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Climate-Smart Governance and Food Security: Exploring the Mediating Effect of Sustainable Supply Chain Practices

*Roshima Haji Said, Nur Zharifah Che Adenan
Faculty of Accountancy, Universiti Teknologi MARA Kedah Branch, Sungai Petani Campus, Kedah, Malaysia
Email: *roshima712@uitm.edu.my, zharifah@uitm.edu.my
Corresponding Author: Roshima Haji Said

Abstract: This study explores the continuing challenge of ensuring food security in an era of increasing climate uncertainty and environmental decline. Weak coordination among institutions and inefficiencies within food supply chains often limit the success of sustainable initiatives, despite growing commitment to climate-smart policies. This study seeks to understand how climate-smart governance can improve food security through the influence of sustainable supply chain practices. Using a narrative review approach, data were gathered from the Scopus database and examined through an integrative thematic analysis, aiming to identify coherent ideas and relationships linking governance, sustainability, and the resilience of food systems. The review shows that effective climate-smart governance contributes to stronger food security when supported by sustainable supply chain practices such as green logistics, reduced food loss, digital innovation, and collaboration among stakeholders. These practices make governance efforts more effective by improving how resources are managed, reducing environmental pressure and helping supply chains adapt to change, all of which support better food availability, access, and stability. This study makes a theoretical contribution by proposing a framework that positions sustainable supply chain practices as the connecting element between governance structures and food security outcomes. Practically, the findings provide valuable guidance for policymakers, supply chain professionals, and agricultural organisations to create more integrated and responsive governance systems. This is important for promoting sustainability, innovation, and building resilient food networks that are able to adapt to future global challenges.

Keywords: *Climate-Smart Governance, Sustainable Supply Chain Practices, Food Security, Sustainability and Resilience, Climate Change Adaptation*

1. Introduction

Food systems around the world face two pressing and interconnected challenges: adapting to climate change and ensuring global food security. As the global population moves towards nearly ten billion by the middle of the century, the demand for safe, nutritious, and affordable food continues to grow. At the same time, agriculture, land use, and supply chain activities contribute heavily to greenhouse gas emissions and environmental degradation. Within this context, climate-smart governance has emerged as a promising approach since it can integrate climate resilience, sustainability, and food system stability into policies, institutions, and supply chain operations. Alongside this, sustainable supply chain practices such as shorter distribution networks, greener logistics, reduced food loss and digital innovations are increasingly recognised as essential strategies for strengthening food systems in a changing climate.

Research on climate-smart agriculture, sustainable supply chain management, and food governance is rapidly expanding. Climate-smart agriculture focuses on improving productivity, building resilience, and implementing initiatives to reduce emissions within agrifood systems. Studies on sustainable supply chains also highlight the importance of efficient logistics, waste reduction, and shortened food pathways, which can improve food security, reduce losses, and preserve freshness. The important role that governance plays cannot be denied as policy support, institutional coordination, and public-private partnerships can drive the adoption of these sustainable practices. However, while each of these areas has been well explored, research examining how sustainable supply chain practices act as the connecting bridge that links climate-smart governance to concrete food security outcomes remains limited.

Despite progress in research and policy, significant gaps remain. Many governance initiatives designed to promote climate-smart food systems still fail to produce meaningful improvements in food security. Even when sustainable agricultural practices are adopted, challenges such as supply chain inefficiencies, food loss, and logistical constraints often contribute to the ineffectiveness of their impact. For example, governance

frameworks frequently emphasise production and adaptation yet neglect of downstream supply chain processes that connect production to consumption persists. In the absence of effective mediation through sustainable supply chain practices, the benefits of governance initiatives are likely to be under-realised.

To address this gap, this study proposes a conceptual framework positioning sustainable supply chain practices as a mediator between climate-smart governance and food security. The aim is to explore how governance systems shaped by climate-smart objectives influence the adoption of sustainable practices such as green logistics, shorter supply chains, food loss reduction, and digital technology, and how these all affect food availability, access, and stability. Using insights from supply chain governance theory and socio-technical systems thinking, this framework seeks to explain how institutional and operational levels interact to build resilient and sustainable food systems.

The significance of this study is both theoretical and practical. It provides policymakers, supply chain managers, and agricultural stakeholders with evidence-based insights into where interventions can have the greatest impact, particularly in strengthening supply chain practices that connect governance strategies to food security outcomes. Academically, the study helps bridge fragmented discussions by integrating governance, supply chain, and food security research into a single conceptual model. Theoretically, it advances supply chain governance scholarship by incorporating climate-smart and food security perspectives. The paper proceeds into several sections as follows: Section 2 reviews the relevant literature; Section 3 presents the proposed conceptual framework and research propositions; Section 4 outlines the methodology; Section 5 discusses the findings; Section 6 elaborates on implications and limitations; and Section 7 concludes with recommendations for future research.

