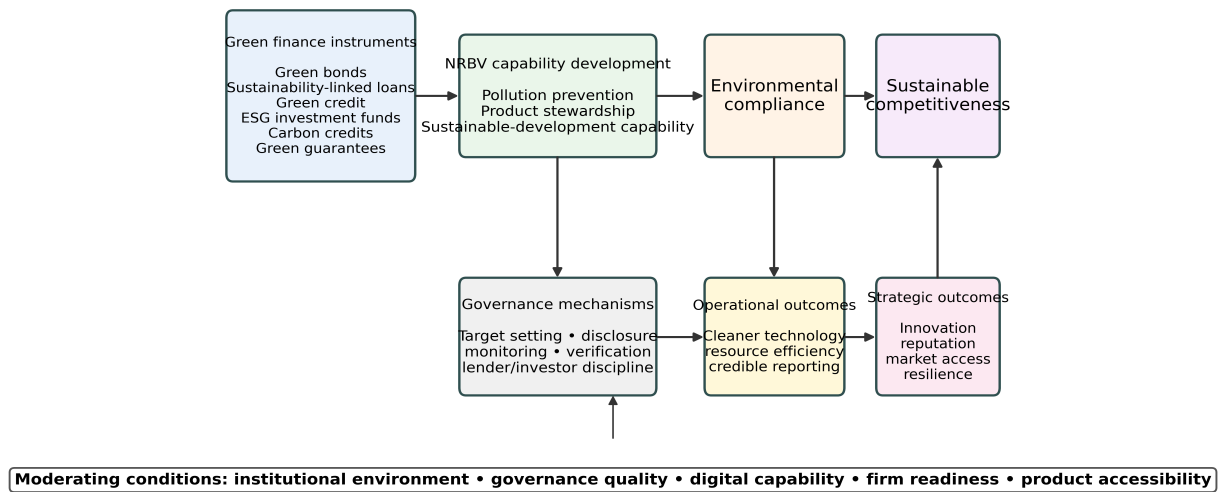


Figure 1. Conceptual pathways linking green finance, environmental compliance and sustainable competitiveness.

Source: Authors' synthesis based on the Natural Resource-Based View and reviewed evidence (2026).

Empirical Review

Green Finance Instruments and Environmental Compliance

Adeyemi et al. (2024) examined whether financial innovation mediates the relationship between green finance and environmental performance in a Nigerian bank. The study used a cross-sectional survey of branch managers in south-western Nigeria, targeting 250 managers and obtaining 200 completed questionnaires. The study used targeted sampling, and the data were analysed using structural equation modelling in STATA 15. The findings showed that green finance improved environmental performance and that financial innovation strengthened this relationship. The authors therefore concluded that green finance can generate stronger environmental outcomes when firms possess appropriate financial-innovation capabilities. The study is relevant because it provides Nigerian evidence that green finance can support compliance-related environmental performance.

Gao and Liu (2023) examined the effect of green credit policy on the ESG performance of Chinese A-share non-financial listed companies from 2010 to 2020. The study used a quasi-experimental design, purposive panel selection, difference-in-differences estimation, and parallel-trend tests. The results showed that green credit improved ESG performance partly by stimulating green technological innovation. The authors described green credit as a disciplinary mechanism that can influence corporate environmental behaviour and argued

for stronger policy enforcement. The study supports the present review by showing how lender pressure and innovation incentives can contribute to environmental compliance.

Li et al. (2024) examined the effect of the Green Credit Guidelines on the environmental performance of high-polluting, high-energy, and surplus-capacity firms. Using a quasi-natural experimental panel design, the study analysed 461 Chinese A-share listed companies from 2008 to 2020 and applied difference-in-differences estimation. The results showed that the guidelines improved environmental performance, including through stronger environmental and social risk assessment. The authors concluded that green credit can encourage environmentally responsible behaviour and recommended stronger bank screening. The study is relevant because it demonstrates how credit conditions can facilitate compliance.

Sun and Hao (2025) examined whether green bond issuance improves corporate environmental performance and whether third-party certification strengthens the effect. The study used an empirical panel design covering green bond issuers and comparable firms with available market and environmental data. The study used purposive sampling and regression analysis. The findings showed that green bonds were associated with improved environmental outcomes and that third-party certification enhanced credibility and reduced greenwashing risk. The authors therefore recommended stronger verification standards. The study is

relevant because it links green bond design to measurable environmental-performance indicators.

