Conditional Complementarity of Green Supply Chain Practices and Supply Chain Resilience: A Contingency Framework for Sustainable Competitive Performance in Tanzania

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DOI: https://doi.org/10.47772/IJRISS.2026.101000781

Received: 28 October 2026; Accepted: 02 November 2026; Published: 18 November 2026

ABSTRACT

Purpose: This conceptual paper develops a Tanzania-oriented contingency framework explaining when green supply chain management (GSCM) practices and supply chain resilience reinforce one another, generate trade-offs or have competing implications for sustainable competitive performance.

Methodology: A purposive integrative review critically synthesises foundational theories, selected peer-reviewed research, Tanzania-specific studies and policy documents. Sources are assessed for conceptual relevance, methodological limitations and transferability. The paper explains the non-systematic selection approach and outlines a reproducible protocol for future review updates. No primary data were collected or empirical effects estimated.

Conceptual findings: Green procurement, eco-efficient operations, sustainable logistics, circularity and supplier collaboration may complement risk sensing, supplier diversification, operational flexibility and adaptive recovery. Four proposed pathways are resource productivity, service continuity, collaborative learning and stakeholder confidence. Complementarity depends on finance, infrastructure, supplier capabilities, digital information quality and institutional support. Excessive inventory buffers, emergency transport and resource-intensive recovery may increase costs or lifecycle environmental burdens.

Theoretical contribution: The framework integrates the natural-resource-based view, dynamic capabilities theory and resilience scholarship. Six propositions distinguish direct associations, green-by-resilience interactions, mediating mechanisms, moderating conditions and net trade-offs across economic, operational, environmental and social outcomes. The SDGs and Tanzania Development Vision 2050 are treated as policy-alignment lenses, not measured national impacts. The model explicitly permits null or negative interactions and treats simultaneous adoption as insufficient evidence of complementarity.

Practical implications: Managers should jointly assess lifecycle sustainability, supply risk, service criticality and the costs of alternative interventions. Policymakers can support reliable infrastructure, supplier development and implementable standards. Longitudinal, multi-sector research is needed to test the model and establish when integrated practices improve balanced performance.

Keywords: Green supply chain management; Supply chain resilience; Conditional complementarity; Sustainable competitive performance; Tanzania.

INTRODUCTION

Supply chains organize interdependent flows of materials, services, information and resources from sourcing through production, distribution and recovery. Their configuration influences costs and service reliability as well as environmental and social outcomes (Carter & Rogers, 2008; Seuring & Müller, 2008). In Tanzania, these networks connect agriculture, agro-processing, mining, manufacturing, healthcare, public procurement, tourism,

retail and transport. Their potential contribution to productivity, domestic value addition and inclusive development is consistent with the strategic priorities in Tanzania Development Vision 2050 (United Republic of Tanzania, 2025).

Green supply chain management integrates environmental considerations into sourcing, design, operations, transport and end-of-life processes (Srivastava, 2007). Supply chain resilience concerns the adaptive capacity of a supply network to prepare for, respond to and recover from unexpected disruptions (Ponomarov & Holcomb, 2009). The former places greater emphasis on resource and environmental impacts; the latter emphasizes continuity, recovery and adaptation. Their relationship is not intrinsically complementary: the literature documents both potential synergies and tensions (Negri et al., 2021; Doetsch & Huchzermeier, 2024). For instance, diversified sourcing can reduce dependence on one supplier but the net environmental result depends on production conditions, transport and logistics configuration rather than supplier location alone.

The strategic challenge facing contemporary supply chains extends beyond the simultaneous occurrence of environmental pressures and operational disruptions to the complex interdependencies between sustainability and resilience decisions. Interventions designed to strengthen one objective may generate unintended economic, operational or environmental consequences elsewhere in the supply network. Negri et al. (2021) demonstrate that sustainability and resilience strategies can produce both synergies and trade-offs while Doetsch and Huchzermeier (2024), drawing on evidence from 143 supply chain practitioners, establish that the two objectives influence one another and face overlapping implementation barriers, particularly financial constraints and product complexity. For instance, sustainability certification may strengthen supplier accountability but impose additional compliance and verification costs on resource-constrained producers (Oya et al., 2017). Similarly, maintaining additional safety stock can improve continuity during disruptions but increase inventory holding costs and the risk of expiry and waste, particularly for perishable products (Yigit & Esnaf, 2023). Conversely, data-driven logistics optimisation can improve resource efficiency and reduce emissions while maintaining operational performance, illustrating opportunities for mutually reinforcing interventions (Deyab et al., 2026). These relationships suggest that the benefits of integrating green supply chain practices and resilience capabilities cannot be assumed to arise automatically. Rather, their effectiveness depends on organizational resources, supplier capabilities, infrastructure reliability and the ability to balance competing performance objectives. In the Tanzanian context, these mechanisms provide a theoretically grounded basis for examining the conditions under which green and resilient supply chain practices jointly contribute to sustainable competitive performance, although their specific effects remain subject to empirical validation.

Tanzania's Development Vision 2050 provides a timely policy context for examining this relationship. The national vision identifies a strong, inclusive and competitive economy, human capabilities and social development and environmental integrity and climate resilience as key pillars. It also recognises integrated logistics as an enabler of development (United Republic of Tanzania, 2025). The SDGs provide a complementary global framework, particularly Goal 8 on decent work and economic growth, Goal 9 on industry and infrastructure, Goal 12 on responsible consumption and production, and Goal 13 on climate action (United Nations, 2015). These policy frameworks create a rationale for considering whether supply chains can improve competitiveness while supporting environmental and social objectives. However, a policy aspiration is not evidence that a particular practice has achieved a particular outcome. Previous research shows that sustainability and resilience may complement or constrain one another depending on strategy, investment and operating conditions (Negri et al., 2021; Doetsch & Huchzermeier, 2024). Additional inventory or suppliers may increase continuity while raising working-capital or coordination costs. A useful framework must therefore account for lifecycle consequences and implementation constraints rather than assume automatic win–win outcomes.

Recent Tanzanian evidence demonstrates that green supply chain practices matter but also indicates why their application is unlikely to be uniform. Singogo (2021) identified positive associations involving information exchange and institutional pressure in local government councils. Selestini and Kabelele (2024) examined drivers and barriers in food and beverage manufacturing. Wabanhu et al. (2025) reported favourable associations between green supply chain management and sustainability outcomes among restaurants in Arusha. These settings differ in procurement mandates, perishability, competitive pressure and capital intensity. The available studies therefore establish context-specific relevance, rather than a common national effect or evidence about the green–resilience interaction.

This article responds by developing a conceptual explanation of when, how and for whom environmental stewardship and resilience capability can combine to support sustainable competitive performance. Specifically, it (i) distinguishes the two practice portfolios; (ii) identifies mechanisms and boundary conditions; (iii) advances testable propositions, including potential tensions; (iv) proposes feasible firm- and network-level indicators; and (v) maps organizational contributions to selected SDG targets and Vision 2050 priorities while distinguishing those contributions from national outcomes. The contribution is analytical and prospective, not an estimation of causal relationships or a claim that the integration debate originates in Tanzania.

Problem Statement

Organizations in Tanzania face the dual challenge of improving environmental sustainability while maintaining operational continuity and competitiveness amid increasing supply chain uncertainties. These challenges are particularly significant in an operating environment characterized by infrastructure limitations, financial constraints and exposure to climate-related disruptions. The World Bank (2024) identifies the need for more resilient transport, energy and digital infrastructure to strengthen Tanzania's climate resilience and economic competitiveness. Similarly, Selestini and Kabelele (2024) identify inadequate financial resources, limited awareness and infrastructure weaknesses as barriers to adopting green supply chain management practices in Tanzania's food and beverage manufacturing sector. Although green supply chain practices offer opportunities to improve resource efficiency and environmental performance, resilience capabilities are intended to strengthen preparedness, adaptability and recovery from disruptions. However, pursuing these objectives independently may create competing resource demands, implementation costs and operational trade-offs, raising important questions about the conditions under which their integration can deliver sustainable competitive benefits (Negri et al., 2021; Doetsch & Huchzermeier, 2024).

Existing Tanzanian studies provide valuable insights into green supply chain management but offer limited explanations of its interaction with supply chain resilience. For instance, Singogo (2021) established positive relationships between buyer–supplier information exchange, institutional pressure and green economic supply chain performance in local government councils. Similarly, Wabanhu et al. (2025) found positive relationships between green supply chain management and environmental, economic and social performance among restaurants in Arusha, with competitor pressure significantly moderating environmental performance. While these findings demonstrate the relevance of green supply chain practices in particular organizational settings, they do not directly establish how green practices interact with resilience capabilities to influence multidimensional performance across Tanzanian supply chains. International studies have examined sustainability–resilience integration and identified potential synergies, trade-offs and shared implementation barriers (Negri et al., 2021; Doetsch & Huchzermeier, 2024). Nevertheless, the extent to which these relationships can be explained within Tanzania's diverse institutional, infrastructural and organizational conditions remains insufficiently specified in the literature considered.