2. Literature Review

Existing research on governance for food systems and climate adaptation suggests that governance arrangements guided by climate-smart objectives provide the institutional foundation for building resilient food systems. For example, Paloviita and Marja Järvelä (2019) emphasise that governance operating at multiple levels including global, national, regional, and within supply chains plays a vital role in enabling food systems to adapt to climate-related risks such as changing rainfall patterns, extreme temperatures, and water scarcity. Their analysis highlights that governance systems integrating public components, such as state policy and regulation, with private elements, such as corporate chain governance and buyer-supplier coordination, are more likely to strengthen the adaptive capacity of food supply chains. This governance foundation creates the conditions for supply chain practices to align with climate-smart goals, including promoting shorter supply chains, encouraging low-carbon logistics, and reducing food loss. However, governance alone is not enough to achieve meaningful improvements in food security unless supply chain practices perform their cooperative function as operational mechanisms that enact governance principles.

Research on sustainable supply chain management within the food sector, including supply chain practices, provides invaluable insights. Prior studies have shown that approaches such as local sourcing, environmentally responsible logistics, waste and inventory reduction, and the use of digital information systems can significantly enhance supply chain performance, particularly in ways that relate to food security. For example, Accorsi and colleagues in 2022 found that sustainable food supply chains benefit from coordinated practices like logistics optimisation, waste minimisation, and collaborative partnerships that foster resilience and sustainability. Similarly, the study by Palazzo (2021) also highlights that effective food supply chain management depends on collaboration, information sharing, operational efficiency, and stakeholder integration. These elements directly support food security: shorter supply chains help maintain freshness and reduce spoilage, waste reduction practices preserve more food for consumption, and digital forecasting improves logistics and supply stability. Yet, despite these advances, the way these practices mediate the relationship between governance and food security remains insufficiently explored.

Significant research gap indicates that there is still a need to clearly map and empirically examine how climate-smart governance influences sustainable supply chain practices, and how these practices, in turn, affect food security in terms of availability, access, and stability. While existing studies acknowledge that governance frameworks shape food system resilience, and that sustainable supply chain practices improve efficiency and

reduce environmental impact, very few have integrated these three dimensions into a single conceptual model. The lack of an empirically tested framework that connects governance, supply chain practices, and food security limits both theoretical development and practical application. To address this, the present study proposes a conceptual framework that positions sustainable supply chain practices as a key mediator between climate-smart governance and food security outcomes. The theoretical foundation of this study draws on supply chain governance theory and socio-technical systems thinking, suggesting that governance exerts its influence indirectly by shaping practices within the chain, which then translate into tangible improvements in food security. In doing so, the study is able to bridge the gap in understanding how governance and food security are operationally connected through supply chain practices.

Climate-Smart Governance

Governance arrangements oriented around climate-smart objectives emphasise the important role of institutional mechanisms, policy frameworks and effective coordination between the public and private sectors in strengthening food system resilience in the face of climate change. Ari Paloviita and Marja Järvelä (2019) highlight that multilevel governance within food supply chains encompasses policy regulation, corporate governance, and stakeholder collaboration. Each of these plays a role in helping food systems adapt to changing climatic conditions by shaping how supply chains are organised and managed. Such governance structures create an enabling environment for climate-smart initiatives, including resource-efficient agriculture, risk management mechanisms, and partnerships between public and private actors. Together, these efforts establish the foundation for aligning supply chain operations with broader sustainability and food security objectives. In this context, climate-smart governance extends beyond agricultural production to involve the coordinated management of policies, institutions, actors and supply chain processes that collectively address climate risks and ensure the long-term stability of food systems.

Sustainable Supply Chain Practices and Food Security

The literature on sustainable supply chain management in food systems shows that practices such as reducing food loss and waste, shortening supply chains, implementing green logistics and leveraging digital technologies are critical to food security outcomes (availability, access, stability). A systematic review of food sustainable supply-chain management (FSSCM) by Palazzo and Vollero (2021) mapped out the building blocks of FSSCM including traceability, collaboration, green purchasing and technology adoption and emphasises research gaps around integrating sustainability into food-chain flows. Additionally, research on food loss and waste (FLW) demonstrates that eliminating losses across chain stages is fundamental to linking supply-chain practices with food-security dimensions. For example, Akkerman and Frans Cruijssen (2024) discuss how drivers of FLW and interventions such as better information flows, packaging innovations, and logistics optimisation link supply-chain performance with nutrition and system stability. In sum, sustainable supply chain practices are pivotal for translating upstream production/governance ambitions into downstream food-security outcomes.

