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Sustainable Supply Chain Management Practices: A Theoretical Review and Research Agenda

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Abstract
Sustainable Supply Chain Management (SSCM) has expanded significantly in the literature over the past two decades in response to environmental, social, and economic pressures, regulatory demands, stakeholder expectations, and global supply chain complexity. Despite this growth, the field suffers from inconsistencies in classifying practices, limited integration of the three Triple Bottom Line (TBL) dimensions (especially the social dimension), and insufficient explanatory mechanisms linking practices to sustainability outcomes. Digital transformation technologies (e.g., big data analytics, IoT, blockchain) are reshaping traceability, transparency, governance, and risk management, yet their comprehensive role in enabling balanced sustainability remains debated. This theoretical-analytical review synthesizes ~89 peer-reviewed studies (2008–2025) from major databases. It proposes a strategic classification of SSCM practices into five interconnected packages (compliance & impact reduction, efficiency & resource optimization, transparency & governance, circularity & value recovery, and social justice & labor rights), transcending traditional functional divisions (procurement, manufacturing, logistics, reverse logistics). Drawing on Triple Bottom Line, stakeholder theory, resource-based view, and dynamic capabilities perspectives, the paper elucidates mechanisms (transparency, governance, risk management, collaborative learning) through which practices achieve TBL outcomes. It highlights persistent gaps in dimension integration, theoretical depth, methodological diversity, contextual focus (especially developing economies like Iraq), and digital integration. A targeted research agenda is proposed to guide future studies toward more integrated, context-sensitive, and mechanism-oriented approaches in complex global supply chains.

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Introduction

Sustainable supply chain management practices have seen a significant expansion in literature over the past two decades, as a response to accelerating environmental, social, and economic transformations, as well as escalating regulatory pressures, growing stakeholder expectations, and the increasing complexity of global supply chains. Despite this expansion, literature still

suffers from inconsistencies in how these practices are organized and analyzed, and from a lack of clarity in explaining their mechanisms of impact, particularly regarding the actual integration of the three dimensions of sustainability (economic, environmental, and social), and especially the limited integration of the social dimension within coherent and applied models. Digital transformation—through big data analytics, the Internet of Things, and blockchain technology—has also contributed to reshaping the supply chain environment by enhancing traceability, transparency, and risk management. However, the role of these technologies in enabling comprehensive sustainability remains a subject of debate, and research issues regarding their effectiveness and the variability of their impact across different contexts are still unresolved.

Therefore, this study focuses on the following question: How have sustainable supply chain management practices evolved in literature, and to what extent are they integrated in achieving a balance between economic, environmental, and social dimensions across the supply chain levels, particularly considering digital transformation and the increasing complexity of global supply chains?

This central question leads to several sub-questions:

1. What are the main classifications/packages of sustainable supply chain practices presented in the literature, and how do they differ according to the chain's functions (procurement, manufacturing, logistics, reverse logistics)?
2. What explanatory mechanisms explain the "how and why" these practices contribute to achieving sustainability outcomes according to the three-line logic (TBL), and what are the shortcomings in integrating the social dimension into applied models?
3. How does digital transformation influence the reshaping of the adoption of sustainable supply chain practices and the promotion of integration, transparency, and risk management across the chain, and what issues remain unresolved in research?

This article stems from the conviction that the quantitative expansion in the literature on sustainable supply chains has not always been accompanied by clarity in analytical frameworks or conceptual integration. Therefore, it does not merely offer a descriptive overview of previous studies but rather seeks to provide an analytical classification of sustainable supply chain management practices that transcend traditional functional divisions. Instead, it reorganizes these practices into strategic packages that reflect the rationale behind their adoption and their objectives across the entire value chain. Furthermore, the article develops an interpretive perspective that clarifies how and why these practices contribute to achieving sustainability outcomes according to a three-pronged approach. This is achieved by highlighting the role of mechanisms such as transparency, governance, risk management, and collaborative learning, particularly in the context of digital transformation. In addition, the article presents a targeted research agenda that considers the specificities of developing economies, especially the context of Iraq and the wider region, where sustainability challenges intersect with institutional, regulatory, and structural constraints. This agenda aims to guide future studies toward a more realistic and integrated approach to sustainable supply chain issues.

Review Methodology

This study adopted a theoretical-analytical review methodology to organize and analyze the literature related to sustainable supply chain management practices, focusing on the analytical and interpretive aspects rather than a purely descriptive approach. Several reputable academic databases were searched, most notably Scopus, Web of Science, and ScienceDirect, using key keywords such as: Sustainable Supply Chain Management Practices, Triple Bottom Line (TBL), Sustainable Procurement, Green Supply Chain, and Digital Transformation in Supply Chains.

Specific inclusion criteria were adopted, including studies published in peer-reviewed scientific journals between 2008 and 2025 that directly address sustainable supply chain practices, their theoretical frameworks, and their practical dimensions. General descriptive studies or those not directly related to the subject matter were excluded. After screening and analysis, approximately *89* academic studies formed the analytical basis of this review, enabling the development of a systematic classification of practices and the identification of research gaps and future research directions.