Auzepy et al. (2023) examined whether sustainability-linked loans are designed to create credible sustainability incentives. Using a documentary empirical approach, the study assessed a large global sample of sustainability-linked loan facilities issued between 2017 and 2022 for which KPI and pricing information were available. The analysis combined KPI-quality scoring with descriptive assessment. The findings showed that many facilities relied on indicators that did not provide sufficiently strong incentives. The authors argued that targets should be material, ambitious, and measurable and that loan design and disclosure should be strengthened. The study is relevant because it highlights both conditionality as a compliance mechanism and greenwashing as a potential constraint.

Kim et al. (2025) examined sustainability-linked lending in relation to ESG outcomes. The study used a large-scale archival design covering borrowers with available facility, ESG-performance, and transparency data. The authors used purposive selection, followed by comparative and regression analyses. The results showed that ESG scores improved after issuance among high-transparency borrowers but declined among low-transparency borrowers. The authors concluded that credible disclosure is essential if sustainability-linked finance is to improve environmental outcomes and recommended greater transparency in loan contracts. The study is relevant because it identifies monitoring and disclosure as central compliance mechanisms.

Dai et al. (2025) studied the environmental effects of China's Green Credit Guidelines on high-polluting firms using A-share listed-company data for 2006–2022. The study purposively selected firms with the required environmental and ESG information and applied difference-in-differences estimation. The results showed improvements in indicators related to resource efficiency, pollution reduction, and ecological conservation, although effects differed across regions and firm types. The authors therefore recommended differentiated green-credit supervision. The study is relevant because it provides evidence that credit regulation can improve environmental compliance while producing heterogeneous outcomes.

Yu and Xiao (2025) examined the effect of green finance pilot zones on the environmental performance of Chinese companies using a difference-in-differences design. The dataset comprised 2,324 A-share listed companies located inside and outside pilot areas with available environmental-performance information. DID regression and heterogeneity tests were used. The results indicated a statistically significant positive effect of green finance policy on corporate environmental performance, with stronger effects for some ownership and monitoring categories. The authors concluded that targeted green-finance policy can encourage compliance behaviour. The study is relevant because it illustrates the role of green-finance infrastructure in supporting environmental outcomes.

Geng et al. (2023) examined environmental-information disclosure among new-energy listed companies under a green-credit framework. The study used a quantitative panel design, purposively selecting firms with both green-credit and disclosure data, and applied regression analysis. The findings showed that green credit was positively associated with environmental-information disclosure and encouraged more transparent reporting. The authors argued that green credit can support compliance by motivating firms to measure and report their environmental impacts more effectively. The study is therefore relevant to the disclosure dimension of environmental compliance.

Liao and Zhou (2024) investigated whether green credit policy generates substantive or merely symbolic green outcomes among polluting Chinese A-share firms listed between 2009 and 2019. The study used a quasi-natural experiment, a treatment and control-group design, purposive panel selection, and difference-in-differences analysis. The findings showed that, for some financially constrained polluting firms, green credit policy could weaken ESG performance because tighter financing constraints crowded out resources for green innovation. The authors therefore called for complementary policy support for constrained firms. The study is relevant because it identifies conditions under which green credit may limit rather than facilitate compliance.

Green Finance Instruments and Sustainable Competitiveness

Flammer (2021) examined corporate green bond issuance and its effects on firms and

investors using global issuance data for 2013–2018. The study employed an archival empirical design, purposively selecting issuers with available bond, stock-market, and environmental data, and applied event-study and comparative analyses. Green bond announcements generated favourable investor responses, particularly for first-time issuers and certified bonds, while issuer outcomes also changed after issuance. The author concluded that green bonds can signal credible environmental commitment and recommended certification as a credibility mechanism. The study therefore links green finance to reputation and market competitiveness.

Li and Lin (2024) examined the relationship between green finance and the financial performance of environmentally responsible enterprises in China. The study used a quantitative panel design covering firms with green-finance and financial data for 2012–2022. Purposive selection and Generalised Method of Moments estimation were applied. The findings showed a positive and significant relationship between green finance and financial performance, indicating that green financing can strengthen the financial capacity of environmentally responsible firms. The authors consequently advocated greater financing support for green enterprises. The study is directly relevant to the sustainable-competitiveness objective.