The central research problem is therefore the limited Tanzania-specific conceptual understanding of how green supply chain practices and resilience capabilities individually and jointly contribute to sustainable competitive performance, particularly through the mechanisms and contextual conditions that may strengthen or constrain their relationships. Specifically, greater theoretical clarification is required regarding the roles of resource productivity, operational continuity, collaborative learning and stakeholder confidence as potential mediating mechanisms, alongside financial capacity, infrastructure reliability, digital visibility and supplier capabilities as possible moderating conditions. This gap has practical implications because organizations may invest in environmental initiatives or resilience measures without adequately considering their combined costs, benefits and consequences across economic, operational, environmental and social performance dimensions. Addressing this problem, the present study integrates the natural-resource-based view, dynamic capabilities theory and supply chain resilience scholarship to develop a Tanzania-oriented contingency framework. The framework advances six testable conceptual propositions explaining when green and resilient supply chain practices may reinforce one another, generate trade-offs or produce competing performance outcomes. In doing so, the study provides a theoretical foundation for future empirical investigation and more context-sensitive supply chain management decisions in Tanzania.

Purpose and Objectives

The purpose of this paper is to develop a conceptual framework explaining how green and resilient supply chain practices may influence sustainable competitive performance in Tanzania.

The specific objectives are to:

i. Explain the principal dimensions of green supply chain practices relevant to Tanzanian organisations.
ii. Examine supply chain resilience capabilities that can support continuity and adaptation across sectors.
iii. Conceptualise sustainable competitive performance as a multidimensional outcome construct.
iv. Develop propositions about the relationships between green practices, resilience practices and sustainable competitive performance.
v. Discuss the implications of the framework for the SDGs, Tanzania Development Vision 2050, management practice and future research.

Research Questions

i. How may green supply chain practices contribute to sustainable competitive performance in Tanzania?
ii. How may supply chain resilience practices influence economic, operational, environmental and social outcomes?
iii. Under what organisational and institutional conditions may green and resilient practices complement or constrain one another?
iv. How can the resulting performance dimensions be aligned with relevant SDGs and Tanzania Development Vision 2050 priorities?

CONCEPTUAL FOUNDATIONS AND DEFINITIONS

Green Supply Chain Practices

Green supply chain practices refer to organizational and inter-organizational activities that integrate environmental considerations into supply chain processes, including product design, procurement, production, distribution and end-of-life management (Srivastava, 2007). These practices primarily emphasize environmental responsibility and resource efficiency, whereas sustainable supply chain management encompasses broader economic, environmental and social objectives (Ahi & Searcy, 2013). Drawing on established literature, particularly Srivastava (2007) and Zhu et al. (2008), this study conceptualizes green supply chain practices through five interrelated dimensions.

Green procurement and supplier management refer to the integration of environmental criteria into purchasing decisions, supplier selection and the management of supplier relationships (Zhu et al., 2008). These practices involve evaluating suppliers' environmental performance, incorporating environmental requirements into procurement specifications and contracts, and promoting environmentally responsible sourcing. Supplier development through training, technical assistance and performance monitoring may further strengthen environmental capabilities across the supply chain (International Organization for Standardization, 2017; Seuring & Müller, 2008).

Eco-efficient operations involve adopting production and operational practices that improve resource productivity while minimizing energy consumption, material waste and environmental pollution (Hart, 1995; Srivastava, 2007). Such practices include cleaner production technologies, energy-efficient equipment, preventive maintenance and systematic monitoring of resource consumption. They reflect the principles of pollution prevention and internal environmental management, which emphasize reducing environmental impacts at their source while improving operational efficiency (Hart, 1995; Zhu et al., 2008).

Sustainable transport and distribution refer to the integration of environmental considerations into logistics activities to reduce fuel consumption, emissions and resource use associated with the movement of materials and products (Srivastava, 2007). Relevant practices include route optimization, load consolidation, improved vehicle

utilization and the adoption of lower-emission transport alternatives where feasible. However, such decisions require balancing environmental efficiency with delivery reliability, operational costs and disruption risks, as sustainability and resilience objectives may generate both complementarities and trade-offs (Negri et al., 2021).

Waste prevention and circularity encompass practices aimed at minimizing waste generation, improving material utilization and extending the productive life of products and resources (Kirchherr et al., 2017). These include waste reduction, reuse, repair, recycling, remanufacturing and reverse logistics, which support resource recovery and reduce dependence on virgin materials (Srivastava, 2007). Nevertheless, their environmental benefits depend on the efficiency of recovery processes and associated lifecycle impacts, highlighting the importance of evaluating circular practices within the broader supply chain system (Kirchherr et al., 2017).

Environmental collaboration and information sharing refer to coordinated activities among organizations, suppliers and customers aimed at improving environmental performance through shared objectives, information exchange and joint improvement initiatives (Vachon & Klassen, 2008). These practices include environmental information sharing, joint supplier assessments, collaborative pollution prevention and supplier-development programmes. Such cooperation facilitates environmental coordination and knowledge exchange across organizational boundaries, although its effectiveness depends on supplier capabilities, information quality and the commitment of participating organizations (Seuring & Müller, 2008; Vachon & Klassen, 2008).

These dimensions provide an analytical classification of green supply chain practices rather than a universally validated measurement scale. Their operationalization should reflect sector-specific characteristics while maintaining conceptual consistency to facilitate comparisons across Tanzanian organizations and support future empirical examination of the proposed sustainability–resilience relationships.

Supply Chain Resilience Practices

Supply chain resilience refers to the capacity of a supply network to anticipate, withstand, respond to and recover from disruptions while maintaining or restoring essential operations (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009). Beyond recovery, resilience encompasses the ability to adapt and reconfigure supply chain activities in response to changing conditions (Wieland, 2021). Drawing on these perspectives and the resilience strategies examined by Paul and Saha (2025), this study conceptualizes supply chain resilience through six interrelated dimensions.

Risk identification and monitoring refer to the systematic identification, assessment and monitoring of potential disruptions affecting supply chain operations (Christopher & Peck, 2004). These practices involve identifying critical suppliers, materials, facilities and transportation routes, assessing their exposure to operational and external risks, and establishing monitoring and early-warning mechanisms. Such activities support disruption preparedness and informed response planning (Ponomarov & Holcomb, 2009).

Supplier diversification and local sourcing involve establishing alternative supply arrangements to reduce dependence on individual suppliers or geographically concentrated supply sources (Christopher & Peck, 2004). Supplier diversification provides alternative procurement options, while local sourcing may reduce exposure to certain international supply disruptions. However, their resilience benefits depend on supplier capacity, geographic risk exposure, reliability and substitutability. Alternative sourcing decisions should also consider associated economic and environmental trade-offs (Negri et al., 2021).

Flexibility and substitutability refer to the capacity of supply chains to adjust operational arrangements and replace unavailable resources when disruptions occur (Paul & Saha, 2025). Flexibility encompasses adjustments to sourcing, production volumes, delivery schedules and distribution channels, whereas substitutability concerns the availability of acceptable alternative materials, suppliers or processes. These capabilities may reduce operational interruptions and strengthen responsiveness to changing supply conditions.

Strategic buffers and continuity planning involve maintaining proportionate reserve resources and establishing contingency arrangements to sustain essential supply chain operations during disruptions (Christopher & Peck, 2004). Strategic buffers may include safety stock, reserve capacity and backup supply arrangements, while continuity planning establishes procedures for disruption response and operational recovery. However, these

measures should reflect supply criticality, disruption exposure and resource constraints because excessive redundancy can increase financial and environmental costs (Negri et al., 2021).

Collaboration and digital visibility involve coordinated information exchange among supply chain partners and the use of information systems to monitor supply chain activities and emerging disruptions (Scholten & Schilder, 2015). Collaboration supports joint planning, communication and coordinated responses, while digital visibility facilitates access to information on inventory, supplier capacity, shipments and delivery performance. These capabilities can support earlier disruption detection and more informed operational decisions, although their effectiveness depends on information quality and partner coordination.

Recovery and learning refer to the ability of supply chains to restore disrupted operations, evaluate response effectiveness and improve future adaptive capabilities (Ponomarov & Holcomb, 2009). Recovery involves restoring essential supply functions within an appropriate timeframe, while learning entails reviewing disruption experiences and improving contingency plans, supplier arrangements and operational processes. Such practices support organizational adaptation and the continued development of resilience capabilities (Wieland, 2021).

These dimensions provide an analytical classification of supply chain resilience practices rather than a universally validated measurement scale. Their effectiveness depends on organizational capabilities, disruption exposure and operating conditions. Resilience investments may improve service continuity while generating additional financial, coordination or environmental costs. Accordingly, their contribution to sustainable competitive performance should be evaluated alongside the potential complementarities and trade-offs associated with green supply chain practices (Negri et al., 2021; Doetsch & Huchzermeier, 2024).

Sustainable Competitive Performance

Sustainable competitive performance is conceptualized in this study as an organization's capacity to maintain or improve its economic and operational outcomes while managing environmental and social responsibilities over time. This author-developed construct integrates the economic, environmental and social dimensions of sustainable supply chain management (Carter & Rogers, 2008; Seuring & Müller, 2008) with the continuity and adaptability considerations emphasized in supply chain resilience literature (Ponomarov & Holcomb, 2009; Doetsch & Huchzermeier, 2024). Accordingly, sustainable competitive performance is examined through four interrelated but conceptually distinct dimensions.

Economic performance refers to an organization's ability to generate and sustain economic value through efficient resource utilization, cost management and long-term financial viability (Carter & Rogers, 2008). Key indicators include cost efficiency, productivity, profitability where applicable, value addition and working-capital management. These indicators reflect the organization's capacity to maintain economic viability while supporting its operational and sustainability objectives (Seuring & Müller, 2008).