The Concept

The concept of sustainable supply chains is a contemporary management concept that emerged in response to the rapid changes in the global business environment (Roy *et al*., 2018; Rebs *et al*., 2019; Donohue *et al*., 2020; Pournader *et al*., 2022) [66, 33, 25, 16] and the increasing environmental, social, and economic pressures facing organizations. This concept reflects a shift in supply chain management from the traditional focus on operational efficiency, cost reduction, and maximizing short-term profitability to adopting a holistic, long-term perspective that balances achieving economic performance with environmental protection and enhancing social responsibility. In this context, sustainable supply chains are not limited to improving operational practices within the organization's boundaries, but extend to include coordination and integration among all actors across the supply chain, from suppliers at the upper levels to customers and stakeholders at the lower levels, ensuring the creation of shared and sustainable value across the entire chain (Seuring and Müller, 2008) [49].

The concept of sustainable supply chains is understood as a management and strategic framework concerned with managing the flows of materials, information and capital, along with the cooperative relationships between organizations, taking into account the three dimensions of sustainable development, namely the economic dimension, the environmental dimension and the social dimension, derived from customer requirements and stakeholder expectations (Seuring and Müller, 2008; Carter and Rogers, 2008; Siems *et al*., 2023; Mugoni *et al*., 2024; Zaghdoud, 2025) [49, 23, 40, 38, 76]. According to this perspective, sustainability becomes an integral part of the decision-making process in the supply chain, where environmental and social considerations are integrated into core activities such as purchasing, production, distribution, storage and returns management, rather than being treated as marginal obligations or temporary responses to regulatory pressures. (Lohmeyer & Schuessler, 2018; Ahlquist & Mosley, 2021) [26, 19] The concept of sustainable supply chains also reflects a qualitative shift in business management philosophy, as

sustainability is no longer viewed as an additional cost or an obstacle to performance, but rather as an approach to enhancing long-term competitiveness, managing risks, protecting corporate reputation, and achieving continuity in environments characterized by uncertainty and volatility (Ahi & Searcy, 2013; Aguado *et al*., 2013; Costantini *et al*., 2017; Huang & Li, 2017; Ivanov *et al*., 2017; Silva *et al*., 2019) [18, 1, 6, 11, 12, 17]. Adopting sustainable practices across the supply chain contributes to reducing environmental and social risks, improving compliance with legislation, enhancing trust with stakeholders, as well as supporting innovation and improving resource efficiency (Freise *et al*., 2015; Narasimhan & Talluri, 2009; Chen *et al*., 2022; Aladaileh *et al*., 2024) [36, 39, 35, 34].

Thus, it can be said that the concept of sustainable supply chains is not merely an extension of traditional or green supply chain concepts but rather embodies an integrated framework for managing the supply chain with a long-term strategic logic. This framework aims to balance the requirements of economic performance with environmental protection and the promotion of equity and social responsibility, thereby ensuring the sustainability of both the organization and its supply chain. The concept of supply chains has undergone a gradual evolution in management literature, linked to the transformations in the business environment and organizational priorities over time.

In its early stages, the focus was on the operational dimension of the supply chain as a means to improve flow, reduce costs, increase efficiency, and respond quickly to customer demands. This reinforced the "traditional supply chain" model, based on a short-term economic logic that prioritizes profitability and operational efficiency (Mentzer *et al*., 2001; Beamon, 1999; Walker *et al*., 2008) [56, 58, 78]. Within this framework, supplier relationships were often managed through short-term contracts governed by price, quality, and delivery criteria, with limited or reactive engagement with environmental and social issues as marginal commitments outside the core of strategic decision-making (Christopher, 2011; Mentzer *et al*., 2001) [73, 56].

However, escalating regulatory pressures, growing stakeholder expectations, and increasing risks spanning global networks—such as reputational risks, non-compliance, and supply disruptions—have exposed the limitations of the traditional cost-and-efficiency perspective. This has led the literature to redefine the supply chain as an interconnected system that transcends individual organizations and necessitates integrated management of flows, relationships, and their multiple impacts (Seuring & Müller, 2008; Pagell & Wu, 2009) [49, 28]. In this context, the concept of sustainable supply chains has evolved as a critical response to the structural shortcomings of the traditional model. The goal is no longer limited to economic performance but now encompasses achieving a broader balance between economic, environmental, and social dimensions across the entire chain (Carter & Rogers, 2008; Ahi & Searcy, 2013) [23, 18]. This shift reflects a move in supply chain management from a logic of "short-term efficiency" to one of "long-term sustainable value," and from managing operations within the organization to managing relationships and influences that extend across suppliers, customers, and stakeholders. This justifies the fundamental distinction between traditional and sustainable chains in terms of the governing philosophy, the scope of decisions, and the nature of relationships across the chain (Carter & Rogers, 2008; Seuring & Müller, 2008) [23, 49].

