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RESEARCH ARTICLE OPEN ACCESS

Sustainable Corporate Loans: A Systematic Literature Review and Future Research Agenda

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ABSTRACT

This paper presents a systematic literature review of sustainable corporate loans (SCLs), including green loans and sustainability-linked loans, to synthesise current academic knowledge and outline future research directions. Using a PRISMA protocol and a bibliometric analysis of 102 peer-reviewed articles published in AJG-ranked journals (3 and above) between January 2009 and May 2025, the review examines publication trends, theoretical perspectives, methodological approaches, thematic patterns and research gaps. The literature shows rapid growth after 2020, with substantial regional concentration in China, the United States and Europe. Stakeholder theory is the most frequently invoked explicit theoretical lens, although many studies do not anchor their analysis in a clearly stated theory. Quantitative designs prevail, but longitudinal, mixed-method and experimental approaches remain scarce. Four main themes emerge: borrower ESG and financial outcomes, lender incentives and risk management, loan contract features, and macroeconomic implications. Key gaps relate to causal identification, ESG metric standardisation and borrower–lender dynamics in emerging markets.

1 | Introduction

In recent years, sustainable corporate loans (SCLs) have emerged as a critical financial innovation that aligns corporate finance with climate goals and supports environmental, social and governance (ESG) integration. The Emissions Gap Report 2024 warns that achieving a 1.5°C pathway requires global emissions cuts of 42% by 2030 and 57% by 2035 relative to 2019 levels (UNEP 2024). Yet, the Global Landscape of Climate Finance 2024 shows that although annual climate finance more than doubled between 2018 and 2022—from USD 674 billion to USD 1.46 trillion—it remains far below the USD 7.4 trillion needed each year through 2030 (CPI 2024). Within this funding gap, SCLs—structured as green loans, social loans, sustainability-linked loans (SLLs), or broader ESG-linked facilities—stand out by embedding ESG considerations directly into loan terms. Green loans earmark proceeds for sustainable projects, while

SLLs tie pricing to borrower-level sustainability performance targets. This innovation marks a shift from one-off ESG screening to an incentive-based model that dynamically links financial and non-financial performance, positioning SCLs as a vital channel for mobilising private credit toward urgent climate and sustainability objectives.

Unlike green bonds, which are predominantly use-of-proceeds instruments issued in public capital markets, SCLs are private debt contracts that embed borrower-specific ESG incentives directly into loan pricing, covenants and monitoring mechanisms. This contractual flexibility allows lenders to tailor sustainability targets to firm-level characteristics and to adjust incentives dynamically over the loan life cycle. As a result, SCLs position banks as active ESG gatekeepers rather than passive capital providers, distinguishing sustainable lending from bond-based sustainable finance.

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The institutionalisation of sustainable lending has been shaped less by a single statutory regime than by voluntary market standards developed for the syndicated and corporate loan markets. The Green Loan Principles (GLPs), Social Loan Principles (SLPs) and Sustainability-Linked Loan Principles (SLLPs), developed through loan-market associations and market participants, provide reference frameworks for classifying, structuring, reporting and verifying sustainable loan products. The GLPs and SLPs structure use-of-proceeds loans around eligible green or social projects, while the SLLPs focus on borrower-level sustainability performance targets and Key Performance Indicator (KPI)-linked incentives. These principles formalise market expectations for proceeds allocation, KPI materiality, target calibration, reporting, verification and product integrity, creating observable mechanisms through which sustainability claims translate into loan contracts. They also raise researchable questions about credibility, monitoring, borrower incentives and greenwashing risk. According to Flottmann et al. (2025), SLL issuance grew to approximately USD 1.9 trillion between 2020 and 2024, exceeding the volume of sustainability-linked bonds over the same period. This growth reinforces the need to study SCLs as a distinct private-debt contracting mechanism, particularly in bank-based financial systems.

Sustainable lending occupies a distinct position within sustainable finance. Unlike public market instruments such as green bonds, corporate loans use bilateral or syndicated structures that allow borrower-specific ESG KPIs, customised pricing incentives and real-time compliance monitoring. Banks, therefore, act as both capital providers and ESG gatekeepers, shaping borrower behaviour through pricing and covenants. This flexibility enables granular ESG integration, especially in markets with developing disclosure and verification systems.

Despite the growing real-world significance of SCLs, academic attention to this area remains limited and fragmented. While considerable research has examined green bonds and sustainable investing, far less has focused on SCLs, particularly contract design, borrower incentives and comparative regional practices. Recent reviews, such as those by Narula et al. (2025) and Ed-Dafali et al. (2025), examine ESG investing, corporate sustainability and financial outcomes, but offer little focus on the mechanics of ESG integration in private debt instruments (Table A1). Similarly, Verma et al. (2025) have provided useful syntheses of 'sustainable finance' in general. Flottmann et al. (2025) have reviewed articles published on 'green debt' addressing three core themes: (i) sustainability premiums, (ii) stock market responses and (iii) issuers' improvements in environmental, social and governance performance. Although the review covers sustainable loans in part, it mainly focuses on sustainable bonds. Consequently, SCLs have remained analytically overshadowed, with few studies examining them as a discrete category within the sustainable finance ecosystem.

A major gap in the extant literature concerns SCLs' distinctive contractual and institutional features. Compared to green bonds, sustainable loans introduce borrower-level incentives and penalties, demand credible KPI frameworks and raise new challenges in areas such as compliance enforcement, greenwashing and asymmetric information. Moreover, regional disparities in regulatory regimes, ESG data quality and banking market structures

influence how these instruments are designed and implemented across jurisdictions. Nevertheless, the existing reviews either ignore these differences or treat loan- and bond-based instruments as generic 'green debt' or 'sustainable finance' categories.

Guided by these gaps, this review addresses five research questions. First, how has the academic literature on sustainable corporate loans (SCL) evolved in terms of publication growth, outlet concentration, geographic coverage and collaboration patterns? Second, what theoretical lenses, research designs and empirical methods have been used to study SCLs? Third, what does the literature show about the role of SCLs in borrower outcomes, lender behaviour, loan contract design, and macroeconomic or policy effects? Fourth, what credibility challenges arise in SCL markets, particularly regarding KPI design, monitoring, verification, enforcement and the risk of greenwashing? Fifth, what research gaps remain, and what future research agenda can advance understanding of SCLs as private-debt instruments?

To address these shortcomings, this study combines a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-based systematic literature review with bibliometric mapping and thematic synthesis. The PRISMA protocol ensures transparency in search, screening and inclusion decisions; bibliometric analysis maps the structure of the emerging SCL literature; and thematic synthesis interprets the mechanisms through which SCLs operate. Although the field is not yet consolidated, it is sufficiently developed to reveal patterns in publication growth, outlet concentration, country coverage, theoretical framing, methodological choices and recurring topics. We therefore use bibliometric analysis as an early-stage mapping tool, not as evidence of field maturity. This matters because SCL research spans banking, sustainable finance, climate policy, corporate governance and ESG measurement. Bibliometric mapping provides the structural overview needed to organise these strands and guide the thematic synthesis that follows.

Drawing on 102 peer-reviewed articles published in AJG ≥ 3 ranked journals between January 2009 and May 2025, we make three contributions. First, we position SCLs as a distinct private-debt instrument rather than a subset of green bonds or generic sustainable finance. Second, we show how the field has evolved in terms of publication growth, geographic concentration, theoretical framing, methodological choices and topical structure. We map the evolution and structure of the SCL literature and show that the field has expanded sharply after 2020, but remains concentrated in a limited set of journals, countries, theories, methods and topics. The evidence is geographically skewed, with most of the studies focused on China, while other regions remain underrepresented. Theoretical framing is uneven, with stakeholder theory appearing most frequently, whereas agency, institutional and information-asymmetry perspectives are used less often. Methodologically, the field is dominated by quantitative panel designs, especially studies of loan pricing, ESG performance, green innovation and policy effects. These patterns reveal an emerging empirical core but also expose weaker coverage of contract implementation, KPI verification, lender monitoring and cross-country institutional heterogeneity. Third, we integrate borrower, lender, contract and macroeconomic perspectives into a future research agenda centred on credibility, enforcement, KPI design, borrower-lender incentives and institutional heterogeneity.

The rest of the paper is structured as follows. Section 2 describes the methodology, including the PRISMA protocol and journal selection criteria. Section 3 presents the bibliometric analysis. Section 4 provides a thematic synthesis from borrower, lender, contract and economic perspectives, and includes a future research agenda. Section 5 concludes with key findings and implications.

2 | Methodology

We conducted a systematic literature review to investigate the research questions. The review synthesises prior evidence to compare and contrast findings across studies and to identify gaps that motivate a future research agenda (Paul and Criado 2020). This approach is advantageous as it enhances the validity, accuracy and generalisability of previous empirical findings (Wilson et al. 2017). In conducting the systematic literature review, we adhered to the PRISMA¹ framework, widely regarded as one of the most effective for such reviews (Moher et al. 2009). PRISMA enhances transparency, rigour and reproducibility in systematic reviews by providing a structured, unbiased and comprehensive approach to literature search, selection and reporting. The framework comprises four sequential phases: (i) identification, (ii) screening, (iii) eligibility and (iv) inclusion (Moher et al. 2009).

2.1 | Identification

Accordingly, we identified relevant studies through searches in Scopus and Web of Science (WoS), followed by title-based removal of irrelevant articles and duplicates. We began with Scopus because it is the largest multidisciplinary database in the social sciences, is widely used by researchers and encompasses a broad range of academic resources in finance (e.g., Baas et al. 2020; Donthu et al. 2020; Martínez-López et al. 2018). Scopus indexes more journals than most of its competitors, such as WoS (Bartol et al. 2014; Falagas et al. 2008). To identify the relevant body of academic literature on SCLs—while systematically excluding bond-related studies. We applied a detailed Boolean search string designed to capture various terminologies associated with sustainability-focused debt instruments, including green, ESG-linked, impact, ethical, responsible, and values-based finance and banking (see Table 1). Although social loans are part of the broader sustainable-lending framework, this review did not include them as standalone search terms in the Boolean strategy because it focuses on sustainable corporate lending. During the review period, the literature on social loans was predominantly oriented toward social purpose, microfinance, financial inclusion and retail lending rather than the corporate borrowing and contracting mechanisms examined here. Accordingly, the search strategy focused on green loans, sustainability-linked lending, ESG-integrated lending and related sustainable corporate-credit terminology.

