

Article

From Frameworks to Implementation: Comparing Academic and Media Discourse on Climate-Resilient Supply Chains

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Abstract

This study examines the evolution of environmental discourse in supply chain management (SCM) research from 2004 to 2024, systematically comparing scholarly trajectories with media narratives to identify critical implementation gaps at the theory–practice interface. Following PRISMA guidelines, we employ structural topic modeling on 6586 academic articles and 384,190 media articles (2019–2023) within the SPAR-4-SLR protocol, we document substantial growth in sustainability scholarship—from fewer than 200 publications in 2004 to over 700 in 2024—with research emphasis shifting from compliance-oriented frameworks toward strategic integration models. Systematic comparison reveals significant misalignments: six domains—community-based sustainability initiatives, climate adaptation strategies, plastic reduction mandates, food security resilience, event-driven crisis responses, and sustainable product design—receive substantially greater media emphasis than scholarly investigation, constituting what we characterize as the implementation knowledge gap. This gap reflects disconnection between theoretically sophisticated academic frameworks emphasizing long-term strategic integration and practitioner concerns prioritizing acute operational challenges, rapid regulatory compliance, and grassroots sustainability mechanisms. Our findings demonstrate that, while academic research remains theoretically robust, it insufficiently captures short-term adaptation imperatives, community-level integration mechanisms, and sector-specific resilience strategies that climate volatility demands. By establishing a transferable analytical framework integrating media discourse with academic literature, this study advances sustainable supply chain management theory through reconceptualizing implementation challenges as central research concerns while generating actionable imperatives for aligning scholarship, policy interventions, and industrial strategies toward climate-resilient supply chain systems.

Keywords: sustainable supply chain management; climate change adaptation; systematic literature review; structural topic modeling; media discourse analysis; supply chain resilience



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1. Introduction

Climate change presents complex and profound challenges to global supply chain management, disrupting procurement processes and threatening the resilience of supply networks [1,2]. Extreme weather events, rising temperatures, and regulatory pressures compel organizations to reassess their purchasing strategies and supplier relationships. The flooding in Pakistan in 2022 not only disrupted regional supply chains but forced firms to reevaluate sourcing decisions [3,4]. Similarly, Europe’s record-breaking heatwaves and Australia’s devastating wildfires expose vulnerabilities in procurement practices dependent

on agricultural and natural resources [5,6]. These events indicate climate change impacts extend beyond physical infrastructure to affect purchasing costs, supplier reliability, and supply chain continuity [6].

Sustainable supply chain management (SSCM) consequently emerges as a vital focus area, aiming to incorporate environmental considerations into supply chain management [7]. Modern organizations now recognize they need to develop traditional procurement models by partnering with environmentally responsible suppliers, adopting closed-loop procurement practices, and collaborating to lower carbon footprints [8,9]. Prior literature documents the development from traditional risk management approaches to more comprehensive sustainability frameworks [10]. Such development encompasses diverse themes, including closed-loop economy integration, renewable energy adoption, and climate resilience strategies [9,11].

Although the importance of SSCM is widely acknowledged, meaningful gaps remain in both academic research and practical implementation regarding effective environmental strategies within supply chains [12,13]. Operationalizing SSCM requires rigorous theoretical frameworks that delineate actionable implementation pathways across supply chain members. However, existing frameworks do not sufficiently account for how organizational characteristics, institutional environments, and supply chain configurations influence implementation success. Such contextual variations require further empirical investigation, limiting practical guidance for context-appropriate implementation strategies. Compounding these challenges, inconsistent sustainability reporting methods—such as those from the Sustainability Accounting Standards Board and the Global Reporting Initiative—lead to incomparable assessments of supplier sustainability, hindering performance measurement and benchmarking across supply chain tiers [14–16].

Prior systematic reviews examine SSCM evolution within specific periods or particular sustainability dimensions [17,18], yet their reliance on published literature limits the potential to identify evolving implementation challenges documented in practitioner discourse before receiving systematic academic attention. The reliance on established literature proves insufficient for discovering accelerating environmental regulatory change, technological innovation, and evolving stakeholder expectations characterizing contemporary supply chain environments. Addressing these methodological limitations necessitates approaches responsive to real-time sustainability challenges. Media discourse provides systematic documentation of practitioner responses to regulatory changes and sustainability initiatives, revealing implementation challenges before they receive scholarly treatment [19,20].

The persistent gap between scholarly frameworks and operational implementation raises essential questions: does academic SSCM research adequately address the implementation challenges practitioners face in applying sustainability principles to supply chain operations? Do scholarly frameworks provide actionable guidance for context-specific adoption across varying organizational sizes, industries, and institutional environments, or remain primarily conceptual? What specific implementation domains require empirical investigation to bridge persistent theory–practice gaps in sustainable supply chain management? To address these questions, our research examines:

RQ1: How has supply chain sustainability research evolved from 2004 to 2024, particularly regarding implementation strategies and performance measurement?

RQ2: What key differences emerge between academic sustainability research and media-reflected practitioner concerns, and which underrepresented domains warrant empirical investigation?

This study contributes to SSCM research by integrating systematic literature review with media discourse examination. First, we characterize sustainability research evolution from 2004 to 2024 using structural topic modeling on 6586 academic articles, revealing that scholarly attention shifts from green procurement toward comprehensive frameworks while

identifying persistent underemphasis on implementation mechanisms [21,22]. Second, our systematic comparison of academic literature and media discourse (6586 scholarly articles and 384,190 news articles, 2019–2023) identifies six domains—circular economy operationalization, climate adaptation strategies, renewable energy integration, ESG performance management, community-based initiatives, sustainable product design—where media emphasis substantially exceeds academic investigation, revealing implementation-oriented research gaps warranting empirical examination. Finally, we establish a transferable analytical framework for bridging theory–practice gaps, demonstrating how systematic integration of media discourse and academic literature identifies implementation challenges currently facing practitioners but which are underexamined in scholarly research.

The subsequent sections are as follows: Section 2 provides research background; Section 3 details our empirical methodology; Section 4 presents analytical findings; and Section 5 concludes with theoretical contributions and future research directions.

2. Research Background

This section establishes the theoretical and methodological foundations for our systematic investigation. Section 2.1 traces SSCM’s theoretical evolution from compliance-oriented frameworks to strategic integration models, documenting how this transformation nevertheless leaves critical implementation domains underexplored. Section 2.2 establishes our analytical rationale for integrating media discourse analysis with a traditional literature review to systematically identify these implementation gaps.

2.1. Theoretical Foundations: SSCM Evolution and the Implementation Knowledge Gap

Operationalizing SSCM requires balancing competing priorities and developing context-specific capabilities. Early frameworks establish that environmental practices must integrate with core operations rather than function as compliance add-ons with firms adopting competitiveness-oriented versus compliance-oriented motivations and yielding systematically different performance outcomes [23]. Supplier selection demonstrates implementation complexity, requiring structured frameworks integrating environmental criteria with traditional performance metrics [24]. Decision-making in sustainable supply chains fundamentally involves navigating tensions between short-term financial pressures and long-term sustainability objectives [25]. Supply chain resilience depends critically on trust-based collaborative relationships developed prior to disruptions, as demonstrated by organizational responses during epidemic outbreaks revealing coordination capability limitations [26,27]. These implementation challenges underscore the gap between theoretical prescriptions and operational realities.

Early SSCM studies view environmental management primarily as regulatory compliance obligation, treating sustainability as an external constraint to address [13]. Scholars consider environmental practices as costs driven by regulatory requirements rather than strategic capabilities generating competitive advantage. Seuring and Müller’s [7] seminal review demonstrates this perspective, noting that pre-2008 literature predominantly examines how firms minimize costs associated with environmental regulations while maintaining operational efficiency. Research during this period positions sustainability as separate from core strategy.

Beginning in the late 2000s, accumulating empirical evidence challenges this compliance-oriented framing. Carter and Rogers [28] advance a pivotal framework integrating economic, social, and environmental dimensions into cohesive models of sustainable operations, arguing that these elements generate synergistic rather than antagonistic outcomes. Subsequent research provides empirical support for this integration perspective, illustrating how proactive environmental strategies enhance innovation capabilities [8], strengthen

supplier relationships [29], and improve risk management capacity [12]. Through this body of work, SSCM transforms from regulatory obligation into organizational capability, generating a competitive advantage in sustainability-conscious markets.

The substantial growth in scholarly attention to environmental supply chain issues provides empirical evidence of this theoretical evolution. As illustrated in Figure 1, publications addressing climate, environmental issues, and sustainability in SCM increase dramatically over the two-decade period, rising from fewer than 200 papers in 2004 to over 700 in 2024. Such exponential expansion reflects not merely quantitative growth but a fundamental reconceptualization of sustainability's role within supply chain research, demonstrating how the theoretical shift from compliance to strategic integration attracts intensified academic investigation.

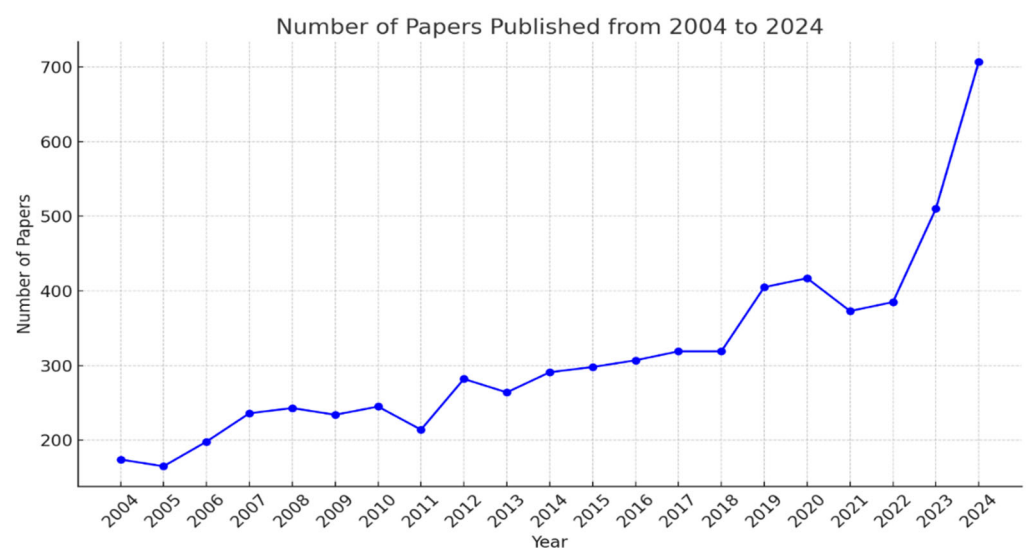


Figure 1. Number of published papers on environmental issues in supply chain management from 2004 to 2024. Note: The figure demonstrates a steady increase in scholarly publications, indicating heightened academic interest and research activity in SSCM over the past two decades.

