Received: 18 December 2023 | Revised: 22 June 2024 | Accepted: 13 July 2024

DOI: 10.1111/beer.12722

Business Ethics, the Environment & Responsibility

WILEY

ORIGINAL ARTICLE

How climate change and modern slavery interact in the supply chain: A conceptual model development through a systemic review

Yuxin Wang | Maryam Lotfi

Cardiff Business School, Cardiff University, Cardiff, UK

Correspondence
Maryam Lotfi, Cardiff Business School, Cardiff University, Aberconway Building, Colum Drive, Cardiff CF10 3EU, Wales, UK.
Email: lotfim@cardiff.ac.uk

Abstract

Despite growing recognition of the interconnectedness between climate change and modern slavery within supply chains, these issues are often studied in isolation, leading to a fragmented understanding of their relationship. This research aims to bridge this gap by investigating the key factors in supply chains that influence both climate change and modern slavery and how interactions among supply chain stakeholders impact the relationship between them. Utilising the PRISMA literature review method, we systematically reviewed 56 articles to identify the underlying mechanisms and stakeholders' interactions that influence the dynamics between climate change and modern slavery in supply chains. Our findings culminate in a conceptual model that delineates 11 factors bi-directionally impacting both climate change and modern slavery. These factors include social (migration, violent conflict, and war as well as tradition and culture), environmental (deforestation, soil erosion, disruption of protected area, extreme weather, and resource) and economic (liabilities, employment, education, and pandemic). Furthermore, it highlights how stakeholder interactions at the government, NGO, supplier, focal firm, worker, and consumer levels impact this relationship. Finally, the model underscores the potential of technology adoption, sustainable development strategies, and stakeholder engagement and collaboration as levers to positively influence the relationship between climate change and modern slavery in supply chains.

KEYWORDS
climate change, modern slavery, supply chain

1 | INTRODUCTION

Climate change and modern slavery are interlinked threats, each capable of triggering the other. The World Bank (2015) warns that by 2030, climate change may drive 100 million people into poverty. While not all weather-related disasters can be directly attributed to climate change, the impact of climate-related shocks is increasingly devastating for vulnerable households and communities (United Nations Human Rights, 2021).

Extreme weather events linked to climate change have disrupted raw material extraction, submerged agricultural lands, and decimated forests, displacing millions and making them

The first author is a master's student of the second author.

susceptible to exploitation (Bharadwaj et al., 2021). Supply chain disruptions resulting from climate-induced imbalances further heighten vulnerabilities, amplifying the risk of exploitation across global extraction hubs (Eitzinger et al., 2013; Mackay et al., 2020; Parvez et al., 2023). Thus, workers in these supply chains are doubly burdened—by the adverse effects of climate change and the risk of modern slavery.

Contrary to being a relic of the past, modern slavery persists globally, especially in sectors with environmentally degrading activities (Bharadwaj et al., 2021). Modern slavery is defined as:

> The recruitment and subsequent exploitation of a person (or a person in chattel or debt bondage slavery), who is deprived of their individual liberty anywhere along the product, human or labour supply chain to the final customer for service provision or production. (Strand et al., 2023, p. 2)

Alarmingly, an estimated 12.2 million workers are enslaved in environmentally harmful activities within supply chains (Global Estimate of Modern Slavery, 2022). Further, the International Labour Organisation (2017) reports that 152 million children and 21 million adults work under conditions akin to slavery or hazardous conditions.

Recent research has begun to uncover the intricate links between climate change, modern slavery, and related issues like gender inequality (Brown et al., 2021; Cameron et al., 2021; Decker Sparks et al., 2021). Brown et al. (2021) investigated the intricate links among modern slavery, environmental degradation, and climate change across four key sectors. In fisheries, exploitative labour was found in Thailand and Bangladesh's fishing industries, linking it to environmental harm. The agricultural sector faces increased challenges due to climate change, intensifying existing pressures and prompting rural migration, potentially leading to more child labour. The forestry sector spotlighted illegal logging in Brazil and human rights abuses in Indonesia's palm oil supply chain, suggesting a need to study the relationship between slave labour and deforestation. In factories, Bull's Trench Kilns (BTKs) in South Asia contribute to climate issues and modern slavery through the debt bondage of seasonal migrants.

Bales and Sovacool (2021) underscored modern slavery as a "threat multiplier" for climate change, emphasising the adaptability of criminal enterprises and slaveholders to changing conditions. Climate disasters increase vulnerability, making people susceptible to deception and enslavement, perpetuating a harmful cycle. The research suggested that freeing slaves could aid in forest restoration and identified pathways to address both modern slavery and climate change. The links between the Sustainable Development Goals (SDGs) and the impact of eliminating modern slavery on climate change were explored by Decker Sparks et al. (2021), finding that enslaved workers often contribute to environmental degradation. Emancipating these workers can lead to positive economic impacts, fostering community growth that benefits both society and the environment. Furthermore, reducing modern slavery can shift consumer spending towards sustainable products, mitigating climate and environmental harm. Nguyen and Zuidwijk (2024) examine literature on sustainable supply chain governance to understand methods for addressing modern slavery, human rights, and environmental issues within supply chains. The study concludes that the integration of transactional or contractual governance mechanisms, the leadership of focal companies, consideration of network standpoint and the establishment of public-private partnerships can effectively govern complex supply chains and promote sustainable development.

Pugh et al. (2024) discuss the imperative for a just transition in the fashion and textile industries, which are heavily impacted by environmental and social issues. This paper highlights the sector's challenges, such as climate change, environmental degradation, unsafe working conditions, modern slavery, and human rights violations. It applies the five concepts of the "Wellbeing Wardrobe"—setting limits, establishing new indicators, promoting fair and just governance, and creating equitable exchange systems to the fashion industry. Additionally, it encourages companies to adopt new business models and consumers to explore alternative consumption patterns to support a just transition, aiming to mitigate the effects of climate change and modern slavery and foster sustainable development.

Aguinaga (2024) reviewed the efficacy of five European legislations on mandatory Human Rights and Environmental Due Diligence in addressing modern slavery issues within corporate supply chains. The findings indicate that, in the absence of regulation, voluntary corporate implementation of human rights and environmental protections remains low. Conversely, mHREDD legislation can enhance corporate awareness of human rights, the environment, and economic development, improving disclosure of human rights and environmental risks.

Finally, the UK-based Modern Slavery and Human Rights Policy and Evidence Centre (Modern Slavery PEC) has studied the impact of public procurement decisions on modern slavery and climate change in supply chains, along with the effectiveness of mandatory Human Rights and Environmental Due Diligence in addressing these issues. Rogerson et al. (2024) highlighted four main risks within public sector supply chains related to climate change and modern slavery, which include a lack of legal mandates, limited access to relevant data, uncertainty in protecting vulnerable groups, and a lack of awareness about sustainability issues in procurement departments.

The existing literature on the connections between modern slavery and climate change often falls short of providing a holistic framework and concrete solutions. Many studies highlight the interplay between these issues and conduct case studies, but the articles only explore and describe them from a single perspective, lacking a macro view, actionable measures to address, and exploration of the supply chain perspective. Moreover, there is a noticeable gap in understanding the underlying drivers of this nexus within the context of supply chain management. Therefore, there is a needed to address these shortages and provide a comprehensive framework that explores the interaction between modern slavery and climate

change within supply chains. This paper, investigates the following research questions to address this gap:

1. What are the key factors in the supply chain that influence climate change and modern slavery, and how do they exert their influence?
2. How do supply chain stakeholders' interactions impact the relationship between climate change and modern slavery?

The paper identifies 11 factors across environmental, social, and economic domains that influence modern slavery and climate change. It proposes that leveraging technology, adopting sustainable development strategies, and promoting stakeholder engagement can enhance their interplay in supply chains.

This paper contributes to sustainable supply chain management by addressing the interconnection between modern slavery and climate change, two pillars of social and environmental sustainability, through shared factors.

The paper's structure is as follows: Section 2 outlines the methods; Section 3 discusses findings via descriptive and content analysis; and Section 4 presents a research model with recommendations for enhancing the relationship between modern slavery and climate change.

2 | METHODS

This study employs a systematic literature review as the research methodology, leveraging secondary data from available sources due to the absence of primary or original data samples.

A systematic literature review systematically and comprehensively describes the content of literature within a specific field, both qualitatively and quantitatively (Marasco, 2008). This method allows for summarising previous research, expanding knowledge boundaries, and gaining a deep understanding of existing work by selecting and summarising relevant literature (Denyer & Tranfield, 2006). Furthermore, it identifies areas requiring further investigation (Xiao & Watson, 2019). According to Ishaya et al. (2023), this approach minimises biases, enhances the reliability of survey results, and ensures the validity of subsequent studies.

Adhering to the PRISMA methodology, this study follows a structured approach to enhance transparency in the systematic review process (Page et al., 2021; Page & Moher, 2017). PRISMA offers a flexible framework applicable across various research fields, with the option to include or exclude meta-analysis. The inclusion criteria of this study include: (1) Formal literature only (excluding books, research reports, etc., for greater maturity and reliability); (2) English-language publications for ease of search and analysis; (3) Relevance to the supply chain, climate change, or modern slavery, with these keywords as criteria; and (4) Papers published from January 2013 to June 2023 to ensure data currency and quality.

Scientific research is built upon prior studies and established knowledge derived from scientific evidence. Researchers must be well versed in the latest developments in the field when designing studies to address new questions (Kumpulainen & Seppänen, 2022). Without an extensive body of literature and broad disciplinary coverage, it is nearly impossible to conduct a comprehensive assessment of a research area. However, most databases lack the capacity and capability for researchers to perform literature review analyses. Web of Science (WoS) and Scopus are two bibliographic databases universally recognised as the most comprehensive data sources for various purposes. WoS was the first broadly scoped international bibliographic database and has become the most influential bibliographic data source traditionally used for journal selection, research evaluation, bibliometric analysis, and other tasks (Jamaluddin & Saibani, 2021). Compared to WoS, Scopus indexes more unique sources not covered by WoS, offering better coverage of academic books (Pranckutė, 2021). While there is overlap in content between the two databases (Pranckutė, 2021), relying solely on Scopus or WoS for bibliometric analysis does not provide a broader perspective on the knowledge and trends within a field. Differences exist between the WoS and Scopus databases in terms of scope, volume of data, and coverage policies, each possessing highly unique sources and articles (Sánchez et al., 2017). Therefore, the two complement rather than exclude each other. Thus, this study utilises the Web of Science (WOS) and Scopus databases.

2.1 | Preliminary retrieval

To comprehensively investigate the vast impact of climate change and modern slavery, we initiated our analysis by meticulously selecting relevant keywords. Initially, "climate change" and "slavery" were individually entered into the databases with specific criteria: a time frame from January 2013 to June 2023 when the search was conducted, English language, and document type set to "Article." This search yielded 36 results in Scopus and 58 in Web of Science. Subsequently, the keywords extracted from these articles were subjected to co-occurrence analysis using VOS Viewer. The settings for this analysis were "create a map based on bibliographic data," analysis type "cooccurrence analysis," and analysis module "keyword analysis," revealing the diverse keywords present in the databases.

In the case of Scopus, a similar method was employed, leading to the identification of a total of 196 keywords. Given the smaller dataset, a minimum occurrence frequency of two times was set. After eliminating irrelevant keywords, 15 pertinent keywords remained. The results produced by VOS Viewer delineated four distinct clusters (Figure 1).

In Web of Science, a total of 384 keywords were found. After removing irrelevant keywords, 42 relevant keywords were obtained. Using VOS Viewer for analysis, the results showed a total of seven clusters, as presented in Figure 2.