To ensure disciplinary relevance, we restricted the results to journal articles classified under the subject areas ‘Economics, Econometrics and Finance’ and ‘Business, Management and Accounting’. We applied additional filters to include only

TABLE 1 | Boolean search query for identifying sustainable corporate loan studies.

<i>TITLE-ABS-KEY</i> (
(‘climate finance’ OR ‘environment borrow*’ OR ‘environment* credit*’ OR ‘environment* finance*’ OR ‘environment* lend*’ OR ‘environment* loan*’ OR ‘ESG-linked borrow*’ OR ‘ESG-linked credit*’ OR ‘ESG-linked finance*’ OR ‘ESG-linked lend*’ OR ‘ESG-linked loan*’ OR ‘ethical bank*’ OR ‘ethical finance*’ OR ‘green borrow*’ OR ‘green credit*’ OR ‘green finance*’ OR ‘green lend*’ OR ‘green loan*’ OR ‘green bank*’ OR ‘impact borrow*’ OR ‘impact credit*’ OR ‘impact finance*’ OR ‘impact lend*’ OR ‘impact loan*’ OR ‘responsible bank*’ OR ‘responsible finance*’ OR ‘responsible lend*’ OR ‘sustainability-linked borrow*’ OR ‘sustainability-linked credit*’ OR ‘sustainability-linked finance*’ OR ‘sustainability-linked lend*’ OR ‘sustainability-linked loan*’ OR ‘sustainable borrow*’ OR ‘sustainable credit*’ OR ‘sustainable finance*’ OR ‘sustainable lend*’ OR ‘sustainable loan*’ OR ‘sustainable bank*’ OR ‘values-based bank*’)
AND NOT TITLE-ABS-KEY (bond*)).

Note: This table reports the Boolean search string applied in Scopus and WoS to identify studies on SCLs. The search captures terminology related to green loans, sustainability-linked loans, ESG-linked borrowing and lending, ethical banking, and responsible finance. Bond-related studies were excluded. Social-loan terminology was not included as a standalone search term because the review focuses on sustainable corporate lending rather than social-purpose, microfinance, financial-inclusion and retail lending.

TABLE 2 | PRISMA protocol.

Stage	Step	<i>n</i>
Identification	Records identified from Scopus	3550
	Records identified from WoS	2329
	Total records identified	5879
	Duplicates removed	2106
Screening	Records after duplicates removed	3773
	Records excluded at AJG 3+ filter	2806
	Records retained for title and abstract screening	967
	Records excluded at title and abstract screening	730
Eligibility	Full-text articles assessed	237
	Full-text articles excluded	135
Included	Studies included in qualitative synthesis	102

Note: PRISMA 2020 flow diagram. Records were identified from Scopus and WoS (total *n* = 5879); after deduplication (*n* = 2106), 3773 records were screened. Screening applied an AJG ≥ 3 outlet filter and relevance checks, resulting in 102 studies included in the synthesis.

documents published in English, of the type ‘article’, and at the final publication or article-in-press stage. Our search, conducted up to May 2025, yielded 3550 candidate records (see Table 2).

We executed an identical search strategy in the WoS database, where we applied further refinements to restrict the results to the categories 'Economics', 'Business Finance', 'Business' and 'Management'. We limited the search to peer-reviewed journal articles published in English and filtered the results by publication stage ('final' or 'early access'). This process produced 2329 additional records.

After removing duplicates across both databases, we obtained a final sample of 3773 unique articles, which formed the initial sample for screening and review. This dual-database strategy ensures robust coverage of the SCL literature and maximises the retrieval of relevant studies while minimising thematic contamination from the green bond literature.

2.2 | Screening

To ensure methodological rigour and maintain comparability across studies, we restricted eligibility to articles published in journals rated 3, 4 or 4* in the 2024 Academic Journal Guide (AJG) issued by the Chartered Association of Business Schools (CABS). We use this threshold as a core-sample filter rather than as a claim that AJG 1 or AJG 2 outlets are irrelevant. A transparent boundary is necessary in any systematic review, particularly when the initial search retrieves a large and interdisciplinary body of records. The $AJG \geq 3$ threshold provides a replicable way to define a manageable sample of studies with more comparable peer-review expectations, reporting standards, methodological transparency and theoretical positioning. Similar sample-bounding strategies have been used in prior systematic and bibliometric reviews; for example, Migliavacca et al. (2022) examine 115 impact-investing papers published in $AJG \geq 3$ journals,² while T. Zhang, Jia, and Chen (2025) also use $AJG \geq 3$ journals in their systematic review of blockchain adoption in sustainable supply chains.

This choice reflects a trade-off between breadth and comparability. Including AJG 2 journals could broaden the sample, especially by adding applied, regional or specialist studies, and may affect the observed geographic, methodological and citation patterns. However, it would also increase heterogeneity in outlet scope, reporting standards and thematic fit. We therefore interpret the 102 (see Section 3.2 for full details) articles as the $AJG \geq 3$ core sample of SCL research, not the full universe of SCL-related publications.

We systematically matched journal titles from the Scopus and WoS search outputs to the AJG 2024 list. To address minor inconsistencies in journal naming conventions across databases, we applied fuzzy string matching to standardise titles and reduce manual misclassification. This procedure identified 967 records published in $AJG \geq 3$ journals for subsequent screening and eligibility checks.

2.3 | Eligibility

In accordance with the PRISMA framework, we conducted the third phase of the review process, which involved a full-text eligibility assessment of the 237 articles retained after abstract-level

screening. We read each article to determine its substantive relevance to the scope of this review. Specifically, we included studies only if they explicitly examined SCLs—defined as debt instruments such as green loans, sustainability-linked loans or ESG-integrated lending products issued by or to corporate entities—and addressed at least one of the five research questions guiding this review. Through this process, we excluded 135 articles that did not meet these inclusion criteria. The final sample therefore comprised 102 peer-reviewed journal articles, each published in an AJG 3 or higher-ranked outlet and deemed methodologically and thematically relevant to the systematic literature review.

2.4 | Inclusion

The final sample constituted the foundation for both the bibliometric and thematic dimensions of this systematic review. These articles, each published in high-quality journals ($AJG \geq 3$), form the bounded core sample used to analyse the state of research on SCLs. To strengthen the completeness of the evidence base, we reviewed the reference lists of the final sample articles to identify additional potential studies. However, we did not identify any further eligible articles through backward citation tracking (Hollebeek et al. 2024). We subsequently analysed and synthesised the selected studies in a two-stage format: (a) a quantitative bibliometric overview and (b) a qualitative thematic synthesis. This dual approach ensures a comprehensive and nuanced understanding of the evolving literature on SCLs (Galletta et al. 2024).

3 | Bibliometric Analysis

This section synthesises bibliometric evidence from the sample articles to characterise (i) research output characteristics (growth, outlet concentration, and geographic and collaboration patterns); (ii) theory, method and robustness (dominant conceptual lenses, empirical designs and identification practices); and (iii) the field's intellectual structure and topical core (keyword co-occurrence, thematic clustering and topic evolution). Each subsection emphasises the main field-level patterns supported by the most relevant figures and tables. These patterns motivate the organisation of Section 4 and inform the research agenda developed from the thematic synthesis.

3.1 | Research Output Characteristics

3.1.1 | Summary Information

The final bibliometric sample comprises 102 peer-reviewed articles (January 2009–May 2025) across 30 journals (Table 3), with an annual publication growth rate of 22.58%. Authorship is strongly collaborative (283 unique authors, only six single-authored papers, and 3.36 co-authors per document), with meaningful cross-border engagement (international co-authorship rate 38.24%). These features matter for interpretation: the literature is large enough to support structured synthesis, but it is also young (average document age 2.33 years) and rapidly expanding, which can produce shifting topical emphasis as new data, standards and policy instruments emerge. The depth of referencing (5387 references) and

the visibility of the sample (mean citations per document: 67.19) suggest a field that has already developed a set of canonical empirical templates and intellectual anchors, which can accelerate the accumulation of evidence but also create path dependence in settings, questions, and identification choices.

3.1.2 | Annual Scientific Publications

The publication trend indicates a clear post-2021 acceleration in SCL research, while annual output before 2021 remained

limited (Figure 1). Publication output reaches 27 papers in 2024. Although 26 papers are recorded for 2025, the search was conducted only through May 2025; the 2025 observations therefore represent a partial year and should not be interpreted as directly comparable with the full-year counts for preceding years. More broadly, the post-2021 expansion suggests that the evidence base has developed largely during a period of rapid change in sustainable lending frameworks, ESG disclosure requirements and data availability.

3.1.3 | SCL Literature by Journals

The outlet distribution indicates concentration with a multi-disciplinary centre of gravity (Table 4). Energy Economics and the International Review of Financial Analysis account for a large share of publications, while interdisciplinary journals (e.g., Business Strategy and the Environment; Technological Forecasting and Social Change) also contribute substantially, signalling that SCL research spans finance, policy and sustainability domains. By contrast, finance-focused outlets (e.g., Journal of Corporate Finance, Journal of Banking & Finance, Journal of Financial Stability) publish fewer studies. However, they more often foreground pricing, contract design and risk. This pattern matters because outlet segmentation is often associated with differences in (i) outcome emphasis (impact/performance versus contracting/risk) and (ii) evidentiary standards for identification and mechanism tests.

3.1.4 | Most Cited Papers in SCL Research

Citation and historiographic evidence indicate that a small set of intellectual anchors and a clear shift in focus over time shape the SCL literature (Table 5). The most-cited study, Goss and Roberts (2011), is the field's pioneering reference point.

TABLE 3 | Summary characteristics of the bibliometric sample.