In contrast, the concept of sustainable supply chains emerged as a critical response to the shortcomings of the traditional model, particularly considering escalating environmental and social challenges (Menon & Ravi, 2021a; Ali *et al*., 2022; Harsanto *et al*., 2023; Abbate *et al*., 2023) [27, 20, 37, 33] and increasing global uncertainty and risks. Sustainable chains adopt a holistic strategic perspective that aims to balance economic, environmental, and social dimensions through integrated management of material, information, and capital flows, and by fostering collaboration and coordination among all stakeholders across the chain (Seuring and Müller, 2008; Carter and Rogers, 2008; Pagell & Wu, 2009) [49, 23, 28]. According to this perspective, sustainability is not a secondary objective or an added cost, but rather an entry point for creating long-term value, enhancing competitiveness, managing risks, and protecting corporate reputation (Ahi & Searcy, 2013; Hassini *et al*., 2012) [18, 84].

The difference between the two models is also evident in their time horizon. Traditional chains focus on short-term performance and immediate response to market demands, while sustainable chains adopt a long-term vision that considers the impact of current decisions on future generations and the sustainability of resources. The differentiation is further reflected in the scope of the chain itself. Traditional chains tend toward a linear perspective that ends with product delivery to the customer, while sustainable chains adopt a broader product lifecycle perspective, encompassing post-consumer phases such as reuse, recycling, and waste management, thus promoting a shift toward more circular and sustainable models (Beamon, 2014; Pagell and Shevchenko, 2014; Aravindaraj & Rajan Chinna, 2022) [57, 29, 87].

Traditional and sustainable supply chains also differ in how they manage relationships with stakeholders. While traditional chains focus on direct stakeholders such as customers, suppliers, and shareholders, sustainable chains broaden their scope to include society, regulators, NGOs, and the environment as implicit stakeholders. This necessitates higher levels of transparency, accountability, and information sharing (Carter and Easton, 2011; Gold *et al*., 2010) [59, 61]. This trend reinforces the shift of competition from the individual company level to the supply chain, where the ability to coordinate and collaborate sustainably becomes a key source of competitive advantage.

Therefore, the fundamental difference between traditional and sustainable supply chains lies not merely in adding an environmental or social dimension to existing practices, but in a radical transformation of the chain management logic. From a time-limited economic efficiency logic, to an integrated strategic logic that seeks to achieve sustainable economic value without harming the environment or society, and establishes the continuity of the supply chain and its ability to adapt and withstand in business environments characterized by complexity and uncertainty (Ahmadi *et al*., 2017; Bag, 2017; Das, 2018; Bag *et al*., 2018; Kusi-Sarpong *et al*., 2019; Bag *et al*., 2019; Huang *et al*., 2023; Silva *et al*., 2023) [43, 45, 7, 46, 13, 44, 11, 89].

Table 1: An analytical comparison between traditional supply chains and sustainable supply chains

Comparison focus	Traditional supply chains	Sustainable supply chains	The most important sources in literature
Management perspective	Operational – purely economic	Strategic – Integrated	Beamon, 1999; Mentzer *et al*., 2001; Seuring and Müller, 2008
Main objective	Reducing costs and maximizing short-term profitability	Achieving long-term and balanced value	Christopher, 2011; Carter and Rogers, 2008; Pagell and Wu, 2009
Time horizon	short term	long term	Hassini *et al*., 2012; Ahi & Searcy, 2013
Scope of decision-making	Within the boundaries of the organization or the first level of suppliers	Across the entire supply chain	Mentzer *et al*., 2001; Seuring and Müller, 2008
Main focus	Efficiency, speed, cost, delivery	Efficiency + Environmental and Social Sustainability	Beamon, 1999; Carter and Easton, 2011
Dealing with the environment	Marginal or responsive to regulatory pressures	Integrated into the core of the strategic decision	Pagell and Shevchenko, 2014; Sarkis *et al*., 2011
social dimension	Limited or not directly addressed	A fundamental element (labor rights, society, justice)	Carter and Rogers, 2008; Seuring and Müller, 2008; Gold *et al*., 2010
Supplier Relationships Model	Contractual, short-term, price-based	Long-term partnerships, risk sharing	Christopher, 2011; Pagell and Wu, 2009; Beske and Seuring, 2014
Supply chain perspective	Linear (from supplier to customer)	Extended/Cyclical (Entire Product Lifecycle)	Beamon, 2014; Pagell and Shevchenko, 2014
Risk management	Reactive after the problem occurs	Proactive and comprehensive	Tang, 2006; Hassini *et al*., 2012; Ivanov *et al*., 2017
Transparency and information sharing	limited	High and includes stakeholders	Gold *et al*., 2010; Sodhi and Tang, 2019
Source of competitive advantage	Cost reduction and improved efficiency	Sustainability, innovation, reputation	Porter and Kramer, 2011; Ahi & Searcy, 2013
Continuity and flexibility	Vulnerable to disturbances	High and durable	Pagell and Wu, 2009; Chowdhury *et al*., 2021
The role of stakeholders	Limited (customers, suppliers, shareholders)	Broad (society, government, environment, civil organizations)	Freeman, 1984; Carter and Easton, 2011
Nature of the realized value	Economic value only	Economic, environmental, and social value	Elkington, 1994; Carter and Rogers, 2008; Seuring and Müller, 2008