Lei et al. (2025) investigated green finance and corporate green innovation among Chinese A-share listed companies using panel data for 2012–2021. Firms with complete information on green finance, financing constraints, and research-and-development activity were selected purposively, and regression-based mediation analysis was applied. The results showed that green finance reduced financing constraints and increased R&D investment, thereby stimulating green innovation. The authors concluded that access to green finance can strengthen innovation capability and recommended measures to improve availability. The study is relevant because green innovation is a major pathway to sustainable competitiveness.

Wang and Liu (2024) examined the relationship between green bond issuance and corporate environmental investment using a quantitative panel design. Firms with green-bond histories and available environmental-investment and financial data were selected purposively, and panel regression was used. The

findings showed that green bond issuance increased corporate environmental investment, with stronger effects among state-owned enterprises and firms facing greater environmental concern. The authors concluded that green bonds can support strategic environmental investment and recommended broader access to bond markets. Such investment can strengthen efficiency, reputation, and long-term competitiveness.

Gao and Liu (2023), already reviewed under the environmental-compliance objective, also provide evidence relevant to sustainable competitiveness. Their difference-in-differences results show that green credit can improve ESG performance through green technological innovation. This pathway connects environmental discipline with reputation, market legitimacy, and strategic differentiation without duplicating the study design discussed in Section 2.3.1.

Adeyemi et al. (2024), discussed in Section 2.3.1, also contribute to the competitiveness objective. Their findings indicate that financial innovation strengthens the environmental-performance effect of green finance in the Nigerian banking sector, suggesting that financial and managerial capabilities can help firms convert green funding into strategic value.

Abidin et al. (2024) examined the effect of green finance on the financial sustainability performance of SMEs in Malaysia and Indonesia using a comparative empirical design. The study focused on SMEs with relevant green-finance and sustainability-performance data and employed purposive sampling and quantitative analysis. The findings indicated generally positive effects, although the strength of the relationship varied with national context and institutional capacity. The authors recommended expanding suitable green-finance products for SMEs. The study is relevant because access to environmental financing can support both sustainability practices and competitiveness among smaller firms.

Hoang (2025) examined the determinants of green finance and green performance among agricultural SMEs in Vietnam, focusing on financial institutions, regulatory frameworks, and enterprise-level initiatives. The study used purposive sampling of SMEs and financing institutions with relevant green-finance experience and applied quantitative sectoral analysis. The findings showed that enterprise readiness, suitable financial products, and

regulatory support improved access to green finance and SME performance. The study therefore indicates that institutional support and managerial capability can strengthen the competitiveness benefits of green finance, particularly for smaller firms.

Liu et al. (2024) examined the effect of green innovation on corporate ESG performance among Chinese A-share listed companies from 2009 to 2021. The authors purposively selected firms with available green-innovation and ESG data and used panel regression. The findings showed that green innovation improved ESG performance across both radical and incremental forms of innovation. The authors recommended policies that encourage firms to strengthen green-innovation capability. The study is relevant because innovation can translate environmentally oriented investment into efficiency, reputation, stakeholder trust, and sustainable competitiveness.

Cheng et al. (2025) examined how green innovation affects future financial and environmental performance using a longitudinal empirical design. The authors purposively selected firms with complete green-patent, financial, and environmental-performance data and applied regression analysis. The findings showed that pollution-prevention innovation improved both economic and environmental outcomes, whereas some pollution-control investments improved environmental outcomes without equivalent financial gains. The authors therefore distinguished among types of green investment and emphasised pollution-prevention innovation. The study is relevant because it shows how the form of green investment can shape sustainable competitiveness.

Khan and Vismara (2025) examined the environmental and financial implications of green bond issuance. The study compared green bond issuers with relevant non-issuing firms using available performance information and quantitative analysis. The findings indicated that green bonds can improve environmental performance, while financial-performance effects vary across the evidence. The authors concluded that environmental benefits may emerge before financial benefits and recommended stronger alignment between green investment and business strategy. The study provides a balanced perspective on the

competitiveness outcomes associated with green bonds.

Wu et al. (2025) explored the relationship among green bond features, ESG performance, and firm valuation. The study focused on issuers with available ESG ratings, bond characteristics, and valuation data and used purposive selection and regression analysis. The findings supported a positive association between appropriately designed green bonds, ESG performance, and valuation, particularly when bond features aligned with credible environmental commitments. The authors concluded that green bonds can strengthen sustainability signalling and market value and recommended more transparent reporting. The study is relevant because it identifies reputation and valuation as pathways linking green finance to competitiveness.