Particular	Value
Timespan	2009–May 2025
Journals/sources	30
Documents	102
Annual growth rate	22.58%
Authors	283
Single-authored documents	6
Co-authors per document	3.36
International co-authorship	38.24%
Author keywords	367
References	5387
Average document age	2.33 years
Average citations per document	67.19

Note: This table reports descriptive bibliometric statistics for the final sample of 102 AJG 3/4/4* articles on sustainable corporate loans published between 2009 and May 2025.

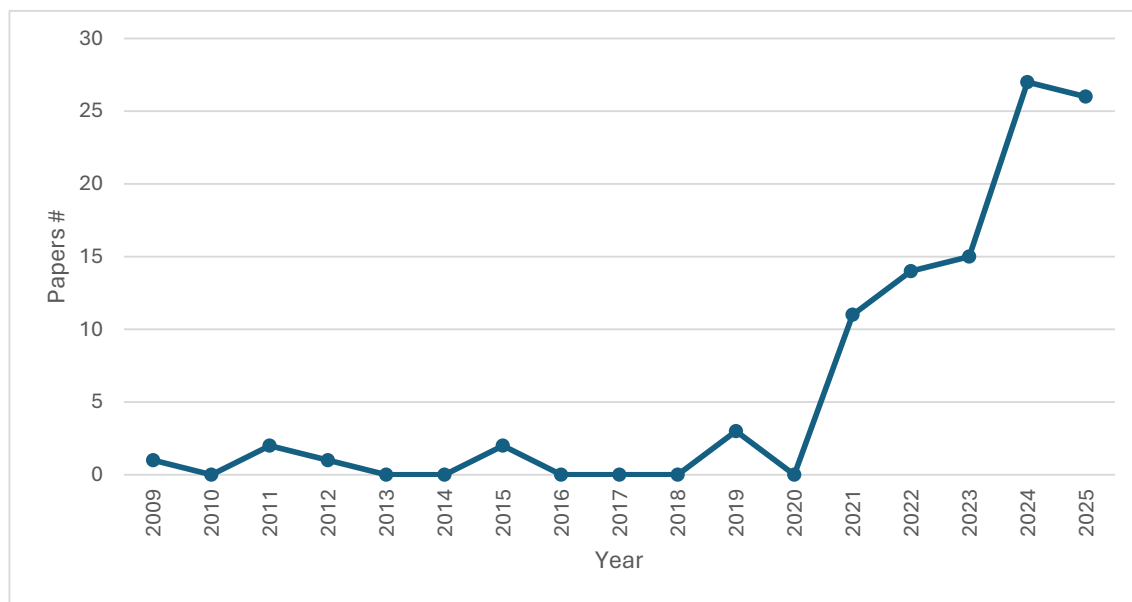


FIGURE 1 | Annual paper publications. *Note:* This figure shows the annual number of SCL publications in the reviewed corpus. Publication activity remained limited before 2021, then increased sharply from 2020 onwards. The search ran through May 2025; therefore, the 2025 observation represents a partial year and is not directly comparable with the full-year publication counts for earlier years.

TABLE 4 | Articles by journals with AJG ranking 2024.

Journal	Articles #	AJG 2024	Publisher
1. Energy Economics	25	3	Elsevier
2. International Review of Financial Analysis	14	3	Elsevier
3. Business Strategy and the Environment	10	3	Wiley
4. Technological Forecasting and Social Change	10	3	Elsevier
5. International Journal of Finance & Economics	4	3	Wiley
6. Economics Letters	3	3	Elsevier
7. European Journal of Operational Research	3	4	Elsevier
8. Journal of Corporate Finance	3	4	Elsevier
9. Journal of Financial Stability	3	3	Elsevier
10. European Journal of Finance	2	3	Taylor & Francis
11. IEEE Transactions on Engineering Management	2	3	IEEE
12. Journal of Banking & Finance	2	3	Elsevier
13. Journal of Business Ethics	2	3	Springer
14. Journal of Economic Behaviour & Organization	2	3	Elsevier
15. Journal of International Money and Finance	2	3	Elsevier
16. British Accounting Review	1	3	Elsevier
17. Ecological Economics	1	3	Elsevier
18. European Accounting Review	1	3	Taylor & Francis
19. Financial Management	1	3	Wiley
20. Financial Markets, Institutions and Instruments	1	3	Wiley
21. International Journal of Production Economics	1	3	Elsevier
22. International Journal of Production Research	1	3	Taylor & Francis
23. Journal of Development Economics	1	3	Elsevier
24. Journal of Financial Intermediation	1	4	Elsevier
25. Journal of Financial Services Research	1	3	Springer
26. Journal of Policy Analysis and Management	1	3	Wiley
27. Journal of the Association of Environmental and Resource Economists	1	3	University of Chicago Press
28. Journal of the Operational Research Society	1	3	Taylor & Francis
29. Review of Finance	1	4	Oxford University Press
30. World Development	1	3	Elsevier
Total	102		

Note: This table lists all journals in which the 102 included studies were published, along with the number of articles and the Academic Journal Guide (AJG) 2024 quality rating.

It provides early large-sample evidence that borrower CSR is priced in syndicated loan contracts, with CSR-linked information and reputational considerations translating into economically meaningful differences in loan spreads and contract terms. It also sets a durable empirical template for treating sustainability-related borrower characteristics as credit-relevant inputs to screening and pricing, a framework later extended to ESG metrics, environmental risk, and policy-driven green credit

settings. Subsequent highly cited work—often centred on policy transmission and green credit interventions (e. g., Hu et al. 2021; Huang et al. 2019; Wen et al. 2021; Zhou et al. 2022)—reinforces scalable quasi-experimental/panel designs and legitimises a core set of outcomes (pricing, investment efficiency, policy transmission), helping explain thinner evidence on contract implementation (e.g., KPI verification, renegotiation, enforcement) that is harder to observe in standard datasets.

TABLE 5 | Most-cited studies in the SCL core sample.

Study	Journal	Citations
Goss and Roberts (2011)	Journal of Banking & Finance	1121
Hu et al. (2021)	Energy Economics	560
Huang et al. (2019)	Technological Forecasting and Social Change	418
Wen et al. (2021)	Energy Economics	395
Zhou et al. (2022)	Ecological Economics	370
Yao et al. (2021)	Energy Economics	328
An et al. (2021)	European Journal of Operational Research	325
Xing et al. (2021)	International Review of Financial Analysis	277
Fan et al. (2021)	Journal of Development Economics	255
D. Zhang (2021)	International Review of Financial Analysis	215

Note: Citation counts are raw citation counts from the bibliometric dataset. They describe visibility within the $AJG \geq 3$ SCL core sample, not article quality.

3.1.5 | Geographic Concentration and Collaboration Networks in SCL Research

Geographic and collaboration patterns jointly indicate that knowledge production in SCL research is highly concentrated and networked (Figures 2 and 3). China accounts for roughly 60% of corresponding authorships, consistent with its green credit regulation and mandated data environment, but this also anchors a large share of evidence in a specific institutional setting (Figure 2). The United Kingdom ranks second, largely through international collaboration, with Australia and several European countries contributing through broader cross-border ties. At the same time, collaboration involving North America and the Middle East remains minimal, implying that external validity is a first-order constraint (Figure 3). Mechanisms identified in highly regulated or state-influenced banking environments may not generalise to jurisdictions with weaker enforcement, different bank ownership structures or less standardised disclosure. This concentration also points to a feasible research frontier—multi-country comparative designs exploiting heterogeneity in disclosure and enforcement—to distinguish general contracting mechanisms from institution-contingent policy effects, which we prioritise in Section 4 of the agenda.

Taken together, the post-2021 expansion, outlet segmentation and China-centred research production suggest a rapidly maturing but institutionally concentrated literature. The next subsection therefore evaluates how theory and empirical designs address recurring inference threats—selection, ESG measurement and policy endogeneity—before mapping the field's topical core and organising the thematic synthesis in Section 4.

3.2 | Theory, Method and Credibility of SCL Research

3.2.1 | Research Designs and Theoretical Framing

Theoretical framing is limited and uneven. Among studies that explicitly state a theoretical lens, stakeholder theory is the most frequently invoked framework, followed by signalling and

legitimacy perspectives, as summarised in Table 6. However, most studies in the sample lack a clearly articulated theoretical foundation. This matters because the literature has largely advanced through empirical evaluation of observable outcomes—loan pricing, ESG performance, credit allocation, green innovation and policy effects—rather than through theory-driven analysis of contracting frictions, KPI negotiation, verification, monitoring, renegotiation or institutional enforcement.

The evidence base is overwhelmingly empirical and quantitative. Empirical studies account for 81.37% of the literature, and quantitative designs represent 76.47% of all studies, consistent with the distribution reported in Table 7. This concentration has accelerated the accumulation of results on measurable outcomes, but it also leaves limited direct observation of how SCLs operate inside the contracting process. Mechanism-revealing designs remain rare: qualitative studies constitute only 2.94% and mixed-method studies 1.96%. Theoretical contributions, which account for 18.63% of the sample, typically offer conceptual framing rather than empirically testable accounts of KPI negotiation, verification, monitoring and renegotiation.

3.2.2 | Empirical tools and credibility checks

Empirical modelling in SCL research is highly standardised. Among the 78 quantitative studies, multivariate linear regression is the principal statistical approach in 65 studies (83.33%), while multivariate logistic regression is used in seven studies (8.97%), as documented in Table 8. This toolkit has generated a large body of comparable evidence on average effects, particularly for pricing and issuance outcomes. At the same time, it may undercapture features that are structurally plausible in SCL settings—non-linear responses created by margin ratchets, heterogeneous effects across borrower types and regulatory regimes, and multi-dimensional KPI architectures—when these are collapsed into single indicators or average-effect specifications. Alternative approaches are used infrequently: synthetic control appears in two studies (2.56%), while the remaining statistical approaches appear in one study each.