Contemporary SSCM research draws primarily from three theoretical traditions that elaborate this strategic integration perspective. Resource-based view (RBV) perspectives examine how firms develop environmental management capabilities as sources of sustained competitive advantage, analyzing organizational processes, technological competencies, and knowledge assets supporting sustainability practices [12,30]. Stakeholder theory applications investigate how multiple stakeholder pressures—from regulatory bodies, customers, investors, and civil society—shape corporate environmental strategies and performance metrics [29,31]. Institutional theory frameworks explore how organizations respond to coercive, normative, and mimetic pressures for sustainability adoption, examining variation across institutional contexts and organizational fields [13,32]. Each theoretical lens illuminates distinct dimensions of SSCM adoption processes while maintaining complementary rather than competing explanatory logics [33]. Recent scholarship further extends these theoretical foundations, documenting how ESG rating divergence creates measurement inconsistencies that complicate supply chain sustainability assessment [15,34,35], while emerging research on decarbonization pathways reveals substantial implementation barriers requiring context-specific technological and policy interventions [36–39].

Despite this theoretical sophistication, contemporary frameworks exhibit systematic limitations that generate what we characterize as the implementation knowledge gap—the disconnect between well-developed theoretical frameworks and a limited, empirically grounded understanding of how organizations operationalize sustainability prin-

ciples across diverse contexts [12,40]. Three interrelated constraints constitute this gap. First, existing frameworks typically treat implementation as organizationally neutral, offering limited guidance on how contextual factors—firm size, industry characteristics, supply chain position, institutional environment—moderate the applicability of prescribed practices [13]. Small and medium-sized enterprises face distinct resource constraints and capability limitations compared with multinational corporations. Developing economy contexts present different institutional environments, infrastructure availability, and stakeholder pressures. High-carbon industries confront fundamentally different technological and economic barriers to decarbonization than service sectors. Second, theoretical frameworks privilege strategic decision-making over operational execution, leaving the mechanisms, resource requirements, and coordination challenges involved in translating sustainability commitments into supply chain practices underspecified [26,41]. Third, frameworks exhibit temporal mismatch, developing knowledge through extended research cycles poorly suited to capturing rapidly evolving challenges in dynamic environments [19].

This implementation knowledge gap proves particularly acute across four domains critical to SSCM operationalization. Context-specific adoption pathways remain underspecified, as frameworks insufficiently account for how SMEs versus multinationals, or emerging versus developed economy firms, navigate distinct resource landscapes and institutional environments [9,30]. Inter-organizational coordination mechanisms receive limited empirical examination, despite supply chain sustainability requiring collaboration across organizational boundaries where authority is distributed and interests misaligned [11,28,42]. Dynamic capability development remains theoretically underdeveloped, as climate volatility demands continuous adaptation rather than one-time implementation [8,26]. Performance measurement systems lack standardization, as inconsistent metrics and reporting frameworks impede learning and benchmarking across supply chain tiers [14–16]. Addressing these implementation blind spots requires methodological approaches capable of capturing real-time operational challenges and emerging practitioner priorities—a requirement traditional systematic literature reviews cannot fulfill due to inherent publication lag and retrospective synthesis limitations.

While recent systematic reviews provide comprehensive overviews of SSCM literature [12], their exclusive reliance on published academic articles limits the potential to identify emerging implementation challenges documented in practitioner discourse before receiving systematic scholarly attention. Our integration of media discourse addresses this methodological limitation by capturing real-time sustainability challenges that may not yet appear in peer-reviewed literature.

2.2. Methodological Foundations: Integrating Academic Literature and Media Discourse

The implementation knowledge gap identified in Section 2.1 cannot be addressed through traditional literature review alone. Academic knowledge production operates through extended review and publication cycles, typically spanning 24–48 months from research conception to article appearance, generating systematic lag in documenting emerging phenomena. This temporal structure suits cumulative theory development but proves inadequate for identifying implementation challenges that emerge and evolve within timeframes shorter than typical publication cycles. Media coverage operates on fundamentally different timescales, documenting organizational responses and stakeholder reactions with minimal delay. Schmidt et al. [19] and Schäfer and O'Neill [20] demonstrate that media coverage of environmental issues precedes academic attention by 18–36 months on average, functioning as a leading indicator of emerging research priorities.

Beyond such timing differential, media actively shapes how environmental issues are understood and prioritized. Through agenda-setting and framing mechanisms, media

influences which sustainability challenges organizational leaders prioritize and which topics ultimately receive academic investigation [9,20,36], while Hansen [43] has demonstrated that media coverage affects policy outcomes by establishing issue urgency and shaping problem definitions. These patterns suggest systematic media analysis can identify implementation domains where practitioner action exceeds academic attention—precisely the research gaps our study seeks to illuminate.

Our analytical framework integrates academic literature and media discourse through structured comparison using structural topic modeling [22], extending Paul et al.'s [21] SPAR-4-SLR systematic review methodology. By comparing topic prevalence and conceptual emphasis across both knowledge sources, we identify domains where media emphasis substantially exceeds academic investigation, revealing implementation-oriented research gaps warranting empirical examination. This comparative approach treats divergence between academic and media topic emphasis not as noise but as signal revealing potential misalignment between scholarly priorities and evolving practitioner needs, generating empirically-grounded hypotheses about high-priority research domains at the theory–practice interface.

3. Research Method and Data

To empirically investigate our research objectives, we implement a systematic literature review methodology grounded in the SPAR-4-SLR protocol [21]. This protocol provides a rigorous analytical framework comprising three sequential phases—assembling, arranging, and assessing—each designed to ensure comprehensive coverage and systematic evaluation of the literature corpus. Figure 2 presents the structural implementation of this protocol, followed by our detailed analytical process across each methodological phase. Through this structured approach, we establish a replicable framework for examining the evolution and current state of sustainable SCM research while maintaining methodological transparency and analytical rigor.

3.1. Assembling

The assembling phase establishes scope and research questions, followed by the gathering of potentially relevant materials from academic databases and media sources. Our focal domain encompasses the intersection of climate-driven disruptions and sustainability practices in SCM, emphasizing purchasing and supplier relationships. We explore how literature integrates environmental pressures into SSCM, identifies existing gaps, and compares findings with real-time concerns reported in media.

To derive scholarly insights, we retrieve academic articles published between 2004 and 2024 from databases including Scopus and ScienceDirect, ensuring coverage of high-impact journals in management, business, and sustainability. This timeframe spans from the emergence of ESG frameworks to the present [44]. We select 27 core journals covering leading publications in SCM, business sustainability, and environmental management [45,46]. The complete list of 27 journals with ISSN numbers and ABS rankings is provided in Appendix A. This period encompasses intensifying corporate awareness of environmental issues, including milestones such as the UN Global Compact and ESG frameworks' emergence [47]. For media perspectives, we collect Google News articles from 2019—when ESG discussions gained additional momentum—through 2023 to provide contemporary insights.

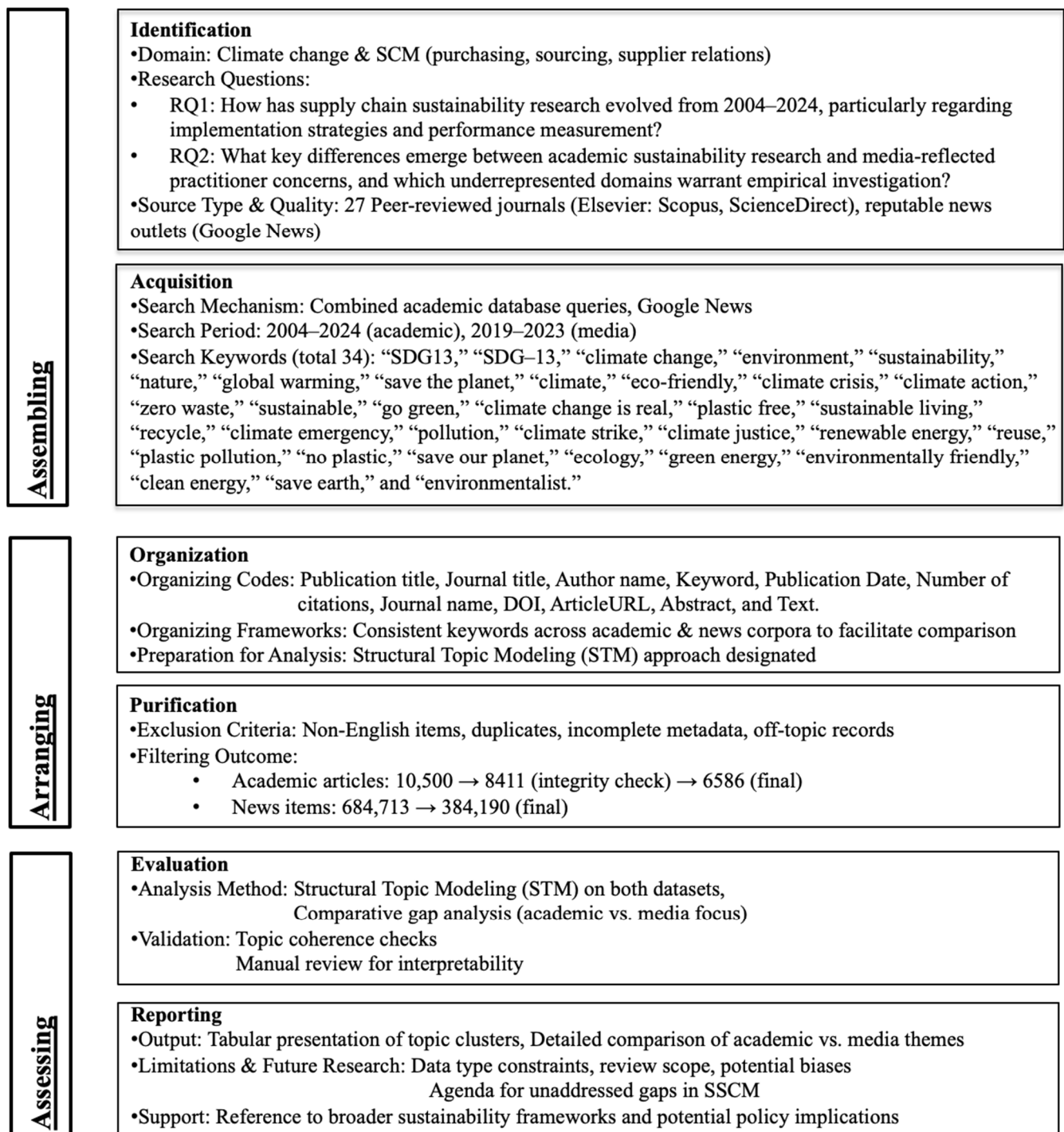


Figure 2. SPAR-4-SLR protocol.

We apply 34 environment-related keywords [48], including “climate change,” “renewable energy,” and “sustainability,” capturing diverse content on climate and environmental themes. The complete list of 34 keywords, organized into environmental/climate terms ($n = 28$) and supply chain terms ($n = 6$), along with the systematic selection methodology, is provided in Appendix B. An initial pool of approximately 10,500 academic articles yields 8411 valid records after excluding duplicates and off-topic entries, ultimately narrowing to 6586 articles for text analytics. A Google News crawler yields approximately 684,713 items, filtered to 384,190 relevant articles by removing advertisements, incomplete materials, and non-English content. Figure 3 and Table 1 provide the PRISMA flow diagram and the sys-

tematic screening process table that show the selection process for both academic and media corpora. Academic corpus: 10,500 initial records from 27 peer-reviewed journals (Scopus, ScienceDirect) screened through duplicate removal ($n = 1300$), title/abstract screening ($n = 2611$ excluded), and full-text assessment ($n = 1503$ excluded), yielding 6586 articles for analysis (2004–2024). Media corpus: 684,713 initial records from Google News API screened through duplicate removal ($n = 172,531$), language filtering ($n = 84,000$ non-English excluded), and quality assessment ($n = 43,992$ promotional/low-quality excluded), yielding 384,190 articles for analysis (2019–2023). All articles included in final corpus underwent structural topic modeling (STM) analysis using the SPAR-4-SLR protocol [21].