Evidence from Africa and Other Emerging Economies

Appiah-Kubi et al. (2024) studied 352 SMEs and found that green financing positively influenced sustainability reporting both directly and indirectly through pro-environmental behaviour and digital capability. The findings broaden the evidence beyond large listed firms by showing that the compliance value of green finance also depends on smaller firms' ability to collect, manage, and report environmental information.

Dzomonda (2022) studied 600 South African SMEs and found that stronger financial performance was associated with improved access to finance, while corporate governance also shaped the financing relationship. The findings link environmental responsibility, governance quality, and access to finance in an African setting and suggest that stronger compliance capabilities can support competitiveness.

In Ghana, Agyapong and Tweneboah (2023) found that financial readiness and investment preparedness facilitated access to finance for circular-economy activities, particularly where the financial environment supported green investment. Using a sample of 240 Ghanaian firms, Agyabeng-Mensah et al. (2020) further showed that green logistics practices improved environmental performance and generated financial benefits through environmental and market pathways.

Taken together, the emerging-economy evidence indicates that firm readiness, governance quality, digital capability, and the

broader financial environment jointly shape green-finance outcomes. These studies are discussed as context for the original objective-level evidence matrix. The percentages reported in Chapter 4 remain based on the 20 auditable empirical studies specified in the methodology.

Using panel evidence from 41 African countries, Nchofoung et al. (2024) found that green finance can support industrial development, although innovation costs and the transition associated with renewable-energy expansion can reduce short-run benefits. The findings indicate that the competitiveness effect of green finance in Africa depends on absorptive capacity, complementary infrastructure, and managerial capability to manage transition costs.

Evidence from South Africa further shows that institutional design matters. Hilbrich et al. (2025) identified regulatory embedding, practical use cases, interoperability, training, and organisational capacity as important for implementing a sustainability taxonomy. This supports the review's conclusion that green finance produces stronger outcomes when credible governance and implementation capacity are present.

These additional African studies strengthen the contextual interpretation of the findings but were not added post hoc to the original objective-level coding matrix. The 20-study evidence matrix and the percentages reported in Chapter 4 therefore remain unchanged and auditable.

Summary of Empirical Review and Research Gap

The reviewed literature indicates that green finance facilitates environmental compliance mainly through dedicated financing, financing conditions, disclosure, and monitoring. However, its effectiveness is reduced when enforcement is inconsistent, sustainability targets are weak, firms remain financially constrained, or transparency is poor. Across the literature, another recurring limitation is the failure to distinguish clearly among specific compliance mechanisms, such as certification, emissions monitoring, regulatory reporting, and environmental-risk reduction.

Green finance can also strengthen sustainable competitiveness by easing financing constraints, encouraging green innovation, improving efficiency and reputation, and expanding access to sustainability-oriented markets. Evidence from Africa and other emerging economies shows that these pathways

are shaped by governance quality, digital capability, institutional support, and firm readiness. The present study therefore integrates compliance and competitiveness within a single objective-oriented framework rather than treating them as unrelated outcomes.

METHODOLOGY

Research Design

The study used a documentary method and systematic literature review design. No primary data were collected. Instead, empirical studies and policy sources on green finance, environmental compliance, and sustainable competitiveness were identified, screened, extracted, and synthesised in relation to the two research questions. This design enabled systematic comparison of instruments, contexts, methods, and outcomes.

Sources of Data

Secondary evidence was gathered from peer-reviewed journal articles and relevant regulatory/policy documents. The search included both outcome terms (e.g. environmental compliance, environmental performance, ESG disclosure, green innovation, firm performance, market value and sustainable competitive advantage) and instrument terms (e.g. green bonds, sustainability-linked loans, green credit). Citation chaining (tracing references from citations to other relevant articles) was used to find empirical studies.

Inclusion and exclusion criteria

Studies were eligible if they were published in English during the main 2019–2026 period, examined at least one green-finance instrument, and reported firm-level evidence on environmental compliance, environmental performance, ESG disclosure, innovation, financing access, firm performance, market value, or competitiveness. Duplicate studies and sources that were not relevant to the research questions were excluded. Foundational theoretical works and regulatory documents were retained for conceptual and contextual analysis but were not coded as empirical evidence.