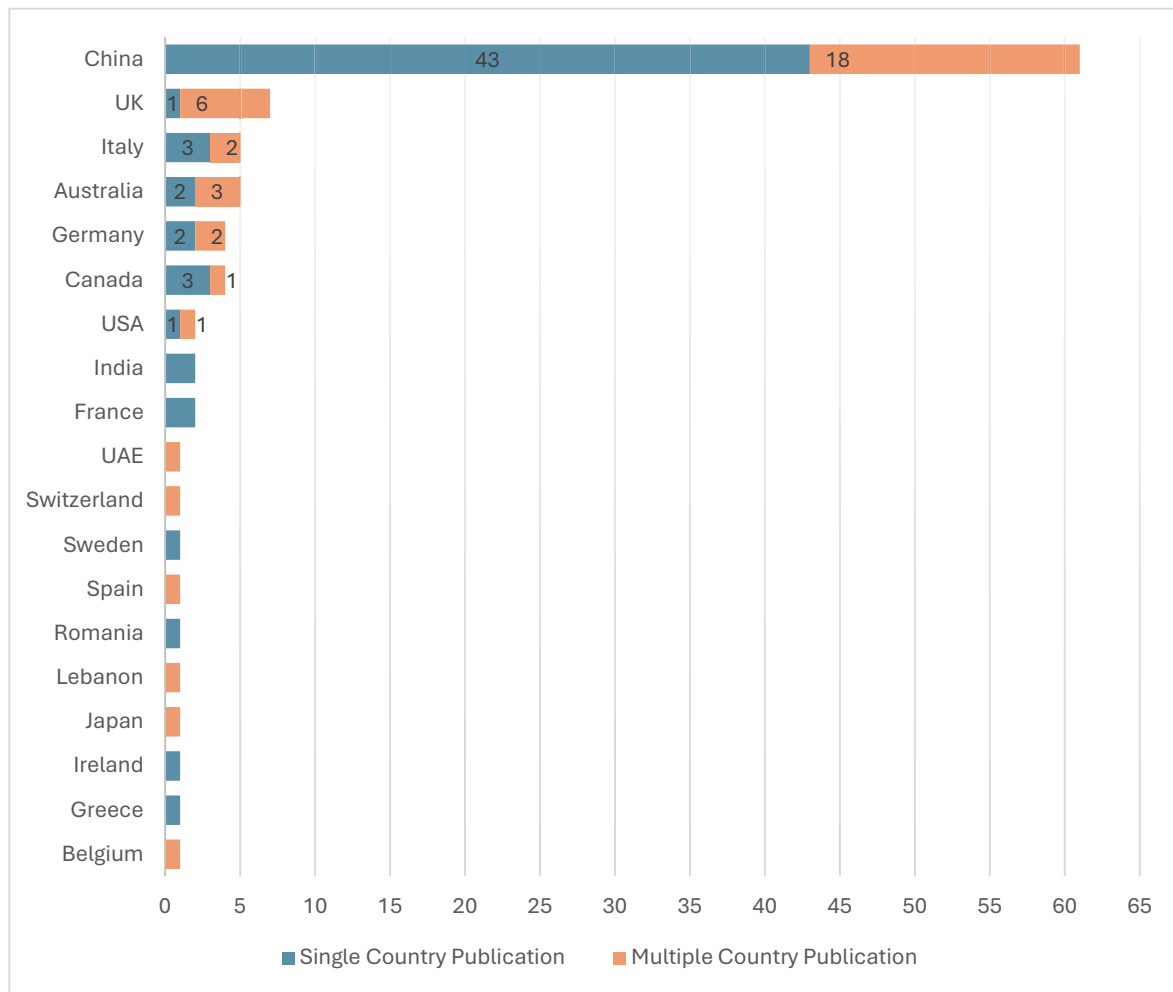


FIGURE 2 | Geographical distribution of SCL publications. *Note:* The figure shows the country distribution of SCL publications by author affiliation. China dominates the corpus, while cross-country publications are mainly concentrated among China, the United Kingdom, Australia, Italy, Germany, Canada and the United States.

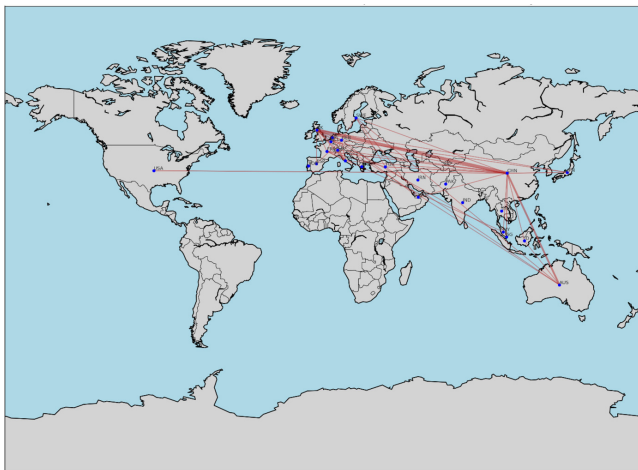


FIGURE 3 | Global collaboration in SCL research. *Note:* This map shows country-level collaboration in SCL research based on authors institutional affiliations. Lines indicate cross-country co-authorship links, not the geographic setting of the study samples. The collaboration network is concentrated around China, Europe, the United Kingdom, Australia and the United States while Africa, Latin America and the Middle East remain weakly represented.

Credibility checks show a similarly concentrated pattern. Difference-in-differences (DiD) is the most common strategy (39 studies), followed by PSM (28 studies), with IV/2SLS used in 14 studies, as shown in Table 9. These are established identification tools, but the credibility of conclusions hinges on transparent diagnostics and sensitivity assessment. Notably, methods that explicitly quantify robustness remain rare: Bootstrapping and Monte Carlo simulation appear only once each, and omitted-variable sensitivity approaches are scarcely used. This matters because selection into SCL contracts and measurement noise in ESG variables are structural threats in this literature, and limited sensitivity practice can weaken confidence in mechanism-based interpretations even when headline estimates are stable.

3.3 | Intellectual Structure and Topical Core

The intellectual structure of SCL research is organised around a compact topical core that links sustainable credit allocation to measurable outcomes and policy transmission. Across keyword salience, clustering and network structure, the field's centre of gravity consistently focuses on impact/performance evaluation,

TABLE 6 | Most used theories in different papers.

Theory	Papers #	Example Paper
Stakeholder theory (Freeman 1984)	9	(Ma et al. 2024)
Signal theory (Spence 1973)	4	(Gambacorta et al. 2024)
Legitimacy theory (Dowling and Pfeffer 1975)	3	(Zhou et al. 2022)
Agency theory (Jensen and Meckling 1976)	2	(Peng et al. 2025)
Information asymmetry theory (Akerlof 1970)	2	(Xing et al. 2021)
Resource-based theory (Barney 1991)	2	(Lu et al. 2025)
Institutional theory (Meyer and Rowan 1977)	1	(Sun et al. 2019)
Shareholder theory (Friedman 1970)	1	(Böhm et al. 2025)

Note: This table reports theories explicitly invoked in the reviewed studies. Counts refer to explicit theoretical use and are not necessarily mutually exclusive, as some studies may draw on more than one theoretical lens. Many studies in the sample do not state a formal theoretical framework.

TABLE 7 | Type of research: theoretical and empirical.

Research type	Papers #	Papers %	Example paper
Theoretical papers:	19	18.63	(Le et al. 2024)
Empirical papers:			
Quantitative	78	76.47	(Xu and Lin 2025)
Qualitative	3	2.94	(Gambacorta et al. 2024)
Mixed	2	1.96	(Weber 2012)
Sub-total	83	81.37	
Total	102	100.00	

Note: This table summarises the distribution of theoretical, quantitative, qualitative and mixed-method studies among the final sample of 102 papers.

TABLE 8 | Most used statistical tools in different papers.

Statistical tool	Papers #	Papers %	Example paper
Multivariate linear regression	65	83.33	(Liu et al. 2024)
Multivariate logistic regression	7	8.97	(Neagu et al. 2024)
Synthetic control method	2	2.56	(Sun et al. 2019)
Semi-parametric econometric model	1	1.28	(Xu and Lin 2025)
Descriptive analysis	1	1.28	(Mengze and Wei 2015)
Data envelopment analysis (DEA)	1	1.28	(Li et al. 2024)
Bayesian inference	1	1.28	(Galán and Tan 2024)
Total	78	100.00	

Note: This table identifies the principal statistical techniques used across the 78 quantitative studies in the review sample. Percentages are calculated using the 78 quantitative studies as the denominator and may not sum exactly to 100% because of rounding.

green credit and policy, and climate-finance alignment. At the same time, governance- and social-dimension constructs remain comparatively peripheral. This section synthesises this structure and its evolution, using Figures 4–7 as supporting evidence.

3.3.1 | Topical Salience and Clustering

Topical salience indicates that the literature has converged on an outcome-oriented vocabulary. High-frequency keywords cluster around impact, performance, green credit and green

TABLE 9 | Most used robustness test instruments in different papers.

Robustness instrument	Instrument usage	Papers #	Example paper
Causal inference:			
Difference-in-differences (DiD)	Controls for unobserved time-invariant heterogeneity. Often used with panel data.	39	(Xu and Lin 2025)
Propensity score matching (PSM)	Balances treatment and control groups based on observables.	28	(Tian et al. 2024)
Placebo	Checks for spurious effects by assigning ‘fake’ treatments.	10	(Fan et al. 2021)
Endogeneity correction:			
2-Stage least square (2SLS)	Uses instruments to correct endogeneity.	14	(Gu et al. 2023)
Heckman	Corrects for selection bias using a two-step estimation.	4	(Tian et al. 2023)
Generalised method of moments (GMM)	Efficient estimator for over-identified models; handles endogeneity.	3	(Zhou et al. 2022)
Lags	Includes lagged variables to control for endogeneity or serial correlation.	2	(Khan et al. 2021)
Simulation-based tests:			
Bootstrapping	Estimates sampling distribution by resampling the data.	1	(Liu et al. 2025)
Monte Carlo simulation	Simulates synthetic datasets to test model sensitivity to data-generating processes.	1	(Tan et al. 2022)
Omitted variable bias assessment: Oster-test	Tests robustness of coefficient estimates to omitted variable bias	1	(Degryse et al. 2023)

Note: This table documents robustness tests and endogeneity correction methods commonly employed in SCL studies, including causal inference designs, instrumental variable approaches and sensitivity checks.