Mediating Effect of Sustainable Supply Chain Practices

The mediating effect emerges when climate-smart governance influences supply-chain practices, which in turn influence food-security outcomes. Governance mechanisms namely policies, incentives, regulations, and stakeholder coordination create the institutional conditions for supply-chain actors to adopt sustainable practices like shorter chains, green logistics, digital information systems and food-loss reduction mechanisms. These practices operationalise governance objectives into tangible chain behaviours, which in turn influence food security by improving availability through reduced losses, shorter transit, fresher produce, efficient distribution access, reduced cost, improved freshness and stability all through resilient supply chains, buffer capabilities, technology-enabled predictability. Thus, without the supply-chain practices acting as the conduit, governance alone may not translate into improved food-security outcomes. The literature reveals that while governance and supply-chain practices are independently studied, their linkage via mediation remains limited research. Therefore, this study aims to address via the proposed conceptual framework.

3. Methodology

Research Design – Narrative Review Methodology

This study adopts a narrative review methodology to critically examine and interpret existing knowledge on the relationship between climate-smart governance, sustainable supply chain practices, and food security. A

narrative review is well-suited for exploratory and theory-building research where the goal is to develop conceptual understanding rather than to quantify relationships (Baumeister and Leary, 1997). Unlike systematic reviews that depend on statistical meta-analysis, the narrative review approach allows for the integration of diverse perspectives drawn from conceptual, empirical, and policy-oriented studies. This flexibility provides a broad analytical lens to capture the complex interconnections between governance structures, sustainability practices, and food system outcomes, which are inherently multidisciplinary and cross-sectoral in nature (Green, Johnson and Adams, 2006). The design of this review therefore supports the development of a conceptual framework that explains the mediating influence of sustainable supply chain practices in linking climate-smart governance to food security.

The review emphasises conceptual clarity and thematic synthesis rather than exhaustive quantitative aggregation. Following Ferrari (2015), the process includes identifying both seminal and contemporary studies, synthesising emerging themes, and evaluating theoretical and empirical coherence across disciplines. This methodological orientation aligns with the study's objective to develop an integrative model that explains how governance mechanisms such as policies, regulations, and institutional coordination shape sustainable supply chain behaviours including green logistics, food loss reduction, and digitalisation, which in turn contribute to improving food availability, access, and stability.

Key Steps in Conducting a Narrative Review

The narrative review was carried out in four main phases: search strategy development, literature screening and selection, data extraction, and thematic synthesis with conceptual integration.

Search Strategy Development

The data collection process was conducted using the Scopus database, and the selection was based on its extensive coverage of high-quality, peer-reviewed journals across environmental science, agricultural economics, supply chain management, and governance studies. Scopus was considered the most suitable source as it provides access to a wide range of multidisciplinary literature that addresses sustainability, policy, and agrifood systems, all of which are central to this study.

Screening and Selection

The initial search identified studies published between 2010 and 2025 to capture both foundational and contemporary perspectives. Titles, abstracts, and keywords were carefully reviewed to ensure that the selected works focused on the intersections among climate governance, sustainable supply chains, and food security. Studies that did not engage with these interrelationships or that lacked empirical depth or theoretical relevance were excluded from further consideration.