Method of Data Analysis

The evidence was organised using narrative synthesis and simple percentage analysis. The following were extracted from each empirical study: green-finance instrument, context, population or data source, sample, analytical method, main finding and relevance in

relation to the research questions. The narrative synthesis was the dominant approach for dealing with the interpretative task, and the percentages were applied only to indicate the frequency of each classification in the review corpus.

A finding was classified as positive when it reported a clear beneficial effect on at least one focal outcome without a substantial countervailing negative result. It was classified as mixed or conditional when the direction or strength varied across subgroups, measures, or contexts, or depended on factors such as KPI quality, transparency, ownership, firm size, regulation, or managerial capability. Negative or limiting evidence included adverse or crowding-out effects and results that were not robust, consistently significant, or sustained across specifications or outcome measures.

Simple Percentage = (Frequency / Total Number of Studies Reviewed in the Category) x 100

The reported percentages are descriptive characterisations of this review corpus; they are not statistical estimates, meta-analytic effect sizes, or population parameters. Each study was counted once per relevant objective, regardless

of sample size, design, or statistical precision. Because the compliance denominator is 10 and the competitiveness denominator is 12, a single additional study would change the respective shares by 10.00 and 8.33 percentage points. The percentages should therefore be interpreted alongside study design, context, and the narrative appraisal rather than as weighted measures of evidential certainty.

Study Selection and PRISMA Flow

All 26 scholarly and policy sources in the auditable review corpus were screened, and no duplicate sources remained in the final corpus. Six sources were excluded from empirical evidence coding, leaving 20 unique empirical studies for qualitative synthesis. Two empirical studies informed both research questions, producing 22 objective-level classifications: 10 for environmental compliance and 12 for sustainable competitiveness. The PRISMA diagram reports only confirmed records because preliminary search hits that were not retained in the final bibliography could not be reconstructed.

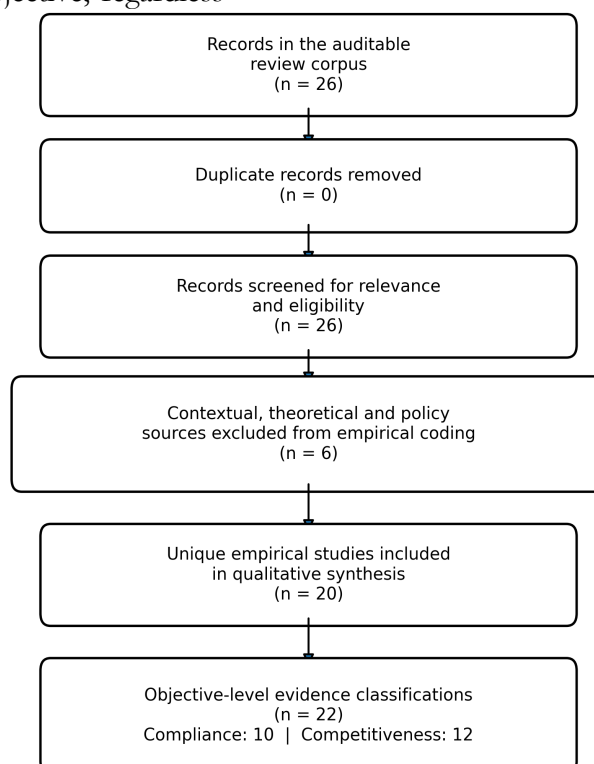


Figure 2. PRISMA 2020 flow of the verifiable study-selection process

Source: Authors' reconstruction from the final review corpus (2026).

ANALYSIS AND DISCUSSION OF REVIEWED FINDINGS

Findings on Environmental Compliance

Table 1. Analysis of Findings on Environmental Compliance

Direction of reviewed findings	Frequency	Percentage
Positive facilitation of compliance/environmental performance	7	70.00%
Mixed or conditional facilitation	2	20.00%
Negative or compliance-limiting effect	1	10.00%
Total	10	100.00%

Source: Researcher's computations (2026)

As shown in Table 1, 70.00% of the studies coded under Objective 1 reported that green finance facilitated environmental compliance or environmental performance. Adeyemi et al. (2024) showed that green finance improved environmental performance in a Nigerian bank, while Gao and Liu (2023) found that green credit stimulated green innovation and improved ESG performance. Li et al. (2024) likewise reported positive environmental effects from the Green Credit Guidelines, and Sun and Hao (2025) showed that third-party certification strengthened the environmental credibility of green bonds and reduced greenwashing risk.