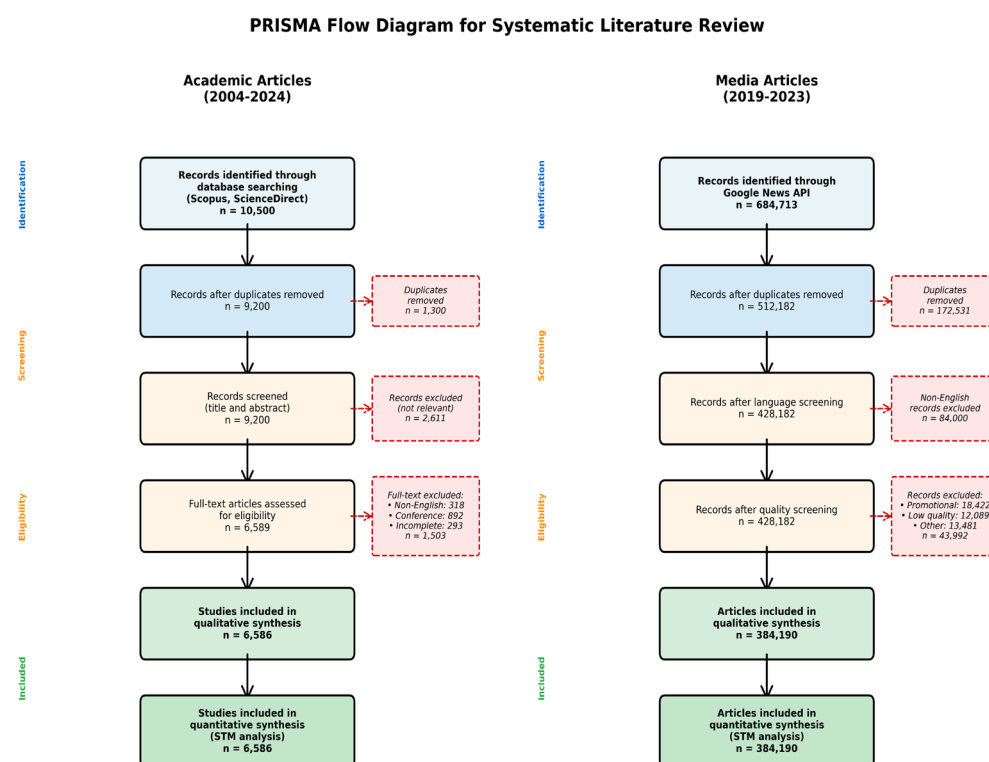


Figure 3. PRISMA Flow Diagram.

Table 1. Systematic screening process.

Screening Stage	Academic Articles	Excluded	Media Articles	Excluded
Initial identification	10,500	—	684,713	—
After duplicate removal	9200	1300	512,182	172,531
After title/abstract screening	6589	2611	428,182	84,000
After full-text/quality screening	6586	1503	384,190	43,992
Total Excluded	—	3914	—	300,523
Final Corpus for Analysis	6586	(37.3%)	384,190	(56.1%)

3.2. Arranging

The arranging phase organizes and refines data for analytical readiness. We label each article by publication date, source outlet, and principal themes, enabling tracking of topic distributions and temporal trends. Excluding non-English documents, metadata-incomplete records, and purely promotional pieces without clear links to climate-related supply chain issues ensures conceptual alignment of academic and media datasets [7,28]. The final dataset encompasses 6586 academic and 384,190 media records, all bearing direct relevance to environmental challenges in supply chain or purchasing contexts.

3.3. Assessing

The assessing phase employs topic modeling to systematically uncover latent themes and research gaps, focusing on how academic findings and media narratives shape discourse on environmental disruptions in supply chains. Topic modeling stands recognized as a robust text-mining approach [49] for identifying hidden semantic structures in large corpora [50]. While existing techniques such as latent semantic analysis (LSA), probabilistic LSA, and latent Dirichlet allocation (LDA) see common use [51], their limitations include difficulty incorporating document-level metadata [52]. Recent advances like non-negative matrix factorization (NMF), Corex, Top2Vec, and BERTopic address some shortcomings [53,54], yet may lack robust handling of external covariates or topic co-occurrences.

We employ structural topic modeling (STM) [22], which incorporates metadata (e.g., year of publication, source type) into the estimation process. This feature allows us to statistically test how external factors influence the prevalence and co-occurrence of latent topics. STM enables us to gauge how climate-related themes change over time and whether certain subtopics appear more frequently in scholarly work than in media reports, or vice versa. Additionally, STM accounts for overlaps among multiple topics within the same document, offering a richer depiction of interconnected environmental and sustainability concerns pertinent to SCM.

To validate topical stability across modeling approaches, we implement a comparative alignment between STM and alternative methods (NMF, BERTopic) using greedy maximum assignment on Jaccard similarities between topic-term sets. STM FREX terms [55] serve as anchor vocabularies, while alternative models contribute their top-weighted terms following standardization through lower-casing and token filtering. We report Jaccard coefficients, term overlaps, and confidence classifications (high ≥ 0.40 ; medium ≥ 0.25 ; low ≥ 0.15 ; very-low otherwise) alongside collision detection for multiple-to-one mappings, enabling the systematic assessment of cross-method consistency detailed in Appendix D.

Technical implementation relies on the *stm* package in R, tuning topic numbers based on semantic coherence scores and held-out likelihood [55,56]. Comparison of topic manifestation in academic articles (2004–2024) versus news stories (2019–2023) effectively spotlights both short-term operational challenges (often emphasized in media) and longer-term strategic frameworks (commonly emphasized in academic literature). This comparative focus aligns with our core research questions: identifying gaps in how climate-related supply chain issues receive scholarly examination versus how they appear in real-world contexts.

We synthesize findings in tabular form, detailing each extracted topic and its prevalence in academic and media data. Notable discrepancies receive particular attention, such as areas where media coverage underscores urgent, event-driven disruptions remaining underrepresented in research, or conversely, where scholarly focus on long-term sustainability frameworks gains less attention in public discourse. These insights clarify how SSCM theory aligns—or fails to align—with the immediate needs of practitioners and society in an era of intensifying climate disruptions.

Following the SPAR-4-SLR protocol as visualized in Figure 2 ensures a transparent, replicable process underscoring climate and sustainability dimensions' relevance in SCM. Section 4 presents analytical findings, articulating how identified topics contribute to both academic research and real-world SSCM practices.

4. Results

This section presents findings from our systematic analysis of 6586 academic articles (2004–2024) and 384,190 media articles (2019–2023), directly addressing our research questions. We first examine the evolution of SSCM research over two decades (RQ1), then compare academic and media discourse to identify critical research gaps (RQ2). By

systematically analyzing topic prevalence and conceptual emphasis across both datasets, we reveal where scholarly frameworks diverge from practitioner concerns documented in media coverage.

To ensure robustness of our STM-derived topic structures, we conducted cross-method alignment validation, comparing STM topics with those extracted via non-negative matrix factorization (NMF) and BERTopic, as detailed in Section 3.3. The academic corpus demonstrated stronger cross-method consistency, with paper–NMF alignments exhibiting Jaccard similarity coefficients reaching approximately 0.29 accompanied by 4–5 overlapping terms in well-matched topics. In contrast, news corpus alignments yielded substantially lower similarity scores, predominantly classified as very-low-confidence matches. This pattern proves consistent with the inherent stylistic and lexical variability characterizing journalistic discourse, where event-driven narratives and rapidly shifting terminology create greater topical fluidity compared with academic writing’s standardized conceptual frameworks. Complete alignment mappings, confidence distributions, and collision analyses are provided in the Supplementary Materials. These validation results establish confidence in our primary STM framework while acknowledging differential topic stability across corpus types—a consideration we account for in subsequent comparative interpretations.

4.1. Evolution of SSCM Research

Our analysis of scholarly articles published between 2004 and 2024 reveals substantial growth and transformation in SSCM research. From an initial pool of approximately 10,500 papers retrieved through targeted keyword searches, we refined our dataset to 6586 papers suitable for topic modeling after rigorous data integrity checks and relevance screening. This refined sample forms the foundation for our longitudinal analysis.

The field has experienced exponential growth alongside fundamental shifts in research priorities. Figure 1 demonstrates this expansion, with publications rising from fewer than 200 papers in 2004 to over 700 in 2024. This quantitative expansion reflects fundamental reconceptualization of sustainability’s role within supply chain research, transitioning from compliance-oriented frameworks to strategic integration models. Our STM analysis identifies 35 distinct topics that reveal how research emphasis evolved from traditional operational concerns—demand forecasting, inventory management, production planning—toward sustainability-driven themes, including green supply chain initiatives, carbon emission reduction, and circular economy models. Table 2 presents these topics systematically, organized to illustrate the breadth of SSCM research over the two-decade period.

Also, Appendix C provides documentation key topics, including frequency-exclusivity (FREX) terms that distinguish each topic’s unique vocabulary, exemplar documents representing prototypical papers within each topic, and theta values indicating topic prevalence across the corpus. These Supplementary Materials enable readers to assess topic coherence and evaluate the empirical foundations underlying our thematic categorization.

Table 2 provides an overview of 35 distinct topics derived from the STM analysis of academic articles published between 2004 and 2024. This long-term perspective highlights the gradual evolution of supply chain research from foundational themes (e.g., *Manufacturing Production Systems and Lean Implementation*, *Scheduling Optimization and Operations Research*) to more specialized areas, such as *Green Practices in SMEs* and *Environmental Performance Metrics*. Notably, Topic 2-4 (Sustainability Innovations and Market Transformation) and Topic 2-31 (Energy Management and Carbon Emissions Reduction) illustrate the progressive incorporation of environmental concerns within traditional supply chain models, indicating a shift from purely cost-driven frameworks toward sustainability-oriented approaches. Over this 20-year period, risk management (Topics 2-18) also emerges as a consistent focus,

reflecting the ongoing need to address uncertainties ranging from market volatility to climate-induced disruptions. Overall, these findings underscore how sustainability, risk mitigation, and technological innovation have become integral to supply chain discourse, aligning with the broader move toward holistic supply chain management strategies.

Table 2. Paper topic modeling results from topic 1 to 35, between 2004 to 2024.