Finally, by observing the keyword density in the density visualisation maps of the two selected databases as presented in Figures 3 and 4, and noting the high overlap of keywords, we identify relevant climate change-related keywords such as Environment, Fossil Fuel,

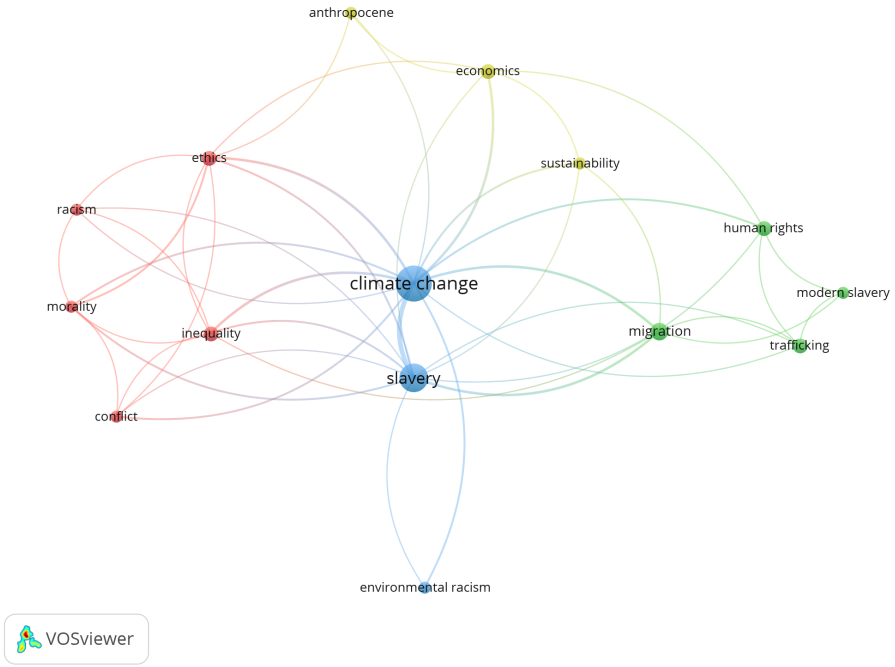

FIGURE 1 Network analysis of co-occurrence of keywords of Scopus documents (Authors' elaboration with VOS viewer).

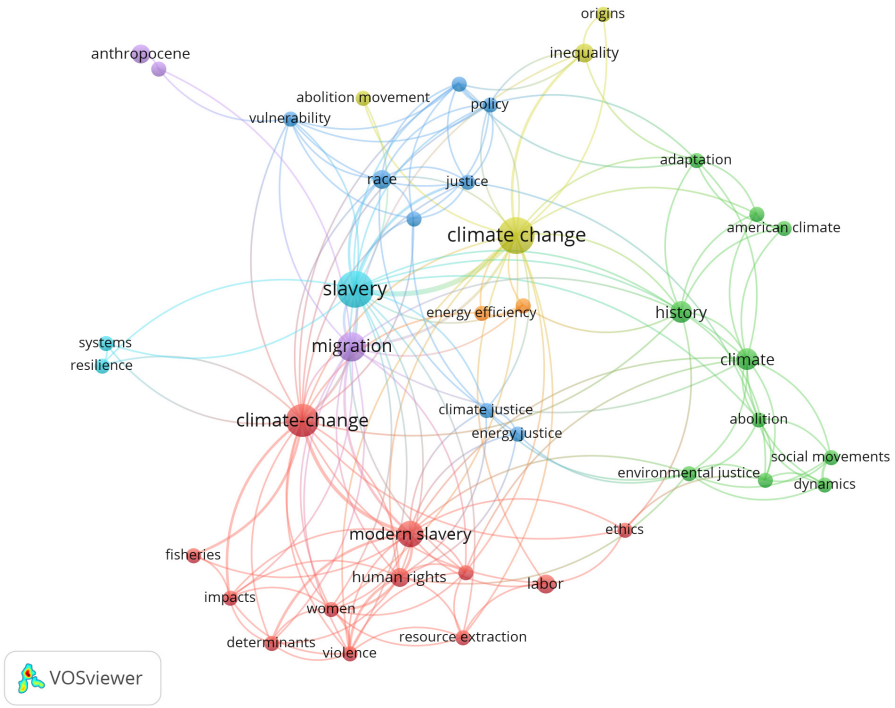

FIGURE 2 Network analysis of co-occurrence of keywords for Web of Science documents (Authors' elaboration with VOS viewer).

Exploit, Atmosphere, Earth, Sustainability, Resource Extraction, and Energy. Additionally, the keywords related to modern slavery include Human, Race, Migrate, Inequality, Justice, Morality, Discrimination, Minority, Ethnic, Violence, Healthy, Human right, Labour, Woman, and social movement.

2.2 | Systematic review process

In the systematic review process, we used three primary keywords: "climate change," "modern slavery," and "supply chain." Alongside these, we incorporated 23 derived keywords selected through VOS Viewer. These keywords formed the basis for four search strings, as detailed in Table 1 applied Boolean operators and the predefined inclusion criteria across all three databases for the search.

2.3 | Selection process

We followed the PRISMA checklist (2020) to select studies based on specific research criteria. The PRISMA process includes identification, screening, and assessment. Identification involved searching

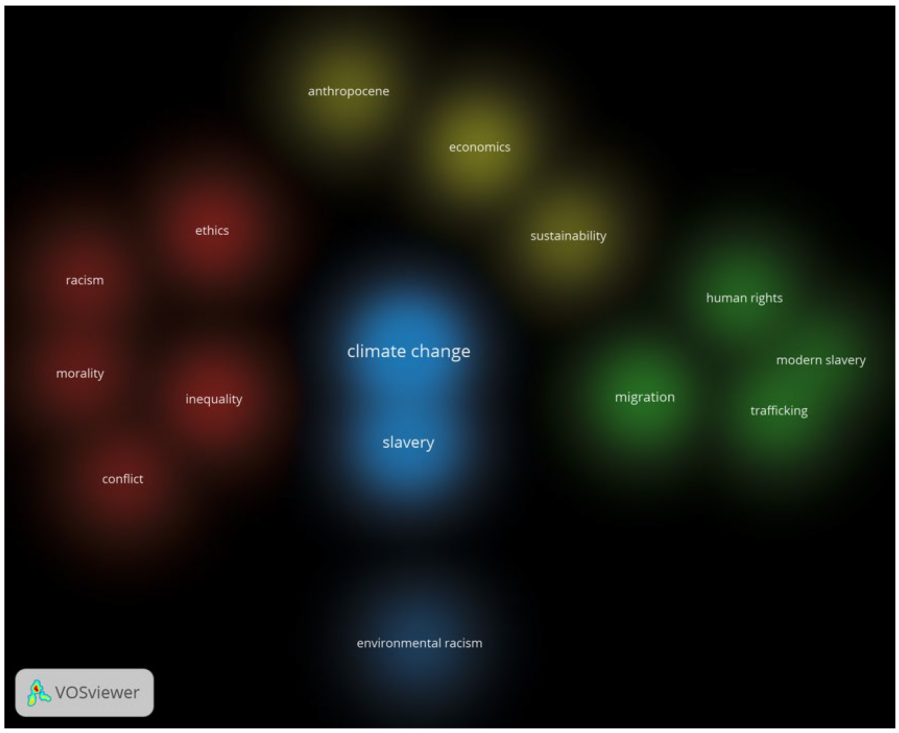

FIGURE 3 The density visualisation map of Scopus documents (Authors' elaboration with VOS viewer).

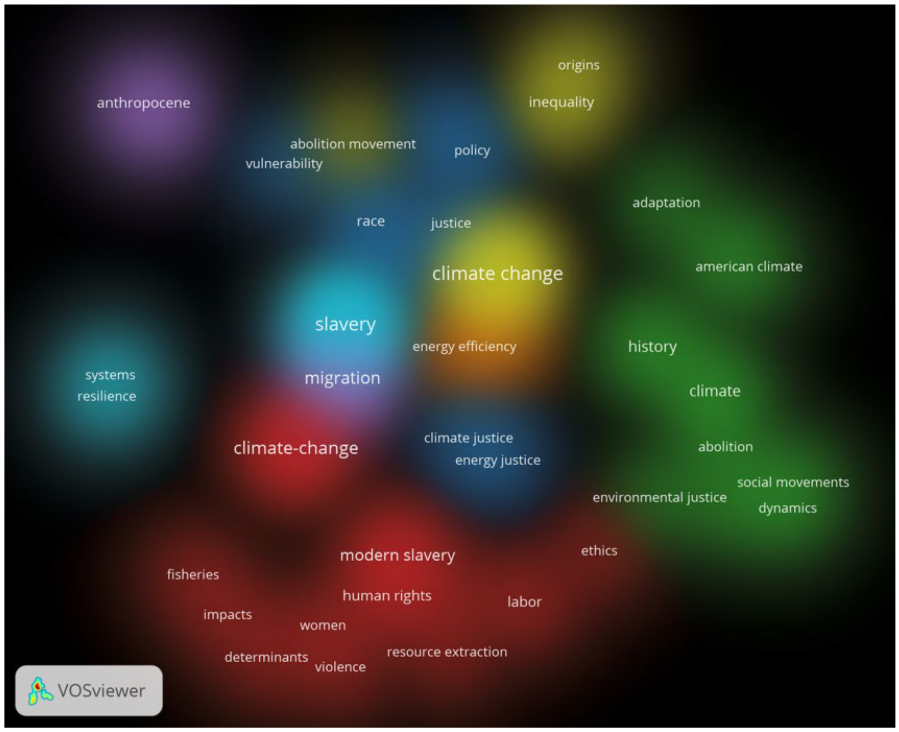

FIGURE 4 The density visualisation map of Web of Science documents (Authors' elaboration with VOS viewer).

for literature across three databases using predefined keywords. Screening comprised of eliminating duplicates and selecting articles based on abstracts and full-text readings using Zotero. Evaluation employed the Critical Appraisal Skills Programme's (CASP) qualitative research checklist to assess bias and validity. Following PRISMA (2020) guidelines, we report 56 selected papers relevant to climate change, modern slavery, and supply chains as presented in Appendix 1.

TABLE 1 Keywords combination and search strings.

Keywords combination	Search strings
Combination 1 "climate change" AND "modern slavery"	"climate change*" AND (environment* OR "fossil fuel" OR exploit* OR atmosphere* OR earth OR sustain* OR "resource extract*" OR energy) AND "modern slavery" AND (slavery OR justice* OR human* OR rac* OR migrat* OR inequal* OR morality OR discriminat* OR minority OR ethnic* OR violen* OR health* OR "human rights" OR labo* Or wom?n OR "social movement*")
Combination 2 "climate change" AND "supply chain"	"climate change*" AND (environment* OR "fossil fuel" OR exploit* OR atmosphere* OR earth OR sustain* OR "resource extract*" OR energy) AND "supply chain*" Upon importing this string, it was observed that the results were too numerous, and most of them had low relevance. Therefore, this study subsequently implemented additional constraints to refine the search (impact* OR influence OR effect)
Combination 3 "modern slavery" AND "supply chain"	"modern slavery" AND (slavery OR justice* OR human* OR rac* OR migrat* OR inequal* OR morality OR discriminat* OR minority OR ethnic* OR violen* ORhealth* OR "human rights" OR labo* Or wom?n OR "social movement*") AND "supply chain*"
Combination 4 "climate change" AND "modern slavery" AND "supply chain"	"climate change*" AND (environment* OR "fossil fuel" OR exploit* OR atmosphere* OR earth OR sustain* OR "resource extract*" OR energy) AND "modern slavery" AND (slavery OR justice* OR human* OR rac* OR migrat* OR inequal* OR morality OR discriminat* OR minority OR ethnic* OR violen* OR health* OR "human rights" OR labo* Or wom?n OR "social movement*") AND "supply chain*"

3 | DESCRIPTIVE ANALYSIS

In our analysis, we used VOS viewer, NVivo, and Tableau software for creating descriptive charts and visualisations. Tableau aids in generating time-series graphs and publication distribution. NVivo conducts word frequency analysis and generates word clouds from full-text articles. VOS viewer enables citation analysis and network visualisation, enhancing our understanding of authors and key article themes.

3.1 | Distribution of reviewed papers over time

Among the 56 identified papers, two of the earliest publications in 2013 reflect the academic interest in the impact of climate change on supply chains. Fahimnia et al. (2013) focused on carbon emissions in closed-loop supply chains, studying a company in Australia, while (Sánchez et al., 2017) assessed the extent of climate change effects on Jamaican farmers and their implications for establishing a sustainable value chain in the local hotel industry. Figure 5 indicates there was a gradual increase in research on climate change and modern slavery in supply chains in 2017, specially from 2021, there has been a rapid growth in the number of papers.