The table shows that sustainable supply chains represent a shift in management and strategic logic, not merely a functional extension of traditional chains. While the traditional model is based on a short-term operational logic focused on cost and efficiency, sustainable chains adopt a long-term vision that seeks to create balanced value across economic, environmental, and social dimensions (Carter & Rogers, 2008; Ahi & Searcy, 2013) [23, 18]. The shift in decision-making from the organizational level to the entire chain level is also evident, confirming that sustainability is managed through relationships and interactions between different stakeholders (Seuring & Müller, 2008; Pagell & Wu, 2009) [49, 28]. Thus, competition in contemporary environments is between supply chains capable of achieving both sustainability and resilience, not between individual organizations (Christopher, 2004; Negri *et al*., 2021) [73, 15].

Theoretical Foundations of Sustainable Supply Chains

Triple Bottom Line Theory of Sustainability

The Triple Bottom Line (TBL) theory of sustainability is one of the most prominent theoretical frameworks that has contributed to establishing the concept of sustainable supply chains. Elkington (1994) introduced this perspective to emphasize that evaluating organizational performance should not be limited to the economic dimension alone but should also include environmental and social dimensions (Elkington, 1994) [41]. This theory has formed the conceptual basis for integrating sustainability into supply chain management, whereby the chain is managed according to the logic of achieving a balance between economic profitability, environmental protection, and the promotion of social well-being across all its stages. In this context, several researchers (Seuring & Müller, 2008; Carter & Rogers, 2008; Del Borghi *et al*., 2014; Choudhary *et al*., 2019; Ahmed *et al*., 2019; Kusi-Sarpong *et al*., 2021; Fu *et al*., 2022) [49, 23, 8, 5, 54, 55, 10] have indicated that adopting a TBL perspective is essential for transforming supply chains from a traditional operating model to a sustainable one, by integrating environmental and social considerations into the chain's strategic and operational decisions. Subsequent literature also confirms that the three-dimensional framework provides an analytical basis for understanding the complexity of decisions in sustainable supply chains, particularly considering trade-offs between the three dimensions (Hassini *et al*., 2012; Pagell and Wu, 2009) [84, 28].

Stakeholder Theory

Stakeholder theory is one of the key theoretical pillars that has supported the development of sustainable supply chains. Freeman (1984) presented an expanded view of the organization as a network of relationships that includes multiple parties, going beyond shareholders and customers to include suppliers, society, government, NGOs, and the environment as an indirect stakeholder (Freeman, 1984) [80]. This perspective has been clearly reflected in the literature on sustainable supply chains, as numerous studies have confirmed that achieving sustainability requires understanding the expectations of multiple stakeholders and integrating them into supply chain decisions (Seuring and Müller, 2008; Carter and Easton, 2011; Boström *et al*., 2015;

Lim *et al*., 2017; Ebinger & Omondi, 2020) [49, 59, 4, 14, 9]. The literature also indicates that increasing pressure from stakeholders, particularly regarding social and environmental responsibility, has driven organizations to adopt more transparent and collaborative practices across the supply chain, thereby enhancing corporate legitimacy and mitigating reputational risks (Gold *et al*., 2010; Sodhi and Tang, 2019). Thus, stakeholder theory provides an explanatory framework for why sustainable supply chains cannot be separated from the management of relationships and responsibilities that extend across the entire chain.

The Resource-Based View (RBV)

Resource-based theory contributes to the interpretation of sustainable supply chains from the perspective of competitive advantage. This perspective posits that the superior performance of organizations depends on possessing scarce resources and capabilities that are difficult to imitate or replace (Barney, 1991). This perspective has been applied in the literature on sustainable supply chains (Negri *et al*., 2021; Pournader *et al*., 2022; Alva Ferrari *et al*., 2023) [15, 16] to illustrate how sustainable practices—such as long-term collaboration with suppliers, environmental capabilities, and knowledge management systems—can constitute strategic resources that enhance long-term performance (Carter and Rogers, 2008; Pagell and Wu, 2009) [23, 28]. Studies indicate that integrating sustainability into the supply chain is not merely about compliance; it can generate unique organizational capabilities, such as resource efficiency, sustainable innovation, and the building of trusted stakeholder relationships—all resources that are difficult for competitors to replicate (Ahi & Searcy, 2013; Beske and Seuring, 2014) [18, 71]. Therefore, a resource perspective provides a theoretical foundation linking sustainability to competitive advantage in supply chains.