FIGURE 4 | Keyword-cloud of SCL research. Note: This word cloud summarises the most frequent keywords in the reviewed SCL literature. Larger terms indicate stronger keyword prominence. The field is mainly centred on *performance*, *impact*, *green credit policy*, *green credit*, *investment*, *CSR* and *innovation*, suggesting an outcome- and policy-oriented literature.

credit policy, signalling that SCL research is primarily framed as an empirical evaluation problem. This also indicates how sustainability-linked credit relates to pricing, allocation and firm outcomes—rather than as a process-oriented account of contracting and enforcement. This concentration is evident in the keyword distribution and the relative weight of core terms in the clustering output, which together suggest that the field’s dominant questions are those that can be consistently operationalised

within standard datasets (Figure 4). The secondary clusters around innovation, regulation, investment and banking institutions indicate an expanding—but still complementary—interest in enabling conditions and channels that connect sustainable lending to broader economic and environmental transitions.

3.3.2 | Temporal Evolution of Concepts

Temporal evidence suggests that consolidation has intensified in recent years. Conceptual attention shifts toward instrument- and policy-specific language over time, with sustained prominence of impact/performance evaluation and green credit policy themes, indicating that the literature increasingly studies SCLs through implementation and measurable outcomes rather than purely normative sustainability framing. Trend-topic patterns further suggest that post-2021 growth is centred on a stable set of recurring concepts—impact, performance, innovation, investment and policy-linked green credit—implying deepening within the established core rather than broad diversification into new conceptual domains (Figure 5).

3.3.3 | Network Structure and Thematic Positioning

Network structure confirms both intellectual coherence and conceptual imbalance. Central bridging nodes connect impact- and performance-oriented terms to policy-linked green credit concepts, indicating an integrated core in which studies share

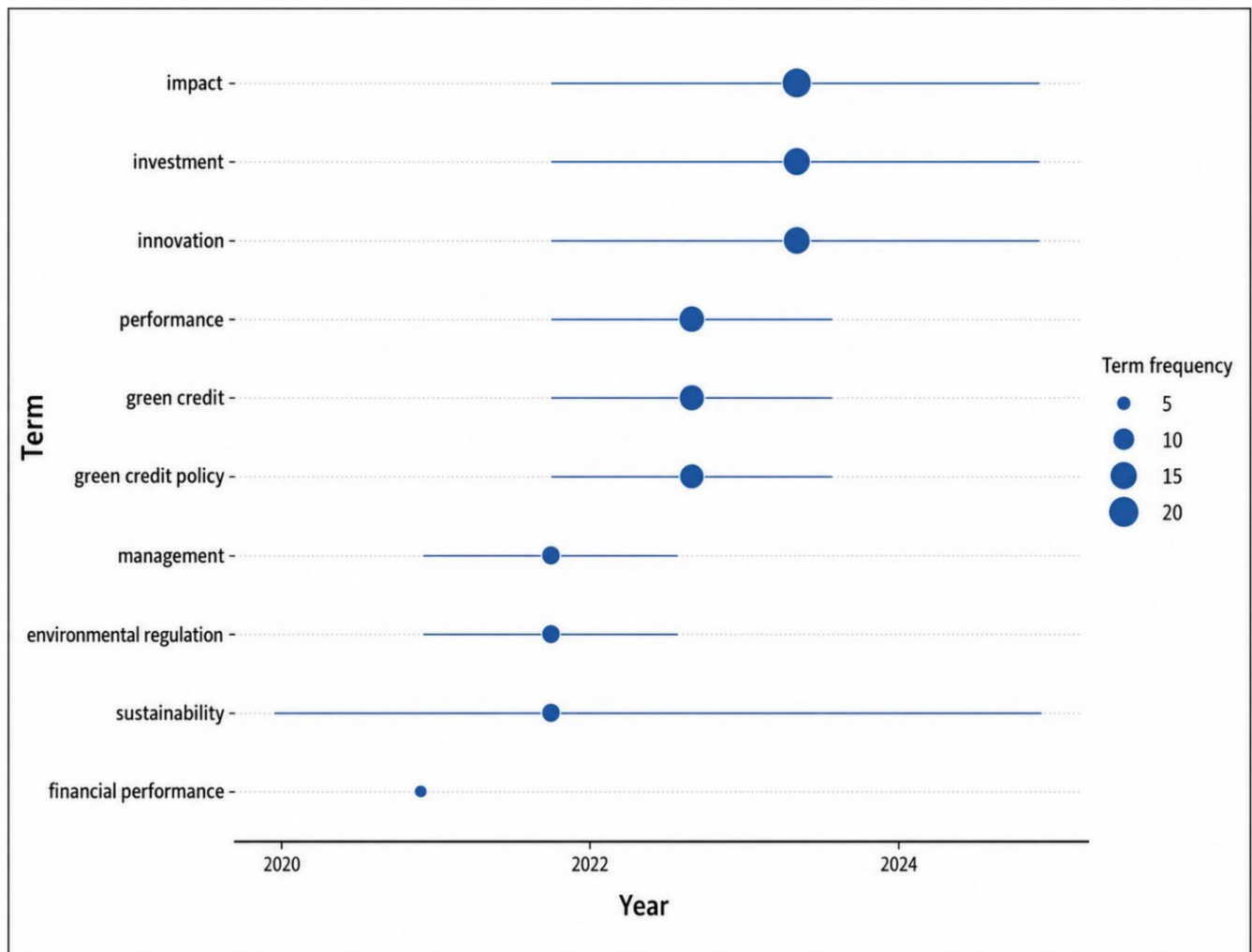


FIGURE 5 | Keywords trend topics in SCL research. *Note:* This figure shows how the main keywords in SCL research have evolved over time. Dot size indicates term frequency, while horizontal lines show the period in which each keyword appears. The recent focus is on impact, investment, innovation, green credit and green credit policy, indicating a shift toward policy-driven and outcome-oriented research.

a common language and closely related empirical questions (Figure 6). Peripheral positioning of CSR- and risk-related terms suggests that adjacent sustainability debates are present but not structurally central to how SCL research is currently organised. The thematic map reinforces this diagnosis: motor themes concentrate around the performance–policy–climate nexus, while other topics appear as basic scaffolding, niche streams that remain weakly connected to the core, or emerging/declining areas that have not yet consolidated (Figure 7). These patterns suggest that SCL research has developed a strong centre—useful for cumulative evidence building—but may be under-integrating perspectives that could explain heterogeneity across jurisdictions and contract designs, especially where governance arrangements and institutional credibility are likely to matter.

Overall, the bibliometric analysis indicates that SCL research has developed around a coherent but relatively narrow conceptual core. The literature is strongest where SCLs can be examined through observable outcomes, such as loan pricing, credit access, ESG performance, green innovation and policy effects. This has made the field empirically tractable, but it has also left less visible mechanisms underdeveloped, particularly

institutional enforcement, organisational implementation within banks and the political-economy conditions that shape credit allocation.

The thematic synthesis, therefore, interprets SCLs through four connected mechanisms. They operate as contracting mechanisms through KPIs, pricing grids, covenants, verification and monitoring; as signalling and legitimacy mechanisms through borrower and lender ESG commitments; as institutional mechanisms through regulation, disclosure, enforcement and financial-system structures; and as organisational and political-economy mechanisms through banks' internal credit routines and the unequal allocation of sustainable credit across firms, sectors, regions and ownership types. The borrower, lender, contract and economic perspectives that follow are therefore treated as inter-dependent channels rather than separate descriptive categories.

4 | Thematic Synthesis

In this section, we move beyond the quantitative bibliometric mapping to present a thematic synthesis of the SCL literature.

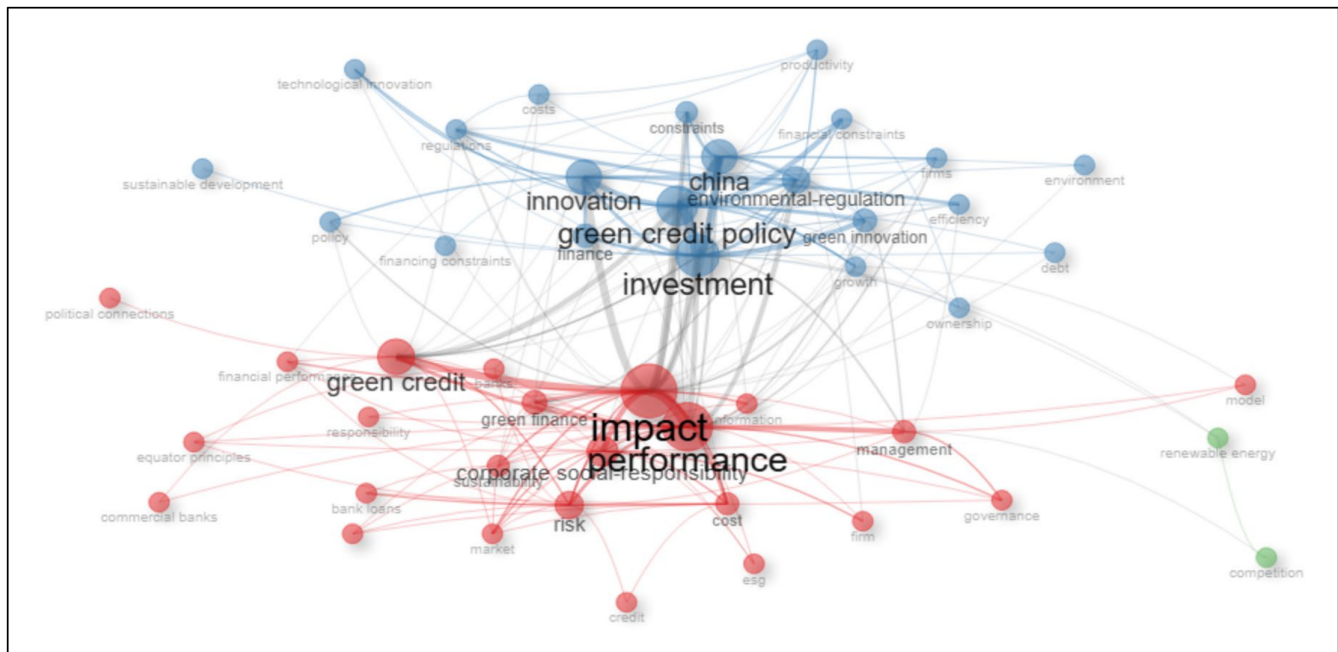


FIGURE 6 | Co-word network in SCL research. *Note:* The co-word network shows how frequently keywords appear together in the reviewed SCL studies. Node size indicates keyword frequency, link thickness shows co-occurrence strength, and colours represent keyword clusters. The network centres on impact, performance, green credit, green credit policy, investment and innovation, showing the field's outcome- and policy-oriented focus.