3.2 | Distribution of reviewed papers by journals

Figure 6 depicts the publication distribution of the 56 papers across various journals. These articles on climate change and modern slavery in supply chains have appeared in a diverse range of journals, with one to three papers in each. Predominantly, they have been published in journals related to supply chain, environment, economics, social sciences, and human rights, aligning with the study's theme. Notably, the journal "Supply Chain Management" leads with three papers, followed closely by "Australian Journal of Human Rights," "Energy Research & Social Science," "International Journal of Production Economics," and "Journal of Cleaner Production," each containing two papers.

3.3 | Distribution of reviewed papers by methodology

Among papers, the largest number falls under analytical conceptual research (30 articles), primarily involving literature reviews and secondary data analysis. Next is empirical case study research (10 articles), focusing on regional and company analyses. Following that are empirical statistical research (8 articles), analytical statistical research (6 articles), and one article each for empirical experimental research and analytical mathematical research. In terms of research methods, it is observed that conceptual analytical research is the most prevalent method, while experimental and mathematical research methods are less common. This could be due to the challenges in controlling variables and environments in empirical experimental analyses and the relatively unexplored nature of analytical mathematical research. In the future, mathematical models could be utilised to analyse such topics. The

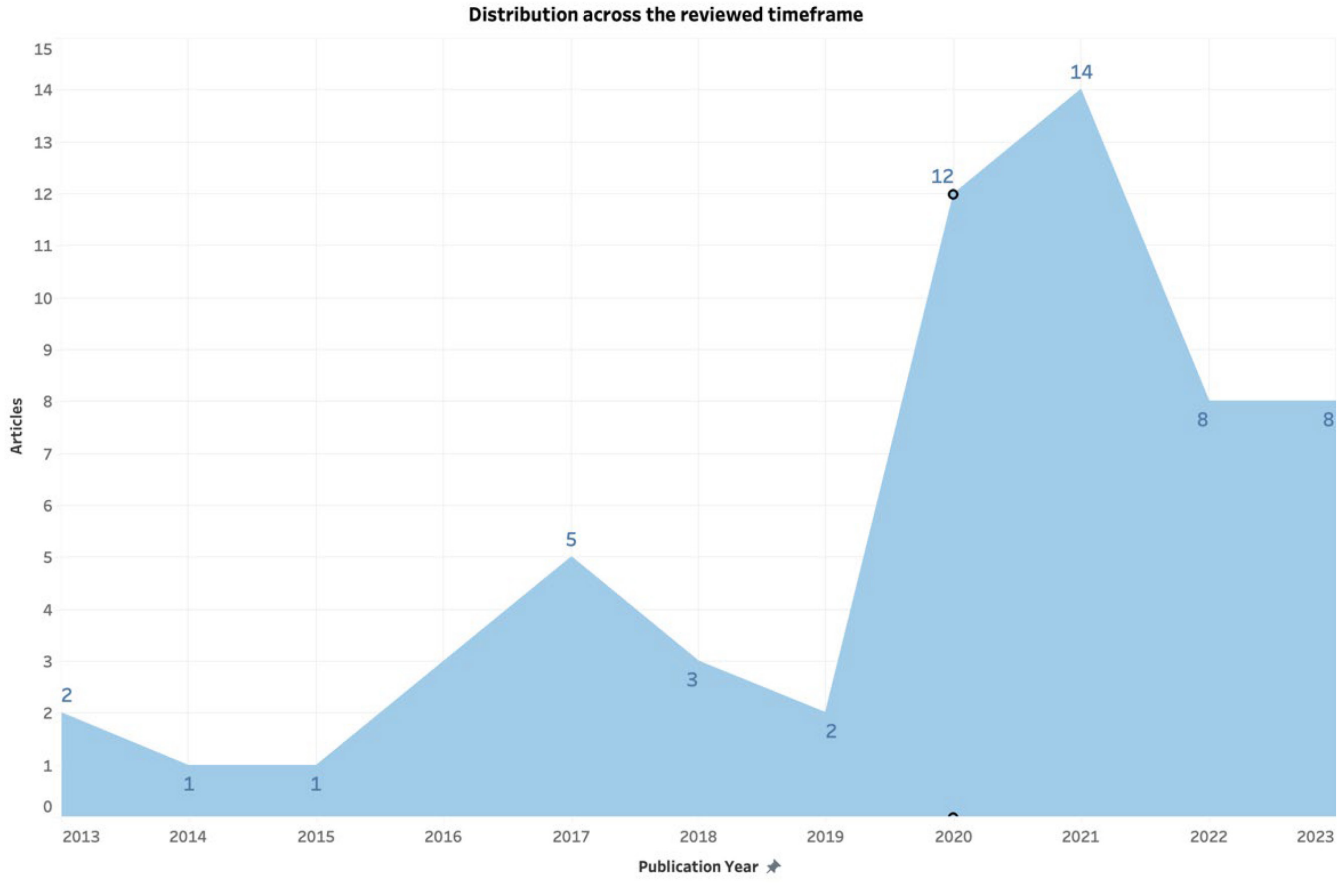

FIGURE 5 Figure Distribution across the reviewed timeframe (Authors' elaboration with Tableau).

FIGURE 6 Reviewed paper distribution across journals (Authors' elaboration with Tableau).

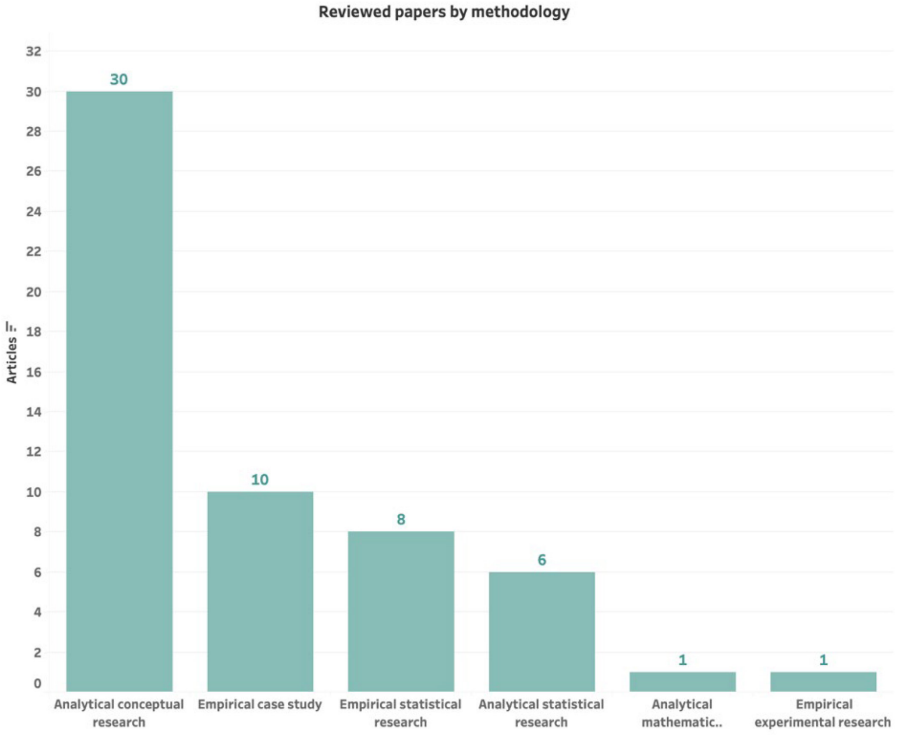

FIGURE 7 Reviewed papers by methodology (Authors' elaboration with Tableau).

distribution of reviewed papers by methodology is presented in Figure 7.

3.4 | Word frequency analysis

Figure 8 shows the word frequency analysis of the 56 articles studied in this research. We used NVivo software for this analysis, selecting all the articles and setting the minimum character length to 5 to display the top 100 most frequently appearing words. The high-frequency words are "slavery," "supply," and "climate." The diverse types of word frequencies also represent that climate change and modern slavery in the supply chain will ultimately affect individuals and organisations.

3.5 | Network of reviewed papers by topic area

Co-occurrence refers to the presence or proximity of similar keywords, enabling us to explore concepts and topics (Waltman et al., 2010). Figure 9 illustrates keyword co-occurrence among the selected 56 papers in this study. Each circle in the figure represents a keyword, with larger circles indicating a higher keyword frequency. To generate this analysis, we employed VOS viewer, which extracted a total of 678 keywords. We refined the analysis by setting a minimum frequency threshold of 4, resulting in 41 keywords that met this criterion.

The network analysis produced four distinct clusters:

1. The red group, comprising 15 keywords, highlights modern slavery in supply chains and the social issues affecting supply chain sustainability.

FIGURE 8 Word frequency of the 100 most cited words (five or more characters) in analysed articles (Authors' elaboration with NVivo).

2. The green group, with 12 keywords, focuses on the environmental aspects, reasons, industries, and regions related to slavery.
3. The blue group, containing 10 keywords, primarily associates with climate change and emphasises its origins and impacts.
4. The yellow group, consisting of only 4 keywords ("government," "impact," "global supply chain," and "forced labour"), underscores

the macro-level aspects of forced labour and the interaction between government and supply chains.

In Figure 9, it is evident that a relative paucity of literature addressing the intersection of climate change and modern slavery, while the nexus between modern slavery and the supply chain is more extensively researched. Future scholarly inquiries may benefit from a deeper exploration of the interplay between climate change and modern slavery within the context of supply chain dynamics.

Figure 10 presents an overlay visualisation map of keywords, illustrating changes in keyword hotspots over time. The year of each article containing a keyword is displayed in the lower right corner of the map. Keywords appearing in vibrant colours are closer to the present, signifying them as current hotspots.

Noteworthy hotspot keywords in this research literature include "modern slavery," "vulnerability," "climate-change," "business," "slavery," "social sustainability," and "COVID-19." The depicted graph reveals a shift in scholarly focus from traditional slavery research towards investigations into modern slavery. Furthermore, there is an observable transition in research emphasis from isolated environmental and business issues to the intertwined complexities of supply chain dynamics. However, because the time span extends from 2019 to the present, dark-coloured keywords continue to hold research significance.

Figure 11 provides a clearer perspective on the keywords within each group. In the first group, "performance," "supplier," and "social responsibility" are less frequently cited terms. In the second group, "Least Developed Countries (ldcs)," "vulnerability," and "human trafficking" are the most intriguing keywords for me, as they are more distantly related but still remarkable in the context of modern slavery. In the third group, "developing countries" is still present, indicating the significant impact of modern slavery and climate change on these countries within the supply chain. Lastly, "logistics" and "deforestation" have a significant influence on climate change within the supply chain.

Table 2 presents the co-occurrence of keywords, links, and their link strength within the selected literature.

3.6 | Thematic analysis

This study employed grounded theory to code the chosen 56 articles, a well-established qualitative research method. According to Glaser and Holton (2004), grounded theory is defined as "a systematically generated set of integrated concepts and hypotheses that provide an inductive theory about a substantive area." It seeks to derive theories from systematically gathered data and utilises comparative analysis to do so. Grounded Theory involves a three-step coding process: open coding (initial coding), axial coding (intermediate coding), and selective coding (advanced coding). Coding entails closely examining phenomena, naming, and categorising them. In literature research, this translates to analysing articles for relevance, breaking them down into sub-concepts, and labelling them accordingly (Birks et al., 2009; Birks & Mills 2015; Chun Tie et al., 2019). We used NVivo software for coding the 56 selected articles.

3.6.1 | Environment factors

In the supply chain's upstream, there is growing evidence of a bidirectional link between modern slavery, environmental degradation, and climate change (Decker Sparks et al., 2021). This

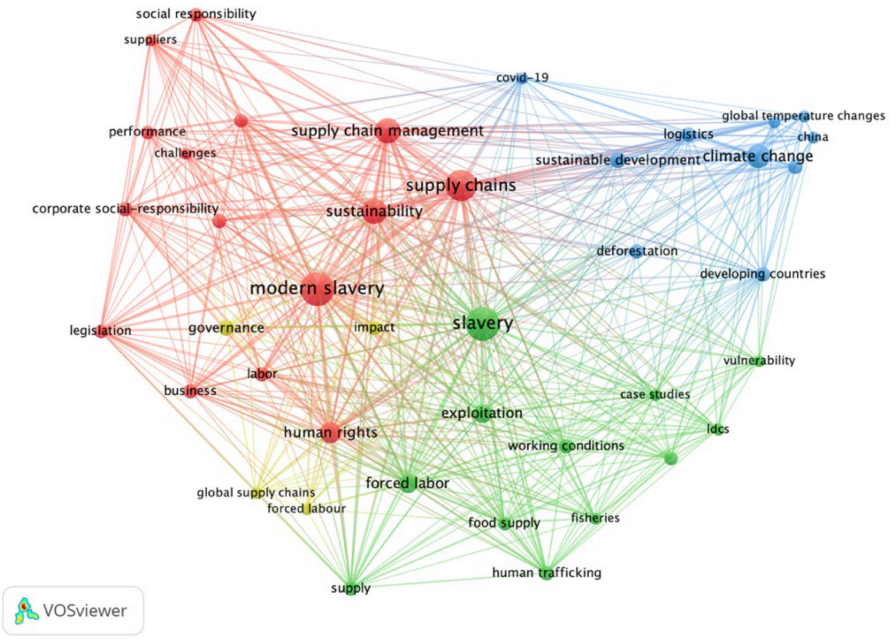

FIGURE 9 Co-occurrence keywords analysis of selection studies (Authors' elaboration with VOS viewer).