Operational performance refers to the effectiveness of organizational and supply chain processes in achieving efficiency, quality, reliability and responsiveness (Paul & Saha, 2025). Its principal indicators include delivery reliability, order fulfilment, lead-time stability, service continuity, product or service quality and responsiveness to changing operational conditions. Within a resilience context, operational performance also reflects the ability to maintain essential supply chain functions and restore acceptable service levels following disruptions (Ponomarov & Holcomb, 2009).

Environmental performance refers to the extent to which an organization reduces the environmental impacts associated with its operations and supply chain activities through responsible resource utilization and pollution prevention (Hart, 1995; Srivastava, 2007). Relevant indicators include energy and water efficiency, greenhouse gas emissions intensity, waste reduction, material recovery and compliance with applicable environmental requirements. These measures provide a basis for assessing environmental outcomes rather than merely the adoption of green management practices (Zhu et al., 2008).

Social performance refers to the extent to which organizational and supply chain activities protect stakeholder welfare, promote responsible employment practices and address relevant social responsibilities (Carter & Rogers, 2008; Seuring & Müller, 2008). Key indicators include occupational health and safety, responsible

supplier labour practices, decent working conditions, equitable local participation and access to essential goods or services where sector-appropriate. These measures reflect the social consequences of organisational activities for employees, supply chain partners and affected communities.

Although these dimensions are interconnected, improvements in one do not necessarily translate into gains in others. Higher profitability, for example, does not automatically imply reduced environmental impacts or improved working conditions (Ahi & Searcy, 2013; Carter & Rogers, 2008). Consequently, the four dimensions should initially be assessed separately, with any composite performance measure justified through appropriate theoretical and empirical validation. This distinction is particularly important for examining whether the integration of green supply chain practices and resilience capabilities generates balanced performance improvements or competing outcomes under different organizational and institutional conditions.

Policy Alignment: SDGs and Vision 2050

The SDGs and Tanzania Development Vision 2050 are treated here as policy-alignment frameworks, not firm-level outcome measures. The SDGs specify global targets and indicators (United Nations, 2015), while the Tanzanian vision provides national strategic aspirations (United Republic of Tanzania, 2025). Organizational practices may contribute to these priorities, but firm-level measures cannot, on their own, demonstrate national achievement. Aggregation and appropriate comparison with target-level indicators would be required for such claims.

The most direct proposed SDG connections are Goal 8 (decent work and economic growth), Goal 9 (industry, innovation and infrastructure), Goal 12 (responsible consumption and production) and Goal 13 (climate action), with Goals 3, 7 and 17 relevant in selected sectors (United Nations, 2015). Vision 2050 emphasizes a competitive and inclusive economy, human capabilities and social development, environmental integrity and climate resilience and integrated logistics as a development driver (United Republic of Tanzania, 2025). The mapping is interpretive; it does not assume measured national progress.

This separation addresses an important problem of levels of analysis. A firm may document lower waste per unit of output without demonstrating that aggregate national resource use has fallen. Equally, higher local procurement expenditure does not by itself establish decent work, food security or inclusion. Where the framework is used for policy reporting, indicators should be connected to a defined SDG target, identified beneficiaries, a baseline, a time period and the possibility of displacement effects. Policy alignment is a plausible contribution pathway not an impact estimate.

LITERATURE REVIEW AND THEORETICAL FOUNDATION

Green Supply Chain Management and Performance

Green supply chain management developed from environmental management within individual organizations toward coordinated attention to sourcing, production, logistics and recovery across supply chain actors (Srivastava, 2007; Zhu et al., 2008). Balon (2020) organizes the literature in terms of pressures, practices and performance, examining financial, operational and environmental outcome categories. The distinction between green and broader sustainable supply chain management also matters: the latter explicitly incorporates social and longer-term economic considerations (Ahi & Searcy, 2013; Carter & Rogers, 2008). This supports a multidimensional evaluation rather than a single undifferentiated sustainability score.

Table 1: Illustrative Evidence and the Remaining Integration Gap

Source and setting	What the source informs	Scope for this framework
Singogo (2021); Tanzania local councils	Information exchange and institutional pressure relate to green economic performance.	Resilience and cross-sector transfer remain untested.
Selestini & Kabelele (2024); food and beverage	Adoption drivers and barriers, including finance and infrastructure.	Net effects under disruption require examination.

Wabanhu et al. (2025); Arusha restaurants	Green practices relate to environmental, economic and social outcomes.	Hospitality findings cannot determine interaction across sectors.
Doetsch & Huchzermeier (2024); international	Integration, shared barriers and complex relationships.	Tanzania-specific boundary conditions and measures require specification.
Paul & Saha (2025); resilience literature	Flexible strategies and resilience performance indicators.	Joint environmental–resilience evaluation remains to be tailored.

Source: Authors' conceptual synthesis (2026).

The natural-resource-based view (NRBV) extends resource-based theory by proposing that capabilities concerned with pollution prevention, product stewardship and sustainable development can contribute to competitive advantage (Hart, 1995). This perspective provides a theoretical reason to investigate cost, process, compliance and innovation benefits from green practices, but it does not guarantee that any particular investment yields immediate returns. Such benefits are conditional on design and capability, and reported relationships between green practices and performance differ by setting (Balon, 2020; Selestini & Kabelele, 2024).

Tanzanian evidence is consistent with the relevance of these relationships, while also indicating that context matters. Singogo (2021) found positive effects of buyer–supplier quality information exchange and institutional pressure on green economic supply chain performance in local government councils. Selestini and Kabelele (2024) considered the adoption of green supply chain practices among food and beverage manufacturing companies. Wabanhu et al. (2025) reported positive associations between green supply chain management and sustainable performance in restaurants in Arusha. The restaurant study is sector-specific and does not establish that the same effect sizes or mechanisms apply across all sectors. Collectively, these studies support further analysis of green practices while leaving room for a cross-sector framework that explicitly incorporates resilience.

The Tanzanian evidence should be read as a differentiated knowledge base rather than a single cumulative estimate. Singogo (2021) reports positive relationships involving buyer–supplier information quality and institutional pressure in a study of 166 local-government procurement officials. Selestini and Kabelele (2024) discuss manufacturing adoption barriers, including limited awareness, finance and infrastructure. Wabanhu et al. (2025) use cross-sectional data from 386 restaurant managers and supervisors in Arusha and report positive associations of GSCM with environmental, social and economic performance; competitor pressure significantly moderates the environmental relationship but not the social or economic relationships. These findings should not be presented as a common national causal effect or as direct evidence of an integrated green–resilience portfolio.

Supply Chain Resilience and Competitive Outcomes

Resilience scholarship emphasizes supply network vulnerability, collaborative risk management, flexibility, readiness, response and recovery (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009). Paul and Saha (2025) distinguish flexible strategies and resilience performance indicators, whereas Ivanov (2020) demonstrates, through simulation of an epidemic-related disruption, how interruption effects can propagate through interdependent supply chains. These contributions justify evaluating resilience as a set of network capabilities and outcomes rather than simply an inventory target.

Resilience may protect continuity, customer service and recovery, but redundancy and contingency arrangements may also increase short-term expenditures. This trade-off is discussed in the resilience and sustainability literature (Christopher & Peck, 2004; Negri et al., 2021; Doetsch & Huchzermeier, 2024). Its importance varies with criticality and disruption exposure; healthcare and food supply are illustrative settings where service interruption can have consequences beyond financial cost. Decisions should compare the expected consequences of disruptions with the financial and environmental costs of mitigation.

In Tanzania, transport and logistics reliability, weather exposure, geographic supplier patterns, information sharing and SMEs' capacity to fund contingency arrangements are relevant dimensions for research. This contextual emphasis is consistent with Tanzania's climate and infrastructure challenges identified by the World

Bank (2024), but it should not be interpreted as evidence that all sectors share identical risks. Sector-specific studies must measure actual exposure and adaptive capability.

Recent resilience scholarship strengthens the argument for differentiated indicators. Paul and Saha (2025) organize flexible resilience strategies alongside performance indicators, underscoring the need to measure both preparedness and observed performance. Ivanov (2020) illustrates how disruptions can propagate through interdependent supply networks and how modelling can explore alternative response strategies. These contributions are valuable for Tanzanian organizations reliant on imported inputs or connected distribution routes; nevertheless, simulation results or international reviews should not be converted into empirical claims about local supply chains. A practical lesson is to distinguish readiness (alternative supplier qualified), response (time to activate a route) and realized consequences (days of interruption or lost service).

Why Green Practices and Resilience Should be Integrated

The literature identifies several plausible joint mechanisms for sustainability and resilience, including visibility, supplier collaboration, process improvement and circular practices (Negri et al., 2021; Doetsch & Huchzermeier, 2024). Shared information may reveal both environmental inefficiency and supply risk. However, diversified or local sourcing is not inherently lower-emission; its environmental consequences depend on production processes, loads, distances and other lifecycle factors. Similarly, recycling and product return can reduce virgin-material demand while creating new reverse-flow dependencies (Srivastava, 2007). These are contingent mechanisms rather than measured relationships in Tanzania.