While the bibliometric analysis identified structural patterns, thematic synthesis allows integration and interpretation of substantive findings. We organise the synthesis into four perspectives—borrower, lender, contract and macroeconomic—to capture how SCLs operate from firm-level outcomes to system-wide effects. This structure helps identify commonalities, divergences and emerging research directions.

4.1 | Borrower Perspective

While lenders are tasked with structuring ESG-linked contracts and managing environmental risk, it is the borrowers who determine the integrity and effectiveness of these instruments through their compliance, performance and behavioural adaptation. In this section, we synthesise the borrower-focused literature into two thematic areas based on 42 reviewed studies: (1) the impact of sustainable lending on borrower outcomes and (2) borrower responses to policy-driven green credit interventions. Together, these themes provide insight into how firm-level characteristics, strategic motives and institutional environments shape borrower engagement with ESG finance.

4.1.1 | Policy Impact on Borrower ESG Behaviour and Risk Reduction

Green credit policies (GCPs) have been shown to reduce firm-level risk in environmentally intensive sectors by driving operational restructuring, diversification and environmental upgrades (Peng et al. 2025). These effects are particularly strong among state-owned enterprises (SOEs) and large firms, where credit reallocation enhances managerial awareness and stimulates R&D investment (Ma et al. 2024). Evidence from China's 2012 Green

Credit Guidelines shows significant increases in green patent output among financially constrained polluters (Hu et al. 2021), while Lu et al. (2022) find that tighter access to credit spurred firms to adopt cleaner technologies. Additional studies confirm that GCPs improve green technology adoption (Wang and Li 2022) and reduce carbon intensity (Lee et al. 2022).

However, effectiveness depends on aligned enforcement and governance. Tan et al. (2025) demonstrate that voluntary implementation of green lending rules produces negligible de-zombification effects. Only when bank performance metrics incorporate GCP compliance do financial constraints and innovation incentives effectively accelerate exit from economic stagnation. These findings suggest that while GCPs catalyse ESG improvements and reduce risk, their impact depends on credible enforcement and institutional support.

4.1.2 | Heterogeneity in Borrower Response and Policy Effectiveness

The impact of green credit is highly heterogeneous, shaped by ownership, governance, location and institutional quality. Weak disclosure regimes heighten the risk of greenwashing, undermining credit transmission and restricting access to additional finance (Xing et al. 2021). Stronger media scrutiny and governance frameworks improve policy effectiveness, particularly for financially constrained firms and state-owned enterprises (He et al. 2024). Conversely, heavy polluting enterprises (HPEs) may experience reduced performance when compliance costs outweigh the benefits of innovation (Yao et al. 2021). Borrower transformation is more robust in firms with sound internal controls, lighter tax burdens, and favourable geographic conditions (Lu et al. 2025).

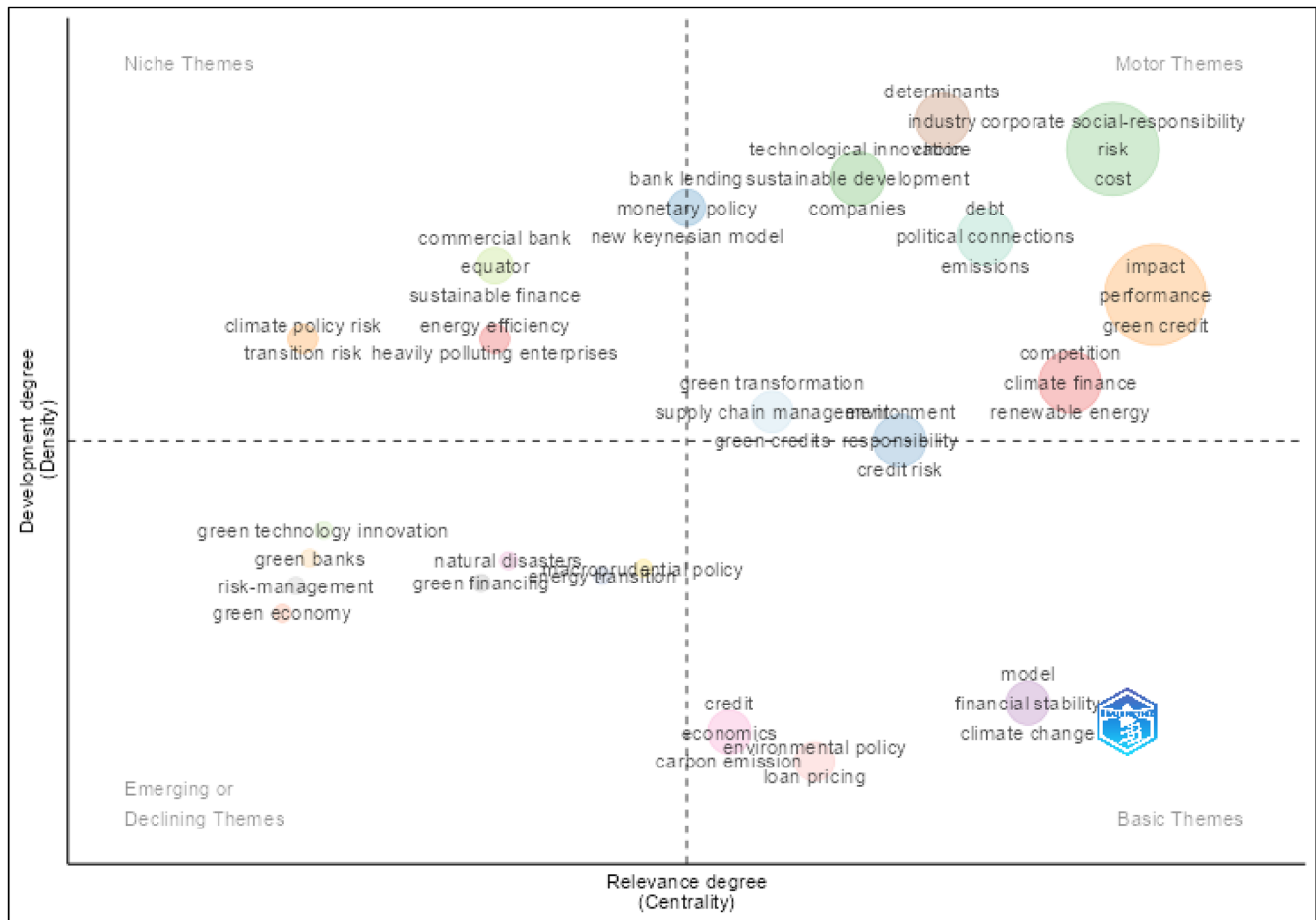


FIGURE 7 | Thematic map of keyword clusters in SCL research. *Note:* The thematic map positions keyword clusters by centrality (horizontal axis) and density (vertical axis). Motor themes are located in the upper-right quadrant, meaning they are both well developed and central to the SCL literature; in this map, they centre mainly on corporate social responsibility/risk/cost and impact/performance/green credit, with related terms such as climate finance, renewable energy and competition. The lower-right quadrant represents the basic-theme cluster around financial stability, climate change and modelling; these themes are central to the field but less internally developed than the motor themes.

Ownership structure and political ties further complicate outcomes. Although SOEs often receive priority in green credit allocation, entrenched political connections can dilute compliance pressure. Lu et al. (2025) show that state ownership and political entrenchment reduce the effectiveness of the GCP, while executive financial literacy enhances its effectiveness. Evidence also suggests that private firms and those operating in liberalised regions benefit more, with stronger improvements in productivity and innovation (Guo and Zhang 2023).

Several studies highlight the limits and unintended effects of policy design. Substitution effects occur when restricted bank lending leads firms to increase reliance on trade credit, reducing overall efficiency (Wen et al. 2021). Energy firms, in particular, may incur financial losses if GCPs raise compliance costs without sufficient incentives for innovation (Dogah et al. 2025). Green credit may also crowd out labour demand in HPEs, though analyst coverage and non-state ownership mitigate this risk (Jiang and Jiang 2023). At the same time, GCPs have been linked to improved audit quality (Tian and Pan 2024) and to behavioural adjustments, such as reduced dividends, as firms manage internal liquidity under stricter lending conditions (Li et al. 2023). Ultimately, ESG improvements

are strongest when policies align with firm-level incentives, capacity and environmental performance metrics (S. Zhang et al. 2022).

4.1.3 | Sustainable Borrowing Implications

An emerging stream of research examines how sustainable borrowing—particularly through green credit and sustainability-linked loans (SLLs)—affects firm performance, innovation and ESG alignment. Evidence suggests that green credit can enhance both efficiency and governance. For example, Cui et al. (2022) report improvements in total factor productivity, while Chen et al. (2023) show reduced risk of stock price crashes among high-polluting firms, driven by stronger bank monitoring and accounting quality. These findings indicate that when backed by credible supervision, green lending can deliver financial and governance benefits.

By contrast, the effectiveness of SLLs remains contested. Auzepy et al. (2023) find little evidence that borrowers improve ESG outcomes after issuing SLLs, while market reactions are mixed—neutral in Europe but negative in the United States—reflecting

concerns about weak KPI enforcement and potential green-washing. Outcomes are also heterogeneous across borrower characteristics. Liu et al. (2024) show that green credit is most effective among private and small-cap firms in favourable market conditions, particularly when banks hold equity stakes in borrowing firms. Similarly, Sobiech and Uchida (2025) find that government-sponsored green loans under feed-in-tariff schemes improve firms' credit ratings, sales and default risk, underscoring the importance of state-led financing.