Sustainability as a Dynamic Capabilities Perspective

With increasing uncertainty and rapid change in business environments, recent literature has shifted towards interpreting sustainable supply chains through a dynamic capability's perspective. This perspective focuses on an organization's ability to sense environmental changes, seize opportunities, and continuously repurpose its resources (Teece *et al*., 1997) [72]. Within this framework, supply chain sustainability is viewed as a dynamic capability that enables an organization to adapt to environmental, regulatory, and social pressures, manage risks, and maintain long-term performance (Pagell and Wu, 2009; Beske *et al*., 2014) [28, 71]. Recent studies also confirm that adopting sustainable supply chain practices enhances chain resilience and its ability to withstand disruptions through continuous learning, innovation, and integration among partners (Ivanov *et al*., 2017; Chowdhury *et al*., 2021) [12, 3]. Thus, the dynamic capabilities perspective offers a more nuanced explanation of how sustainability can evolve from a mere set of practices into an ongoing strategic capability within the supply chain.

Sustainable supply chains should not be understood as an operational extension of traditional supply chains or a set of practices that merely respond to environmental and regulatory pressures, but rather as an integrated strategic framework built upon a conscious interaction of several theoretical foundations. While the three-line approach to sustainability provides the value-based foundation for guiding chain decisions toward balancing economic, environmental, and social dimensions (Elkington, 1994; Seuring & Müller, 2008; Carter & Rogers, 2008) [41, 49, 23], stakeholder theory highlights the broad scope of organizational responsibility, encompassing a complex network of actors with divergent interests (Freeman, 1984; Carter & Easton, 2011) [80, 59]. Conversely, the resource perspective demonstrates how sustainability practices can become genuine sources of long-term competitive advantage (Barney, 1991; Ahi & Searcy, 2013) [21, 18], while the dynamic capabilities perspective adds a more advanced explanatory dimension, redefining sustainability as a renewable organizational capability that enables the supply chain to adapt to uncertainty and continuously respond to change (Teece *et al*., 1997; Ivanov *et al*., 2017) [72, 12]. Accordingly, we emphasize that understanding sustainable supply chains requires dealing with these theories as an integrated interpretive system, not separate frameworks, which paves the way for analyzing the dimensions of sustainable supply chains as a direct applied translation of this theoretical foundation.

The social dimension, however, is the least represented and least developed in literature, despite growing recognition of its importance. Studies addressing it have focused on issues of workers' rights, working conditions, social justice, suppliers' social responsibility, prevention of child labor, and occupational health and safety (Carter & Easton, 2011; Yawar & Seuring, 2017; Barton, 2000; Dempsey *et al*., 2011) [59, 74, 60, 62]. This dimension is often treated in a normative or ethical manner, without being effectively integrated into supply chain management models or linked to clear performance indicators. This has created a clear gap between theoretical discourse and practical application (Gualandris *et al*., 2015; Villena & Gioia, 2020) [63, 64].

A critical review of the literature reveals that the fundamental weakness lies not in the definition of the dimensions themselves, but rather in their weak integration within a single analytical framework. Although many researchers emphasize the need to balance the three dimensions (Seuring & Müller, 2008; Carter & Rogers, 2008; Ansari & Kant, 2017) [49, 23, 65], most studies tend to address each dimension separately or focus on a single dimension as representative of sustainability. This contradicts the fundamental logic of sustainable supply chains as interconnected, multi-level, and multi-stakeholder systems (Pagell & Wu, 2009; Gold *et al*., 2017) [28, 61]. Therefore, while the literature has successfully framed the dimensions of sustainable supply chains theoretically, it still suffers from analytical shortcomings in understanding the interrelationships between these dimensions, particularly in complex industrial environments and global supply chains, where economic objectives are intertwined with environmental pressures and social responsibilities (Gruˇzauskas *et al*., 2018; Khan *et al*., 2022; Aladaileh, 2025) [67, 68, 76].

Sustainable Supply Chain Practices in the Literature: A Critical Analytical Review

This literature review demonstrates that sustainable supply chain practices have been the primary mechanism through which sustainability has moved from a normative conceptual framework to operational and strategic applications within supply chains. These practices have evolved gradually in response to regulatory, market, and technological pressures.

However, this evolution has not been linear or homogeneous across the three dimensions of sustainability (Seuring & Müller, 2008; Carter & Rogers, 2008; Pagell & Wu, 2009).

Classifying Sustainable Supply Chain Practices

Classifying sustainable supply chain practices according to traditional chain functions (procurement, manufacturing, logistics, reverse logistics) is insufficient, as this classification—while operationally important—does not explain the rationale behind adopting the practices or their level of strategic maturity across the chain. The literature indicates that understanding sustainable supply chains requires moving beyond a purely functional approach to an integrated analysis that considers strategic objectives and mechanisms for creating sustainable value (Seuring & Müller, 2008; Carter & Rogers, 2008; Pagell & Wu, 2009) [49, 23, 28]. Therefore, this study proposes a dual analytical classification that combines functional and strategic dimensions, allowing practices to be understood not only in terms of their position within the chain but also in terms of the overall system objective they aim to achieve. Based on the literature analysis, sustainable supply chain practices can be organized into five interconnected strategic packages:

1. The compliance and impact reduction package, which includes practices related to adhering to environmental legislation, reducing emissions, and managing waste, as a response to regulatory and stakeholder pressures (Sarkis *et al*., 2011; Seuring, 2011) [31, 63].
2. The efficiency and resource optimization package, which focuses on improving resource use, environmental design, cleaner production, and enhancing operational efficiency to achieve simultaneous economic and environmental benefits (Hassini *et al*., 2012; Zailani *et al*., 2012; Ahi & Searcy, 2015) [84, 32, 18].
3. The transparency and governance package, which relates to developing supplier standards, enhancing traceability and disclosure, and employing digital technologies such as data analytics and blockchain to support cross-chain accountability (Gold *et al*., 2010; Saberi *et al*., 2019; Sodhi & Tang, 2019) [61, 30, 66].
4. The circularity and value recovery package, which includes reverse logistics, reuse, recycling, and remanufacturing, supporting the transition to a circular economy (Pagell & Wu, 2009; Metta & Badurdeen, 2013; Corona *et al*., 2019) [28, 44, 72].

The social justice and labor rights package, which addresses working conditions, worker safety, supplier social responsibility, and local supplier development, is one of the most challenging packages to measure and integrate into practical models (Carter & Easton, 2011; Yawar & Seuring, 2017; Villena & Gioia, 2020) [59, 75, 79].

This classification contributes to the shift from viewing practices as isolated operational activities to understanding them as strategic packages reflecting different approaches to sustainability. It also allows for the analysis of the degree of integration between economic, environmental, and social dimensions within the supply chain, particularly in complex environments and developing economies.

The proposed strategic classification is practically embodied within the various supply chain functions. The packages do not operate in isolation from procurement, manufacturing, logistics, or reverse logistics, but rather are distributed across them with varying degrees of integration. The efficiency and resource optimization package may manifest itself in adopting cleaner production within manufacturing processes and in improving transportation networks within logistics, while the social justice and labor rights package is clearly embodied in supplier selection and evaluation policies within procurement activities. Thus, functional classification becomes a tool for identifying the application of strategic packages within the value chain, not a replacement for them. The relationship between strategic packages, value chain functions, and sustainability outcomes can be understood within an interconnected conceptual sequence that begins with strategic packages of practices, which are implemented across different value chain functions and operate through intermediary mechanisms such as transparency and information sharing, governance and coordination among partners, risk management, co-learning, and innovation, ultimately leading to the achievement of the three-pronged sustainability outcomes. In this context, digital transformation is an enabler that enhances the effectiveness of these mechanisms, while the institutional and industry context is a determining factor in their success or failure.

The literature tends to classify sustainable supply chain practices into four main, interconnected groups, reflecting the stages and core functions of the supply chain. In the area of sustainable procurement, studies have focused on selecting suppliers according to environmental and social criteria, developing sustainable suppliers, and building long-term relationships based on transparency and shared responsibility (Ahi & Searcy, 2015; Grimm *et al*., 2016; Kusi-Sarpong *et al*., 2019) [18, 66, 13]. Sustainable production and manufacturing practices have focused on resource efficiency, environmentally friendly design, waste reduction, adoption of clean technologies, and remanufacturing (Zailani *et al*., 2012; Yu *et al*., 2017; Beamon, 2014) [32, 70, 57]. Regarding sustainable distribution and logistics, the literature has focused on improving transport networks, reducing carbon emissions, adopting clean fuels, and improving storage, packaging (Mollenkopf *et al*., 2010; Gruˇzauskas *et al*., 2018) [86, 60]. Reverse logistics and waste management have received increasing attention as pivotal practices for achieving a circular economy, through recycling, reuse, product recovery, and extending product lifecycles (Pagell & Wu, 2009; Metta & Badurdeen, 2013; Corona *et al*., 2019) [28, 44, 72].

Despite the extensive body of literature on sustainable supply chains, the current review reveals a key research gap: the absence of an integrated analytical framework that explains how and why sustainable supply chain practices interact across different levels of the chain to achieve a genuine balance between economic, environmental, and social dimensions. Most studies show a clear tendency to treat sustainability practices as isolated functional activities (in procurement, manufacturing, or logistics) or to link them to one-dimensional outcomes, often environmental or economic, without in-depth analysis of the interactions between these practices or the mechanisms that govern their mutual impact across the entire supply chain.

This central gap gives rise to several interconnected sub-gaps. First, there is a gap in the integration of dimensions, where a

clear weakness is observed in integrating the social dimension into analytical models of sustainable supply chains. This dimension is often addressed in a normative or ethical manner, without linking it to decision-making mechanisms or performance indicators across the chain. Second, there is a gap in theoretical explanation. The three-pronged approach to sustainability is used in most studies as a descriptive framework, while the application of management theories—such as stakeholder theory, resource perspective, and dynamic capabilities—remains partial and fragmented, limiting their ability to explain the dynamics of sustainability in complex supply chains. Third, the digital transformation gap, where literature focuses on the operational benefits of digital technologies without developing conceptual models that explain their role in reshaping governance, transparency, and the distribution of environmental and social responsibilities across the supply chain. Finally, the context gap, where most studies are concentrated in advanced economies and specific industrial sectors, with a clear lack of understanding of how sustainable supply chain practices are formed in developing economies and resource-intensive sectors, where institutional and regulatory constraints intersect with sustainability challenges in a more complex way.