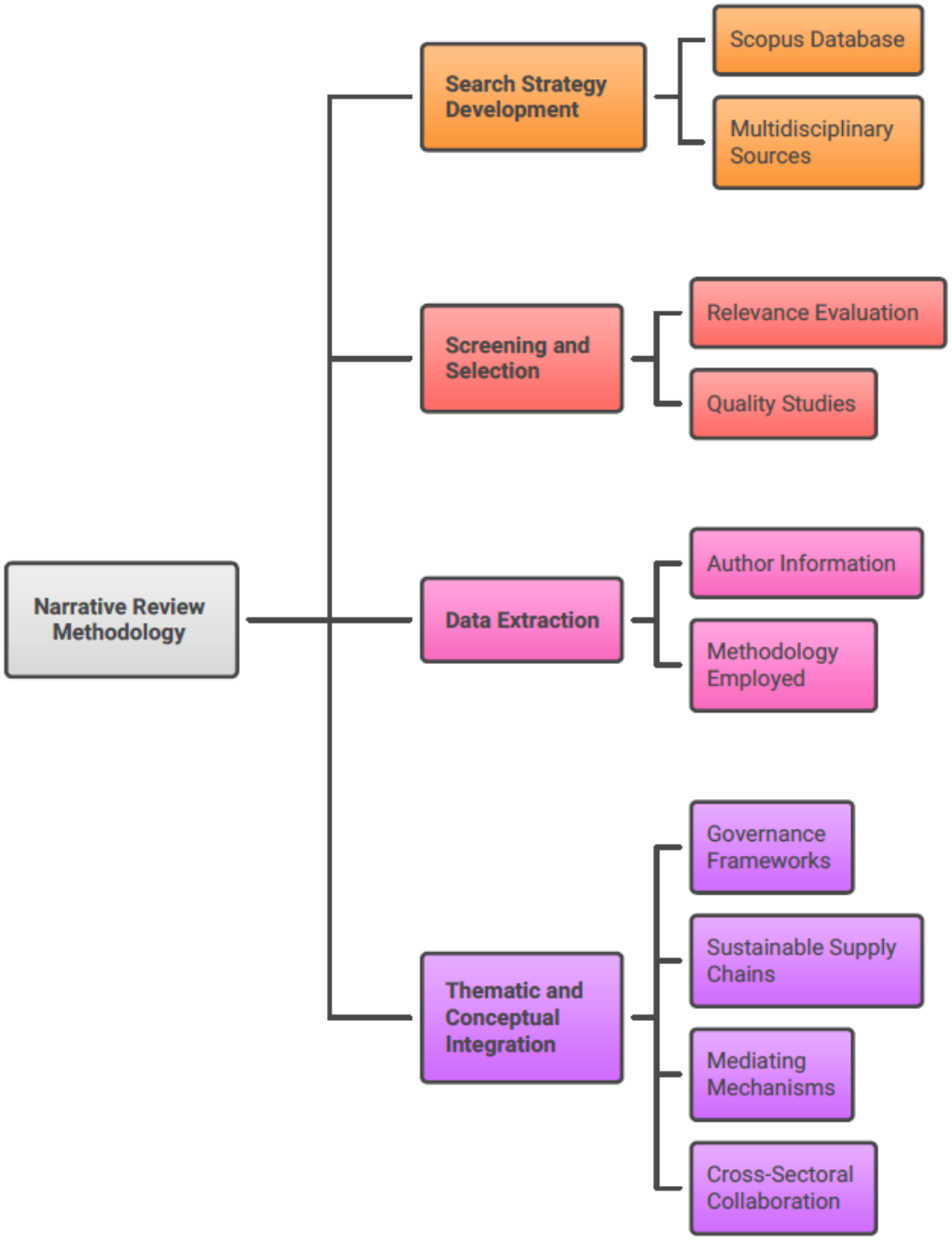
Data Extraction

Full texts of the selected articles were examined to extract essential information including author, year, research objectives, methodological approach, main findings, and theoretical underpinnings. The extracted information was then organised thematically to capture both recurring and divergent viewpoints within the literature.

Thematic and Conceptual Integration

An integrative thematic analysis approach, as described by Braun and Clarke (2006), was applied to identify, code, and cluster patterns across the reviewed studies. This analytical process informed the synthesis of four central themes: governance frameworks for climate adaptation, sustainable supply chain management practices, mediating mechanisms that influence food security, and cross-sectoral collaboration with corresponding policy implications.

Figure 1: Narrative Review Methodology: Climate Governance, Supply Chains, and Food Security



Data Collection and Review Strategy

Data collection was systematically conducted using the Scopus database as the primary source. The following search string was applied to retrieve relevant documents from titles, abstracts, and keywords:

("climate" OR "environment" OR "sustainability") AND ("governance" OR "management" OR "policy" OR "administration") AND ("food security" OR "nutrition" OR "food safety" OR "hunger") AND ("supply chain" OR "logistics" OR "distribution" OR "procurement") AND ("sustainable" OR "eco-friendly" OR "green" OR "responsible") AND ("practices" OR "strategies" OR "methods" OR "approaches").

This query was refined to include peer-reviewed journal articles, conference papers, and book chapters, while

excluding non-academic materials such as reports or editorials. The search yielded approximately 250 initial records, which were filtered through inclusion and exclusion criteria focusing on thematic relevance and publication quality. Duplicates were removed, and 90 articles were shortlisted for detailed review.