Integration also entails potential conflict. Lean inventory or tightly consolidated transport may reduce routine storage and transport burdens but leave less flexibility under disruption; additional suppliers may improve continuity while complicating audit and coordination; emergency freight may restore service at additional environmental cost. The tension is consistent with the synthesis by Negri et al. (2021) and empirical practitioner evidence on complex sustainability–resilience relationships reported by Doetsch and Huchzermeier (2024). A balanced strategy evaluates service criticality, lifecycle impacts, exposure and total cost.

This integration is compatible with the dynamic capabilities perspective, which emphasizes sensing change, seizing opportunities and reconfiguring resources in response to a changing environment (Teece, 2007). Organizations may need to sense environmental and supply risks, seize opportunities through supplier and process innovation, and reconfigure procurement, logistics and inventory arrangements. Dynamic capabilities help explain how organizations can adjust green and resilience practices over time rather than treating them as static checklists.

To organize the trade-offs, this paper proposes four analytic combinations: low-green/low-resilience, high-green/low-resilience, low-green/high-resilience and high-green/high-resilience supply networks. These are an original heuristic, not a validated industry typology. The latter combination seeks a balanced portfolio but is not automatically the optimal choice for every flow: for low-criticality items, added redundancy may cost more than expected disruption losses; for essential health supplies, continuity may warrant higher safeguards (Negri et al., 2021; Doetsch & Huchzermeier, 2024).

Theoretical Framework

The proposed framework combines the natural-resource-based view and dynamic capabilities theory, supported by supply chain resilience scholarship. The NRBV explains why environmental capabilities can create operational and competitive value (Hart, 1995). Dynamic capabilities theory explains how organizations adapt routines and resources to changing conditions (Teece, 2007). Supply chain resilience literature explains the specific capabilities through which networks anticipate, absorb, recover from and adapt to disruption (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009).

The theories explain different parts of the proposed relationships: the NRBV supports a resource-productivity pathway for environmental practices (Hart, 1995); dynamic capabilities theory explains adaptation and reconfiguration (Teece, 2007); and resilience scholarship elaborates preparedness and response capacities (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009). Their proposed combined effect on sustainable

performance is therefore a theoretical inference, conditional on implementation and context, rather than an established empirical result for Tanzania.

This framework further builds on sustainable supply chain theory, which treats economic viability as interdependent with environmental and social performance (Carter & Rogers, 2008). Wieland (2021) calls for understanding supply chains as adaptive social–ecological systems rather than static linear flows. These perspectives help distinguish resilience as more than "bouncing back": recovery may need to be transformative when the previous network structure was itself inefficient, inequitable or environmentally damaging. The integration therefore rests on three different claims: environmental routines can generate resource value; adaptive capabilities can protect and reconfigure value; and stakeholder and institutional arrangements shape whose benefits are created, who bears costs and whether improvements persist. Evidence from buyer–supplier relationships in Tanzania's fishing industry also associates information exchange quality with perceived benefits, offering a useful local construct without establishing resilience effects (Singogo & Kassimba, 2024).

Recent Evidence and Implications for the Conceptual Gap

Contemporary evidence reinforces the need to distinguish digital enablers, adaptive capabilities and performance outcomes. Chowdhury and Anzum (2026) combine structural equation modelling and a neural-network approach to examine analytics-enabled supply chain adaptation, but their setting does not establish causal effects in Tanzania. Sardar et al. (2026) examine blockchain capabilities alongside circular-economy practices and green innovation; these variables suggest plausible transmission pathways, not a requirement that organizations adopt blockchain. Nabila and Anzum (2024) examine blockchain-enabled alignment and green innovation in manufacturing and provide a related international comparison rather than evidence about Tanzanian firms.

Work on technology implementation also cautions against treating visibility as a costless resource. Diraz et al. (2026) analyze implementation barriers for smart sustainable supply chains in Bangladesh, and Disha et al. (2026) identify organizational, infrastructural and managerial barriers to AI integration into green supply chains. Their insights support the proposed conditioning roles of data quality, skills, finance and infrastructure, but different national institutions limit direct transfer. Anzum (2026) evaluates adaptive sustainability scoring through a simulated garment-sourcing portfolio; its simulation, audit safeguards and sourcing constraints illustrate possible decision rules, not proven improvements in real Tanzanian supply chains.

The contribution of the present framework is therefore not that green supply chains, resilience, circularity or digitalization have previously been ignored. Rather, it makes their separate effects, interactions, mediating processes, enabling conditions and potential negative externalities simultaneously explicit in a Tanzania-oriented, falsifiable set of propositions. It deliberately avoids identifying technological sophistication with sustainable competitive performance.

Compared with studies that focus mainly on resilience strategy (Paul & Saha, 2025), digital antecedents (Chowdhury & Anzum, 2026), circularity pathways (Sardar et al., 2026), or the general sustainability–resilience relationship (Negri et al., 2021; Doetsch & Huchzermeier, 2024), the proposed model specifies (a) separate portfolios G and R, (b) their interaction G × R, (c) multiple non-equivalent mediators, (d) context-dependent moderation, and (e) an explicit possibility of negative net lifecycle and distributional consequences. The paper's original contribution lies in how it integrates these concepts into a framework that can be tested empirically.

REVIEW METHODOLOGY

This article adopts a conceptual integrative review to connect bodies of literature that use partly different terminology, units of analysis and performance criteria. An integrative review is appropriate for theory development, the reconciliation of divergent perspectives and the construction of propositions (Torraco, 2005; Snyder, 2019). The approach is intentionally distinct from a systematic review, scoping review or meta-analysis: it does not offer exhaustive retrieval, a formal screening flow diagram, risk-of-bias ratings or pooled effect estimates. Its value lies in explaining conceptual relationships transparently and identifying propositions that can be challenged in future research.

The literature discussed in this article was assembled purposively around four questions: how green practices are defined, how resilience capability is developed, what outcomes might follow and which Tanzanian conditions may matter. The cited materials include foundational theory, methodological literature, selected peer-reviewed studies and United Nations and Tanzanian policy documents. The material was compared for conceptual definitions, proposed mechanisms, trade-offs, measurement suggestions and transferability. This article is not a registered systematic or scoping review, and it does not report exhaustive database searches, reproducible screening counts or pooled effect estimates (Snyder, 2019; Torraco, 2005).

To guard against over-interpretation, the synthesis separates three evidentiary levels. Published empirical findings are attributed to the source and its studied population. General mechanisms inferred from theory are presented as plausible explanations, not verified Tanzanian effects. Proposed indicators, interactions and interventions are labelled as suggestions for future testing. This distinction is especially important when moving from a specific restaurant, manufacturing or local-government setting to a cross-sector national discussion. The resulting framework is an analytical model rather than an empirical results model.

Review Transparency, Selection Criteria and Reproducibility Boundaries

Review question and scope. The synthesis was organised around how GSCM practices and resilience capabilities are conceptualized; the mechanisms through which each portfolio may affect economic, operational, environmental and social outcomes; the contingencies governing their joint effect; and the relevance of findings to Tanzania. The unit of synthesis is the theoretical or empirical claim not the paper as an interchangeable unit of evidence. The review combines foundational contributions and selected research available up to 3 November 2026, rather than restricting theory papers to an arbitrary recent publication period.

Source selection. Eligible material comprises (a) peer-reviewed conceptual and empirical research directly addressing GSCM, supply chain resilience, supply chain sustainability, digital enablement, circularity or performance; (b) established theoretical and review-methodology papers needed to define mechanisms and boundaries; (c) credible Tanzania-specific empirical research; and (d) authoritative governmental, multilateral or standard-setting documents used strictly for context or practice guidance. Studies are prioritised for direct conceptual relevance, clear constructs, transparent design, identifiable setting and contribution to at least one framework pathway. Purely promotional sources, unverifiable claims and articles without an identifiable relationship to the research questions are excluded from substantive evidentiary claims. Conference research is identified as such and interpreted with appropriate caution.

Database coverage and selection limitation. The historical literature was compiled purposively from disciplinary scholarship, cited-source tracing, Tanzanian journals and publicly available policy documents. There is no retained original database export, search-date record, deduplication log or exclusion register; accordingly, this is not an exhaustive Scopus, Web of Science, Dimensions or Google Scholar review and no record counts or PRISMA diagram are reported. For the November 2026 revision, the six specifically identified recent works were checked using their exact DOIs against publisher or conference-proceedings records. This verifiable six-item metadata check is distinct from the initial literature search and is not presented as a systematic database search. A replicable protocol for a later systematic update is stated below.

Analytical synthesis and evidence differentiation. In developing the original framework, the cited works were compared for their reported design and setting, definitions of practices or capabilities, claimed mechanisms, measured versus hypothesised outcomes, relevant contingencies and limits of transfer to Tanzania. The revised discussion separates published associations from causal inferences, simulations from field observations, and policy aspirations from measured performance. The original review did not maintain an item-level extraction spreadsheet; Appendix A provides a transparent, retrospective conceptual evidence map of selected pivotal sources, not a reconstructed screening register.

Critical appraisal and weighting. Empirical findings are interpreted in light of sampling, temporal ordering, common-method exposure and whether outcome data are independently measured; simulations are treated as design demonstrations; conceptual papers as explanatory arguments; and policy documents as descriptions of aspirations or enabling context. These are qualitative credibility checks, not formal independent risk-of-bias

scores. A cited source is not considered causal or nationally generalisable merely because it is recent or peer-reviewed.