Accordingly, this review emphasizes that theoretical progress in the field of sustainable supply chains requires moving from describing practices and enumerating their benefits to developing integrated explanatory frameworks that clarify the mechanisms by which sustainable practices interact with the three dimensions of sustainability, the role of digital transformation in enabling this interaction, and the limits of its effectiveness in different industrial and institutional contexts.

The Timeline of Sustainable Supply Chain Practices

The literature indicates that the evolution of sustainable supply chain practices has gone through three main phases. In the first phase, the focus was on environmental compliance and minimizing negative impacts, primarily driven by regulations and legislation. Practices were reactive and limited in scope (Seuring, 2011; Sarkis *et al*., 2011) [63, 31]. The second phase saw a gradual shift towards integrating sustainability into operational decisions, linking it to efficiency, cost reduction, and improved operational performance (Hassini *et al*., 2012; Bai *et al*., 2019) [84, 22]. In the most recent phase, practices have evolved towards a strategic and integrated perspective, supported by digital technologies, big data analytics, the Internet of Things (IoT), and blockchain technology. This has enabled enhanced transparency, risk management, and support for sustainable decisions across the supply chain (Wang *et al*., 2016; Saberi *et al*., 2019; Ghobakhloo, 2020; Liu *et al*., 2023) [50, 30, 62, 64].

Third: Strengths and Weaknesses of Sustainable Supply Chain Practices. Despite the diversity of sustainable supply chain practices, the literature reveals several key strengths, most notably their ability to improve operational efficiency, reduce risks, enhance regulatory compliance, improve corporate reputation, and build a long-term competitive advantage (Bai *et al*., 2019; Mastos & Gotzamani, 2022) [22, 66].

Conversely, studies also reveal a clear weakness: an unbalanced focus on environmental and economic practices, coupled with a weak integration of the social dimension, as well as a tendency to treat practices in isolation without an integrated framework linking them across different stages of the supply chain (Carter & Easton, 2011; Gualandris *et al*., 2015; Yawar & Seuring, 2017) [59, 65, 75].

An Introduction to Research Gaps

The review highlights that the fundamental gap in the literature on sustainable supply chain practices lies not in the scarcity or ambiguity of practices, but rather in the absence of comprehensive analytical frameworks that explain how these practices interact with the three dimensions of sustainability and with different industrial contexts, particularly in highly complex environments and global supply chains. The literature also points to the limited number of studies that integrate sustainable practices and digital transformation within a unified, circular, and strategic perspective. This opens the door for future research aimed at developing more integrated and comprehensive conceptual frameworks (Khan *et al*., 2022; Aladaileh, 2025) [42, 34]. Therefore, analytical value is not achieved simply by listing practices across chain functions, but by understanding how they are integrated as strategic packages operating through shared mechanisms to produce balanced outcomes within a three-pronged logic point the review reveals the literature has yet to fully address.

Research Gaps and Future Research Trends in Sustainable Supply Chain Literature

Despite the remarkable expansion of sustainable supply chain literature over the past two decades, this review reveals that the quantitative growth in studies has not necessarily been matched by a balanced qualitative development in theoretical and analytical approaches. The main research gaps in this field can be categorized into four interrelated groups.

Theoretical Gaps

The literature exhibits an over-reliance on limited theoretical frameworks, primarily the three-line perspective of sustainability, often treated as a descriptive framework rather than a profound interpretive tool (Seuring & Müller, 2008; Carter & Rogers, 2008) [49, 23]. Despite repeated calls for a broader application of management theories, such as stakeholder theory, resource perspective, and dynamic capabilities, their application remains partial or fragmented, often used to justify findings rather than guide the conceptual design of studies (Pagell & Shevchenko, 2014; Allen *et al*., 2021; Govindan, 2022) [29, 55, 67]. This gap highlights the urgent need to develop integrated theoretical frameworks that interpret sustainable supply chains as dynamic, multi-level systems, not merely as an operational extension of traditional supply chain management.

Conceptual and Integrative Gaps

The literature reveals a clear weakness in integrating the three dimensions of sustainability within unified analytical models. Despite the theoretical consensus on the importance of balancing environmental, economic, and social dimensions, applied studies tend to focus on one dimension, often environmental or economic, with relative neglect of the social dimension or treating it in a normative manner (Carter & Easton, 2011; Yawar & Seuring, 2017; Villena & Gioia, 2020) [59, 75, 79]. Furthermore, most studies have addressed sustainable supply chain practices in a fragmented way, categorized by function (procurement, production,

distribution), without analyzing the interactions between these practices at the chain level (Pagell & Wu, 2009; Gold *et al*., 2017) [28, 61]. This highlights a clear gap that necessitates research focusing on horizontal and vertical integration within sustainable supply chains.