A further 20.00% of the evidence was mixed or conditional, mainly because outcomes depended on loan design, transparency, and

implementation quality. Auzepy et al. (2023) found that some sustainability-linked loans relied on KPIs that were too weak to create credible incentives. Kim et al. (2025) similarly found that high-transparency borrowers improved their ESG scores after issuance, whereas low-transparency borrowers experienced weaker or negative outcomes. The remaining 10.00% represented negative or limiting evidence, as shown by Liao and Zhou (2024), who found that tighter credit constraints could crowd out green innovation among some polluting firms. Overall, green finance supports compliance most effectively when instrument design, monitoring, and complementary support are strong.

Findings on Sustainable Competitiveness

Table 2. Analysis of Findings on Sustainable Competitiveness

Direction of reviewed findings	Frequency	Percentage
Positive effect on competitiveness/performance/innovation	8	66.67%
Mixed, delayed or conditional effect	3	25.00%
Weak or not consistently significant financial effect	1	8.33%
Total	12	100.00%

Source: Researcher's computations (2026)

As shown in Table 2, 66.67% of the analysed evidence reported a positive effect of green finance on sustainable competitiveness. Flammer (2021) found favourable investor responses to corporate green bond announcements, especially when bonds were certified. Li and Lin (2024) reported improved financial performance among green enterprises, while Lei et al. (2025) showed that green finance reduced financing constraints and promoted green innovation. Together, these findings indicate that green finance can strengthen

competitiveness through reputation, improved access to financing, innovation, and financial performance.

A further 25.00% of the evidence provided mixed, delayed, or conditional support, showing that benefits can depend on firm size, ownership, sector, regulatory pressure, and managerial capacity. Green finance can support SMEs where suitable products and supportive policies are available (Abidin et al., 2024; Hoang, 2025). Cheng et al. (2025) also show that pollution-prevention innovation can produce

stronger combined economic and environmental benefits than some end-of-pipe investments. Khan and Vismara (2025) report that green bonds do not generate uniformly consistent financial effects even where

environmental outcomes are favourable. Sustainable competitiveness is therefore not automatic; firms must translate green finance into innovation, efficiency, and credible market signals.

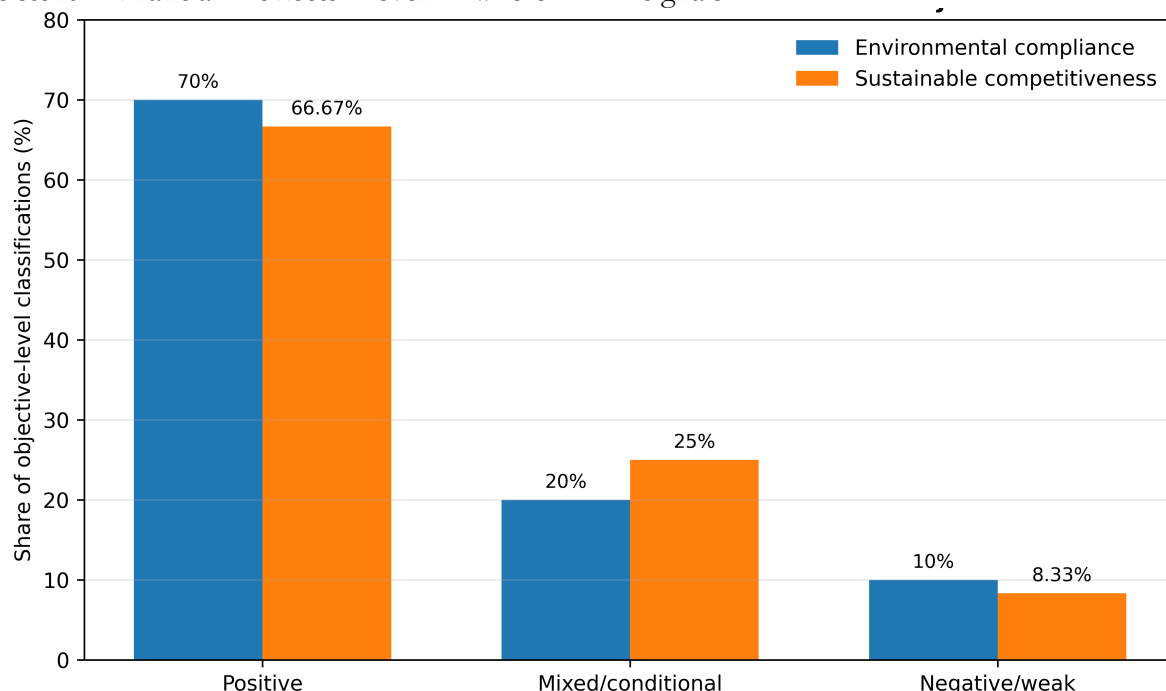


Figure 3. Distribution of evidence classifications across the two review objectives.