Search Coverage and Selection Logic

To support an independently reproducible update of this purposive integrative review, a future reviewer would search Scopus and Web of Science, supplement retrieval using Google Scholar, and identify Tanzania-specific publications through institutional repositories and relevant journal platforms. Each database would be searched from its inception to a precisely recorded execution date. Search syntax and field restrictions would be adapted to the capabilities of each source, and every executed version would be retained. A core Boolean string is shown in Table 2 below.

Table 2: Proposed keyword blocks and Boolean combinations

Concept block	Search terms	How to combine
A. Green or sustainable supply chains	"green supply chain" OR "sustainable supply chain" OR "circular supply chain"	A AND B AND C (core search)
B. Resilience and adaptation	resilien* OR robust* OR flexibil* OR "disruption recovery"	Use OR within block
C. Performance and integration	perform* OR competiti* OR integrat* OR complemen*	Use OR within block
D. Regional context	Tanzania OR "East Africa"	D AND E (contextual search)
E. Relevant practices	"green procurement" OR "supply chain resilience" OR "digital supply chain"	Use OR within block

Source: *Authors' proposed literature search strategy (2026).*

Screening, appraisal and reporting requirements

The future update should use prespecified eligibility criteria aligned with the review question. Two reviewers should independently screen titles and abstracts, then full texts; disagreements should be reconciled through discussion or a third reviewer. Source appraisal should be appropriate to each study design, with conceptual and policy materials identified separately from empirical studies.

Actual 2026 reference-verification audit. On 3 November 2026, the six requested recent sources were verified by exact DOI and bibliographic-title lookup using Springer Nature journal records (10.1007/s40171-025-00478-4; 10.1007/s43615-026-00874-7; 10.1007/s43621-026-04745-x), the Elsevier journal record (10.1016/j.joitmc.2026.100728), IEOM Society conference proceedings (10.46254/BA07.20240231) and SciEn Conference Series: Engineering (10.38032/scse.2026.4.29). Four were classified as journal articles and two as conference-proceedings publications. All six were retained because each informs an explicitly identified mechanism or boundary condition; none is treated as Tanzanian outcome evidence. Publisher records and DOI links permit independent bibliographic verification. This verification covers these six sources only, not the entire cited literature.

CONCEPTUAL SYNTHESIS AND PROPOSED FRAMEWORK

The synthesis yields a conditional conceptual framework, not statistically established relationships. Green supply chain management represents an environmental practice portfolio (Srivastava, 2007), while resilience encompasses anticipation, absorption, response, recovery and adaptation (Ponomarov & Holcomb, 2009; Paul

& Saha, 2025). Four sustainable competitive performance dimensions; economic, operational, environmental and social draw on Carter and Rogers (2008). Resource productivity, continuity, collaborative learning and stakeholder confidence are proposed mechanisms; finance, managerial capability, infrastructure, data quality, regulation and supplier readiness are potential boundary conditions. Figure 1 illustrates these pathways while the SDGs and Vision 2050 serve as policy-alignment lenses rather than firm-level outcomes.

Green and resilience practices represent analytically distinct managerial portfolios. Their proposed mechanisms can overlap: digital visibility may improve both resource efficiency and risk sensing, while supplier collaboration may advance learning and early warning. Empirical researchers should justify whether each portfolio is specified formatively (dimensions jointly define the construct) or reflectively (indicators arise from a shared latent factor), since this choice affects construct validity and interpretation.

Table 3: Constructs, Illustrative Indicators and Model Roles

Construct	Illustrative measurable indicators	Conceptual role
Green practices	• Share of purchases meeting defined criteria	Explanatory practice portfolio.
	• Energy or waste intensity	
	• Recovery rate.	
Resilience practices	• Critical suppliers mapped	Explanatory capability portfolio.
	• Qualified alternatives	
	• Documented recovery exercise.	
Intermediate mechanisms	• Material productivity	Proposed causal pathways, not observed effects.
	• Stockout avoidance	
	• Jointly resolved supplier incidents.	
Enabling conditions	• Access to working capital	Pre-specified moderators or controls.
	• Transport uptime	
	• Digital record quality	
	• Supplier readiness.	
Sustainable performance	• Cost per output	Separate economic, operational, environmental and social outcomes.
	• OTIF delivery	
	• Emissions intensity	
	• Worker safety.	

Source: Authors' conceptual synthesis (2026).

Conceptual Framework

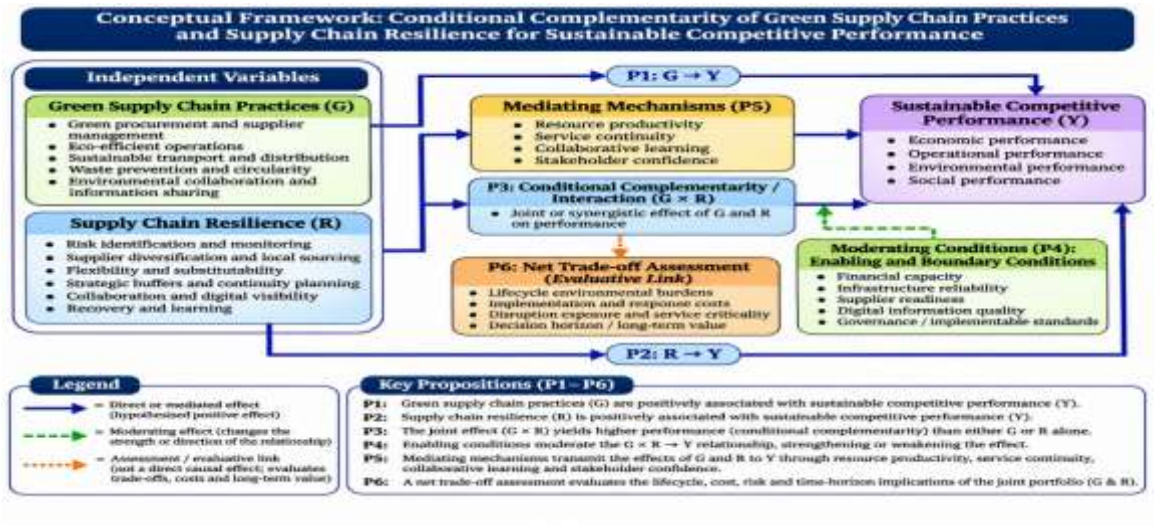


Figure 1: Conditional complementarity model showing P1–P6

P3. *The positive association between green supply chain practices and sustainable competitive performance is expected to be stronger when supply chain resilience is higher.*

Source: Authors' conceptual synthesis (2026)

Propositions

Proposition 1: *Green supply chain practices are expected to be positively associated with sustainable competitive performance when environmental practices are implemented effectively and are aligned with operational requirements.* The logic is that resource efficiency, waste prevention, supplier environmental management and improved logistics can lower avoidable costs, reduce environmental harm and support customer or regulatory expectations. The proposition does not assume that every green investment generates immediate financial returns; the relationship may depend on investment costs, organisational capabilities and the time horizon.

Proposition 2: *Supply chain resilience practices are expected to be positively associated with sustainable competitive performance by improving continuity, responsiveness and recovery capability.* Risk monitoring, supplier alternatives, flexibility, information visibility and continuity planning can reduce the duration or severity of disruption. However, the net benefit is likely to depend on the criticality of the item or service and the cost of resilience measures.

Proposition 3*: The combination of green supply chain practices and resilience practices is expected to support more balanced sustainable competitive performance than the isolated pursuit of either objective.* In empirical work, complementarity has a narrower meaning than simultaneous adoption. A positive G × R coefficient on a defined, correctly oriented performance indicator is evidence consistent with statistical complementarity on that measurement scale, subject to model validity and uncertainty. Joint use can nevertheless worsen emissions intensity, supplier welfare or working capital. Researchers should estimate the interaction for economic, operational, environmental and social outcomes separately; a high score on one outcome must not compensate silently for a deterioration in another.

The complementarity claim is deliberately conditional. It predicts a positive green-by-resilience interaction only where complementary information and operating routines outweigh coordination costs. It does not mean that the combined effect must always be statistically significant, that both domains necessarily improve each performance dimension or that greener sourcing is synonymous with shorter transport distances. Researchers should compare marginal effects at meaningful values of the other portfolio and report trade-offs rather than simply declaring overall sustainability superior.

Proposition 4: *The positive contribution of the combined practice portfolio will be stronger when organisational capabilities and enabling conditions particularly adequate finance, reliable infrastructure, supplier readiness, digital information quality and implementable standards are more favourable.* The same environmental measure may be practical in a mature manufacturing network and financially prohibitive in a small informal supplier network. Implementation capacity should therefore be operationalised as distinct constructs, not a single undefined "environment" variable. Digital systems may support learning only where records are accurate and routinely shared; an environmental purchasing rule may reduce impacts only where capable suppliers can credibly meet it. Contextual conditions should be modelled as pre-specified moderators or controls based on theory.

Proposition 5*: Resource productivity, disruption continuity, collaborative learning and stakeholder confidence are proposed mechanisms linking green and resilience practices to particular performance dimensions.* The mechanisms should be tested separately, with clear temporal ordering, to avoid making mediation claims from cross-sectional correlations alone.

Proposition 6: *The net performance value of combined green and resilience investments varies by criticality, lifecycle impact, risk exposure and evaluation horizon.* Where environmental or financial costs of redundancy exceed its continuity benefits, a positive net effect is not expected. A lifecycle and risk-adjusted decision screen should therefore predict more balanced outcomes than a rule that maximises either environmental efficiency or redundancy in isolation.