Methodological and Contextual Gaps

Methodologically, the literature shows a clear dominance of quantitative and applied studies, compared to a limited number of theoretical studies and in-depth analytical reviews that seek to reorganize accumulated knowledge and develop new research avenues (Sánchez-Flores, 2020; Govindan & Hasanagic, 2018) [88, 67]. Furthermore, the majority of studies focus on the context of developed countries and specific industrial sectors, while industrial environments in developing economies, and complex resource-intensive supply chains, such as the oil and construction industries, remain significantly under-researched (Khan *et al*., 2022; Aladaileh, 2025) [42, 34]. This indicates a need to broaden the scope of research to include diverse contexts that consider institutional, organizational, and cultural specificities.

Gaps Related to Technology and Digital Transformation

Despite the growing recognition of the role of digital technologies, such as big data analytics, the Internet of Things (IoT), and blockchain, in supporting sustainable supply chain practices, the literature still lacks conceptual frameworks that explain how these technologies can be integrated within a comprehensive sustainability perspective, particularly in the context of a circular economy (Saberi *et al*., 2019; Ghobakhloo, 2020; Liu *et al*., 2023) [30, 62, 64]. Furthermore, most studies focus on operational and technological benefits, neglecting the long-term social and organizational implications of digital transformation in sustainable supply chains.

This study contributes to the development of sustainable supply chain literature through three interconnected contributions.

First, it presents a typology of sustainable supply chain practices that transcends the traditional functional division based on chain stages. Instead, it organizes practices into strategic packages that reflect the rationale behind their adoption and their objectives. This allows for a deeper understanding of the varying levels of sustainability maturity across supply chains and addresses the shortcomings of literature that has treated these practices in a fragmented or one-dimensional manner.

Second, the study develops a mechanism-based interpretive perspective that explains how and why sustainable supply chain practices contribute to achieving the three-pronged sustainability outcomes. It highlights the role of mechanisms such as transparency, governance, risk management, and cross-chain learning, particularly in the context of digital transformation. This helps bridge the interpretive gap prevalent in literature that has focused on outcomes without analyzing the mechanisms that generate them.

Third, the study proposes a future research agenda based on a clear pivotal gap, directing future research towards developing integrated theoretical frameworks, analyzing the interrelationships between sustainability practices and economic, environmental and social dimensions, expanding the scope of research to include industrial contexts in developing economies and resource-intensive sectors, and employing multi-level research approaches capable of capturing the complexity of contemporary supply chains.

Future Research Agenda

Based on the above, several future research directions can be proposed. First, there is a need to develop integrated theoretical frameworks that combine the perspectives of sustainability, dynamic capabilities, and digital transformation to understand sustainable supply chains as renewable strategic capabilities. Second, there is a need to promote research that focuses on integrating the three dimensions of sustainability and analyzing the interactions between them across different stages of the supply chain. Third, there is a need to expand theoretical studies and conceptual reviews that reorganize the literature and define clear research paths, rather than relying solely on fragmented applied studies. Finally, research attention should be directed toward industrial contexts in developing economies and resource-intensive sectors, focusing on the role of digital technologies in achieving comprehensive sustainability that transcends the environmental dimension to encompass balanced economic and social dimensions.

This study presents a critical analytical review of the literature on sustainable supply chains, aiming to move beyond traditional descriptive approaches toward a deeper understanding of the concept's evolution, its theoretical foundations, its dimensions, and related practices in contemporary industrial contexts. The review revealed that sustainable supply chains are no longer understood as a set of limited environmental practices or regulatory responses, but rather as a multidimensional strategic framework reflecting a complex interplay between economic objectives and environmental and social responsibilities across the entire supply chain.

The findings also highlighted that literature, despite its quantitative expansion, still suffers from a clear disparity in the depth of its theoretical treatment, with a dominant focus on environmental and economic dimensions at the expense of integrating the social dimension into comprehensive analytical models. The review explained that sustainable supply chain practices have evolved from environmental and operational compliance to more strategic and integrated approaches, driven by advancements in digital technologies and the shift towards a circular economy. However, this transformation has not been accompanied by comprehensive explanatory frameworks capable of interpreting the interactions of these practices across different levels of the supply chain.

This study contributes to the literature by organizing the accumulated knowledge on sustainable supply chains and offering a critical analysis that identifies shortcomings and research gaps, particularly those related to the integration of the three dimensions of sustainability, the application of management theories, and the role of digital transformation in supporting overall sustainability. The study also proposes a future research agenda focused on developing integrated theoretical frameworks and expanding research to encompass diverse industrial and economic contexts. This will enhance the understanding of sustainable supply chains as dynamic strategic capabilities that contribute to long-term value for both organizations and society.

Thus, this review underscores that genuine progress in sustainable supply chains is not achieved through adopting isolated practices or technological solutions, but rather

through building integrated theoretical and applied perspectives capable of guiding research and practice toward achieving more balanced and inclusive sustainability in an increasingly uncertain and complex business environment.

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