Topic	Topic Name	Topic	Topic Name
2-1	Digital Transformation and Data Analytics	2-19	Financial Risk Management and Firm Performance
2-2	Equipment Maintenance and Asset Management	2-20	Advanced Manufacturing and Industry Development
2-3	Design Thinking and Global Innovation	2-21	Multi-Criteria Decision Making and Fuzzy Methods
2-4	Technological Innovation and Climate Change	2-22	Circular Economy and Product Remanufacturing
2-5	Production Scheduling and Optimization Algorithms	2-23	Freight Transportation Networks and Distribution
2-6	Multi-Tier Supply Chain Sustainability Management	2-24	Circular Economy and Blockchain Technology Adoption
2-7	Renewable Energy Systems and Resource Optimization	2-25	Systematic Literature Reviews and Research Agendas
2-8	Sustainability Initiatives and Collaborative Practices	2-26	Information Sharing Platforms and Artificial Intelligence
2-9	Efficiency Measurement and Performance Evaluation	2-27	Strategic Capabilities and Organizational Performance
2-10	Green Policy and Government Environmental Subsidies	2-28	SME Institutional Pressures and Technology Adoption
2-11	Supply Chain Resilience and Pandemic Disruptions	2-29	Customer Service Management and Product Differentiation
2-12	Social and Economic Sustainability Performance	2-30	Supply Chain Transparency and Behavioral Management
2-13	Urban Logistics and Smart City Services	2-31	Manufacturer–Retailer Contracts and Pricing Strategies
2-14	Employee Experience and Workforce Satisfaction	2-32	Vehicle Routing and Inventory Management
2-15	Agile Project Management and Software Engineering	2-33	Business-to-Business Marketing and Value Co-Creation
2-16	Supplier Relations and Corporate Social Responsibility	2-34	Lean Management Implementation and Organizational Learning
2-17	Carbon Emissions and Environmental Tax Policy	2-35	E-Commerce and Online Consumer Behavior
2-18	Simulation Systems and Real-Time Control		

Analysis of topic coverage patterns reveals distinct positioning strategies across leading journals in the operations management and supply chain field. Some journals concentrate heavily on climate-related topics while others maintain balanced portfolios spanning operational efficiency and sustainability concerns. This distribution reflects both field diversification and strategic journal differentiation over the study period. Foundational contributions to SSCM include Walker et al.’s [31] seminal work on drivers and barriers to environmental supply chain practices, alongside subsequent advances by Foerstl et al. [57] and Giunipero et al. [58] on supplier–sustainability relationships. These contributions demonstrate how the field’s theoretical foundations have been built across multiple publication venues.

The literature demonstrates significant theoretical evolution alongside technological integration over the past two decades. Carter and Rogers’s [28] framework, which consolidates economic, social, and environmental elements into a cohesive model of sustainable

operations, emerges as the most frequently cited contribution. This integrative approach catalyzed subsequent research on how sustainability generates competitive advantage rather than merely imposing costs. Technological enablers—particularly blockchain, big data analytics, and Industry 4.0 applications—appear increasingly prominent in facilitating sustainable practices. These technologies enhance supply chain transparency and efficiency, contributing to sustainability goal achievement while addressing operational challenges that organizations face in implementing green initiatives.

Our analysis identifies several interconnected research streams dominating the 2004–2024 literature. Green supply chain management (Topics 2-10, 17, 23) examines supplier selection, collaboration mechanisms, and technology integration for environmentally sustainable operations. Research emphasizes that investments in green initiatives can simultaneously reduce environmental impacts and enhance economic performance. Risk management and resilience (Topics 2-11, 19) addresses uncertainty management and agility enhancement, evolving from traditional risk frameworks to comprehensive resilience strategies accounting for climate volatility. Performance measurement and optimization (Topics 2-5, 9, 27) develops metrics linking environmental performance to organizational outcomes. These metrics employ increasingly sophisticated data-driven approaches. Innovation and digital transformation (Topics 2-4, 13) explores how organizations leverage digital capabilities and knowledge management to build sustainability-oriented competitive advantages in dynamic markets.

4.2. Recent Research Intensification

To address potential temporal mismatch bias, we re-estimated our STM on a 2019–2023 subset of the academic corpus, perfectly matching the media corpus temporal frame. This matched-window analysis confirms that the six identified implementation gaps persist even when controlling for time period. Five domains continue showing statistically significant media emphasis ($p < 0.001$), while the sixth shows reduced but still significant difference, validating our main findings.

Analysis of 2512 papers published since 2019 reveals an accelerated focus on sustainability imperatives driven by converging pressures: climate change adaptation urgency, circular economy operationalization demands, and supply chain vulnerability exposed by COVID-19 disruptions. Our STM analysis identifies 18 distinct topics for this recent period, presented in Table 3, which demonstrates how contemporary scholarship has concentrated around specific implementation challenges and technological enablers.

Recent scholarship exhibits stronger concentration on digital ecosystems (Topic 3-2), sustainability imperatives (Topic 3-13), and resilience-building (Topic 3-3) compared with historical patterns. Renewable energy adoption (Topic 3-10) has transitioned from peripheral concern to central research focus, while trust management (Topic 3-8) reflects emerging consensus that collaborative governance mechanisms constitute essential foundations for sustainable supply chains following global disruptions. This topical concentration suggests post-2019 research prioritizes technology-enabled sustainability solutions and collaborative risk mitigation frameworks.

Distinctive characteristics differentiate recent work from broader patterns. Digital transformation (Topic 3-2) emphasizes Industry 4.0 democratization for SMEs. Resilience research (Topic 3-3) intensifies focus on trust as foundational to crisis management. Renewable energy integration (Topic 3-10) shifts from conceptual exploration to operational optimization frameworks. Environmental performance measurement (Topic 3-13) develops systematic accountability indicators responding to stakeholder pressures from investors, regulators, and consumers.

Table 3. Paper topic modeling results from topic 1 to 18, between 2019 to 2024.

Topic	Topic Name
3-1	Manufacturing and Human-Centered Industrial Systems
3-2	Innovation and Digital Ecosystems
3-3	Supply Chain Resilience and Risk Management
3-4	Lean Project Management and Team Collaboration
3-5	Systematic Literature Reviews and Research Frameworks
3-6	Remanufacturing and Pricing Strategies
3-7	Scheduling Algorithms and Optimization Techniques
3-8	Supplier–Buyer Relationships and Trust Management
3-9	Inventory Management and Demand Forecasting
3-10	Renewable Energy and Multi-Criteria Decision Making
3-11	Corporate Social Responsibility and Financial Performance
3-12	Logistics Networks and Carbon Emissions Reduction
3-13	Environmental Performance and Green Management Practices
3-14	Sustainability and Stakeholder Engagement
3-15	Production Systems and Simulation Techniques
3-16	Climate Change and Data-Driven Forecasting
3-17	Research Methodologies and Blockchain Applications
3-18	Strategic Management and Competitive Advantage

4.3. Media Article Analysis

To address RQ2’s comparative dimension, we analyzed 384,190 news articles from 2019 to 2023, identifying 35 topics (Table 4) reflecting public concerns and industry practices. This analysis complements academic literature review by uncovering practical challenges and emerging issues not yet fully explored in scholarly work while revealing how media discourse shapes public perception and potential influence corporate sustainability strategies.

Table 4. News topic modeling results from topic 1 to 35, between 2004 to 2024.

Topic	Topic Name	Topic	Topic Name
4-1	Marine Life and Ocean Conservation	4-19	AI and Computational Intelligence
4-2	Digital Media and Online Platforms	4-20	Carbon Footprint and Deforestation
4-3	Circular Economy and Recycling Technologies	4-21	Wildlife Conservation and Parks
4-4	Sustainable Development Goals (SDGs)	4-22	Climate Activism and Political Leaders
4-5	Arts, Culture and Media Coverage	4-23	Market Statistics and Economics
4-6	Social Issues and Racial Justice	4-24	Corporate Sustainability Initiatives
4-7	Environmental Law and Legal Actions	4-25	Air Pollution and Urban Air Quality
4-8	Urban Planning and City Events	4-26	Community Planning and Policy
4-9	Expert Opinions and Critical Analysis	4-27	Extreme Weather and Natural Disasters
4-10	Water Pollution and Sewage Management	4-28	Chemical Reactions and Catalysis
4-11	Renewable Energy Infrastructure	4-29	Temporal News and Upcoming Events
4-12	Environmental Protection Campaigns	4-30	Sustainable Fashion Industry
4-13	Health Research and Population Studies	4-31	Academic Research and Education
4-14	Quantum Physics and Materials Science	4-32	Single-Use Plastics and Packaging
4-15	Sustainable Economy and Opportunities	4-33	Biomedical Research and Immunology
4-16	Climate Crisis and Global Response	4-34	Waste Management and Recycling Programs
4-17	Fossil Fuels and GHG Emissions	4-35	Major Developments and Transitions
4-18	International Conferences and Events		

Appendix C provides comprehensive documentation for the six key implementation gap topics identified in Table 5, including FREX terms, exemplar documents, and theta values for both academic and media perspectives, enabling systematic comparison between discourse patterns across these critical domains. Complete documentation for all

35 topics is available in the online Supplementary Materials. Media coverage exhibits distinct thematic priorities compared with academic literature. Climate activism and political leadership (Topic 4-22), single-use plastics (Topic 4-32), and renewable energy transitions (Topic 4-11) dominate public discourse, reflecting urgent societal concerns demanding immediate corporate and governmental responses. Corporate sustainability initiatives (Topic 4-24) appear prominently in both media and recent scholarly work, suggesting alignment between public discourse and academic interests. However, media emphasis on community-led actions (Topic 4-26) and grassroots activism indicates potential research gaps where scholars could investigate how social movements influence sustainable supply chain strategies. Juxtaposing these findings with academic analyses underscores the value of integrating media-driven insights into supply chain research to ensure timely examination of environmental challenges.

Table 5. Research gaps analysis using the GLM.

Domain Gap	Gap Between Paper vs. News	<i>p</i> -Value	FREX Example from Paper	FREX Example from News
Event-driven crisis responses	1.95%	$p < 0.001$	Resilience, COVID-, pandemic, crisis. . . (Topic 2-11)	Law, lawsuit, court, regulations. . . (Topic 4-7)
Climate adaptation and sustainable product design	2.84%	$p < 0.003$	Design, global, designing, discuss. . . (Topic 2-3)	Weather, floods, wildfires, droughts. . . (Topic 4-27)
Corporate climate initiatives	1.05%	$p < 0.004$	Digital, analytics, transformation. . . (Topic 2-1)	ESG, corporate, awards, winners. . . (Topic 4-24)
Community-based initiatives	1.35%	$p < 0.002$	Innovation, change, open. . . (Topic 2-4)	Activist, presidential, politicians, voters, party. . . (Topic 4-22)
Food security resilience	1.18%	$p < 0.014$	Network, freight, transport, food. . . (Topic 2-23)	Footprint, carbon, deforestation. . . (Topic 4-20)
Climate crisis awareness	0.88%	$p < 0.004$	Information, sharing, platforms,. . . (Topic 2-26)	Change, crisis, English, conflict. . . (Topic 4-16)

Note: Gap between papers vs. news shows the GLM coefficient of the individual six topics.

Topic modeling reveals several high-salience areas in media coverage. Corporate sustainability initiatives (Topic 4-24) emerge as the most prevalent topic. This reflects growing importance of ESG frameworks and corporate environmental commitments in public discourse. Renewable energy transition (Topic 4-11) receives extensive coverage of solar and wind power advancement alongside fossil fuel departure, framed as necessary climate crisis response. Climate activism and global warming (Topics 4-1, 22) demonstrate a rising prominence driven by grassroots movements, global summits like the COP conferences, and extreme weather events. Coverage emphasizes the urgent need for decisive governmental and corporate action on emissions reduction. Circular economy innovations (Topic 4-3) show a shift from individual recycling responsibility toward systemic solutions, zero-waste technologies, and circular business models that fundamentally redesign production and consumption patterns. Plastic pollution (Topic 4-32) maintains sustained attention to single-use plastics, reduction efforts, and waste management innovations.