Yet, green borrowing can also produce unintended effects. Z. Zhang, Luo, et al. (2025) find that high-polluting, smaller private firms may experience reduced green productivity under credit constraints, though strong CSR ratings can mitigate these pressures. New institutional mechanisms are emerging to address such challenges: Roy (2025) proposes a sustainability clustering and decision system (SCDS) to classify borrowers, while Yin et al. (2025) show that mandatory environmental credit ratings improve access to loans, especially for non-state-owned enterprises. Finally, Xu and Lin (2025) reveal that the impact of green credit on innovation is nonlinear and regionally differentiated, with U-shaped or n-shaped effects depending on local financial and policy environments. Together, these findings highlight both the promise and the limitations of sustainable borrowing, pointing to the need for nuanced, context-sensitive credit frameworks.

4.1.4 | Summary and Future Research

The literature shows that GCPs yield neither uniformly positive nor universally negative outcomes. Their effectiveness depends on borrower characteristics, sectoral risk exposure, enforcement strength and governance quality. When incentives are well aligned and monitoring is credible, GCPs promote ESG improvements and resilience. Weak enforcement or political entrenchment, however, limits their impact and generates uneven responses across sectors and regions. Future research should address the following gaps. First, future research should directly address the underexplored social and governance dimensions of SCLs by examining how S/G KPIs are selected, measured and verified, and whether SCL adoption affects stakeholder outcomes beyond environmental metrics. Governance-focused work can test how board oversight, ownership structure and assurance/verification choices shape KPI credibility, enforcement and renegotiation over the loan life cycle. Second, more cross-country comparisons are required, particularly in settings with nascent sustainable finance frameworks, to assess the external validity of the current findings. Third, the role of external actors—media, civil society and ESG rating agencies—warrants closer study, as these actors can amplify or constrain policy transmission. Other promising avenues include examining how firm-level factors—innovation capacity, product complexity and political ties—influence responses to sustainable borrowing. Research should also assess the design and credibility of SLL KPIs across countries, as well as the effects of institutional ownership and state-led evaluation systems on loan access and ESG alignment. Benchmarking algorithmic tools, such as sustainability clustering models, against traditional credit assessments could clarify their predictive power. Finally, studies should explore unintended

consequences, including the crowding out of green investment by high-polluting or financially constrained firms, and evaluate whether targeted instruments such as regional initiatives or public guarantees mitigate these risks.

4.2 | Lender Perspective

Lenders are central to the development of SCL markets, acting not only as financial intermediaries but also as organisational sites where ESG commitments are translated into credit decisions. Through borrower eligibility criteria, sustainability-linked pricing, covenant monitoring and KPI verification, banks shape the credibility and effectiveness of sustainable lending. Recent studies show a shift from traditional credit assessment toward ESG-integrated practices driven by regulatory pressure, digital innovation and reputational incentives. However, evidence remains mixed because lender behaviour varies across institutional types, governance models, ownership structures and regional contexts, while the internal processes through which banks implement ESG lending remain poorly observed. Drawing on 22 peer-reviewed studies, this section synthesises lender-focused research across two themes: (1) ESG integration and strategic orientation and (2) lending outcomes, risk exposure and market impacts.

4.2.1 | ESG Integration and Strategic Orientation

Lenders differ widely in their ESG integration strategies. Barigozzi and Tedeschi (2015) distinguish between 'ethical' banks, which finance only socially beneficial projects in collaboration with motivated borrowers, and 'standard' banks, which prioritise profit maximisation. This theoretical framing helps explain why some institutions actively mitigate agency frictions and contribute to social welfare, while others selectively embed ESG. Empirical work confirms these divergences. For example, Schulte et al. (2025), studying Nordic banks, find a gap between sustainability rhetoric and operational practice, underscoring the need for systems-thinking approaches that move beyond narrow carbon metrics.

Recent studies highlight innovation and digitalisation as key drivers of ESG integration. George et al. (2025) introduce the emission-elastic lending rate (EELR), which penalises carbon-intensive borrowers and aligns with regulatory welfare goals, though it also risks excessive loan growth and financial instability. Similarly, Y. Zhang, Ye, et al. (2025) show that digitalisation enhances banks' ability to manage green credit risk through improved monitoring and information flows, with management-level digital tools proving most effective. Cross-country comparisons further reveal institutional variation: Mengze and Wei (2015) find that Canadian and Japanese banks outperform peers in aligning environmental credit risk management with policy frameworks.

Institutional ownership structures shape lender behaviour. Zhou et al. (2022) show that the relationship between green lending and credit risk depends heavily on state ownership, with partially state-owned banks responding more strongly to policy signals. Huang et al. (2025) extend this by showing that

climate policy uncertainty in China produces divergent lending strategies depending on whether banks are state-owned, privately owned, or systemically important. Together, these findings confirm that institutional context, governance design, and risk appetite mediate ESG integration, raising questions about the consistency and scalability of green lending practices.

4.2.2 | Lending Outcomes, Risk Exposure and Market Impacts

Green lending influences both financial outcomes and systemic stability. Luo et al. (2021) show that green credit strengthens bank competence, while Tian et al. (2023) find that loan announcements are associated with positive market valuations, indicating that ESG lending can align with financial objectives. Yet, performance varies across operational stages: Li et al. (2024) report high efficiency in profit-earning activities but weaknesses in deposit conversion, with state-owned banks showing greater improvement over time. These results highlight the importance of policy consistency and process innovation for sustaining ESG returns.

Risk exposures present more complex challenges. J. Zhang, Wei, et al. (2024) and Wang et al. (2025) caution that concentrated carbon-related lending amplifies systemic vulnerabilities, particularly under climate transition shocks and in dense financial networks. Cregan et al. (2024) add that ESG ratings often reflect forward-looking pledges rather than past lending behaviour, raising questions about disclosure integrity. Portfolio rebalancing under transition risk is evident: D. Zhang, Wu, et al. (2024) show that banks adjust loan books to minimise exposures, though sometimes through superficial strategies. Mueller et al. (2025) further reveal that US banks responded to deregulatory signals by securitising brown loans, effectively masking carbon risk.

Crisis resilience also appears mixed. Malandrakis and Drakos (2024) find that European green banks modestly outperformed peers during crises in capital adequacy and loan loss reserves, but ESG orientation alone was insufficient to ensure systemic stability. Taken together, these findings suggest that while green lending can deliver financial and reputational benefits, its contribution to systemic resilience remains conditional on robust prudential safeguards and credible monitoring of climate-related exposures.

4.2.3 | Summary and Future Research Directions

Despite valuable progress, the lender perspective in SCL research leaves several avenues for future exploration. More comparative studies are needed to understand how different ownership structures, governance models and regulatory environments shape ESG integration strategies across regions. The effectiveness of innovative instruments such as the EELR and digital ESG monitoring tools also warrants deeper scrutiny, particularly regarding their unintended impacts on credit market stability and systemic risk. Further work should examine how lenders balance ESG objectives with prudential safeguards

under crisis conditions, and whether green-oriented banks can demonstrate resilience beyond capital adequacy metrics. Additionally, the gap between rhetorical commitments and operational practices raises questions about greenwashing risks and the credibility of ESG ratings, which future studies could address by linking internal lending data with external disclosures. Finally, syndicate-level dynamics—such as how lead arrangers and participant banks differ in enforcing sustainability covenants—remain underexplored, offering fertile ground for advancing knowledge on lender coordination and monitoring effectiveness in sustainable lending.

4.3 | Loan Contracts Perspective

SCL contracts have become essential vehicles for embedding ESG incentives into corporate financing. These contracts often link interest rates or lending terms to sustainability metrics, enabling lenders to influence borrower behaviour through financial incentives, covenants and disclosure requirements. The contract perspective therefore links the theoretical concern with signalling to the institutional concern with enforceability: ESG-linked pricing and KPIs create credible incentives only when verification, monitoring and renegotiation procedures prevent sustainability commitments from becoming symbolic. This section synthesises key empirical findings on the structure and effects of ESG-linked loan contracts, with emphasis on pricing, governance, verification and regulatory implications.

4.3.1 | Pricing and Non-Pricing Terms

A foundational concern in the literature is whether ESG performance is systematically priced into loan contracts. Goss and Roberts (2011), among the earliest empirical studies on the topic, show that US firms with poor social responsibility records face a loan spread penalty of 7–18 basis points relative to more responsible firms. Their findings imply that lenders perceive CSR risk as credit-relevant and they adjust pricing accordingly, providing early evidence that social performance enters lending decisions through the cost of capital.

Later studies expand on this. Ehlers et al. (2022) present strong evidence of a ‘carbon premium’, showing that more carbon-intensive borrowers pay higher spreads following the Paris Agreement. Degryse et al. (2023) corroborate this, showing that green banks reward borrowers with cheaper loans—though only after 2015—suggesting that international climate policy plays a catalytic role in shaping loan pricing. However, Ding et al. (2023) find that carbon emissions do not significantly affect loan pricing; instead, they reduce loan maturity, suggesting that ESG risks may influence loan structure beyond simple pricing mechanisms.

Gu et al. (2023) add nuance, finding that the pricing effects of green loans are more pronounced among privately owned enterprises (POEs), small firms, new borrowers and those with low credit ratings. This implies that ESG-linked pricing is not uniform but instead depends on borrower characteristics, creditworthiness and informational asymmetries.

4.3.2 | Monitoring and Technology Use

A key concern in ESG loan contracts is enforcing use-of-proceeds conditions and the risk of greenwashing. Wang et al. (2024) model the misuse of green loan funds in a supply chain context and propose blockchain as a monitoring tool. Their results show that blockchain adoption curbs the misuse of green loans and improves environmental outcomes, though at the expense of consumer surplus. This illustrates how technological innovations can enhance the integrity of loan contracts. Similarly, Ding et al. (2025) analyse the effects of policy-induced ESG obligations on heavily polluting borrowers and find that such firms face reduced access to long-term loans and increased financial distress. While this enhances social responsibility, it also raises concerns about the unintended consequences of aggressive ESG enforcement.