For a critical item, a proposed decision comparison is net economic value = avoided expected disruption losses + routine resource savings − additional capital, operating, inventory and emergency-response costs. Environmental and social effects remain separate measured consequences rather than automatically monetised deductions. The preferred portfolio is not defined as maximum redundancy or minimum environmental intensity: it is the non-dominated set of feasible alternatives under stated service-level and minimum labour/environment safeguards. Sensitivity analysis should vary disruption probability, loss severity, financing costs and lifecycle emission factors. A null or negative interaction is a substantive finding, not a failure of the framework.

Proposition-to-test Alignment and Empirical Validation Architecture

Table 4. Prespecified empirical expectations, distinct indicators and potential falsification conditions (proposed tests; no fieldwork reported).

Hypothesis	Operational indicators	Analysis	Disconfirming result
P1 · G → Y	Green purchasing share (% spend); energy use (kWh/unit); reject rate (%); emissions (kg CO_2e/unit)	Adjusted associations of G with each outcome, controlling for R and baseline conditions.	No adjusted gain, or higher full-lifecycle emissions/cost despite greater G.
P2 · R → Y	Critical supplier alternatives (n); stockout days/year; time to recover (hours); on-time-in-full (%)	Estimate R separately, including realized disruption exposure and implementation cost.	Redundancy increases cost or waste without measurable continuity improvement.
P3 · G×R	Predefined G and R indices; four separate outcome dimensions and confidence intervals	Product-term coefficient, marginal effects and subgroup contrasts; assess interaction scale.	Null/negative interaction or gains confined to one dimension with harm elsewhere.

P4 Conditions	Finance access; electricity/road uptime (%); supplier audit readiness (%); digital record completeness (%)	Prespecified interactions with G×R; examine sector heterogeneity and multiplicity.	Joint advantage unchanged or reversed under supposedly favourable conditions.
P5 Mediation	Material yield (%); stockout avoidance; joint incident closure time; stakeholder trust measures	At least three waves: prior practices → intermediary process → subsequent outcomes; bootstrap uncertainty.	Mechanism fails temporal ordering or indirect association approaches zero.
P6 Net trade-offs	Lifecycle kg CO_2e/unit; total cost/unit; expected downtime loss; employee/supplier safeguards	Risk/lifecycle scenario comparisons and multiobjective dominance frontier.	Separate optimisation dominates combined portfolio after realistic costs and risks.

Source: Authors' conceptual synthesis (2026)

Proposed research design. A sequential mixed-method programme can begin with 15–25 exploratory cognitive interviews and a small multi-sector pilot to refine meanings and feasibility, followed by a stratified sample of Tanzanian agriculture and agro-processing, manufacturing, logistics, and public/essential-service supply chains. The numbers for interviews are planning guidance, not research already performed. The quantitative phase should sample independently operated firms or procurement units within sectors and record the supply chain position and geographic region. Researchers must undertake an a priori statistical power analysis based on anticipated interaction effects, clustering and attrition rather than asserting an unsupported universal sample minimum.

Measurement strategy. Specify green supply chain practices (G) as observable green procurement, eco-efficiency, low-impact logistics, circularity and supplier environmental collaboration; resilience capabilities (R) as risk monitoring, alternatives, flexibility, continuity arrangements and recovery learning. Their dimensions may form composites, while valid reflective scales should be used only when indicator covariance and theoretical meaning support that model. Specify sustainable performance as four separate dependent variables: economic (unit cost or margin), operational (on-time-in-full delivery, interruption days and recovery time), environmental (energy, material or greenhouse-gas intensity and waste), and social (verified safety events, payment timeliness or labour safeguards). Where possible, measure indicators from records with documented denominators and comparable reporting windows instead of from the same respondent's perceptions.

Propositions 1 and 2: Estimate separately the adjusted associations of G and R with each outcome, explicitly conditioning on baseline performance, size, sector, ownership, disruption exposure and relevant infrastructure; do not describe cross-sectional coefficients as causal effects.

Proposition 3: Specify a green-by-resilience product term G × R in each outcome equation; report the coefficient, confidence interval, predicted marginal effects and plots at substantively meaningful practice levels. A positive interaction is expected only when integration benefits exceed costs, and a non-positive estimate is a legitimate refutation, not a statistical failure.

Proposition 4: Test moderation in separate pre-specified models by financial capacity, transport or energy reliability, supplier readiness and the integrity of shared digital records. To avoid an uninterpretable proliferation of terms, select priority moderators before data collection and control multiplicity in secondary analyses. For example, the model may include G, R, G × R, infrastructure reliability (Z), and G × R × Z with its necessary lower-order terms. Multiple-group comparisons require a measurement-invariance assessment before comparing coefficients across sectors.

Proposition 5: Examine resource productivity, continuity, collaborative learning and stakeholder confidence as distinct mediators using time-separated measures, preferably a minimum of three waves: baseline practices and

context, subsequently observed mechanisms, and later performance. Estimate indirect effects with uncertainty intervals while acknowledging residual confounding; avoid treating a same-period survey mediation model as proof of causal order.

Proposition 6: Test configurations against risk-adjusted lifecycle cost, disruption losses and environmental burdens, with criticality and exposure recorded at product or supplier level. Compare alternatives such as dual sourcing, buffer stock, transport rerouting and process redesign using observed operating records and bounded scenario analysis; identify thresholds where an intervention reverses from net benefit to net cost.

Indicative Estimation Framework

For organization *i*, outcome dimension *k* and period *t*, the proposed estimation model is specified as follows:

$$Y_{k,i,t+1} = \alpha_k + \beta_{1k} G_{i,t} + \beta_{2k} R_{i,t}$$

$$+ \beta_{3k} (G_{i,t} \times R_{i,t}) + \gamma_k X_{i,t}$$

$$+ u_{sector} + u_{region} + \varepsilon_{i,t}$$

Estimation and model validation. Each directional hypothesis and its expected interaction scale should be pre-registered. Continuous predictors may be mean-centred where useful. Diagnostic assessments should examine variance inflation, influential observations, and missing-data mechanisms.

Structural Equation Modelling (SEM) can assess theoretically defensible latent-variable relationships, while panel fixed-effects or event-study designs can address some time-invariant confounding. Neither SEM nor an artificial neural network alone makes observational estimates causal.

Robustness, ethics and reporting. Where feasible, collect at least one objective outcome from a supplier, customer or administrative source, use multi-informant assessments, cluster standard errors at the relevant network level, and report missingness and sensitivity to outliers and alternative operational definitions. Obtain institutional ethical review before any actual surveys or interviews and protect commercial and employee data. The present manuscript remains conceptual: none of these recruitment, fieldwork, models or performance estimates has been undertaken.

Practical Tanzania-specific case-study agenda. In perishable horticultural chains, compare food loss per delivered kilogram, energy use in cold storage, delivery interruption and farmer payment timeliness before and after an intervention. In manufacturing, compare defect/scrap rates, electricity intensity, critical component shortages and supplier compliance costs. In public-health procurement, study essential medicine stockout days, emergency purchasing cost, waste from expiry and contract fairness. In freight and distribution, measure emissions per tonne-kilometre alongside recovery time after route closure and costs of diversion. These are candidate evaluation designs, not documented Tanzanian effects.

Table 5. Tanzania-oriented evaluation templates, including proposed counterfactuals and trade-off indicators (illustrative designs, not findings).

Sector	Unit of observation	Candidate comparison	Four-domain measures and trade-offs
Perishable horticulture	Producer group + aggregation/cold-chain route	Before/after with matched route or co-op; season and weather controls	Food loss (% of kg handled), cooling kWh/kg delivered, OTIF (%), farmer payment days; backup energy emissions
Manufacturing / agro-processing	Plant + critical inputs and qualified suppliers	Supplier-development pilot vs comparable untreated line; 6–12 months	Scrap kg/unit, electricity kWh/unit, shortage days, qualification cost, SME supplier exclusion

Essential health products	Health facility × medicine-month	Stockout trend across matched facilities; policy and demand adjustment	Stockout days, expired units, emergency procurement surcharge, supplier compliance, service equity
Freight/ distribution	Shipment or corridor-month	Diversion events vs ordinary weeks and comparable corridors	Delivery OTIF (%), recovery hours, CO_2e/tonne-km, diversion cost, driver safety

Source: Authors' conceptual synthesis (2026)

DISCUSSION: IMPLICATIONS FOR TANZANIA

Agriculture and agro-processing

Agricultural supply chains link farmers, aggregation facilities, storage, processors, transport, wholesalers and retailers. The Food and Agriculture Organization of the United Nations (FAO, 2019) identifies storage, handling, infrastructure and logistics as important factors in food loss and waste and cautions that interventions should reflect where losses occur. On that basis, this framework proposes investigating efficient resource use, reduced post-harvest losses, reusable transport packaging, more reliable logistics and alternative sourcing as possible joint green–resilience strategies. Any expected performance gains remain hypotheses to be tested in specific Tanzanian supply chains.