The integrative thematic analysis was utilised to guide the interpretation of data. Each study was coded based on its contribution to understanding (1) the governance mechanisms supporting climate-smart transitions, (2) sustainable supply chain practices such as food-loss reduction, circular logistics, and digital traceability, and (3) the implications of these practices on food security. Through iterative coding and comparison, thematic clusters emerged linking governance interventions with operational practices and food-system resilience outcomes. The final synthesis produced a conceptual framework illustrating how sustainable supply chain practices mediate the relationship between climate-smart governance and food security, providing an empirically grounded yet conceptually rich perspective.

Key Findings from the Narrative Review

Table 1: Key Findings from the Narrative Review

Theme / Key Finding	Description and Insight	Source(s)
Short Supply Chains	Shorter supply chains help bring producers and consumers closer together, reducing the distance food travels and limiting postharvest losses and carbon emissions. This approach ensures that food remains fresher and more nutritious by the time it reaches consumers. Local sourcing also strengthens community resilience by supporting regional economies and reducing dependence on long and vulnerable global supply networks. In doing so, it aligns with the goals of climate-smart governance, which promotes low-carbon, decentralised, and sustainable food systems that are better equipped to adapt to climate change and safeguard long-term food security..	Morkūnas et al. (2022)
Sustainable Supply Chain Management (SSCM)	Sustainable supply chain management practices, including green logistics, environmentally friendly packaging, and product traceability, play a crucial role in enhancing operational efficiency and ensuring food safety. These practices bring together environmental, social, and economic objectives within supply chain operations, creating a more balanced and responsible approach to production and distribution. By integrating sustainability principles into everyday operations, they not only improve efficiency but also strengthen resilience and contribute to the long-term stability and sustainability of food systems.	Aljoghaiman (2023); Melkonyan et al. (2019); Munuhwa & Hove-Sibanda (2024)
Climate-Smart Agriculture (CSA)	Climate-smart agriculture combines different adaptive farming methods, like conservation agriculture, precision irrigation, and integrated pest management, to deal with climate risks and boost productivity. These methods make better use of resources and help keep agricultural production steady even when the weather changes. Climate-smart agriculture directly supports the three main pillars of food security—availability, access, and stability— by encouraging higher yields and better resource management. It makes food systems better able to grow enough food, makes sure that everyone has fair access, and keeps the supply steady even when the economy or the environment changes. It also protects natural ecosystems for future generations.	Roy (2019); Scherer & Verburg (2017)
Government Support	Subsidies, policy tools, and institutional frameworks all help businesses adopt climate-smart and sustainable supply-chain	Erfanian et al. (2024)

Theme / Key Finding	Description and Insight	Source(s)
	practices. Good governance uses incentives, monitoring, and capacity-building programmes that connect national strategies with local food systems to improve and expand sustainability results.	
Food Loss and Waste (FLW) Management	Better logistics, storage, and inventory management can greatly cut down on food loss and waste (FLW), making food more available and having less of an impact on the environment. FLW management serves as an operational link between governance directives and food-security performance, with waste reduction being a key way to do this.	De Boni et al. (2022); Olabode et al. (2025)
Digital Technologies and Supply-Chain Resilience	Digitalisation enhances forecasting, monitoring, and data sharing along supply chains. Technologies such as IoT sensors, blockchain, and AI improve traceability and efficiency, reduce uncertainty, and support real-time responses to climate-related disruptions—thereby strengthening food-system stability.	Aldhaheri et al. (2023)
Integrated Governance and Stakeholder Engagement	Collaborative governance—linking public policies with private sector initiatives—fosters collective action across stakeholders. Such engagement ensures knowledge sharing, joint resource management, and alignment between environmental and economic priorities within food supply chains.	Paloviita & Järvelä (2019); Tsoulfas (2025)

The narrative review emphasises that sustainable supply chain practices act as the intermediary through which climate-smart governance influences food security outcomes. Climate-smart governance anchored in policy coherence, institutional support, and multi-level coordination establishes an enabling environment for sustainable actions, while supply-chain practices operationalise these governance directives into measurable outcomes. In particular, short supply chains and green logistics help lower emissions and keep food fresher. CSA practices, in turn, help businesses become more productive and resilient in the face of climate change. Government support in providing resources, incentives, and regulatory oversight is also helpful in accelerating adoption. At the same time, reducing FLW and using digital technologies make operations more resilient and make better use of resources. This means that food is not only produced in a way that is good for the environment, but it is also delivered to customers quickly and easily. These practices can bridge the gap between strategy and operations, translating high-level governance frameworks into real-world effects on food security by making food more available (through production and waste reduction), more accessible (through efficient distribution), and more stable (through resilience and real-time management).