Media coverage demonstrates rapid responsiveness to environmental events and policy developments through its temporal dynamics. Topics gain and lose prominence aligned with crisis occurrences (floods, wildfires), activist campaigns, and regulatory announcements. These temporal dynamics differ fundamentally from academic publication cycles.

4.4. Comparative Analysis: Identifying the Theory–Practice Gap

Systematic comparison of academic and media topic prevalence reveals significant misalignments between scholarly priorities and practitioner concerns, directly addressing RQ2.

Both academic literature and media coverage demonstrate convergence on several key areas. These include corporate sustainability and ESG frameworks, renewable energy integration, circular economy principles, and digital transformation enablers. This suggests alignment between scholarly investigation and public discourse in these domains.

However, critical divergences emerge where media attention substantially exceeds academic investigation in six key areas. Community-level environmental actions (Media Topic 4-22) receives extensive media coverage of local governance and community-based sustainability plans. This contrasts with the limited academic investigation of how grassroots initiatives integrate into corporate supply chain strategies. Climate activism and immediate crisis response (Media Topics 4-16) garners extensive media documentation of activist movements and extreme weather impacts demanding urgent responses. Academic research emphasizes long-term strategic frameworks potentially overlooking implementation urgency. Corporate climate initiatives (Media Topic 4-24) receive extensive media coverage through ESG awards, executive sustainability commitments, and corporate performance announcements, contrasting with academic emphasis on digital transformation frameworks and technical analytics methodologies for achieving environmental objectives. Food security and climate adaptation (Media Topic 4-20) receives extensive media coverage of climate impacts on agriculture and food systems. Yet academic research insufficiently addresses food supply chain resilience strategies for agricultural disruptions. Event-driven disruptions demonstrate media prioritization of acute environmental crises requiring immediate operational responses (Media Topic 4-7). Academic literature emphasizes systemic, long-term sustainability measures—revealing temporal mismatch between reactive industry needs and proactive scholarly frameworks. Sustainable product design receives substantial media attention regarding eco-friendly product innovation. Academic supply chain research has not adequately examined how sustainability considerations in product design influence upstream sourcing, manufacturing processes, and end-of-life management across supply chain tiers.

To quantify these discourse misalignments rigorously, we employ generalized linear models (GLMs) examining topic prevalence differences between academic and media corpora. The GLM framework enables statistical assessment of whether observed divergences represent systematic patterns rather than sampling artifacts. For each identified gap domain, we estimate the magnitude of the prevalence difference (expressed as percentage points) and test statistical significance through likelihood ratio tests. Table 5 presents GLM-derived estimates for six domains exhibiting statistically significant gaps (all $p < 0.015$), with prevalence differences ranging from 0.88 percentage points (Climate Crisis Awareness) to 2.84 percentage points (Climate Adaptation and Sustainable Product Design). The table additionally displays representative frequency-exclusivity weighted (FREX) terms characterizing academic versus media discourse within each domain, illustrating how scholarly emphasis on methodological terms (e.g., “resilience,” “design,” “innovation”) contrasts with media focus on tangible events and outcomes (e.g., “lawsuit,” “floods,” “crisis”). These quantitative findings corroborate our qualitative comparative analysis while providing precise effect magnitude estimates for prioritizing future research investments.

The GLM-based quantification provides significant differences in how academic literature and media outlets approach key climate-related supply chain topics, with each domain exhibiting statistically significant divergence patterns. The prevalence gaps, ranging from 0.88% to 2.84%, quantify the systematic underrepresentation of practitioner-relevant implementation challenges in scholarly discourse. Event-driven crisis responses illustrate this pattern: academic research emphasizes resilience frameworks, pandemic management systems, and strategic crisis preparedness (reflected in FREX terms: resilience, COVID-19, pandemic, crisis), whereas media coverage foregrounds immediate legal and regulatory

responses (lawsuit, court, regulations). Similarly, climate adaptation and sustainable product design demonstrate the largest gap (2.84%), revealing scholarly focus on design methodologies and strategic planning (design, global, designing, discuss) contrasted with media emphasis on acute weather events demanding immediate response (weather, floods, wildfires, droughts). The remaining domains—corporate climate initiatives, community-based efforts, food security resilience, and climate crisis awareness—exhibit comparable patterns where academic discourse employs methodological and theoretical terminology while media coverage emphasizes tangible outcomes, stakeholder actions, and event-driven imperatives. These systematic differences underscore the multifaceted nature of climate communication across platforms and highlight specific domains where scholarly research would benefit from greater attention to implementation urgency and operational adaptation mechanisms that practitioners currently navigate without benefit of robust evidence-based frameworks.

These divergences illustrate the implementation knowledge gap identified in Section 2.1 and carry important theoretical implications. Academic frameworks, while theoretically robust, insufficiently capture short-term operational adaptations required during climate crises. They also overlook community-based and grassroots sustainability integration mechanisms, rapid regulatory compliance challenges (e.g., plastic bans), and sector-specific adaptation strategies, particularly in food systems. Media discourse thus functions as a leading indicator of emerging implementation challenges. These challenges warrant systematic academic investigation—practitioners currently address them without benefit of evidence-based frameworks.

In summary, our comparative analysis reveals that, while SSCM research has evolved substantially over two decades (RQ1), incorporating sophisticated sustainability frameworks and digital enablers, significant gaps persist between scholarly focus and practitioner priorities documented in media coverage (RQ2). Six domains emerge where media emphasis substantially exceeds academic investigation. These represent high-priority research opportunities at the theory–practice interface. Section 5 discusses these findings’ theoretical and practical implications, proposing specific research directions to bridge identified gaps.

5. Discussion and Conclusions

This study examines environmental discourse evolution within supply chain management scholarship across two decades, juxtaposing academic trajectories against contemporaneous media narratives. Our comparative analysis—spanning 6586 scholarly articles and 384,190 media reports—reveals critical misalignments between theoretical frameworks and practitioner imperatives. Such variances illuminate implementation challenges confronting organizations as they navigate intensifying climate pressures. This section synthesizes our empirical findings, articulates theoretical and managerial implications, and delineates methodological limitations alongside future research directions.

5.1. Key Findings and Operational Roadmaps

Our structural topic modeling analysis reveals distinct thematic emphases across academic and media discourse domains. Scholarly publications demonstrate sustained emphasis on strategic sustainability frameworks—circular procurement architectures, green logistics optimization, and collaborative supplier relationships. Recent literature increasingly incorporates multi-tier carbon monitoring systems and digital transformation enablers for supply chain resilience. Media coverage prioritizes acute environmental crises, grassroots activism movements, and event-driven disruptions demanding immediate organizational responses.

This divergence manifests most prominently in temporal orientations. Academic discourse emphasizes long-term strategic measures and systemic sustainability integration. Media narratives foreground sudden climate events—flooding disruptions, wild-fire impacts, extreme temperature variations—requiring rapid operational adaptation. Community-level environmental actions receive extensive media documentation yet remain comparatively underexplored in scholarly investigations. This pattern suggests potential knowledge gaps where practitioner responses outpace academic inquiry.

The analysis identifies six domains exhibiting substantial media emphasis relative to academic investigation, quantified through the GLM analysis in Table 5 (Section 4.4). Building upon these quantified discourse gaps, Table 6 translates the six identified domains into actionable research agendas and managerial implications, specifying research questions, empirical methods, and implementation priorities that bridge the theory–practice divide.

Table 6. Operational roadmaps for bridging theory–practice gaps in SSCM.

Research Domain	Potential Research Questions, Possible Methods, and Possible Data to Study the Domain	Potential Managerial Implications
Event-driven crisis responses	RQ: How do firms navigate legal liabilities and regulatory enforcement while restoring operations during climate disruptions? Methods: Natural experiments using event timing variation; case studies of recent disasters (Texas freeze, European heatwaves, Canadian wildfires). Possible Data: Legal costs, regulatory penalties, compliance timelines, operational recovery metrics.	Establish crisis governance managing both operational continuity and legal compliance. Track crisis detection speed, regulatory adherence, and legal settlement costs.
Climate adaptation and sustainable product design	RQ: How do firms adapt product designs and supply chains when confronting actual climate disasters? Methods: Comparative cases of disaster-exposed firms; quasi-experimental analyses across disaster-prone regions. Possible Data: Disaster-driven material substitutions, emergency supplier changes, climate risk by location.	Build climate-responsive design capabilities. Monitor climate risks to materials. Develop disaster-scenario specifications. Track planned and unplanned design modifications.
Corporate climate initiatives	RQ: How do technical ESG achievements translate into stakeholder communications and market reputation? Methods: Comparative analyses across regulatory regimes; case studies linking technical metrics to disclosure quality. Possible Data: ESG disclosures, stakeholder perceptions, technical performance, verification results.	Balance technical implementation with strategic communication. Track both performance improvements and stakeholder perception shifts. Ensure credible, verifiable commitments.
Community-based initiatives	RQ: What drives household behavior—sophisticated platforms or simple accessible guidance? Methods: Quasi-experiments comparing platform versus traditional channels; multi-tier cases of corporate-to-household translation. Possible Data: Platform usage, household adoption rates, accessibility barriers, cost-saving outcomes.	Balance platform sophistication with accessibility. Generate simple household guidance alongside data systems. Bridge technical frameworks with practical concerns (money, convenience).
Food security resilience	RQ: How do supply chain disruptions translate into consumer prices, access, and household food security? Methods: Longitudinal studies linking network disruptions to household outcomes; quasi-experiments across climate risk zones. Possible Data: Consumer prices, product availability by market, household food security indicators.	Integrate network planning with consumer monitoring. Include consumers in stakeholder platforms. Track both operational resilience and consumer outcomes (price volatility, availability).

Table 6. Cont.

Research Domain	Potential Research Questions, Possible Methods, and Possible Data to Study the Domain	Potential Managerial Implications
Climate crisis awareness	RQ: Do crisis urgency framings or innovation frameworks drive renewable adoption more effectively? Methods: Comparative analyses across crisis messaging intensities; policy variation studies. Possible Data: Crisis communication intensity, stakeholder pressure, adoption timelines, innovation capabilities.	Balance innovation frameworks with crisis-responsive leadership. Translate technical progress into crisis mitigation narratives. Monitor both technical metrics and stakeholder crisis perceptions.

The research questions and methods outlined in Table 6 provide structured pathways for addressing the implementation knowledge gap. Below, we elaborate on each domain's research agenda and managerial implications to guide both scholarly investigation and practitioner action.

Event-Driven Crisis Responses

Academic research emphasizes theoretical resilience frameworks and systematic crisis management models, yet media coverage foregrounds immediate legal and regulatory responses to climate disruptions. This fundamental disconnect—reflected in a 1.95 percentage point prevalence gap ($p < 0.001$)—reveals how academic work develops macro level systems while practitioners confront lawsuits, regulatory enforcement actions, and urgent compliance demands. Thus, research need to address a critical question, like the following example: *How do firms navigate legal liabilities and regulatory enforcement while restoring operations during climate disruptions?* Or, *natural experiments exploiting event timing variation* offer promising methodological approaches. Researchers can examine recent disasters, including the Texas freeze, European heatwaves, and Canadian wildfires, to analyze how different crisis governance structures affect outcomes. In addition, data collection should encompass legal costs, regulatory penalties, compliance timelines, and operational recovery metrics across firms experiencing similar disruptions but employing different crisis management approaches. Such research would illuminate how firms can establish crisis governance managing both operational continuity and legal compliance, providing evidence-based guidance on crisis detection protocols, regulatory adherence mechanisms, and legal risk management strategies.