Cold-chain investments can reduce some spoilage risks but require reliable energy, maintenance and appropriate evaluation of lifecycle consequences. FAO (2019) stresses that impacts and beneficiaries of food-loss interventions depend on where changes occur in the chain. Likewise, locally sourced products are not necessarily lower-impact than alternatives: economic, logistical and environmental effects should be assessed on comparable units and supply-chain boundaries rather than inferred from geographic proximity alone. These are decision principles, not a claim that all Tanzanian agricultural chains have the same pattern.

In selected perishable-food networks, fragmented collection and downstream perishability could create simultaneous environmental and continuity problems. The framework therefore suggests examining cold-chain capacity, returnable crates, aggregation points and alternative sourcing against cost, spoilage, delivery reliability and producer-level effects. Improved aggregation could increase load efficiency yet create a concentrated disruption point. Such possible trade-offs should be evaluated with measured loss, transport intensity per delivered kilogram, payment timeliness and service during extreme weather (FAO, 2019; World Bank, 2024).

Manufacturing and Industrial Supply Chains

Manufacturers can consider environmental criteria in supplier selection, reduced process scrap, energy efficiency, materials recovery and packaging redesign, alongside contingency sourcing, supplier development and production flexibility. These practices reflect GSCM research (Zhu et al., 2008) and resilience scholarship (Paul & Saha, 2025). Their potential contribution to a competitive and innovative economy is consistent with Vision 2050 (United Republic of Tanzania, 2025), whereas capital, skills and infrastructure barriers have been discussed in Tanzanian food and beverage manufacturing (Selestini & Kabelele, 2024). Their net performance effects remain to be tested.

Cross-sector research should distinguish large enterprises from SMEs. Selestini and Kabelele (2024) identify financing, awareness and infrastructure barriers to GSCM adoption in their Tanzanian manufacturing context, suggesting that affordability and capability should be measured explicitly. Possible interventions for smaller firms include waste tracking, preventive maintenance, supplier communication, technical extension and shared infrastructure, but their feasibility and effects require evaluation.

In manufacturing, the location of environmental and resilience decisions within the supply network matters. A lead firm can specify lower-impact inputs but may externalise compliance costs to smaller suppliers. Supplier-development support, shared testing services and staged qualification can lower this asymmetry while preserving minimum environmental requirements. The distinction between frequently purchased commodities and critical imported components also matters: dual sourcing may be justified for a high-impact bottleneck item but

uneconomic for easily substituted materials. Process-level measurements can indicate whether lower scrap, faster changeovers and equipment reliability produce genuine joint value rather than a transfer of costs between firms.

Public Procurement and Essential Services

Public procurement can incorporate environmental and social criteria through specifications, supplier qualification, lifecycle evaluation, contract management and performance monitoring, as reflected in guidance on sustainable procurement (International Organization for Standardization, 2017). For healthcare and other essential services, supply interruption can have consequences beyond purchase price, motivating critical-item classification and proportionate continuity arrangements (National Academies of Sciences, Engineering and Medicine, 2022). The appropriate criteria should remain verifiable and consistent with applicable procurement law; the present article does not give a legal interpretation of Tanzanian requirements.

The Tanzanian evidence on buyer–supplier information exchange and institutional pressure in local government councils suggests that collaboration and institutional arrangements deserve attention (Singogo, 2021). The framework extends this line of inquiry by asking whether information sharing and procurement practices are associated not only with green economic outcomes but also with continuity and broader sustainability performance. This extension remains a research proposition, not an empirical conclusion.

For essential public services, the proposed decision criterion includes consequences of non-delivery, not only acquisition price. Criticality-based planning is supported by medical supply chain resilience literature (National Academies of Sciences, Engineering, and Medicine, 2022); lifecycle considerations are addressed by ISO sustainable procurement guidance (International Organization for Standardization, 2017). This paper proposes transparent supplier criteria, market engagement, reasonable transition arrangements and documented procedures for legitimate emergencies, subject to legal review before any operational application.

Transport, Logistics and Distribution

Transport and logistics connect production, distribution and service networks. The World Bank (2024) identifies resilient and lower-carbon transport and energy infrastructure as an important Tanzanian policy need, and Vision 2050 treats integrated logistics as a development driver (United Republic of Tanzania, 2025). Against this context, potential green measures include route optimisation, load consolidation and efficient warehousing, while resilience measures include route and carrier alternatives, visibility and contingency procedures. Their net lifecycle and service effects require local assessment rather than assumption (Negri et al., 2021).

A logistics operator may therefore need to monitor emissions per tonne-kilometre together with on-time delivery, route exposure, contingency utilisation and recovery time. Considering these metrics jointly can prevent a misleading claim of success when fewer planned trips are offset by expensive emergency journeys. The ability to use rail, marine transport or lower-emission alternatives is geographically and commercially specific; no modal shift should be presumed optimal without comparing actual infrastructure, volume, reliability, loading and full lifecycle effects.

Tourism, Retail and Service Supply Chains

Tourism, retail and service operators rely on flows of food, energy, amenities, equipment and transport. Research on Tanzanian restaurants finds associations between GSCM and several sustainable performance dimensions (Wabanhu et al., 2025), but this does not establish effects for other tourism or retail businesses. The framework proposes examining green purchasing, waste reduction, reusable products, supplier coordination and substitution together with cost, service quality and customer experience in these settings.

For services, the proposed measurement approach treats the overall customer experience as relevant alongside environmental performance. A hotel using reusable amenities without dependable replenishment could reduce packaging yet lower service quality; this is an illustrative scenario, not an observed finding. Shared deliveries or collection services may offer efficiencies for smaller firms but require appropriate governance and cost allocation. Any claimed benefit should be tested against operational interruptions, satisfaction and waste intensity rather than inferred from environmental labels alone (Carter & Rogers, 2008; Wabanhu et al., 2025).

Implications for the SDGs and Vision 2050

The proposed framework connects organisational actions to particular development priorities without equating firm performance with national impact. For example, procurement and circularity may be mapped to SDG 12; resource efficiency and innovation to Goal 9; productivity and decent work to Goal 8; and climate-risk adaptation to Goal 13 (United Nations, 2015). These are potential contribution pathways; application should identify the relevant targets, baselines, units of analysis and any distributional effects.

Table 6: Illustrative SDG Target and Vision 2050 Alignment

Policy reference	Firm- or network-level evidence	Interpretive limit
SDG 8.2 / 8.8	• Productivity per worker	Not equivalent to national productivity or decent-work statistics.
	• Reportable safety incidents	
	• Supplier labour safeguards.	
SDG 9.4	• Energy per unit of output	Firm efficiency does not establish economy-wide infrastructure upgrading.
	• Cleaner equipment adoption.	
SDG 12.2 / 12.3 / 12.5	• Material intensity	Requires relevant baseline and boundary definition.
	• Food loss	
	• Share of waste recovered.	
SDG 13.1	• Exposure mapping	Readiness is not the same as measured community resilience.
	• Time to restore climate-affected critical services.	
Vision 2050	• Logistics reliability	Organisational alignment is not proof of achievement of the Vision.
	• Value addition	
	• Inclusion	
	• Lower resource intensity.	

Source: Authors' conceptual synthesis (2026).

Vision 2050 emphasizes a competitive and inclusive economy, human capabilities, environmental integrity and resilience, with integrated logistics among the drivers of transformation (United Republic of Tanzania, 2025). Table 6 provides an author-created interpretation of how selected firm indicators could align with targets and strategic aspirations; it is not a United Nations or Tanzanian government scoring framework. Public policy may support such ambitions through proportionate procurement standards, supplier capacity building, digital and logistics infrastructure and credible environmental monitoring (World Bank, 2024; International Organization for Standardization, 2017).

A policy-alignment claim should begin at the target level. SDG target 8.2 concerns productivity and technological upgrading; target 8.8 concerns labour rights and safe working environments; target 9.4 concerns resource-efficient and cleaner infrastructure; targets 12.2, 12.3 and 12.5 concern resource use, food loss and

waste; and target 13.1 concerns resilience to climate-related hazards (United Nations, 2015). Organisational indicators can identify plausible contributions, but national SDG indicators often measure larger populations or different units. The same caution applies to Vision 2050: integrated logistics, economic competitiveness, human development and environmental integrity are strategic directions, not scores to be mechanically assigned to firms.

THEORETICAL AND CONCEPTUAL CONTRIBUTIONS

This paper makes four interrelated contributions. First, it extends an established international debate on supply chain resilience and sustainability into a Tanzania-specific cross-sector research agenda, rather than claiming to originate that debate (Doetsch & Huchzermeier, 2024). Second, it specifies the mechanisms through which green practices and resilience capabilities may act jointly: resource productivity, continuity, collaborative learning and stakeholder confidence. Third, it recognizes that complementarity is conditional and can be offset by identifiable economic, environmental and coordination costs. Fourth, it offers an operationalization and policy-alignment architecture that keeps firm-level performance conceptually separate from national SDG and Vision 2050 achievement. Together, these contributions make the proposed framework more falsifiable, comparable across sectors and useful for evidence-based decision-making.

PRACTICAL AND POLICY IMPLICATIONS

For managers, the conceptual framework suggests mapping critical suppliers, material and energy use, waste flows, transport dependencies and service-critical items before choosing interventions. This joint assessment is consistent with research on integrating sustainability and resilience (Negri et al., 2021; Doetsch & Huchzermeier, 2024). Procurement teams can apply proportionate environmental considerations (International Organization for Standardization, 2017), while operations teams monitor resource intensity, continuity and service measures. Digital investments should be justified by defined decision needs, data quality and staff capabilities rather than assumed to generate performance automatically.