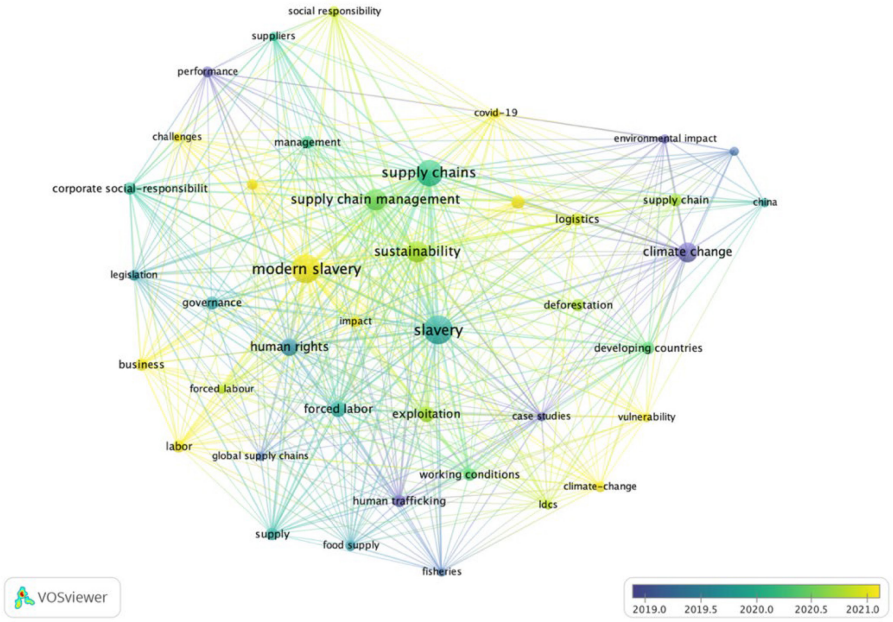

FIGURE 10 Co-occurrence time-based keywords analysis of selection studies (Authors' elaboration with VOS viewer).

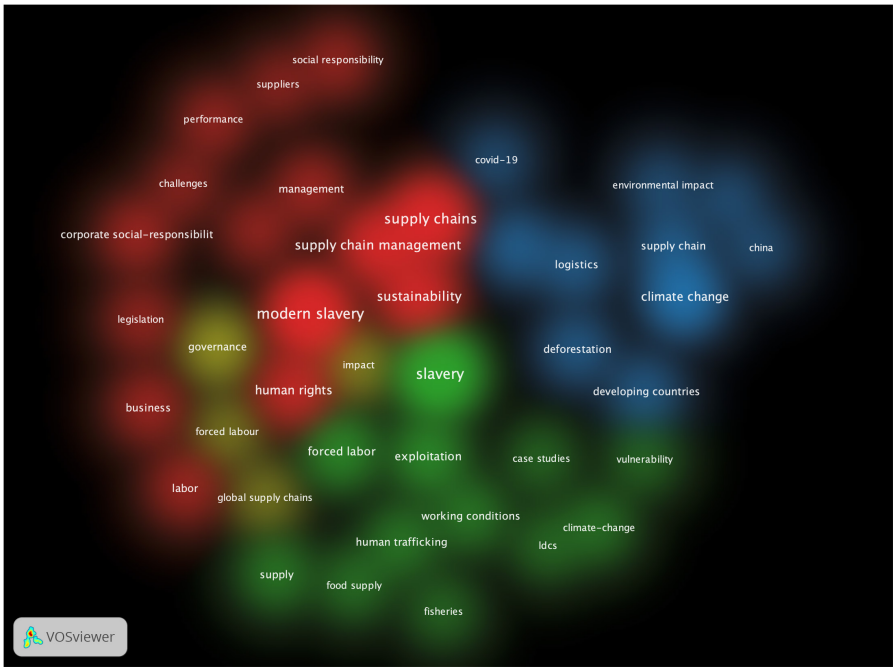

FIGURE 11 Co-occurrence density-based visualisation keywords analysis of selection studies (Authors' elaboration with VOS viewer).

degradation involves deforestation, soil erosion, and disruptions to protected areas (Jackson et al., 2020). Inexpensive slave labour not only drives deforestation but also supports highly polluting activities like shrimp farming, brick-making, and gold mining (Gerrard, 2017).

Deforestation

Forests are vital for some of the world's most vulnerable populations, and deforestation, which contributes to climate change, threatens their survival. Many communities worldwide depend on forests and their resources for daily life and livelihoods (Bethany et al, 2020). According to estimates by Decker Sparks et al. (2021) and Brown et al. (2021), nearly half of global deforestation is conducted by workers trapped in modern slavery.

Due to ongoing global warming, trees are invaluable resources for mitigating climate change. Reforestation is a critical measure, especially in tropical regions. However, modern slavery and deforestation undermine these efforts, worsening global climate change (Jackson & Decker Sparks, 2020). While environmentally conscious consumers invest in eco-friendly products at the end of the supply chain, these efforts are counteracted upstream (Biello & Moskowitz, 2016), resulting in overall supply chain unsustainability.

TABLE 2 Results of co-occurrence of keywords.

Keywords	Links	Total link strength	Occurrences	Cluster
Modern Slavery	38	161	24	1 Red (15 items)
Supply Chains	39	156	21	
Supply Chain Management	39	120	15	
Sustainability	40	117	15	
Human Rights	34	80	11	
Business	24	43	6	
Corporate Social-Responsibility	23	49	6	
Labour	23	48	6	
Management	22	36	6	
Legislation	25	52	5	
Performance	19	32	5	
Social Responsibility	19	37	5	
Social Sustainability	24	44	5	
Challenges	22	35	4	
Suppliers	19	36	4	
Slavery	39	157	24	2 Green (12 items)
Exploitation	30	65	9	
Forced Labour	34	78	9	
Human Trafficking	25	48	6	
Supply	24	54	6	
Working Conditions	28	51	6	
Climate-Change	21	31	5	
Food Supply	26	44	5	
Case Studies	28	47	4	
Fisheries	22	37	4	
Ldcs	23	37	4	
Vulnerability	21	24	4	
Climate Change	26	51	13	3 Blue (10 items)
Sustainable Development	22	36	7	
Deforestation	14	17	6	
Developing Countries	28	51	6	
Logistics	27	53	6	
Supply Chain	21	32	6	
China	13	24	4	
Covid-19	29	40	4	
Environmental Impact	17	27	4	
Global Temperature Changes	16	26	4	
Governance	18	29	7	4 Yellow (4 items)
Impact	21	31	5	
Forced Labour	17	25	4	
Global Supply Chains	18	25	4	

Soil erosion

Soil degradation can contribute to modern slavery. Livestock farming and cultivation are crucial for food supply and security (Godde et al., 2021). However, frequent and intense weather events make water, arable land, and pastures more vulnerable to soil contaminants. This susceptibility is worsened by excessive agricultural cultivation and overgrazing. It amplifies the risks posed by climate change, leading to disruptions in agriculture, more severe wildfires, habitat loss, shifts in agricultural zones, and changes in the suitability of crops and livestock (Bales & Sovacool, 2021; Godde et al., 2021). Rising

temperatures and extreme droughts may reduce the fertilising effects of carbon dioxide and nitrogen on crops, diminishing crop quality in the future (Godde et al., 2021). Food supply interruptions and insecurity can lead to increased migration and refugee flows, making people more vulnerable to enslavement (Bales & Sovacool, 2021).

Modern slavery-induced soil degradation also affects the agricultural climate. Balancing fallow land, pastures, and cultivated fields is challenging (Godde et al., 2021). Enslaved workers, often lacking specialised knowledge, work for illegal enterprises and use low-cost chemicals, industrial fertilisers, or immature cultivation methods for land clearance and planting. Combined with climate change and poor farming practices, this can result in forest desertification and unsustainable soil practices, which are significant drivers of climate change.

The disruption of protected areas

The destruction of natural conservation areas not only accelerates the harm caused by climate change but also fosters conditions conducive to modern slavery. Take, for instance, the Sundarbans mangrove forest in Bangladesh, renowned for its rich and unique flora and fauna. Despite stringent logging restrictions in place, the interests of local illegal fish processing camps persistently drive illegal logging activities. These illicit practices intertwine with forced labour and the deforestation of mangrove trees, leaving the nearby communities vulnerable to recurrent storm surges and cyclones (Bales & Sovacool, 2021). This degradation not only disrupts the plant environment but also upends the living conditions of animals, prompting migration to neighbouring ecosystems and heightening competition among species. For certain insects, amphibians, and plants, this constitutes a looming extinction threat (Bales & Sovacool, 2021).

Biodiversity loss can also contribute to modern slavery, particularly in the fishing supply chain. Climate change adds pressure on fish resources, diminishing marine biodiversity and leading to the rapid expansion of aquaculture (Brown et al., 2021). This expansion exerts ecological stress, necessitating fishing vessels to widen their operations geographically and temporally. To meet fishing quotas, workers are compelled to intensify their labour, thereby narrowing profit margins. Consequently, the demand for cheap labour surges, heightening the risk of labour exploitation. This scenario increases the likelihood of fishermen engaging in illegal activities (OkaforYarwood, 2020, cited in Mackay et al., 2020). Additionally, the reduction in fish diversity exacerbates illegal, unregulated, or unreported fishing practices, often involving enslaved labour, as indicated by the perspective of Bales and Sovacool (2021).

Extreme weather

In agriculture, extreme weather weakens crop defences, fostering pest and weed outbreaks, disrupting food supplies, and indirectly contributing to modern slavery. For instance, climate-induced sea-level rise and flooding impede the production of animal feed like palm kernel cake in the food and feed supply chain (Godde et al., 2021). On a societal level, extreme weather can drive human trafficking as the demand for cheap labour surges in the aftermath of weather disasters (Sheu et al., 2021). United Nations Environment Programme (2011) data indicate that human trafficking during disasters may increase by 20% to 30%, with displaced individuals becoming prime targets. Helmer and Hilhorst (2006) project more frequent and severe climate disasters, which will likely escalate human trafficking and slavery. Sea-level rise can trigger localised flooding, posing significant threats to coastal communities vulnerable to storm surges from hurricanes, cyclones, or tsunamis (Bales & Sovacool, 2021).

According to Eitzinger et al. (2013), small islands like Jamaica will be among the first to face the severe impacts of climate change and global warming. Rising sea levels could lead to the loss of local farmland due to erosion, time-dependent flooding, and soil salinisation, forcing impoverished people into displacement and susceptibility to enslavement.

Resource

Climate change-induced resource scarcity contributes to the emergence of modern slavery. Environmental degradation caused by climate change leads to unsustainable resource exploitation, resulting in shortages. This intensifies pressure on supply chains, making illicit resource extraction more widespread (Decker Sparks et al., 2021). In times of resource scarcity, industries often rely on primitive and inefficient production methods that require modern slavery, resisting the adoption of more efficient technologies due to complexity and cost (Decker Sparks et al., 2021).

The scarcity of clean water indirectly drives modern slavery, rendering individuals, especially women and children, more vulnerable as they travel longer distances in search of water sources, increasing the risk of trafficking and exploitative activities such as sex work (Cameron et al., 2021; Decker Sparks et al., 2021). Water pollution is intertwined with worker health, as a lack of potable water indicates unstable living conditions, potentially leading to enslavement (Decker Sparks et al., 2021). On the other side, in supply chains heavily impacted by slavery, like brick production, wastewater and heavy metal pollutants can contaminate water sources, reach forests and fields, and contribute to environmental destruction. These pollutants can also evaporate and lead to acid rain, posing climate hazards. Ultimately, they may infiltrate groundwater, endangering the health of impoverished populations reliant on it for drinking (Parvez et al., 2023).