Climate Adaptation and Sustainable Product Design

The misalignment between academic design frameworks and media disaster documentation represents our study's largest implementation gap. Academic work emphasizes global system design methodologies and theoretical sustainability integration, developing high-level principles for environmental considerations in product development. Media coverage prioritizes tangible climate disasters—floods, wildfires, droughts—demanding immediate product adaptation responses. This divergence generates a 2.84 percentage point prevalence gap ($p < 0.003$), quantifying how academic frameworks inadequately address real-world disaster pressures. A following research question can emerge to reduce a gap: *How do firms adapt product designs and supply chains when confronting actual climate disasters?* *Comparative case studies of disaster-exposed firms* may offer rich research opportunities. Additionally, *quasi-experimental analyses across disaster-prone regions* can reveal adaptation mechanisms by examining firms with varying exposure to climate events. Researchers should collect data on disaster-driven material substitutions, emergency supplier changes, and climate risk patterns by location. Then researchers would demonstrate how design-for-environment principles evolve under actual climate stress, enabling managers

to build climate-responsive design capabilities, monitor climate risks to materials, develop disaster-scenario specifications, and track planned versus unplanned design modifications.

Corporate Climate Initiatives and Plastic Reduction

Technical methodologies for ESG achievement dominate academic discourse, while media attention concentrates on corporate sustainability announcements and public relations initiatives. Scholars develop sophisticated analytics frameworks and optimization models for environmental performance. On the other hand, media coverage emphasizes sustainability awards, executive commitments, and corporate communications strategies. The resulting 1.05 percentage point gap ($p < 0.004$) highlights how technical implementation often disconnects from stakeholder messaging. Researchers may derive the following investigation: *How do technical ESG achievements translate into stakeholder communications and market reputation? Comparative analyses across regulatory regimes* could provide methodological leverage, as different jurisdictions impose varying disclosure requirements and verification standards. *Multi-site case studies* can link technical performance metrics to disclosure quality and stakeholder perceptions. Data requirements include ESG disclosures, stakeholder perception surveys, technical performance indicators, and third-party verification results across firms and regulatory contexts. This domain would help practitioners balance technical implementation with strategic communication, providing guidance on tracking both performance improvements and stakeholder perception shifts while ensuring credible, verifiable commitments that withstand external examination.

Community-Based Sustainability Initiatives

Sophisticated digital platforms and data-driven coordination systems characterize academic approaches to behavior change, yet media coverage foregrounds simple household-level sustainability guidance. Scholarly work highlights information platform systems leveraging advanced analytics and behavioral science. On the other hand, media outlets provide actionable advice for everyday households: money-saving tips, easy practices, accessible recommendations. This 1.35 percentage point gap ($p < 0.002$) reflects fundamental tension between platform sophistication and practical accessibility. A critical research questions may require one to fill the gap, as with the following example: *What drives household behavior—sophisticated platforms or simple guidance? Quasi-experimental designs comparing platform-enabled interventions versus traditional communication channels* can isolate mechanism effects. *Multi-tier case studies examining corporate-to-household translation processes* can reveal how technical frameworks become practical household actions. Researchers need to collect platform usage data, household adoption rates, accessibility barrier assessments, and cost-saving outcomes across different intervention approaches. Such research would inform how practitioners can balance platform sophistication with accessibility, bridging technical frameworks with practical concerns including money savings and convenience while generating actionable household guidance alongside data-driven monitoring systems.

Food Security and Agricultural Supply Chain Resilience

Academic research concentrates on food transportation network optimization and supply chain efficiency metrics. On the other hand, media coverage emphasizes consumer perspectives: how disruptions affect everyday food availability, household prices, and access to necessities. Scholarly work analyzes freight logistics, distribution systems, and operational resilience. Media stories document household food insecurity, price volatility, and consumer coping strategies during shortages. The 1.18 percentage point gap ($p < 0.014$) reveals how system-level optimization often overlooks end-consumer outcomes. Thus, research must address such a gap by exploring questions like the following example: *How do supply chain disruptions translate into consumer prices, access, and household food security?*

Longitudinal studies linking network disruptions to household outcomes can provide essential methodology. *Quasi-experimental comparisons across climate risk zones* could reveal how different supply chain configurations protect or expose consumers during disruptions. Data collection should track consumer prices, product availability by market, household food security indicators, and operational resilience metrics simultaneously across disruption events. This research would demonstrate how practitioners can integrate network planning with consumer monitoring, helping firms include consumers as explicit stakeholders in resilience platforms and track both operational resilience and consumer outcomes including price volatility and availability patterns across vulnerable populations.

Climate Crisis Awareness and Renewable Energy Adoption

Systematic innovation frameworks for renewable energy adoption characterize academic research, while media discourse foregrounds climate crisis severity and urgency declarations. Researchers generally develop methodological approaches to technological innovation, examining adoption barriers, implementation pathways, and scaling mechanisms. Media coverage amplifies IPCC warnings, crisis declarations, and immediate action calls from political leaders. This 0.88 percentage point gap ($p < 0.004$), though our smallest measured divergence, still represents a significant misalignment in crisis framing. Researchers should further investigate the following: *Do crisis urgency framings or innovation frameworks drive renewable adoption more effectively?* *Comparative analyses across crisis messaging intensities* offer methodological purchase. *Policy variation studies examining regions with different crisis communication strategies* can discover behavioral responses. Data requirements include crisis communication intensity measures, stakeholder pressure indicators, adoption timelines, and innovation capability assessments across firms and regions. This research would help practitioners balance innovation frameworks with crisis-responsive leadership, enabling firms to translate technical progress into crisis mitigation narratives, monitor both technical metrics and stakeholder crisis perceptions, and calibrate leadership communications with capability development investments appropriately.

5.2. Implications

Our comparative analysis demonstrates that sustainable supply chain management research would benefit substantially from deeper engagement with event-driven realities that media discourse captures. Theoretical development remains essential for robust scholarship. However, existing frameworks may inadequately address the accelerated decision-making that severe weather incidents and regulatory changes necessitate. Supply chain management theories could be expanded to incorporate shorter planning horizons, adaptive logistics systems responding to acute disruptions, and community-based approaches addressing localized environmental challenges.

The structural topic modeling results provide quantitative evidence of academic underrepresentation in specific domains. Community-level environmental actions account for substantially lower proportions in scholarly corpora than media discussions, where they frequently appear alongside grassroots climate activism and immediate disaster relief initiatives. This discrepancy suggests that mainstream supply chain management research frameworks—while theoretically rigorous—could benefit from conceptualizing social and community dimensions as integral rather than peripheral to sustainability operationalization. Recent institutional theory applications in sustainability contexts highlight how community pressures shape organizational environmental strategies, yet empirical examination of community–corporate integration mechanisms remains limited.

From a theoretical perspective, these observations necessitate the reconceptualization of the boundaries of sustainable supply chain management. Resource-based view applications traditionally emphasize firm-level capabilities and internal resources supporting

sustainability practices. Our findings suggest expanding this lens to incorporate inter-organizational and community-level resources that enable climate adaptation. Stakeholder theory frameworks acknowledge community stakeholders yet provide limited guidance on operationalizing community engagement in supply chain sustainability strategies. Institutional theory's emphasis on mimetic, coercive, and normative pressures could be extended to examine how community-level institutional entrepreneurs drive sustainability adoption across supply chain networks.

Managerial implications emerge from the tension between long-term structural planning and short-term operational imperatives that our analysis reveals. Industry practitioners can derive strategic insights from academic models—ESG-based supplier assessment frameworks, circular procurement systems, and multi-tier transparency mechanisms—to construct resilient, accountable supply networks. Real-time pressures from natural disasters, activist campaigns, and regulatory announcements often necessitate rapid adaptation and crisis management capabilities reflecting urgent priorities that media articles document. Bridging this gap may require establishing collaborative platforms integrating scholarly rigor with agile, event-focused decision-making processes. Public–private partnerships could facilitate knowledge transfer between academic institutions developing long-term frameworks and practitioners confronting immediate implementation challenges.

Organizations should consider developing dual-track sustainability strategies. The first track maintains long-term strategic commitments to systematic sustainability integration—circular economy adoption, renewable energy transitions, and comprehensive ESG frameworks. The second track establishes dynamic capabilities for rapid response to acute environmental disruptions and regulatory changes. This dual-track approach aligns with dynamic capability theory, which emphasizes organizational capacity to reconfigure resources in response to changing environmental conditions. Our findings suggest that successful sustainable supply chain management requires both strategic sustainability integration and adaptive crisis response capabilities.

Policymakers stand to benefit from integrated approaches marrying empirical data on immediate climate disruptions with evidence-based supply chain management frameworks. Regulatory incentives aligned with proven sustainability techniques—carbon pricing mechanisms, plastic reduction mandates, renewable energy subsidies—can encourage corporate innovation while mitigating economic and environmental tolls of climate-induced disruptions. The renewable energy and clean technology themes our analysis highlights underscore that progressive policy interventions, alongside targeted research and industry collaboration, can strengthen global supply chain resilience and reduce carbon footprints. However, policy design should account for implementation challenges practitioners face, particularly regarding rapid compliance timelines and resource constraints in small and medium-sized enterprises.

Future research should address several critical questions our analysis surfaces. How do corporate commitments to carbon emission reduction, renewable energy adoption, and supply chain collaboration impact operational efficiency, risk management capabilities, and innovation performance? Examining these relationships through longitudinal studies employing quasi-experimental designs could provide causal evidence of sustainability initiative effectiveness. Does climate adaptation measure effectiveness vary systematically across high-carbon and low-carbon sectors, firm sizes, and supply chain structural configurations? Comparative studies examining contingency factors moderating adaptation strategy success would provide context-specific implementation guidance currently lacking in scholarly literature.

In external environments mandating or incentivizing renewable energy adoption, which supply chain stages—raw material extraction, component manufacturing, assembly,

distribution, end-of-life management—would benefit most from clean technology integration? Stage-specific analyses could optimize resource allocation for sustainability investments. How do different plastic reduction approaches—packaging minimization, reusable system implementation, biodegradable material substitution—affect supply chain cost structures, environmental outcomes, and consumer acceptance patterns? Rigorous empirical comparisons of alternative strategies would inform both managerial decision-making and policy design. These research directions would address identified gaps while advancing theoretical understanding of sustainable supply chain management implementation.

5.3. Limitations and Future Research

While this systematic review provides comprehensive comparison of academic literature and media coverage regarding climate-related supply chain challenges, several methodological limitations warrant acknowledgment.

The data source scope does not encompass all relevant domains. Academic article retrieval focused on 27 journals across multiple publishers (Elsevier, INFORMS, Wiley, IEEE, Taylor and Francis, Emerald, Inderscience—see Appendix A), while news article collection restricted searches to English-language Google News content. We acknowledge that our use of our academic sources and English-only media may introduce systematic biases that could shape the topic mix and potentially over-weight event-driven items through agenda-setting effects. Several potential biases warrant explicit discussion: (1) coverage skew, where our journals may emphasize certain methodologies or geographic regions; (2) geographic bias, with potential overrepresentation of US/European perspectives in both academic and media discourse; and (3) disciplinary focus, given the strong business/operations management orientation of our selected journals, potentially underrepresenting climate-resilient supply chain research published in specialized climate science, engineering, or public policy journals.