An implementable managerial sequence is as follows. First, map material, information and payment flows, identifying the highest-cost environmental hotspots and the most consequential disruption nodes. Second, segment products and suppliers by criticality, exposure and replaceability. Third, build a baseline dashboard covering emissions or resource use, delivery reliability, stockouts, quality and worker or supplier outcomes. Fourth, evaluate interventions using lifecycle cost plus expected disruption consequences, including costs transferred to vulnerable suppliers. Fifth, pilot the highest-value changes, monitor intended and unintended effects, and revise the portfolio after disruptions. Digital platforms should be adopted only after the required decisions, responsible data owners and quality checks have been specified.

For policymakers and regulators, the analysis points toward environmental and resilience criteria that can be measured and implemented proportionately, alongside SME capability building and logistics and digital infrastructure. These directions accord with the Tanzanian development context identified by the World Bank (2024), the national strategic priorities of Vision 2050 (United Republic of Tanzania, 2025) and sustainable procurement guidance (International Organization for Standardization, 2017). Their effectiveness and fiscal feasibility would still require contextual assessment.

For development partners and financiers, support may be directed toward investments that have credible business cases and demonstrable sustainability benefits, including resource-efficient equipment, storage, renewable energy where appropriate, waste recovery systems and supply chain information infrastructure. Funding criteria should consider lifecycle impacts, maintenance capacity, local supplier participation and resilience outcomes.

The implementation principle is proportionality. High-capital solutions may be justified for energy-intensive, service-critical flows, whereas smaller enterprises may begin with accurate stock records, supplier scorecards, preventive maintenance, basic route planning and waste segregation. A balanced scorecard should report trends, not merely adoption counts: the number of suppliers trained is an activity indicator; fewer non-conforming deliveries or reduced waste intensity is a performance outcome. Managers should report the costs and timing of transitions alongside the benefits so that short-term financial pressure does not remain invisible.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This paper is conceptual and based on a targeted integrative review. It does not provide a systematic census of the literature, primary data, statistical estimates or causal evidence. The framework is intended to guide research and practice rather than to prove that the proposed relationships hold in every sector. The cross-sector scope is useful for conceptual integration but can conceal differences in risk exposure, regulation, supply chain structure and performance priorities.

Future research should first validate the proposed constructs with Tanzanian practitioners and sector experts. Quantitative studies could test the direct effects of green practices and resilience practices on separate performance dimensions, followed by tests of complementarity or interaction effects. A multi-sector design should account for firm size, ownership, sector, supply chain position and digital capability. Longitudinal studies would help distinguish short-term implementation costs from longer-term performance benefits. Comparative case studies could explain how organizations balance emissions reduction against recovery speed during disruption.

A feasible first empirical design would begin with cognitive interviews and expert assessment of item wording, followed by sector-specific pilot surveys and validation of the measurement model. A cross-sectional multi-sector survey could examine associations while controlling for enterprise size, age, ownership, sector, digital maturity and disruption exposure. If using structural equation modelling, researchers should test discriminant validity, collinearity and the appropriateness of higher-order constructs; studies of moderation need adequate power and interpretability. Longitudinal or event-based data are preferable for mediation, actual recovery and persistence of benefits, since a single survey cannot show that practices preceded changes in performance.

Researchers should also develop sector-appropriate measures. Possible indicators include procurement spend meeting defined environmental criteria; material, water and energy use per unit of output; waste recovery rates; delivery-in-full and on-time performance; lead-time variability; stockout frequency; time to recover from disruption; supplier concentration; customer complaints; and selected worker-safety or local supplier participation indicators. Each measure requires a clear definition, reliable data source and suitable reporting period. National SDG contribution should be assessed only where an explicit causal or contribution pathway and appropriate aggregate indicators are available.

The unit of analysis also requires advance specification. Firm respondents may know about internal resource efficiency but not upstream emissions or downstream labour conditions. A buyer–supplier dyad or network design is more suitable for testing information quality, shared investment and distributional outcomes, while a transaction or SKU-level panel may best capture service continuity and inventory cost. Multiple respondents, operational records and independent environmental measurements would reduce common-method concerns. Case studies across agriculture, manufacturing and public services could investigate counterexamples where ostensibly sustainable interventions increased vulnerability, or where recovery arrangements weakened climate performance.

CONCLUSION

Green supply chain management and supply chain resilience address different but interconnected requirements of sustainable competitiveness. Green practices focus on reducing environmental impacts and improving resource productivity while resilience practices help organizations anticipate disruption, maintain critical flows, recover and adapt. An integrated approach may support economic, operational, environmental and social performance, but outcomes depend on the design of interventions and the organizational and institutional context.

For Tanzania, the proposed approach is relevant for future investigation across agriculture, manufacturing, public procurement, healthcare, logistics, tourism and retail. It is broadly aligned with selected SDGs and with Tanzania Development Vision 2050 (United Nations, 2015; United Republic of Tanzania, 2025), particularly their attention to responsible production, competitive economic activity and climate resilience. Policy alignment should not be mistaken for measured impact. Accordingly, the proposed framework treats green practices and

resilience capabilities as explanatory constructs, sustainable competitive performance as an outcome construct and national goals as policy contexts. Empirical work must validate the relationships and identify which interventions deliver balanced and equitable benefits.

DECLARATIONS

Funding: This research received no external funding from any public, commercial, or not-for-profit funding agency.

Conflict of interest: The authors declare that there are no financial, professional, or personal conflicts of interest that could have influenced the conduct, interpretation, or presentation of this study.

Ethical approval: Ethical approval was not required for this study, as it is a conceptual review based exclusively on previously published scholarly literature and publicly available policy documents. The study did not involve the recruitment of human participants, animal experimentation, or the collection of confidential or personally identifiable information.

Data Availability Statement: No new primary data were collected, and no original empirical dataset was generated or analyzed as part of this conceptual review. The study draws exclusively on previously published academic literature and publicly accessible policy documents, all of which are appropriately acknowledged and identifiable through the reference list.

Declaration of Generative AI Assistance: OpenAI's ChatGPT assisted during manuscript preparation and editorial revision with language editing, document organization, literature comparison, methodological exposition, conceptual-diagram preparation and descriptions of proposed analytical tests. The tool was not used to collect primary data or create observed empirical results. The named authors retain responsibility for the accuracy, originality, attribution and integrity of the final publication.

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APPENDIX A: EVIDENCE SELECTION AND CRITICAL APPRAISAL MAP

This matrix records the role and transferability of selected pivotal sources already cited in the manuscript. It is a retrospective transparency aid, not a systematic-search screening log or independent quality-scoring instrument. Sources were retained to establish distinct definitions, mechanisms, context or policy boundaries; reporting one study does not imply that results are nationally generalisable.

Table A1. Selected pivotal evidence, justification and limits of inference.

Source/cluster	Evidence category	Reason for inclusion	Key limitation
Hart (1995); Teece (2007)	Foundational theory	Environmental capability value; sensing, seizing and resource reconfiguration.	Explanatory constructs, not measured green–resilience effects in Tanzania.
Carter & Rogers (2008); Seuring & Müller (2008)	Conceptual / synthesis	Distinguishes financial, environmental and social dimensions.	Does not make operational continuity interchangeable with sustainability.

Negri et al. (2021); Doetsch & Huchzermeier (2024)	International synthesis / mixed evidence	Documents sustainability–resilience synergies, conflicts and integration issues.	Cannot yield a national pooled effect for Tanzanian sectors.
Singogo (2021); Singogo & Kassimba (2024)	Tanzanian local government / fisheries studies	Information exchange, institutional pressure and buyer–supplier relations.	Different populations; no direct estimate of G × R complementarity.
Selestini & Kabelele (2024); Wabanhu et al. (2025)	Tanzanian manufacturing / Arusha restaurants	Adoption constraints and green performance associations.	Sector-specific and generally observational evidence; not causal multi-sector validation.
Chowdhury & Anzum (2026)	Journal; analytics / resilience modelling	Separates digital analytics, flexibility and resilience capability.	AI context and modelling do not substantiate Tanzania-specific joint effects.
Sardar et al. (2026)	Journal; Bangladesh cross-sectional survey	Circular-economy and green-innovation mediation pathways.	Cross-sectional mediation is associational; country and construct transfer limited.
Anzum (2026)	Journal; stylised garment-sourcing simulation	Adaptive audit and sustainability scoring under explicit constraints.	Simulation outcomes are not demonstrated factory or Tanzanian effects.
Nabila & Anzum (2024)	Conference proceeding; Bangladesh manufacturing survey	Blockchain alignment and green-innovation resilience mechanism.	Proceedings study and specific sector; not independent replication in Tanzania.
Diraz et al. (2026)	Journal; Bangladesh expert decision framework	Smart supply-chain barriers: infrastructure, governance and analytics.	Expert priorities vary by geography; not direct tests of G×R performance.
Disha et al. (2026)	Conference proceedings; Bangladesh multi-stakeholder modelling	AI integration barriers; finance, management commitment, infrastructure.	Expert elicitation and setting limit transfer to Tanzanian supplier networks.
United Nations (2015); Tanzania Vision 2050 (2025); World Bank (2024)	Authoritative policy / diagnostics	Anchors policy alignment and infrastructure relevance.	Not firm-level causal evidence or proof of SDG/national-plan impacts.