Source: Authors' computation from the objective-level evidence matrix (2026).

DISCUSSION OF FINDINGS

The findings show that green finance can support environmental compliance when financing is tied to specific environmental projects, measurable performance targets, disclosure, and verification. Positive outcomes are more likely when credit conditions or bond certification encourage investment in cleaner technologies, monitoring systems, environmental management, and transparent reporting (Adeyemi et al., 2024; Li et al., 2024; Sun & Hao, 2025). In this sense, green finance functions simultaneously as capital and as a governance mechanism.

Green finance can also strengthen sustainable competitiveness by easing financing constraints, supporting green innovation and operational efficiency, improving reputation, and facilitating access to sustainability-oriented markets. Flammer (2021), Li and Lin (2024), and Lei et al. (2025) demonstrate these pathways. The findings are consistent with the NRBV, which suggests that the strategic value of green finance emerges when funding is converted into difficult-to-imitate capabilities such as cleaner

processes, environmental information systems, innovation routines, and credible stakeholder relationships.

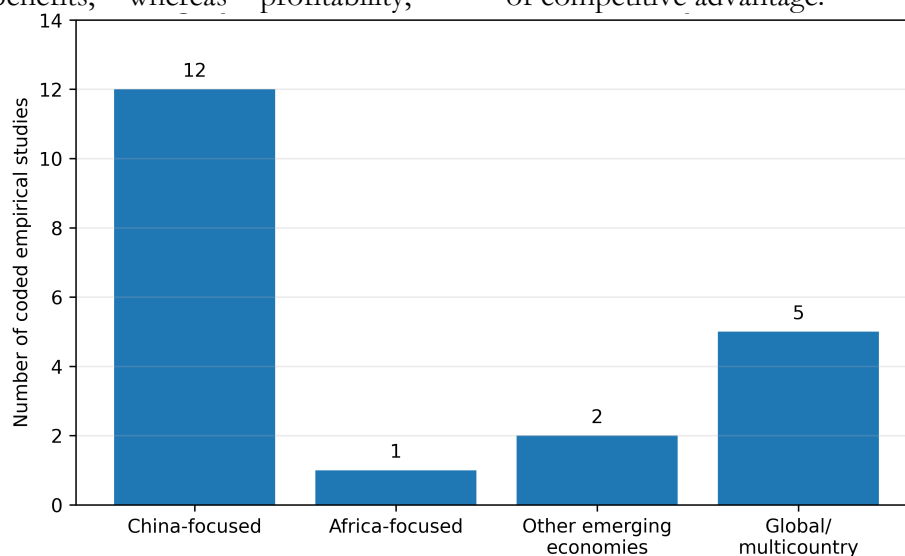
The mixed, conditional, and weak findings require equal analytical attention: they account for 30.00% of the compliance evidence and 33.33% of the competitiveness evidence. Green finance is less effective when sustainability targets are unambitious, incentives are weak, disclosure is inadequate or unreliable, and verification is insufficient. Under these conditions, financing can support symbolic compliance or greenwashing rather than measurable environmental improvement (Auzepy et al., 2023; Kim et al., 2025).

Firm-level and institutional constraints also explain underperformance. Green credit regulation may create a crowding-out effect for financially constrained polluting firms if tighter credit reduces resources for innovation before technical or transition support is available (Liao & Zhou, 2024). Transaction, reporting, and verification costs also weigh more heavily on smaller firms, which may have weaker digital capability and less environmental data with which to demonstrate eligibility. African

evidence similarly indicates that green-finance outcomes depend on governance quality, financial readiness, taxonomy implementation, infrastructure, and related absorptive capacities (Dzomonda, 2022; Appiah-Kubi et al., 2024; Hilbrich et al., 2025; Nchofoung et al., 2024).