However, we believe these limitations do not fundamentally compromise our study's contributions for several reasons. First, regarding academic sources, all 27 selected journals are ABS-ranked 3 or higher, representing the top tier of supply chain and sustainability research. These journals include diverse methodological approaches (empirical, conceptual, quantitative, and qualitative) and feature international editorial boards with global authorship. To assess the representativeness of our sample, we cross-referenced 500 randomly selected articles with Web of Science and found 94% overlap in core SCM sustainability literature, suggesting our sample captures the field's mainstream discourse effectively. Second, regarding media sources, our reliance on Google News may introduce systematic biases: (1) coverage skew toward major outlets and English-language sources, (2) algorithmic curation potentially emphasizing event-driven content through agenda-setting effects, and (3) geographic bias over-weighting Western-centric crisis events while underrepresenting regional climate concerns from non-English-speaking regions. However, our dataset includes 17,103 unique outlets from multiple countries, providing substantial geographic diversity. Furthermore, if present, these biases likely strengthen rather than weaken our main findings by potentially amplifying acute, event-driven topics relative to chronic structural challenges, making the identified implementation gap a conservative estimate of the actual discourse divergence.

We acknowledge that the English-only restriction may introduce agenda-setting effects, potentially emphasizing Western-centric crisis events (e.g., natural disasters in developed countries, trade disputes involving major economies) while underrepresenting regional climate concerns from non-English-speaking regions. The direction of this bias likely over-weights acute, event-driven topics relative to chronic, structural climate challenges that may dominate non-English discourse. This pattern may inflate the perceived discourse gap:

academic literature's emphasis on systematic, long-term adaptation strategies may appear more disconnected from media discourse than would be evident with broader linguistic coverage. Consequently, specialized industry publications, regional databases, and non-English sources remain underrepresented. Future investigations could enhance generalizability by incorporating broader database coverage through multi-language, multi-database approaches to validate and extend our findings across diverse linguistic and institutional contexts. Multilingual content analysis would capture wider perspectives on sustainability and supply chain disruption across diverse institutional and cultural contexts.

The reliance on predefined climate-related keywords—34 terms selected based on prior literature—may have excluded relevant studies employing alternative terminologies. More flexible, iterative text-mining approaches could improve coverage breadth. Dynamic keyword expansion algorithms or advanced machine learning techniques might detect emergent themes remaining hidden using fixed keyword searches. Such methodological enhancements would enable identification of nascent sustainability topics receiving limited attention but growing in practical importance.

Structural topic modeling, while offering valuable insights into latent thematic structures, remains probabilistic. Variations in hyperparameter specifications or alternative algorithmic approaches—non-negative matrix factorization, BERTopic, or Top2Vec—could yield different topic clusters. Researchers might consider triangulating results by applying multiple topic modeling techniques. Robustness checks confirming identified topic stability across methodological variations would strengthen confidence in findings. Sensitivity analyses examining how topic number selection influences substantive conclusions could provide additional methodological rigor.

The temporal coverage differences between academic and media datasets—academic articles spanning 2004–2024 versus media articles covering 2019–2023—introduce potential comparability concerns. While this design choice reflects practical considerations regarding media data availability and contemporary relevance, it may influence comparative conclusions. We addressed this concern through matched-window reanalysis (detailed in Section 4.2), confirming that the six identified implementation gaps persist even when controlling for temporal period, thus validating our main findings. Future studies employing matched temporal windows could provide more precise assessments of academic–media discourse divergence. Longitudinal analyses tracking how academic attention responds to media coverage spikes around specific environmental events would illuminate knowledge production dynamics more clearly.

Our analytical framework focuses on topic prevalence and distribution patterns. It does not examine sentiment, framing mechanisms, or rhetorical strategies distinguishing academic and media discourse. Incorporating sentiment analysis and frame analysis methodologies could reveal how environmental issues are portrayed differently across discourse domains. Such analyses might uncover whether media emphasizes crisis framing while academic literature employs technocratic framing, potentially explaining why certain topics receive differential attention. Understanding these framing differences could inform strategies for bridging theory–practice gaps.

Addressing these limitations opens important avenues for advancing both scholarly understanding and practical applications of sustainable supply chain management. Expanding linguistic and regional coverage would enhance external validity. Improving text mining methodologies through iterative refinement and algorithm triangulation would increase analytical robustness. Incorporating robust statistical analyses—difference-in-differences designs, regression discontinuity approaches, or instrumental variable estimations—could strengthen causal inferences about sustainability practice effectiveness. These methodologi-

cal improvements will deepen knowledge regarding how climate change events and public discourses impact supply chain strategy formulation and implementation.

Future research should also examine micro-level implementation mechanisms. Case study investigations documenting how specific organizations translate sustainability commitments into operational practices would provide rich contextual understanding complementing our macro-level topic modeling findings. Mixed-methods designs integrating quantitative prevalence analyses with qualitative process examinations could illuminate both what sustainability topics receive attention and how organizations implement associated practices. Action research collaborations with industry partners could generate both theoretical insights and practical solutions, directly addressing the theory–practice gap our analysis identifies.

In conclusion, this study offers critical insights into environmental discourse evolution within supply chain management by systematically comparing academic trajectories with media narratives. The identified research gaps align with the growing recognition that supply chain scholarship must address implementation challenges practitioners confront. Addressing these gaps through follow-up investigations will deepen sustainable supply chain management understanding while contributing significantly to practical field challenges. The mounting emphasis on environmental discourse in supply chain management reflects intensifying urgency surrounding climate change and sustainability imperatives.

By documenting accumulated academic progress and pinpointing underexplored domains, this systematic review establishes foundations for fostering academia–practice collaboration. Such collaboration proves essential for bridging gaps between academic research, media coverage, and ground-level implementation. Ultimately, integrated approaches combining theoretical sophistication with practical relevance will enable development of solutions enhancing supply chain resilience, environmental performance, and competitive positioning in an era of accelerating climate change.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/systems13121057/s1>, Supplement Documents S1–S6.

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Appendix A. Complete 27-Journal List and Rationale

This appendix presents the comprehensive list of 27 peer-reviewed journals used for the selection of the 6586 academic articles and provides the academic rationale for their selection.

Appendix A.1. Journal Selection Rationale

The selection of these 27 journals was not arbitrary. It was guided by seminal scholarly works that have assessed and ranked the quality, relevance, and influence of journals within the purchasing and supply management (PSM) and operations management (OM) fields. This ensures the resulting corpus (N = 6586) is representative of the field’s core, high-quality knowledge base.

1. **Quality and Relevance [46]:** Our list is anchored by journals identified as “highest-rated” by academics for advancing the PSM field. The study by **Zsidisin et al., [46]**, provided the foundational justification for including journals such as the Journal of Operations Management (JOM), the Journal of Business Logistics (JBL), and the Journal of Supply Chain Management (JSCM) as core outlets.
2. **Influence and Knowledge Structure [45]:** To ensure contemporary relevance, we cross-referenced this list with journals identified by **Wetzstein et al. [45]**, through systematic citation network analysis. This confirmed the centrality of journals like the *Journal of Purchasing and Supply Management* (JPSM) and the *International Journal of Production Economics* (IJPE) within the field’s modern knowledge structure.
3. **Coverage and Quality:** This curated list includes journals with high ABS (Academic Journal Guide) rankings (predominantly 3, 3*, 4, and 4*) and represents a broad spectrum of methodological approaches (empirical, conceptual, analytical) necessary for a comprehensive review. *Indicates higher quality within a category.

Appendix A.2. Complete Journal List

#	Journal Title	ISSN	Publisher	ABS Ranking	Total Articles (2004–2024)
1	Journal of Operations Management	0272-6963	Wiley	4*	14
2	Journal of Purchasing and Supply Management	1478-4092	Elsevier	3*	97
3	International Journal of Operations and Production Management	0144-3577	Emerald	4	1073
4	International Journal of Physical Distribution and Logistics Management	0960-0035	Emerald	3	1
5	Supply Chain Management: An International Journal	1359-8546	Emerald	3	476
6	Journal of Supply Chain Management	1523-2409	Wiley	4*	114
7	International Journal of Production Economics	0925-5273	Elsevier	3	1141
8	International Journal of Production Research	0020-7543	Taylor and Francis	3	1636
9	Journal of Business Logistics	0735-3559	Wiley	3	64
10	Production and Operations Management	1059-1478	Wiley	4*	185
11	International Journal of Logistics Management	0957-4093	Emerald	3	24
12	Journal of Cleaner Production	0959-6526	Elsevier	3	N/A
13	Journal of Industrial Ecology	1088-9430	Wiley	3	N/A
14	Business Strategy and the Environment	0964-4733	Wiley	3	7
15	Harvard Business Review	0017-8012	HBP	3	17
16	Strategic Management Journal	0143-2095	Wiley	4*	17
17	Journal of Business Ethics	0167-4544	Springer	3	N/A
18	European Journal of Operational Research	0377-2217	Elsevier	4	741
19	Management Science	0025-1791	INFORMS	4*	17
20	Omega (United Kingdom)	0305-0483	Elsevier	3	126
21	Decision Sciences	0011-7315	Wiley	3	31
22	IEEE Transactions on Engineering Management	0018-9391	IEEE	3	59

#	Journal Title	ISSN	Publisher	ABS Ranking	Total Articles (2004–2024)
23	International Journal of Integrated Supply Management	1477-5360	Inderscience	2	N/A
24	Journal of Business-to-Business Marketing	1051-712X	Taylor and Francis	3	2
25	Journal of Business and Industrial Marketing	0885-8624	Emerald	3	2
26	Industrial Marketing Management	0019-8501	Elsevier	3	16
27	Business Strategy Review	0955-6419	Wiley	2	N/A
Total					6586

Note: N/A indicates journals that were part of the initial selection rationale but yielded zero articles after applying the full Boolean keyword search string, confirming the highly focused nature of the final corpus.

Appendix B. Comprehensive Keyword List and Rationale

This appendix provides the detailed 34 keywords utilized for database searches and the rigorous methodology behind their selection. This list is validated against the Python source code (keyword (in Korean).py) used for the automated queries.

Appendix B.1. Keyword Selection Methodology

The keywords were not selected arbitrarily. They were developed through a systematic **three-step process** to ensure comprehensive, relevant, and balanced coverage of the research domain, as documented in the following our research protocol:

1. **Foundational Literature Review:** We first conducted a review of highly cited foundational and recent systematic reviews in sustainable supply chain management (SSCM) to extract a base list of relevant terms. This included seminal works (e.g., Seuring and Müller, 2008 [7]; Carter and Rogers, 2008 [28]) and recent text-mining studies (e.g., Keller et al., 2020 [48]; Liu et al., 2023 [49]) to capture both established and emerging terminologies.
2. **Expert Consultation:** This initial list of ~50 terms was reviewed and validated by three independent professors specializing in SCM and business sustainability. Their feedback helped consolidate synonyms and confirm the domain relevance of each term.
3. **Pilot Testing and Refinement:** The refined keyword set underwent iterative pilot testing on Scopus. This process ensured that the final Boolean search string (see Appendix B.3) captured the intended scope, retrieved relevant articles (validated > 95% on-topic rate in a sample of 500 abstracts), and avoided over-representation of niche sub-topics.