3.6.2 | Social factor

Migration

Modern slavery tends to increase after natural disasters or conflicts, with disruptions in agriculture, coastal erosion, and flooding from rising sea levels rendering a substantial population, particularly women and children, susceptible to severe hardships, including violence, harassment, sexual abuse, exploitation, and forced labour

(Gerrard, 2017; Jackson & Decker Sparks, 2020; Sheu et al., 2021). In Thailand's cat food supply chain, both adult and underage males, mostly foreign immigrants, are trafficked and enslaved on coastal fishing vessels, enduring horrendous conditions with no means of escape (Fischman, 2017).

Climate change, combined with modern slavery-induced food insecurity, also drives population displacement. Food scarcity forces families into perilous migration and recruitment into exploitative labour, becoming channels for enslavement. Food insecurity, coupled with shifting vegetation zones, triggers large-scale migration, turning settled populations into refugees or enslaved labourers within supply chains (Bales & Sovacool, 2021). This perpetuates a cyclical modern slavery system. Addressing any link within this cycle is crucial, as climate warming is expected to cause further displacement (Gemenne, 2010).

Violent conflict and war

Resource scarcity fuels resource grabbing by companies, particularly in regions like the Amazon, Southeast Asia, and Central Africa, where criminal organisations engage in illegal activities, accounting for 50%–90% of the forestry sector (Verité, 2017, cited in Jackson & Decker Sparks, 2020, p. 3). This directly affects indigenous populations, exacerbating conflicts and enslavement risks. Indigenous communities and forest defenders may face violence and murder when resisting environmental destruction. According to Butt et al.'s (2019) data, over 1500 individuals were murdered for defending ecosystems or land rights between 2002 and 2017. In supply chains, slaveholders compel workers to labour, confiscate documents, restrict movement, and withhold wages (Fischman, 2017). Such abuse can incite anger among labourers, leading to unrestrained environmental degradation and worsening climate change impacts.

Climate change-induced diseases, droughts, and famines can also trigger conflicts within and between nations (Sheu et al., 2021). For instance, the Russia-Ukraine conflict disrupted the supply chain, affecting global wheat production due to transportation disruptions. This led to increased freight costs, reduced food production, and supply chain repercussions, particularly in areas already strained and reliant on imports in Africa and other regions (Allam et al., 2022). War further exacerbates climate and environmental problems, causing land degradation, resource destruction, pollution, fires, and the abandonment of agricultural lands. Social upheaval and infrastructure destruction during conflicts necessitate reconstruction, setting off a chain reaction of climate change effects (Allam et al., 2022).

Tradition and culture

Traditional, unequal societies significantly shape climate change and slavery within supply chains (Han et al., 2022). Deeply-rooted discrimination and social hierarchies increase the vulnerability of marginalised populations to modern slavery (Bodendorf et al., 2023). Cultural norms and beliefs in some societies legitimise modern slavery, especially when discrimination and exploitation are accepted (Han et al., 2022).

According to Farley (2022), sexual exploitation of women and resource extraction in the supply chain are deeply interconnected. In such societies, where males hold dominant roles, women have limited control over their circumstances (Lambrou & Piana, 2006, cited in Sheu et al., 2021, p. 325). Climate change exacerbates the situation, increasing susceptibility to impacts like sex trafficking and enslavement (Leth, 2005, cited in Sheu et al., 2021, p. 325).

However, some traditions and cultures take positive action against climate change. In cultures like New Zealand's indigenous Māori people, a profound connection to nature fosters respect for the environment and sustainable resource use (United Nations Environment Programme, 2017). Their defence against destructive exploitation contributes to local climate protection.

3.6.3 | Economic factor

Liabilities

Microfinance institutions, according to Mader (2015), establish a significant relationship between finance and impoverished individuals through microloans. They employ a debt-driven accumulation strategy that induces fear of property confiscation or self-blame for default, ultimately leading people into slavery.

In the Thai fishing supply chain, bonded labour primarily manifests through debt bondage, sustained by capital's fraudulent practices and exorbitant interest rates (ILO, 2018). Workers accumulate initial debt, and fees and interest are deducted from their earnings, making it impossible to leave their jobs until the debt is settled (Natarajan et al., 2021). Similarly, in Cambodian brick kilns, debt bondage prevails, subjecting workers to harsh conditions and making it nearly impossible to escape due to accumulating interest (Brown et al., 2021).

The situation for those seeking employment also verges on enslavement. Climate-induced or environmentally driven migration from rural to urban areas leads to urban challenges. High living costs and fierce competition in urban centres make it difficult for migrants to repay debts, potentially trapping them in persistent indebtedness (Jackson & Decker Sparks, 2020). This exacerbates workers' vulnerability.

Other factors

In addition to the primary factors mentioned earlier, employment and education indirectly influence both climate change and modern slavery. Structural unemployment, driving poverty, plays a major role in modern slavery (Crane, 2013). When joblessness and local insecurity prevail, the deceptive promises of human traffickers may appear as a lifeline for those in economic distress. People from these regions are often coerced or misled into becoming slaves in other areas (Han et al., 2022), and climate change-induced environmental upheaval exacerbates this

situation. Climate change fuels these dynamics by creating volatile conditions, exemplified by the presence of "sweatshops" in the manufacturing supply chains of developing countries. While these sweatshops provide employment and economic opportunities for those facing difficulties, workers remain unaware of the underlying causes of their unemployment. This perpetuates exploitation as an apparently logical route to development for the global impoverished population (Stringer et al., 2022).

A lack of awareness among workers about exploitation or enslavement is primarily tied to their level of education. Individuals with lower levels of education or those hailing from economically disadvantaged nations are more vulnerable to exploitation by traffickers. Limited education translates to worker unawareness regarding the perils of slavery (Andrees, 2023, cited in Han et al., 2022). Furthermore, education levels impact the knowledge base of workers. Those involved in natural activities within the supply chain may lack knowledge, leading to the use of environmentally harmful methods and, inadvertently, contributing to environmental and climate degradation. Therefore, education plays a pivotal role in mitigating climate change and modern slavery within the supply chain.

COVID-19, along with its impact on public health, influences modern slavery and climate change (Trautrims et al., 2020). Warming the Earth prompts land and marine creatures to migrate poleward, fostering encounters between species that seldom meet. This interaction can facilitate the transmission of pathogens to new hosts. Environmental degradation, notably deforestation and habitat loss, increases the likelihood of wildlife-human encounters, fostering the trafficking of endangered species and the introduction of unfamiliar viruses to human populations (Harvard, 2020).

3.7 | In-depth analysis of the interactions among stakeholders and how they impact the relationship between climate change and modern slavery

3.7.1 | Interactions at the government level

From a governmental perspective, unstable governments, inadequate regulations, legal inequalities, and weakened inspection standards worsen climate change and modern slavery issues in supply chains (Crane et al., 2019; Mackay et al., 2020; Sheu et al., 2021). Unstable governments lack the necessary resources and disaster management capabilities. When governments can't address supply chain disruption risks from climate change at a macro level, the supply chain becomes fragile. Climate-induced disasters also provoke conflicts (Sheu et al., 2021), and unstable governments can't resolve these issues, leading to more slavery, especially in supply chains where one disruption can affect the entire chain.

As an example, in fisheries supply chains, regulatory failures, corruption, and weak law enforcement foster illegal fishing and modern slavery (Mackay et al., 2020). If legal inequalities and inspection standards regress, issues in developing countries will worsen (Hays, 2020). Governments, as policymakers, should craft context-aligned laws and regulations to address these challenges.

3.7.2 | Interactions at the social (NGO) level

Social organisations, including labour unions and non-governmental organisations (NGOs), are pivotal in addressing climate change and modern slavery. Biassed labour unions and NGOs, however, can worsen exploitation. Labour laws mandate unions to support workers (Uddin et al., 2023). Prejudice often leads to exclusion based on race, religion, or politics, neglecting vulnerable minority groups (Bales & Sovacool, 2021). This exclusion amplifies their vulnerability and contributes to exploitation.

Prejudiced NGOs also abuse their influence. Biassed labour unions and NGOs manipulate documents and favour government officials and factory owners for their economic gain (Uddin et al., 2023). This not only harms workers but also exacerbates climate change. In manufacturing supply chains, informal factories release wastewater and harmful gases that contribute to climate change. Workers in these factories face exploitation and oppression, supported by government and union backing. Resistance by workers is often met with suppression, especially during a pandemic. Some labour unions and NGOs publicly proclaim their legitimacy but privately support governments and factory owners, distancing themselves from affected industries (Uddin et al., 2023).

3.7.3 | Interactions at the supplier level

Suppliers in the supply chain exert influence on climate change and modern slavery. The intricate supply chain complexity challenges supplier management, rendering them a significant factor driving both climate change and modern slavery. The materials or semi-finished products from these vendors form the largest share of goods, which is critical in the supply chain's upstream. Vertical integration of suppliers can worsen the impact, particularly in agriculture, where illegal suppliers traffic and exploit victims on their cultivation sites (Crane et al., 2019).

In outsourced supplier networks within the supply chain, climate and slavery issues are also prevalent. Forced labour in the global value chain often occurs within lower suppliers, especially in cases of informal or illegal subcontracting. This awful environment makes managing suppliers more difficult, and due to economic interests, companies may tolerate these unsustainable conditions, ultimately leading to more severe exploitation and degradation.

In outsourced supplier networks, climate and slavery issues persist (Crane et al., 2019; Han et al., 2022). Forced labour frequently arises among lower-tier suppliers, particularly in informal or illicit subcontracting arrangements (Crane et al., 2019). Such challenging conditions complicate supplier management, and driven by economic motives, companies may turn a blind eye to these

unsustainable practices, ultimately fostering increased exploitation and degradation.

3.7.4 | Interactions at the company level

Enterprises are pivotal within the supply chain, with ethical principles such as corporate social responsibility (CSR) and corporate environmental responsibility (CER) being vital for each firm. Nevertheless, a series of scandals exposed that many companies have not upheld these principles, indicating a deficit in responsible corporate environmental behaviour (CEP) and conscientious corporate social practices (CSP). Some firms engage in excessive mining and pesticide application, causing environmental harm and fuelling climate change. Others exploit child labour, migrants, and marginalised communities, ultimately perpetuating modern slavery (Fracarolli Nunes et al., 2021).

Examples like the 2010 BP Gulf of Mexico oil spill (Pallardy, 2023), the 2012 Foxconn worker conditions exposure, and the 2013 Rana Plaza disaster in Bangladesh reveal how companies' relentless pursuit of profits, cost-cutting, and competition can yield serious consequences (Fracarolli Nunes et al., 2021; Uddin et al., 2023). While companies have their own codes of ethics and conduct, process opacity leads to discrepancies between reported and actual conditions, hindering audits and wasting resources (Bubicz et al., 2021).

Many individuals, including women, children, and bonded labourers in Thailand and Bangladesh's fishing industry, migrate due to climate change and economic pressures. False promises of paid work often ensnare them into slavery (Brown et al., 2021). Profit-driven companies hire workers indiscriminately, perpetuating exploitation.

3.7.5 | Interactions at the worker level

Under climate change, the workforce is prone to modern slavery, contributing to environmental harm and climate impacts (Cameron et al., 2021). Worker conditions are closely related to their rights and status; those lower in the supply chain often lack a voice (Berg et al., 2020; Gerrard, 2017). Although unintentional, these workers endure physical and psychological abuse, harsh working conditions, minimal sustenance, and little sleep (Fischman, 2017). Research by Crane et al. (2019) in the United Kingdom highlights that many forced labourers are immigrants, including those legally documented, often mistaken for illegal workers by employers, restricting their rights and subjecting them to modern slavery.

Supply chain workers, the most vulnerable, face compromised safety (Cameron et al., 2021). The climate-slavery relationship has a temporal dimension. During climate-related disasters, all slavery activities cease as businesses relocate to avoid calamity, leaving vulnerable workers behind (Bales & Sovacool, 2021). Those who remain or escape become extremely vulnerable, especially child labourers and women trapped in slavery. Climate-induced trauma heightens susceptibility to diseases, malnutrition, developmental delays, psychological issues, and sleep disorders (Cameron et al., 2021). Physically weakened, they perpetuate the cycle of vulnerability and slavery.