The mediating function of sustainable supply chain practices consists of converting policy intent into systemic action, thereby linking governance with on-the-ground implementation. Without this kind of mediation, governance actions could stay the same instead of changing things. The review emphasises that integrated governance, multi-stakeholder engagement, and technological innovation are crucial for enhancing this mediation effect, guaranteeing that climate-smart governance successfully promotes sustainable food-security outcomes amid escalating environmental uncertainty.

Theoretical Framework Development

This study is based on the Resource-Based View (RBV) and Institutional Theory. These two theories together explain how governance mechanisms and sustainable supply-chain practices work together to affect food security outcomes. RBV asserts that organisational and systemic performance is derived from the efficient utilisation of valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). In the context of food systems, these resources encompass sustainable technologies, human competencies, and eco-friendly logistics infrastructures that facilitate climate-smart adaptation. Institutional Theory enhances the Resource-Based View (RBV) by highlighting the influence of rules, norms, and governance frameworks on organisational conduct (Scott, 2014). Climate-smart governance through policies, incentives, and regulatory mechanisms that

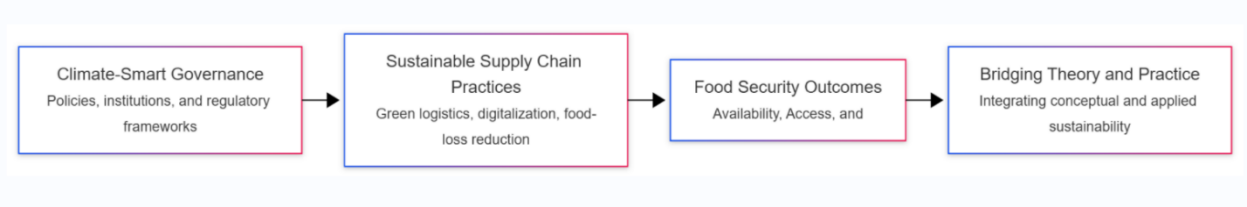
create institutional pressures that force supply-chain actors to use sustainable methods. These theories collectively offer a multifaceted perspective: RBV emphasises the enhancement of internal capabilities within supply chains, whereas Institutional Theory elucidates the external governance factors that shape sustainability alignment and food security outcomes (DiMaggio & Powell, 1983).

The application of these theories in the current study elucidates the mediating function of sustainable supply-chain practices. Climate-smart governance creates the institutional setting through policy frameworks, standards, and resource facilitation that encourages the use of green logistics, reducing food waste, digital traceability, and farming methods that use fewer resources. These practices, in turn, put governance goals into action by making food systems more efficient, resilient, and adaptable (Melkonyan et al., 2019; Tsoulfas, 2025). Theoretically, sustainable supply-chain practices function as dynamic capabilities (Teece, 2007) that convert governance inputs into quantifiable food-security outcomes, including availability, access, and stability. A conceptual framework based on this rationale positions sustainable supply-chain practices as a mediating mechanism that connects governance structures (institutional forces) and food-system performance (resource outcomes). This framework highlights the relationship between policy design and supply-chain execution. It also shows how regulatory compliance can lead to a competitive edge and social benefits through smart use of resources and adaptation to new technologies.

The theoretical integration provides substantial practical ramifications. It implies that attaining food security amidst climate unpredictability necessitates not only robust policy commitment but also the intrinsic capability of supply-chain participants to execute sustainable practices efficiently. Policymakers should prioritise the creation of institutional frameworks that promote innovation, collaboration, and accountability. Concurrently, businesses and agricultural producers must cultivate the ability to align their operational practices with climate-smart principles (Paloviita & Järvelä, 2019). By combining RBV and institutional perspectives, this study makes a theoretical contribution by showing that sustainability performance comes from both following institutional rules and organising resources strategically. In practice, the framework provides a guide for governments, supply-chain managers, and development agencies to work together to create integrated strategies that turn governance mandates into food systems that are strong and fair. To sum up, the proposed theoretical framework helps in understanding how climate-smart governance and supply-chain sustainability work together to create long-term food security outcomes. It is important to connect theory and practice in the field of sustainability.