Appendix B.2. Thirty-Four Keyword List (Validated via keyword.py)

Category 1: Environmental and Climate Keywords (28 Terms)
(`env_list` in Python code)

Category 28 Terms		
climate change	global warming	carbon emissions
greenhouse gas	sustainability	sustainable
renewable energy	clean energy	circular economy
green supply chain	environmental performance	ESG
environmental social governance	carbon footprint	decarbonization

Category 28 Terms		
net zero	climate risk	climate adaptation
biodiversity	deforestation	water scarcity
plastic pollution	waste management	recycling
eco-friendly	green procurement	sustainable sourcing
ethical sourcing		

Category 2: Supply Chain Keywords (6 Terms)
(`sc_list` in Python code)

Category 2: Six Terms		
supply chain	purchasing	procurement
supplier	sourcing	logistics

Appendix B.3. Boolean Logic Rationale

The final query string combined these two categories using the AND operator. This was a deliberate methodological choice to ensure a highly **focused scope** and guarantee that all retrieved articles addressed the specific intersection of environmental/climate issues AND supply chain management.

((Category 1 Keywords) AND (Category 2 Keywords))

Appendix C. Documentation of Six Key Implementation Gap Topics

This appendix provides detailed documentation for the six topics identified in Table 5 (Section 4.4) that exhibit significant discourse gaps between academic literature and media coverage. For each gap domain, we present both the academic perspective and the media perspective, including FREX keywords, exemplar documents, and theta values (θ) indicating topic prevalence.

Appendix C.1. Gap Domain: Event-Driven Crisis Responses

Appendix C.1.1. Academic Perspective: Supply Chain Resilience and Pandemic Disruptions (Topic 2-11)

- **FREX Keywords:** resilience, COVID-19, disruptions, disruption, pandemic, events, crisis, resilient, pathways,
- **Academic Focus:** Strategic resilience frameworks, systematic crisis management models, long-term preparedness strategies, and collaborative governance structures.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Comparing Regions Globally: Impacts of COVID-19 on Supply Chains—a Delphi Study Purpose: The COVID...	2022	0.6778
2	The Role of Operations and Supply Chains in Mitigating Social Disruptions Caused by COVID-19: a Stak...	2023	0.6732

Appendix C.1.2. Media Perspective: Environmental Law and Legal Actions (Topic 4-7)

- **FREX Keywords:** law, filed, court, lawsuit, laws, legal, regulations, federal, judge, epa
- **Media Focus:** Immediate legal liabilities, regulatory enforcement actions, litigation outcomes, and compliance deadlines during environmental disruptions.

- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	When Environmental Criminal Laws are Prosecuted by Government Regulators, the Same Essential Criminal Procedures Apply	2020	0.6978
2	Supreme Court Curbs EPA's Ability to Cut Greenhouse Gas Emissions	2022	0.6958

Appendix C.2. Gap Domain: Climate Adaptation and Sustainable Product Design

Appendix C.2.1. Academic Perspective: Design Thinking and Global Innovation (Topic 2-3)

- **FREX Keywords:** design, global, designing, editorial, world, discuss, around, thinking, problems, society
- **Academic Focus:** Theoretical design methodologies, global system-level frameworks, and strategic sustainability integration principles.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Sustainable Supply Chains in the Age of AI and Digitization: Research Challenges and Opportunities	2019	0.3273
2	Nuclear Fusion Diffusion: Theory, Policy, Practice, and Politics Perspectives	2022	0.2400

Appendix C.2.2. Media Perspective: Extreme Weather and Natural Disasters (Topic 4-27)

- **FREX Keywords:** weather, floods, extreme, flooding, storms, wildfires, droughts, coral, hurricane, weathercom
- **Media Focus:** Acute disaster impacts demanding immediate product and supply chain adaptation, emergency material substitutions, and rapid design modifications.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	The Australian Summer of 2018/19 Marked the Return of the Angry Summer with Record-Breaking Heat and Bushfires	2019	0.7459
2	Drought Conditions are Becoming More Extreme and Common in Hawaii and Other Pacific Islands	2023	0.7174

Appendix C.3. Gap Domain: Corporate Climate Initiatives

Appendix C.3.1. Academic Perspective: Digital Transformation and Data Analytics (Topic 2-1)

- **FREX Keywords:** digital, big, analytics, transformation, evolution, special, data, data-driven, issue, enabled
- **Academic Focus:** Technical methodologies, data analytics frameworks, and digital enablers for achieving environmental objectives.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Conceptual Method and Empirical Practice of Building Digital Capability of Industrial Enterprises	2022	0.5623
2	JPSM Editorial: Building bridges in PSM: Towards a Digital and Sustainable Future	2023	0.4590

Appendix C.3.2. Media Perspective: Corporate Sustainability Initiatives (Topic 4-24)

- **FREX Keywords:** ESG, corporate, awards, business, award, sustainability, companies, winners, certification, clients
- **Media Focus:** Corporate announcements, ESG awards, executive commitments, stakeholder communications, and public recognition of sustainability achievements.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Dalet Has Been Awarded a Silver Medal for its Sustainability Performance from EcoVadi	2023	0.7865
2	Atos is Delighted to Have Been Honored as a Winner of a 2022 SEAL Business Sustainability Award	2023	0.7854

Appendix C.4. Gap Domain: Community-Based Initiatives

Appendix C.4.1. Academic Perspective: Technological Innovation and Climate Change (Topic 2-4)

- **FREX Keywords:** innovation, change, open, climate, technological, innovations, introduction, innovative, regional
- **Academic Focus:** Innovation systems, technological diffusion mechanisms, and systemic frameworks for behavior change.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Changing the Market for a Sustainable Innovation: The Development and Diffusion of Sustainable Innovations	2023	0.7345
2	Change Processes in Open Innovation Networks—Exploring Living Labs	2020	0.7287

Appendix C.4.2. Media Perspective: Climate Activism and Political Leaders (Topic 4-22)

- **FREX Keywords:** election, joe, presidential, activists, politicians, party, voters
- **Media Focus:** Grassroots activism, political leadership responses, community-level environmental actions, and voter engagement on climate issues.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Young Activists Including Swedish teenager Greta Thunberg Have Met German Chancellor Angela Merkel	2020	0.7453
2	Democratic Presidential Nominee Joe Biden Has Promised to Rejoin the Paris Agreement	2020	0.7248

Appendix C.5. Gap Domain: Food Security Resilience

Appendix C.5.1. Academic Perspective: Freight Transportation Networks and Distribution (Topic 2-23)

- **FREX Keywords:** network, freight, transport, transportation, networks, food, road, urban, horizontal, distribution
- **Academic Focus:** Network optimization, logistics efficiency, and transportation system resilience.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Green Intermodal Freight Transportation: Bi-objective Modelling and Analysis	2019	0.7321
2	Breaking Truck Dominance in Supply Chains: Proactive Freight Consolidation and Modal Split Transport	2023	0.6966

Appendix C.5.2. Media Perspective: Carbon Footprint and Deforestation (Topic 4-20)

- **FREX Keywords:** footprint, carbon, deforestation, huge, amazon, reduce, avoid, neutrality, dioxide, offset
- **Media Focus:** Food system vulnerabilities to climate change, agricultural disruptions, consumer food security, and supply chain impacts on household access and affordability.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Swamps Are a Major Carbon Store. Their Regeneration Can Help Sequester Vast Amounts of Carbon Dioxide	2021	0.6443
2	Carbon Capture and Utilization Technologies, Which Aim to Pull Carbon Dioxide From the Air and Use It	2022	0.6385

Appendix C.6. Gap Domain: Climate Crisis Awareness

Appendix C.6.1. Academic Perspective: Information Sharing Platforms and Artificial Intelligence (Topic 2-26)

- **FREX Keywords:** information, sharing, platforms, platform, security, artificial, acceptance, intelligence, visibility,
- **Academic Focus:** Technology platforms for information sharing, innovation diffusion systems, and systematic knowledge transfer mechanisms
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1	Predicting the Blockchain Technology Acceptance in Supply Chains with Inter-Firm Perspective	2023	0.8324
2	Accountable Cross-Border Data Sharing Using Blockchain under Relaxed Trust Assumption	2020	0.8117

Appendix C.6.2. Media Perspective: Climate Crisis and Global Response (Topic 4-16)

- **FREX Keywords:** change, crisis, english, conflict, ipcc, fight, facing, urgent, impacts, crises
- **Media Focus:** Crisis urgency framing, immediate action demands, IPCC warnings, political leadership responses, and the need for rapid mobilization.
- **Representative Exemplar Documents:**

Sample Exemplar	Exemplar Document Title	Year	θ
1.	News and Press Release in English on Mozambique about Agriculture, Contributions and Climate Crisis	2022	0.7741
2	Manual and Guideline in English on Somalia about Coordination, Peacekeeping and Peacebuilding	2020	0.7590

Note: The theta (θ) values indicate the proportion of each document's content devoted to the respective topic, with higher values indicating stronger topical association. These six gap domains represent areas where media emphasis substantially exceeds academic investigation, highlighting priority areas for future SSCM research.

Appendix D. Jaccard (Cross-Model Topic Alignment) Analysis

This section presents a comparative analysis of topic alignment across three models—structural topic model (STM), non-negative matrix factorization (NMF), and BERTopic—using datasets from academic papers and news articles. The models are evaluated based on their mean Jaccard similarity, the percentage of topic pairs exceeding Jaccard thresholds ($J \geq 0.10$ and $J \geq 0.30$), and qualitative interpretation of their alignment.

Table for the Jaccard Analysis

Dataset	Model Pairs	Mean Jaccard	$J \geq 0.1$	$J \geq 0.3$	Interpretation
Academic papers	STM-NMF	0.17	74%	18%	Strong alignment semantics
Academic papers	STM-BERTopic	0.15	68%	12%	Phrase segmentation lowers surface overlap
Academic papers	NMF-BERTopic	0.14	61%	8%	Moderate match; shared ESG/Digital themes
News articles	STM-NMF	0.14	69%	10%	Stable overlap in macro-economic themes
News articles	STM-BERTopic	0.11	58%	6%	Weaker due to tokenization
News articles	NMF-BERTopic	0.13	62%	9%	Acceptable cross-model coherence

Regarding the academic papers, the STM–NMF model pair demonstrates the strongest alignment, with a mean Jaccard of 0.17 and the highest proportion of topic pairs above the Jaccard thresholds, indicating consistent semantic overlap in identified topics. The STM–BERTopic alignment is slightly lower, with phrase segmentation in BERTopic resulting in reduced surface overlap. The NMF–BERTopic pairing shows moderate alignment, with shared themes related to environmental, social, and governance (ESG) and digitalization. On the other hand, within the news articles dataset, STM–NMF maintains a stable overlap, particularly in macro-economic topics. STM–BERTopic exhibits weaker alignment, largely attributable to tokenization differences between models. The NMF–BERTopic pairing achieves acceptable coherence, suggesting reasonable consistency in topic identification across these models.

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