3.7.6 | Interactions at the consumer level

Consumers, downstream from the impactful supply chain issues of climate change and modern slavery, often remain unaware and indifferent. Stringer et al. (2022) categorise the challenges consumers face into three categories: spatial, social, and psychological distance.

Spatial distance refers to the vast geographical gap between consumers and midstream supply chain activities (Stringer et al., 2022). Consumers often lack transparent insight into climate change and slavery upstream. For example, in the United States, consumers unknowingly purchase cat food with fish caught by enslaved labour, oblivious to the forced labour behind such products (Fischman, 2017).

Social distance highlights the disconnect between those impacted by supply chain activities and consumers (Stringer et al., 2022). Consumers are not directly involved in actions causing climate change and slavery and may disregard these issues, perceiving worker welfare concerns as culturally and experientially distant.

4 | DISCUSSION

This literature review study sought to answer two research questions, which are discussed in the sections below.

4.1 | What are the key factors in the supply chain that influence climate change and modern slavery, and how do they exert their influence?"

Through the SLR, 11 factors bi-directionally impacting both climate change and modern slavery. These factors include social (migration, violent conflict, and war as well as tradition and culture), environmental (deforestation, soil erosion, disruption of protected area, extreme weather, and resource), and economic (liabilities, employment, education, and pandemic).

Environmental factors in *deforestation*, the loss of forests directly heightens people's vulnerability, increasing the risk of exploitative practices linked to modern slavery (Decker Sparks et al., 2021; Jackson & Decker Sparks, 2020).

Additionally, *Soil erosion* impacts food security, reduces crop quality, and leads to supply chain disruptions, thereby increasing the vulnerability of refugees and migrants to enslavement (Bales & Sovacool, 2021; Godde et al., 2021). Conversely, enslaved workers, often lacking proper knowledge, contribute to soil degradation through improper farming practices and pesticide misuse (Godde et al., 2021).

The disruption of protected areas can also accelerate modern slavery. The destruction of these areas is accompanied by a loss of local biodiversity, the pressure on company performance and the decline in wild stocks can force workers into more intense labour or lead to the illegal employment of cheap labour, resulting in modern slavery (OkaforYarwood, 2020, cited in Mackay et al., 2020). Furthermore, government bans on protected areas cause resource scarcity, which may entice companies to hire illegal workers for illicit activities in these regions. These practices will continue to degrade the local climate and lead to extreme weather events (Bales & Sovacool, 2021).

Extreme weather exacerbated by climate change, heighten the risk of modern slavery (Bales & Sovacool, 2021). On the other side, slavery-induced environmental degradation, notably in industries heavily reliant on enslaved labour like brick kilns, mining, quarrying, fishing, and agriculture, contributes to carbon dioxide emissions, leading to rising sea levels and global temperature increases (Decker Sparks et al., 2021).

Companies seeking a competitive edge in *resource* acquisition may turn to modern slavery. Fossil fuels like oil and coal, extracted through illegal and modern enslavement methods, are consumed by the transportation, manufacturing, and construction sectors. The increased energy consumption and resulting greenhouse gas emissions from these industries contribute to global warming, altered weather patterns, and increased flooding, especially within the supply chain (Parvez et al., 2023). Water resources are also significantly impacted by modern slavery and climate change. Access to clean water is vital for human adaptation to environmental stress and climate change (Cameron et al., 2021). Conversely, modern slavery practices can result in severe water pollution (Parvez et al., 2023).

4.1.1 | Social factors

Climate change-driven population *migration* can lead to modern slavery, as displaced people become more vulnerable to trafficking. Climate change and environmental degradation have dire consequences, leading to domestic abuse, armed *conflicts*, and violence due to resource extraction (Gerrard, 2017). Altered rainfall patterns and rising temperatures escalate the risk of human conflicts (Sheu et al., 2021). Furthermore, patriarchal societies also heighten the vulnerability of marginalised populations to climate change-induced enslavement (Sheu et al., 2021).

4.1.2 | Economic factors

Worker debt is intricately linked to climate change and modern slavery. In agricultural supply chains, microcredit supports production but becomes unsustainable due to climate change, which increases the risks associated with crop production (Natarajan et al., 2019). As a result, farmers are forced to keep borrowing to mitigate climate impacts, creating significant risks. To repay these debts, many families resort to wage labour when agricultural returns are insufficient (Natarajan et al., 2021).

4.2 | How do supply chain stakeholders' interactions impact the relationship between climate change and modern slavery?"

We found how the stakeholder interactions at the government, NGO, Supplier, focal firm, worker, and consumer levels impact this relationship.

At the government level, effective government oversight, fair legislation, and enhanced inspection standards can notably alleviate the impact of climate change and modern slavery on supply chains. According to Bodendorf et al. (2023), economic, social, environmental, and political-legal factors significantly influence modern slavery within supply chains. Enforcement disparities across governments (Han et al., 2022) contribute to climate and slavery issues in supply chains.

At the NGO level, labour unions and NGOs exhibiting bias can result in the marginalisation and neglect of minority groups, thereby intensifying exploitation and slavery within supply chain (Bales & Sovacool, 2021; Uddin et al., 2023). Additionally, certain unions may abuse their influence by colluding with governments and corporations, prioritising economic benefits over environmental protection and human rights (Uddin et al., 2023).

At the supplier level, asymmetrical power dynamics among suppliers and buyers impact climate change and modern slavery (Ishaya et al., 2023; Szablewska & Kubacki, 2023). Supply and demand imbalances, fierce price competition, and supply chain corruption contribute to this power disparity. Achieving a sustainable supply chain development path necessitates a balanced power dynamic between suppliers and buyers.

At the company level, overreliance on specific regions can worsen climate issues and modern slavery (Decker Sparks et al., 2021; Uddin et al., 2023). Bangladesh's garment sector, for instance, appeals to Western retailers due to cheap labour and tax regulations, despite ethical concerns (Uddin et al., 2023). This approach, profitable amid climate change, shifts the burden onto workers to maintain profitability (Stringer et al., 2022). Furthermore, climate change-induced fraudulent practices and exploitative hiring can foster modern slavery within the supply chain (Brown et al., 2021; Ishaya et al., 2023).

At the worker level, immigrants and migrants face heightened risk in the supply chain slavery, driven by climate-induced migration, resulting in low wages, inadequate healthcare, and limited labour rights (Berg et al., 2020; Kunz et al., 2023). In many nations, workers' organisations are suppressed, legal protections are scarce, and recourse is limited. Weak labour unions and law enforcement render workers powerless (Bales & Sovacool, 2021; Uddin et al., 2023).

At the consumer level, psychological distance concerns the perceived gap between ethical consumption decisions and climate

change consequences. Western consumers' preference for inexpensive fashion often discourages investment in non-exploitative products. Additionally, personal impulses often override purchasing intentions, especially in comparison to issues requiring immediate attention (Stringer et al., 2022). Failure to bridge this gap between consumers and supply chain stakeholders will exacerbate the impacts of climate change and modern slavery.

Therefore, based on the discussions above, we offer the conceptual model in Figure 12.

Finally, based on our findings we offer the following recommendations to reduce the mutual impact of climate change and modern slavery in the supply chain.

4.3 | Recommendations to reduce the mutual impact of climate change and modern slavery in the supply chain

4.3.1 | Develop technologies to address climate change and modern slavery in supply chains

Transparency and supply chain visualisation can help address climate change and modern slavery (Fischman, 2017; Gold et al., 2015; Hok et al., 2020; LeBaron et al., 2017). Transparent supply chains reveal industry nodes and responsibilities on company websites, holding them accountable (Fischman, 2017). Transparent supply chains require support from visualisation technologies. Supply chain visualisation can visualise and monitor all processes from suppliers to end customers (Ishaya et al., 2023).

Digital tools reduce climate change and modern slavery (Berg et al., 2020; Han et al., 2022; Szablewska & Kubacki, 2023). They recognise risks and disclose slavery (Han et al., 2022). Green technologies can also assess energy consumption, quantify emissions, and manage greenhouse gas emissions in the supply chain (Nikzad & Sedigh, 2017). The traceability of blockchain can enhance supply chain transparency (Szablewska & Kubacki, 2023) and the traceability of materials and products, ensuring sustainability, and reducing emissions or human rights issues in the supply chain (Gold et al., 2015).

Remote sensing satellites can map, date, and extract data from supply chain events like slavery and environmental degradation, expanding our understanding of their scope (Boyd et al., 2021). This aids in problem-solving (Jackson et al., 2020). The proliferation of smartphones empowers supply chain workers and environmentally conscious individuals to report inhumane practices and advocate for vulnerable groups (Berg et al., 2020).

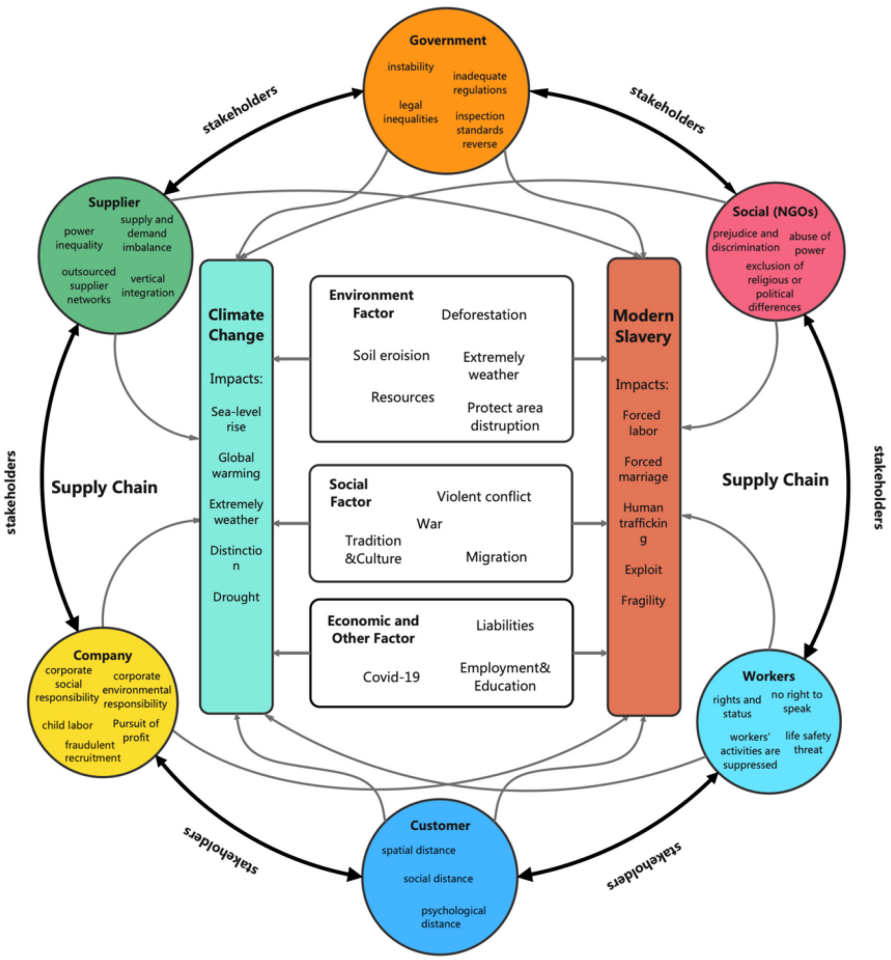

FIGURE 12 Modern slavery and climate change in the Supply Chain Management (Authors' elaboration with Yitu software).

4.3.2 | The concept of sustainable development contributes to the elimination of climate change and modern slavery in supply chains

The United Nations' 17 Sustainable Development Goals (SDGs) can guide supply chain businesses towards sustainability, encompassing environmental, social, and economic aspects (Decker Sparks et al., 2021). Aligning with these SDGs comprehensively addresses supply chain climate and modern slavery issues (Cameron et al., 2021).

Government policies can also combat climate change and modern slavery in supply chains. Initiatives like China's carbon neutrality plans promote green economic growth (Wang et al., 2021). In the United Kingdom, the Net Zero Plan and Modern Slavery Act drive sustainable development (Crane et al., 2019). The U.S. Withhold Release Orders target forced labour in supply chains, combating human trafficking (Hok et al., 2020).