A further explanation for mixed findings is the timing mismatch between environmental and financial outcomes. Pollution-prevention investment can produce relatively immediate compliance benefits, whereas profitability,

market-share, and valuation gains may emerge only after firms develop relevant capabilities and stakeholders recognise the credibility of the change. This helps explain why some studies report positive environmental outcomes alongside delayed, conditional, or inconsistent economic returns. Overall, the evidence supports a contingent conclusion: green finance is most effective as a governance and capability-building tool rather than as an automatic source of competitive advantage.



Note: Additional African studies were used for contextual discussion but were not added to the objective-level percentage matrix.

Figure 4. Geographic orientation of the 20 empirical studies in the coded evidence matrix.

Source: Authors' classification of the coded studies (2026); additional African contextual studies in Section 2.3.3 were not added to the original matrix.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

The review examined green finance as a strategic tool for environmental compliance and sustainable competitiveness. For the first objective, the evidence shows that green bonds, green credit, sustainability-linked loans, ESG-related instruments, and associated disclosure mechanisms can finance pollution-control technologies, monitoring systems, certification, and reporting. For the second objective, green finance can strengthen sustainable competitiveness by easing financing constraints, supporting green innovation, improving efficiency, building investor confidence and reputation, and expanding access to sustainability-sensitive markets.

Conclusion

The study concludes that green finance can strategically connect environmental compliance with sustainable competitiveness. It

helps firms meet environmental requirements by financing cleaner production, remediation, monitoring, and disclosure, while also supporting innovation, reputation, investor confidence, and long-term resilience. These benefits depend on credible targets, transparent reporting, reliable third-party verification, regulatory support, and managerial capability. Green finance should therefore be used as a governance and performance instrument rather than as a symbolic public-relations label.

Contribution to Knowledge

This paper contributes to the green-finance literature by integrating two firm-level outcomes that are often examined separately: environmental compliance and sustainable competitiveness. It shows that green finance can support financing, conditionality, monitoring, and disclosure for compliance, while also supporting innovation, reputation, cost efficiency, and market access for competitiveness. The paper further clarifies the relationship between the two outcomes: when

firms use green finance to build credible environmental capabilities, compliance can become a foundation for sustainable competitive advantage.

Recommendations

- Firms should direct green-finance proceeds to verifiable compliance investments, including pollution-control technology, environmental monitoring, ISO 14001 certification, waste-management systems and sustainability-reporting infrastructure.
- Regulators, banks and capital-market institutions need to further strengthen disclosure, third-party verification and sustainability target requirements to incentivize green bonds and sustainability-linked loans to create tangible environmental impact and not greenwashing.
- Since the literature indicates that the capacity and financing requirements of the firms drive their green finance choices and their actual compliance with green finance measures and their green competitiveness, financial institutions should create inclusive green finance products for SMEs.
- Regulators and financial institutions should evaluate green-finance programmes against SDGs 7, 8, 9, 12 and 13, using measurable indicators for clean energy, inclusive growth, innovation, responsible production and climate action.

Limitations and Future Research

This review has several limitations. First, the evidence corpus is relatively small, comprising 20 unique empirical studies and 22 objective-level classifications. Second, the percentage analysis is descriptive and unweighted and therefore does not adjust for differences in sample size, research design, measurement quality, or statistical precision.

Third, the review relies primarily on published English-language research, creating potential publication and language bias. Fourth, the evidence is geographically skewed, with China more heavily represented than Africa and several other emerging-economy contexts. Finally, variation in green-finance instruments and outcome measures limits direct comparability and makes formal meta-analysis difficult.

Future studies should use larger, quality-appraised evidence sets and pre-registered, multi-database search strategies. Where comparable effect measures are available, quality-weighted synthesis and meta-analysis should be considered. More longitudinal and quasi-experimental research is also needed in Africa, other emerging economies, and especially among SMEs to assess how green finance affects compliance and competitiveness over time. Comparative studies should examine how taxonomy design, KPI ambition, third-party verification, digital reporting capacity, ownership structure, and regulatory enforcement shape outcomes across instruments and jurisdictions.

Conflict of Interest Statement

The authors hereby declare no competing interests.

Data Availability

All data generated or analysed during the study are included in this published work (see attached supplementary file)

CRedit (Contributor Roles Taxonomy)

MCM: Conceptualisation, Methodology, Writing-original Draft

FIO: Investigation, Data Curation, Writing-review & editing, Supervision

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