Figure 2 shows the proposed theoretical framework that shows how climate-smart governance and sustainable supply chain practices work together to create food security outcomes. This fills the gap between theoretical ideas and real-world sustainability practices. In this framework, climate-smart governance is the set of rules and institutions that shape how people behave in the food system in a way that is good for the environment. Governance promotes the adoption of sustainable supply chain practices, such as green logistics, digitalisation, and reducing food loss, by using tools like regulations, incentive structures, and coordination between stakeholders. These practices serve as mediating mechanisms that translate governance objectives into concrete outcomes, enhancing the availability, access, and stability of the food system. This interaction results in the development of robust and flexible food systems that can tackle both environmental and socio-economic issues. The model underscores the amalgamation of theoretical constructs (originating from the Resource-Based View and Institutional Theory) with pragmatic sustainability strategies, thereby guaranteeing the conversion of conceptual governance frameworks into quantifiable enhancements in food security performance.

Figure 2: The Proposed Theoretical Framework



4. Findings

Proposition Development: Climate-Smart Governance and Food Security

Climate-smart governance is very important for setting up the rules and institutions needed to make food security more robust as climate change becomes more of a threat. Effective governance involves coordination at multiple levels among public, private, and community actors to ensure that policies that promote sustainability lead to real actions in the supply chain (Paloviita & Järvelä, 2019). Climate-smart governance creates the right conditions for sustainable farming and distribution practices that make food systems more resilient using adaptive policies, open resource management, and decision-making that involves everyone. The translation of governance strategies into concrete food security outcomes is contingent upon the degree to which sustainable supply chain practices, including green logistics, food-loss reduction, and digital innovation, influence this relationship (Tsoulfas, 2025; Melkonyan et al., 2019). These practices put governance goals into action by making food more available, easier to get to, and more stable by combining efficiency, technological progress, and cooperation into agri-food systems (Ghadge et al., 2021). Without this kind of mediation, reforms to governance might not have much of an effect on how well the food system works in the real world. It is therefore argued that sustainable supply chain practices constitute the fundamental mechanism through which climate-smart governance realises its intended effect on food security.

Proposition 1: Sustainable supply chain practices serve as intermediaries in the relationship between climate-smart governance and food security, facilitating the transformation of governance mechanisms into resilient, efficient, and equitable food systems.

Proposition Development: Climate-Smart Governance and Sustainable Supply Chain Practices

Climate-smart governance lays the groundwork for sustainability-focused behaviour across agri-food supply chains by setting up the rules, policies, and institutions that businesses and governments need to follow. Governments and regulatory bodies create conditions that encourage innovation, coordination, and resilience in the supply chain by making climate adaptation goals part of governance systems (Paloviita & Järvelä, 2019). Clear policy mandates, financial incentives, and multi-stakeholder platforms are examples of good governance tools that encourage supply chain actors to use sustainable practices like green logistics, digital traceability, and resource-efficient production (Melkonyan et al., 2019). These sustainable supply chain practices, in turn, serve as operational mediators that convert high-level governance frameworks into concrete actions that improve environmental performance, minimise waste, and guarantee more equitable resource allocation (Tsoulfas, 2025). Stakeholders can make supply chains more resilient and sustainable by working together, being flexible, and sharing information. This helps supply chains meet governance goals and respond quickly to climate-related disruptions (Ghadge et al., 2021). When done right, climate-smart governance makes supply-chain systems better able to put sustainability plans into action that improve long-term competitiveness and environmental responsibility. Consequently, it is suggested that the existence of strong climate-smart governance has a favourable impact on the implementation and efficacy of sustainable supply chain practices, establishing an essential connection between governance frameworks and systemic sustainability results.

Proposition 2: Climate-smart governance positively impacts the execution of sustainable supply chain practices by establishing the requisite institutional, policy, and regulatory frameworks essential for actualising sustainability and resilience within agri-food systems.

Proposition Development: Food Security and Sustainable Supply Chain Practices

Food security as defined by availability, access, utilisation, and stability, is increasingly reliant on the efficacy and sustainability of supply chain practices that guarantee the continuous delivery of safe, nutritious, and affordable food from production to consumption. Sustainable supply chain practices (SSCPs), including resource-efficient logistics, minimising food loss and waste, and embracing digital technologies, are essential for alleviating the negative impacts of climate change on food systems while bolstering their resilience (Melkonyan et al., 2019). SSCPs enhance food availability and accessibility by advocating for green logistics and effective resource management, especially in areas susceptible to environmental disturbances or economic volatility (Tsoulfas, 2025). Likewise, efforts that improve cooperation between stakeholders and promote technological innovation make it easier to make decisions in real time and respond to climate-related problems in a flexible way, which protects the safety of food and the continuity of supply (Ghadge et al., 2021).

Additionally, incorporating sustainability principles throughout the supply chain increases stability by lowering systemic weaknesses and improving local production and distribution capabilities (Paloviita & Järvelä, 2019). So, sustainable supply chain practices are the operational backbone of food system resilience, and they have a direct effect on society's ability to reach long-term food security goals.