Dominant supply chain enterprises must establish sustainable development strategies and performance indicators to evaluate themselves and their suppliers (Guerrero et al., 2021; Ishaya et al., 2023). Research by Guerrero et al. (2021) reveals that companies in fast-moving consumer goods supply chains emphasising sustainability often proactively tackle deforestation issues.

Additionally, adopting a circular economy perspective can help mitigate the risks of modern slavery within supply chains. The circular economy is one of the most favoured strategies for achieving sustainable development (Ferrante et al., 2024), demonstrates economic benefits while conserving resources. By adhering to business models that promote zero waste and reduce the use of natural materials and emissions (Ho et al., 2024), the circular economy not only benefits the climate and environment but also indirectly reduces modern slavery in supply chains through interconnected factors.

Moreover, strong sustainable development performance correlates with efforts to combat modern slavery in the supply chain (Geng et al., 2022). These performance indicators help companies balance profits with ethics and social responsibility (Uddin et al., 2023). They also facilitate supplier assessment, promote responsible procurement, mitigate environmental and climate impacts, and reduce modern slavery risks stemming from forced labour (Hok et al., 2020). Companies like Mars use scorecards and responsible procurement indicators to identify and eliminate forced labour risks (Fischman, 2017). Marks and Spencer, for example, has a sustainable development scoreboard covering environmental factors, human resources, ethical trade, and lean production to address and assess sustainability issues (Marks & Spencer, 2017).

4.3.3 | The engagement and cooperation of stakeholders in the supply chain can reduce climate change and modern slavery

Numerous direct factors impact climate change and modern slavery, including supply chain stakeholders. They can establish multi-stakeholder networks to advance supply chain interests (Ishaya et al., 2023).

Governments can incentivise climate-friendly practices and human rights protection within the supply chain (Szablewska & Kubacki, 2023). This includes promoting sustainable materials to reduce pollution-related climate issues and ensuring fair competition among all stakeholders (businesses, workers, government bodies, NGOs, and non-profits).

Social organisations and trade unions can initiate charitable and educational programmes to support enslaved workers and raise awareness about modern slavery and climate change (Kunz et al., 2023). The Coalition of Immokalee Workers (CIW), for example, exposed cases of modern slavery in Florida's tomato fields, leading to the liberation of over 1000 enslaved workers through legal action (Kunz et al., 2023). These efforts can increase awareness among workers engaged in environmentally harmful practices and modern slavery, potentially changing their attitudes and encouraging resistance to unsustainable practices.

Social and mainstream media can report and expose corporate activities, pressuring companies to address social and environmental responsibility (Flynn, 2020; Fracarolli Nunes et al., 2021; Geng et al., 2022). Additionally, supply chain stakeholders can participate in ethical alliances like the Ethical Trading Initiative, International Labour Organisation, or Fairtrade organisations to collectively address modern slavery and climate disruption in supply chains.

5 | CONCLUSION

This paper utilises a systematic literature review to probe the nexus of climate change and modern slavery in supply chains, addressing two core research questions. It identifies eleven pivotal supply chain factors impacting climate change and modern slavery, offering in-depth insights into their mechanisms. Furthermore, the paper illuminates how supply chain stakeholders shape these dynamics. It culminates with a framework of modern slavery and climate change in the context of the supply chain and concludes by presenting actionable recommendations to mitigate the intertwined impact of climate change and modern slavery in supply chains.

5.1 | Theoretical and practical implications

This research meticulously disaggregates the relationship between climate change and modern slavery into distinct factors through the proposed framework, facilitating a nuanced understanding of their interplay. By scrutinising the stakeholders within supply chains, the study underscores the pivotal roles of collaboration and oversight in addressing the intertwined challenges of modern slavery and environmental degradation.

The framework proposes that the factors influencing climate change and modern slavery are not isolated, binary influences;

rather, they manifest as a complex, network-like relationship (Bales & Sovacool, 2021).

The study offers actionable insights and strategic recommendations to guide supply chain experts in adeptly navigating these challenges. To ameliorate the confluence of climate change and modern slavery within supply chains, it is imperative to rigorously analyse the principal contributing factors and collaborate synergistically with all supply chain stakeholders to instigate transformative change (Crane et al., 2019). Governmental bodies should implement stringent regulatory frameworks, precluding companies with dubious ethical standings from market access. Concurrently, enterprises ought to cultivate heightened awareness of and address anomalies within their supply chains, thereby engendering a more transparent operational landscape. Lastly, workers should coalesce through unionisation to counteract the adverse impacts of climate change and modern slavery manifesting within supply chain dynamics (Rogerson et al., 2024).

5.2 | Research limitations and future research areas

While this study undertakes an in-depth analysis of 56 articles, research into the relationship between climate change and modern slavery within supply chains remains nascent and warrants further exploration. The current research primarily serves as an exploration of concepts, necessitating empirical validation and additional case studies to corroborate the relationships among the investigated entities.

Beyond the relationship between climate change and modern slavery, economic issues within supply chains also demand attention, especially in light of recent economic downturns (Ishaya et al., 2023). Investigating the potential connections between economic fluctuations, climate change, and modern slavery would be immensely valuable. The disruptions caused by the COVID-19 pandemic underscore the significant impact of unforeseen events or "Black Swan" events on supply chains (Allam et al., 2022), investigating the impact of external factors such as wars and viruses on supply chain issues is crucial for understanding future effects on climate change and modern slavery within supply chains. Furthermore, the interconnections between climate change and modern slavery are becoming increasingly evident. Expanding the Greenwashing measurement standards for evaluating environmental issues within supply chains to encompass social dimensions can significantly enhance supply chain sustainability (Bernini et al., 2024). Future research should explore whether the standards employed to address climate and environmental issues have a direct or indirect impact on modern slavery within supply chains.

Overall, further studies are required to understand the direct and indirect interactions among the identified factors impacting climate change and modern slavery. As technology continues to evolve, investigating its potential positive and negative implications for the relationship between climate change and modern slavery becomes increasingly crucial.

FUNDING INFORMATION

No funders available.

CONFLICT OF INTEREST STATEMENT

No conflicts of interest.

PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/beer.12722.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

ORCID

Yuxin Wang https://orcid.org/0009-0002-8112-9182
Maryam Lotfi https://orcid.org/0000-0002-1261-9834

REFERENCES

Aguinaga, D. G. S. (2024). Policy Brief Update: Effectiveness of mandatory human rights and environmental due diligence legislation in addressing modern slavery in business value chains. https://modern-slavery.files.svdcdn.com/production/assets/downloads/Updated-HRDD-briefing.pdf?dm=1711554244

Allam, Z., Bibri, S. E., & Sharpe, S. A. (2022). The rising impacts of the COVID-19 pandemic and the Russia–Ukraine war: Energy transition, climate justice, global inequality, and supply chain disruption. *Resources (Basel)*, *11*(11), 99. https://doi.org/10.3390/resources11110099

Andrees, B. (2023). Forced labour and trafficking in Europe: how people are trapped in, live through and come out. https://www.ilo.org/wcmsp5/groups/public/---ednorm/---declaration/documents/publication/wcms_090548.pdf

Bales, K., & Sovacool, B. K. (2021). From forests to factories: How modern slavery deepens the crisis of climate change. *Energy Research & Social Science*, *77*, 102096. https://doi.org/10.1016/j.erss.2021.102096

Berg, L., Farbenblum, B., & Kintominas, A. (2020). Addressing exploitation in supply chains: Is technology a game changer for worker voice? *Anti-Trafficking Review*, *14*, 47–66. https://doi.org/10.14197/atr.201220144

Bernini, F., Giuliani, M., & Rosa, F. L. (2024). Measuring greenwashing: A systematic methodological literature review. *Business Ethics, the Environment & Responsibility*. https://doi.org/10.1111/beer.12631

Bethany, J., Jessica, L., Decker, S., Chloe, B., & Doreen, S. B. (2020). Understanding the co-occurrence of tree loss and modern slavery to improve efficacy of conservation actions and policies. *Conservation Science and Practice*, *2*(5), e183. https://doi.org/10.1111/csp2.183

Bharadwaj, R., Bishop, D., Hazra, S., Pufaa, E., & Annan, J. K. (2021). Climate-induced migration and modern slavery. https://www.iied.org/climate-induced-migration-modern-slavery

Biello, D., & Moskowitz, C. (2016). Blood and earth: Modern slavery, ecocide, and the secret to saving the world. *Scientific American*, *314*(3), 72. https://doi.org/10.1038/scientificamerican0316-72b

Birks, M., & Mills, J. (2015). *Grounded theory: A practical guide* (2nd ed.). SAGE.

Birks, M., Mills, J., Francis, K., & Chapman, Y. (2009). A thousand words paint a picture: The use of storyline in grounded theory research.

Journal of Research in Nursing, *14*(5), 405–417. https://doi.org/10.1177/1744987109104675

Bodendorf, F., Wonn, F., Simon, K., & Franke, J. (2023). Indicators and countermeasures of modern slavery in global supply chains: Pathway to a social supply chain management framework. *Business Strategy and the Environment*, *32*(4), 2049–2077. https://doi.org/10.1002/bse.3236

Boyd, D. S., Perrat, B., Li, X., Jackson, B., Landman, T., Ling, F., Bales, K., Choi-Fitzpatrick, A., Goulding, J., Marsh, S., & Foody, G. M. (2021). Informing action for United Nations SDG target 8.7 and interdependent SDGs: Examining modern slavery from space. *Humanities and Social Sciences Communications*, *8*(1), 111. https://doi.org/10.1057/s41599-021-00792-z

Brown, D., Boyd, D. S., Brickell, K., Ives, C. D., Natarajan, N., & Parsons, L. (2021). Modern slavery, environmental degradation and climate change: Fisheries, field, forests and factories. *Environment and Planning. E, Nature and Space (Print)*, *4*(2), 191–207. https://doi.org/10.1177/2514848619887156

Bubicz, M., Barbosa-Povoa, A., & Carvalho, A. (2021). Social sustainability management in the apparel supply chains. *Journal of Cleaner Production*, *280*, 124214. https://doi.org/10.1016/j.jclepro.2020.124214

Butt, N., Lambrick, F., Menton, M., & Renwick, A. (2019). The supply chain of violence. *Nature Sustainability*, *2*(8), 742–747. https://doi.org/10.1038/s41893-019-0349-4

Cameron, E. C., Hemingway, S. L., Cunningham, F. J., & Jacquin, K. M. (2021). Global crises: Gendered vulnerabilities of structural inequality, environmental performance, and modern slavery. *Human Arenas: An Interdisciplinary Journal of Psychology, Culture, and Meaning*, *4*(3), 391–412. https://doi.org/10.1007/s42087-020-00154-2

Chun Tie, Y., Birks, M., & Francis, K. (2019). Grounded theory research: A design framework for novice researchers. *SAGE Open Medicine*, *7*, 1–8. https://doi.org/10.1177/2050312118822927

Crane, A. (2013). Modern slavery as a management practice: Exploring the conditions and capabilities for human exploitation. *Academy of Management Review*, *38*(1), 49–69. https://doi.org/10.5465/amr.2011.0145

Crane, A., LeBaron, G., Allain, J., & Behbahani, L. (2019). Governance gaps in eradicating forced labor: From global to domestic supply chains. *Regulation and Governance*, *13*(1), 86–106. https://doi.org/10.1111/rego.12162

Decker Sparks, J. L., Boyd, D. S., Jackson, B., Ives, C. D., & Bales, K. (2021). Growing evidence of the interconnections between modern slavery, environmental degradation, and climate change. *One Earth*, *4*(2), 181–191. https://doi.org/10.1016/j.oneear.2021.01.015

Denyer, D., & Tranfield, D. (2006). Using qualitative research synthesis to build an actionable knowledge base. *Management Decision*, *44*(2), 213–227. https://doi.org/10.1108/00251740610650201

Eitzinger, A., Läderach, P., Gordon, J., Benedikter, A., Quiroga, A., Pantoja, A., & Bruni, M. (2013). Crop suitability and climate change in Jamaica: Impacts on farmers and the supply chain to the hotel industry. *Caribbean Geography*, *18*(9), 21–39.