4.3.3 | Reputational and Governance Constraints

The motivations behind ESG-linked loan contract design are not limited to borrower characteristics. Hrazdil et al. (2024) find that lender behaviour is driven less by borrower fundamentals and more by reputational concerns after ESG controversies. In contrast, Böhm et al. (2025) report no significant shift in bank lending practices in response to ESG shareholder preferences, suggesting a disconnect between shareholder activism and actual contract terms. Finally, Barigozzi and Tedeschi (2019) present a theoretical model showing how ethical loan markets emerge under moral hazard and adverse selection. Their framework supports the view that ESG-linked contracts serve as screening devices in imperfect credit markets.

4.3.4 | Summary and Future Research Directions

This review reveals a growing body of research exploring how sustainable objectives are embedded within loan contract terms. Key findings show that ESG considerations can influence both pricing and structure (e.g., maturity), but effects are heterogeneous across borrower types and jurisdictions. Technology and reputational risk also play central roles in shaping contract design and enforcement. Future research should explore the dynamic aspects of ESG loan contracting, including renegotiation clauses and borrower non-compliance over time. Comparative cross-country studies could shed light on the institutional conditions that enhance the effectiveness of ESG-linked covenants. Moreover, more work is needed to assess how ESG disclosure standards and third-party verification interact with contract enforcement and greenwashing risks.

4.4 | Economic Perspective

The economic implications of SCLs are increasingly recognised in recent literature. Evidence shows that green loans and financial system reforms can significantly contribute to emissions reduction and green innovation. D. Zhang et al. (2023) find that green loan expansion in market-based economies leads to measurable reductions in greenhouse gas emissions, supporting the strategic role of sustainable lending in national energy transitions. Similarly, Chen et al. (2024) report that strong credit-based

green financial policies foster technological progress and environmental quality, albeit with delayed effects and contingent on regional R&D capacity and financial development. Zhou et al. (2022) emphasise the complementary role of fintech—especially green credit and investment channels—in promoting green economic growth, with regionally heterogeneous outcomes. However, Wasan et al. (2024) identify persistent economic barriers to scaling up green finance, including fragmented policy frameworks, limited credit enhancement and underdeveloped risk-sharing mechanisms.

In summary, at the macroeconomic level, political-economic mechanisms matter most. Green credit policies and SCL expansion do not reallocate capital in a neutral institutional environment. They operate through banking systems shaped by state priorities, regulatory capacity, industrial policy, sectoral lobbying, ownership structures and uneven regional development. Evidence from China-centred green credit studies is therefore informative but institutionally specific: policy-induced credit allocation may generate environmental gains while also shifting transition costs across high-polluting firms, private firms, state-owned enterprises, smaller borrowers and regions with different levels of financial development.

4.4.1 | Summary and Future Research Agenda

Despite these advances, significant research gaps remain. First, future studies should adopt borrower-level designs to causally identify the economic and environmental impact of SCLs, moving beyond macro-level inference. Second, comparative research across financial systems and income groups is needed to uncover the institutional conditions that enhance or constrain SCL effectiveness. Third, longitudinal analyses can better capture the time-lagged effects of green financial policies. Fourth, the integration of fintech into SCL origination and monitoring warrants deeper exploration, particularly regarding inclusion and risk pricing. Lastly, policy-focused research using quasi-experimental or simulation approaches could test the effectiveness of combined public-private green finance mechanisms to accelerate sustainable lending at scale. Overall, the future macro-level research should therefore examine not only whether SCLs support green innovation, emissions reduction or financial stability, but also who receives sustainable credit, who is excluded, and how transition risks and benefits are distributed across the economy.

5 | Conclusion and Implications

This review synthesises high-quality research on SCLs—green loans and SLLs—using the PRISMA protocol and restricting the analysis to AJG ≥ 3 journals. It maps how the field has evolved, the theories and methods employed, the main themes studied and the persisting gaps. Research activity accelerates after 2020, aligned with the introduction of GLPs, SLLPs and mandatory ESG disclosure frameworks. SCLs have shifted from a niche topic to a recognised research area. However, the evidence base is geographically skewed: China dominates due to data availability, while Africa, Latin America, the Middle East and much of Southeast Asia remain underrepresented, limiting external validity.

Stakeholder theory is the most frequently invoked explicit framework, whereas legitimacy, signalling, agency, institutional, behavioural and organisational perspectives are invoked less often. Methodologically, quantitative econometric studies—mainly panel regressions using syndicated-loan datasets—dominate, while qualitative, mixed-method and organisational-process studies are scarce, leaving questions about how ESG-linked lending operates within banks. Borrower-focused work documents a sustainability premium but offers limited insight into compliance behaviour. Lender studies show partial ESG integration but rarely explore internal decision-making or syndicate dynamics. Contract-level research examines KPIs and pricing adjustments but provides little evidence on verification, enforcement, or renegotiation. Macro-level studies—mostly China-based—identify effects on innovation, emissions and credit allocation, but cross-country comparisons are lacking.

SCL research is expanding but remains theoretically narrow, methodologically uniform and geographically concentrated. Underexplored areas include borrower resistance, KPI credibility, greenwashing risks, bank organisational processes and institutional heterogeneity across countries. A broader conceptual base and more diverse empirical strategies are essential to understanding how sustainable lending can support climate and development goals.

The thematic synthesis identifies four perspectives: borrower, lender, contract design and economic implications. Borrower-focused studies find that stronger ESG performance is associated with lower loan spreads. Lender studies examine how banks incorporate ESG into credit assessment, though little is known about internal processes or cross-departmental coordination. Contract-level work centres on KPI-linked covenants and pricing adjustments, but evidence on borrower compliance, KPI verification and enforcement over the loan life cycle remains limited. At the economic level, research—concentrated in China—shows how SCLs support environmental policy and financial stability, yet international comparisons and global policy implications remain underdeveloped.

Several gaps emerge. Research is concentrated in a small number of countries, limiting generalisability; developing-economy contexts remain severely understudied. Theoretical engagement is narrow and would benefit from incorporating institutional, organisational and political-economy perspectives. Methodological uniformity—dominated by quantitative panel regressions—restricts insight into how sustainable lending is designed and implemented. Themes such as borrower resistance to ESG covenants, KPI burdens, tensions between sustainability ambition and financial feasibility, and just-transition lending remain nascent.

The findings of this review generate distinct implications for policymakers, scholars and practitioners involved in the design, regulation and implementation of SCLs. The review highlights the need for coherent regulatory frameworks that strengthen SCL credibility, particularly through standardised ESG disclosure, credible KPI verification and consistent enforcement mechanisms. Policymakers should recognise SCLs as a complementary instrument to green bonds, especially in bank-based financial systems, and design policies that mitigate

greenwashing while preserving incentives for borrower participation across regions and income groups. For researchers, the findings point to substantial opportunities to broaden the theoretical and methodological foundations of SCL research. Future studies would benefit from integrating institutional, organisational, and political economy perspectives, employing mixed-methods and longitudinal designs, and expanding empirical coverage beyond dominant country contexts. Such approaches are essential to advancing causal understanding and improving the external validity of existing evidence. For banks and corporate borrowers, the review underscores the importance of aligning ESG-linked loan design with credible monitoring, realistic KPIs, and internal governance capacity. Practitioners should integrate ESG considerations into credit assessment and lifecycle monitoring, balancing sustainability ambition with financial feasibility to ensure SCLs deliver both environmental impact and prudent risk management. Expanding rigorous research on SCLs is critical for informing global climate and financial policy, as banks remain central to mobilising private capital for the real-economy transition in both developed and emerging markets.

These implications should be interpreted in light of the review's sample boundary. The $AJG \geq 3$ criterion improves comparability and methodological transparency, but it also creates a boundary condition. Because SCL research is recent and interdisciplinary, excluding $AJG 2$, specialist or regional outlets may understate thematic and geographic diversity and amplify concentration in journals, countries and citations. Since outlet thresholds can affect bibliometric conclusions (Goodell et al. 2023), our findings should be interpreted as describing the $AJG \geq 3$ core of SCL research rather than the entire field. Future reviews could test the robustness of these conclusions by including $AJG 2$ journals.

Author Contributions

Md Nurul Islam Sohel: conceptualization, methodology, software, data curation, formal analysis, writing – original draft, visualization. **Abdullah Iqbal:** investigation, validation, supervision, writing – review and editing, project administration. **Rizwan Ahmed:** investigation, validation, supervision, project administration, writing – review and editing. **Vasileios Pappas:** investigation, validation, supervision, project administration, writing – review and editing.

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Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

¹ PRISMA guidelines are available at: <http://www.prisma-statement.org/>.

² Used to be known as ABS journals.

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Appendix A

TABLE A1 | Positioning this review against adjacent sustainable finance reviews.

Review	Focus and treatment of SCLs	Remaining gap addressed by this review
Narula et al. (2025)	Reviews ESG investing, firm performance, and ESG ratings rather than private-debt contracts	Does not examine loan pricing, KPIs, covenants, monitoring or lender–borrower contracting
Ed-Dafali et al. (2025)	Reviews ESG practices and sustainability/financial outcomes broadly, with no dedicated SCL focus	Does not isolate SCLs or analyse lender incentives, borrower responses and enforcement
Verma et al. (2025)	Maps the green finance domain across multiple instruments and themes	Provides limited insight into private loan markets and borrower-level sustainability targets
Kumar et al. (2025)	Maps sustainable finance as a broad research field using large-scale analytics	Does not synthesise SCL-specific mechanisms such as KPI credibility, verification and monitoring
Galletta et al. (2024)	Reviews greenwashing in banking, with relevance to credibility and disclosure	Does not examine SCL contract design, pricing, borrower incentives or covenant enforcement
Flottmann et al. (2025)	Reviews green debt, including bonds and loans, but treats loans within a broader debt universe	Does not treat SCLs as the focal instrument across borrower, lender, contract and macro channels
This review	Reviews sustainable corporate loans as the focal private-debt instrument	Synthesises SCL evidence around contract credibility, KPI design, incentives, enforcement and institutional heterogeneity

Note: This table compares the present review with adjacent sustainable finance reviews. SCLs include green loans, social loans, sustainability-linked loans and ESG-linked corporate loan facilities.

Abbreviation: KPIs, key performance indicators.