Proposition 3: Sustainable supply chain practices positively impact food security by increasing the availability, accessibility, and stability of the food system through greater resource efficiency, less waste, and adaptive resilience mechanisms.

Proposition Development: The Mediating Role of Sustainable Supply Chain Practices

The connection between climate-smart governance and food security is not only direct. It is also heavily affected by the role of sustainable supply chain practices (SSCPs) that turn policy goals into real-world results. Climate-smart governance creates the institutional, regulatory, and strategic frameworks needed to make food systems more resilient and long-lasting (Paloviita & Järvelä, 2019). However, the success of these governance goals depends on the extent to which SSCPs such as collaborating with stakeholders, using resources wisely, cutting down on food waste, and using digital tools are practiced in the supply chain (Melkonyan et al., 2019; Tsoulfas, 2025). These practices put governance directives into action by improving environmental performance to ensure product traceability and increase adaptive capacity. This makes food systems more resilient to climate shocks and changes in the economy (Ghadge et al., 2021). Sustainable supply chain mechanisms also help ensure that food resources are available, accessible, and stable over the long term by shaping production, logistics, and consumption patterns that are aligned with climate adaptation goals. When strong SSCPs support governance mechanisms, it is easier to see and measure the effects of policies on food security. This connects institutional governance with grassroots implementation. Thus, SSCPs are the way climate-smart governance makes real and lasting improvements in food security outcomes.

Proposition 4: Sustainable supply chain practices serve as intermediaries in the relationship between climate-smart governance and food security by converting policy and institutional frameworks into operational mechanisms that improve resilience, efficiency, and sustainability throughout food systems.

5. Conclusion and Recommendations

The study finds that climate-smart governance, sustainable supply chain practices, and food security are all very important parts of sustainable development. The main findings show that climate-smart governance sets the institutional and policy groundwork for climate adaptation and sustainability. However, the successful use of sustainable supply chain practices serves as the operational link that turns governance goals into measurable food security results. Theoretically, this study enhances the governance and sustainability literature by identifying the mediating role of sustainable supply chain practices within the climate-smart governance–food security framework. It combines Institutional Theory and the Resource-Based View to show how governance structures affect an organisation's abilities and the way the supply chain works, which in turn makes food more available, accessible, and stable. The findings provide practical guidance for policymakers, supply-chain managers, and agricultural stakeholders, underscoring the necessity of integrated governance, digital innovation, and stakeholder collaboration in the development of resilient food systems. This study is constrained by its narrative review methodology, which may inadequately represent the comprehensive range of emerging empirical evidence or regional disparities. Subsequent research ought to utilise quantitative or mixed-method approaches to empirically substantiate the proposed framework, evaluate cross-national disparities, and investigate the enduring impacts of digital transformation and circular economy principles on climate-smart food governance.

This study makes several important scholarly contributions. First, it advances conceptual understanding by positioning sustainable supply chain practices as a key mediating mechanism between climate-smart governance and food security, addressing a theoretical gap in existing sustainability and agri-food literature. Second, it synthesises previously fragmented knowledge from environmental governance, supply chain management, and food security into an integrated framework, offering a holistic perspective for future empirical exploration. Third, by combining Institutional Theory and the Resource-Based View, the study proposes a multidimensional theoretical model that explains how institutional structures interact with

organisational resources to drive sustainable food-system performance. Lastly, the study provides a comprehensive narrative synthesis that maps current research trends and identifies critical areas requiring further empirical validation, thereby guiding future scholarly inquiry.

Several policy implications arise from these findings. Policymakers should prioritise strengthening climate-smart governance structures by embedding climate adaptation, sustainability standards, and transparent monitoring mechanisms into national agricultural and food policies. In addition, governments should also incentivise the adoption of sustainable supply chain practices through targeted subsidies, digital infrastructure development, and capacity-building programmes, particularly for smallholder farmers and local SMEs. Integrated governance platforms that connect public agencies, private sector actors, and community-based organisations are essential to ensure coordinated responses to climate risks and supply-chain disruptions. Furthermore, investment in digital technologies such as traceability systems, early-warning climate analytics, and blockchain-based supply networks can significantly enhance supply-chain efficiency and accountability. Regionally inclusive policies should also be developed to reduce disparities in food-system resilience, particularly in climate-vulnerable rural areas. Ultimately, the study underscores that robust governance, aligned with sustainable operational practices, forms the backbone of resilient, secure, and climate-adaptive food systems.

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