Fahimnia, B., Sarkis, J., Dehghanian, F., Banihashemi, N., & Rahman, S. (2013). The impact of carbon pricing on a closed-loop supply chain: An Australian case study. *Journal of Cleaner Production*, *59*, 210–225. https://doi.org/10.1016/j.jclepro.2013.06.056

Farley, M. (2022). Making the connections: Resource extraction, prostitution, poverty, climate change, and human rights. *The International Journal of Human Rights*, *26*(6), 1032–1055. https://doi.org/10.1080/13642987.2021.1997999

Ferrante, M., Vitti, M., Facchini, F., & Sassanelli, C. (2024). Mapping the relations between the circular economy rebound effects dimensions: A systematic literature review. *Journal of Cleaner Production*, *456*, 142399. https://doi.org/10.1016/j.jclepro.2024.142399

Fischman, K. (2017). Adrift in the sea: The impact of the business supply chain transparency on trafficking and slavery act of 2015 on forced labor in the Thai fishing industry. *Indiana Journal of Global Legal Studies*, *24*(1), 227–252. https://doi.org/10.2979/indjglolegstu.24.1.0227

Flynn, A. (2020). Determinants of corporate compliance with modern slavery reporting. *Supply Chain Management*, *25*(1), 1–16. https://doi.org/10.1108/SCM-10-2018-0369

Fracarolli Nunes, M., Lee Park, C., & Shin, H. (2021). Corporate social and environmental irresponsibilities in supply chains, contamination, and damage of intangible resources: A behavioural approach. *International Journal of Production Economics*, *241*, 108275.

Gemenne, F. (2010). What's in a name: Social vulnerabilities and the refugee controversy in the wake of hurricane Katrina. In T. Afifi & J. Jäger (Eds.), *Environment, forced migration and social vulnerability* (pp. 29–40). Springer. https://doi.org/10.1007/978-3-642-12416-7_3

Geng, R., Lam, H. K. S., & Stevenson, M. (2022). Addressing modern slavery in supply chains: An awareness-motivation-capability perspective. *International Journal of Operations & Production Management*, *42*(3), 331–356. https://doi.org/10.1108/IJOPM-07-2021-0425

Gerrard, M. B. (2017). Climate change and human trafficking after the Paris agreement. *University of Miami Law Review*, *72*(2), 345.

Glaser, B. G., & Holton, J. (2004). Remodeling grounded theory. https://www.proquest.com/docview/869223799/abstract/91678EEDDB40430CPQ/1

Global Estimates of Modern Slavery. (2022). Global Estimates of Modern Slavery: Forced Labour and Forced Marriage. https://www.ilo.org/global/topics/forced-labour/publications/WCMS_854733/lang--en/index.htm

Godde, C. M., Mason-D'Croz, D., Mayberry, D. E., Thornton, P. K., & Herrero, M. (2021). Impacts of climate change on the livestock food supply chain; a review of the evidence. *Global Food Security*, *28*, 100488. https://doi.org/10.1016/j.gfs.2020.100488

Gold, S., Trautrims, A., & Trodd, Z. (2015). Modern slavery challenges to supply chain management. *Supply Chain Management*, *20*(5), 485–494. https://doi.org/10.1108/SCM-02-2015-0046

Guerrero, A. M., Jones, N. A., Ross, H., Virah-Sawmy, M., & Biggs, D. (2021). What influences and inhibits reduction of deforestation in the soy supply chain? A mental model perspective. *Environmental Science and Policy*, *115*, 125–132. https://doi.org/10.1016/j.envsci.2020.10.016

Han, C., Jia, F., Jiang, M., & Chen, L. (2022). Modern slavery in supply chains: A systematic literature review. *International Journal of Logistics Research and Applications*, *27*, 1–22. https://doi.org/10.1080/13675567.2022.2118696

Harvard, T. H. (2020). *Chen School of public health*. Coronavirus and Climate Change. https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/

Hays, D. (2020). My Brother's keeper: A framework for a legal obligation to respect human rights in global supply chains. *George Washington Law Review*, *88*(2), 454–480.

Helmer, M., & Hilhorst, D. (2006). Natural disasters and climate change. *Disasters*, *30*(1), 1–4. https://doi.org/10.1111/j.1467-9523.2006.00302

Ho, O., Iyer-Raniga, U., Sadykova, C., Balasooriya, M., Sylva, K., Dissanayaka, M., Sukwanchai, K., Pal, I., Bhatia, A., Jain, D., & Sivapalan, S. (2024). A conceptual model for integrating circular economy in the built environment: An analysis of literature and local-based case studies. *Journal of Cleaner Production*, *449*, 141516. https://doi.org/10.1016/j.jclepro.2024.141516

Hok, D. C., Natta, P. M., Acuff, O., & Zaharatos, G. (2020). Eradicating forced labour in global supply chains. *Global Trade and Customs Journal*, *15*(8), 388–400.

ILO. (2018). Baseline research findings on fishers and seafood workers in Thailand. https://www.ilo.org/asia/publications/WCMS_619727/lang--en/index.htm

International Labor Organization. (2017). Global Estimates of Child Labour: Results and trends, 2012–2016. https://www.ilo.org/global/publications/books/WCMS_575499/lang--en/index.htm

Ishaya, B. J., Paraskevadakis, D., Bury, A., & Bryde, D. (2023). A systematic literature review of modern slavery through benchmarking global supply chain. *Benchmarking: An International Journal*, *31*, 558–589. https://doi.org/10.1108/BIJ-09-2022-0554

Jackson, B., Boyd, D. S., Ives, C. D., Decker Sparks, J. L., Foody, G. M., Marsh, S., & Bales, K. (2020). Remote sensing of fish-processing in the Sundarbans reserve Forest, Bangladesh: An insight into the modern slavery-environment nexus in the coastal fringe. *Maritime Studies*, *19*(4), 429–444. https://doi.org/10.1007/s40152-020-00199-7

Jackson, B., & Decker Sparks, J. L. (2020). Ending slavery by decarbonisation? Exploring the nexus of modern slavery, deforestation, and climate change action via REDD+. *Energy Research & Social Science*, *69*, 101610. https://doi.org/10.1016/j.erss.2020.101610

Jamaluddin, F., & Saibani, N. (2021). Systematic literature review of supply chain relationship approaches amongst business-to-business partners. *Sustainability*, *13*(21), 11935. https://doi.org/10.3390/su132111935

Kumpulainen, M., & Seppänen, M. (2022). Combining web of science and Scopus datasets in citation-based literature study. *Scientometrics*, *127*(10), 5613–5631. https://doi.org/10.1007/s11192-022-04475-7

Kunz, N., Chesney, T., Trautrims, A., & Gold, S. (2023). Adoption and transferability of joint interventions to fight modern slavery in food supply chains. *International Journal of Production Economics*, *258*, 108809.

LeBaron, G., Lister, J., & Dauvergne, P. (2017). Governing global supply chain sustainability through the ethical audit regime. *Globalizations*, *14*(6), 958–975. https://doi.org/10.1080/14747731.2017.1304008

Mackay, M., Hardesty, B. D., & Wilcox, C. (2020). The intersection between illegal fishing, crimes at sea, and social well-being. *Frontiers in Marine Science*, *7*, 589000. https://doi.org/10.3389/fmars.2020.589000

Mader, P. (2015). Financialisation through microfinance: Civil society and market-building in India. *Financialisation and development in Asia*, *38*, 601–619.

Marasco, A. (2008). Third-party logistics: A literature review. *International Journal of Production Economics*, *113*(1), 127–147. https://doi.org/10.1016/j.ijpe.2007.05.017

Marks & Spencer. (2017). Marks & Spencer Food: Sustainability scorecard for suppliers, making business mutual case. https://www.sbs.ox.ac.uk/sites/default/files/2018-06/marks_and_spencer_-_mutuality_case_study_13.10.17.pdf

Natarajan, N., Brickell, K., & Parsons, L. (2019). Climate change adaptation and precarity across the rural-urban divide in Cambodia: Towards a 'climate precarity' approach. *Environment and Planning E: Nature and Space*, *2*(4), 899–921. https://doi.org/10.1177/2514848619858155

Natarajan, N., Brickell, K., & Parsons, L. (2021). Diffuse drivers of modern slavery: From microfinance to unfree labour in Cambodia. *Development and Change*, *52*(2), 241–264. https://doi.org/10.1111/dech.12623

Nguyen, L. T., & Zuidwijk, R. (2024). Sustainable supply chain governance: A literature review. *Business Ethics, the Environment & Responsibility*. https://doi.org/10.1111/beer.12668

Nikzad, R., & Sedigh, G. (2017). Greenhouse gas emissions and green technologies in Canada. *Environmental Development*, *24*, 99–108. https://doi.org/10.1016/j.envdev.2017.01.001

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews*, *10*(1), 89. https://doi.org/10.1186/s13643-021-01626-4

Page, M. J., & Moher, D. (2017). Evaluations of the uptake and impact of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement and extensions: A scoping review. *Systematic Reviews*, *6*(1), 263. https://doi.org/10.1186/s13643-017-0663-8

Pallardy, R. (2023). Deepwater Horizon oil spill environmental disaster, Gulf of Mexico 2010. https://www.britannica.com/event/Deepwater-Horizon-oil-spill

Parvez, M. A., Rana, I. A., Nawaz, A., & Arshad, H. S. H. (2023). The impact of brick kilns on environment and society: A bibliometric and thematic review. *Environmental Science and Pollution Research International*, *30*(17), 48628–48653. https://doi.org/10.1007/s11356-023-26011-7

Pranckutė, R. (2021). Web of science (WoS) and Scopus: The titans of bibliographic information in today's academic world. *Publication*, *9*(1), 12. https://doi.org/10.3390/publications9010012

Pugh, R., Brydges, T., Sharpe, S., Lavanga, M., & Retamal, M. (2024). The 'wellbeing wardrobe' as a tool to promote just transitions in the fashion and textile industry. *Contemporary Social Science*, *19*(1-3), 223–243. https://doi.org/10.1080/21582041.2024.2341143

Rogerson, M., Grosvold, J., & Alves, K. (2024). Climate change and modern slavery in public procurement. https://www.unseenuk.org/wp-content/uploads/2024/01/Procurement-modern-slavery-full-report-1.pdf

Sánchez, A. D., Del Río, M. D. L. C., & García, J. Á. (2017). Bibliometric analysis of publications on wine tourism in the databases Scopus and WoS. *European Research on Management and Business Economics*, *23*(1), 8–15. https://doi.org/10.1016/j.iedeen.2016.02.001

Sheu, J. C., Torres, M. I. M., Gordon, M. R., Nguyen, P. T., & Coverdale, J. H. (2021). Potential impact of climate change on human trafficking: A narrative review. *The Journal of Nervous and Mental Disease*, *209*(5), 324. https://doi.org/10.1097/NMD.0000000000001312

Strand, V., Lotfi, M., Flynn, A., & Walker, H. (2023). A systematic literature review of modern slavery in supply chain management: State of the art, framework development and research opportunities. *Journal of Cleaner Production*, *435*, 140301.

Stringer, T., Payne, A. R., & Mortimer, G. (2022). As cheap as humanly possible: Why consumers care less about worker welfare. *Journal of Fashion Marketing and Management*, *26*(4), 717–737. https://doi.org/10.1108/JFMM-06-2021-0158

Szablewska, N., & Kubacki, K. (2023). Empirical business research on modern slavery in supply chains: A systematic review. *Journal of Business Research*, *164*, 113988.

Trautrims, A., Schleper, M. C., Cakir, M. S., & Gold, S. (2020). Survival at the expense of the weakest? Managing modern slavery risks in supply chains during COVID-19. *Journal of Risk Research*, *23*(7–8), 1067–1072. https://doi.org/10.1080/13669877.2020.1772347

Uddin, M., Azmat, F., Fujimoto, Y., & Hossain, F. (2023). Exploitation in Bangladeshi ready-made garments supply chain: A case of irresponsible capitalism? *International Journal of Logistics Management*, *34*(1), 164–188. https://doi.org/10.1108/IJLM-12-2021-0565

United Nations Environment Programme. (2011). Women at the frontline of climate change: Gender risks and hopes. https://wedocs.unep.org/handle/20.500.11822/7985

United Nations Environment Programme. (2017). *Indigenous people and nature: a tradition of conservation*. https://www.unep.org/news-and-stories/story/indigenous-people-and-nature-tradition-conservation

United Nations Human Rights. (2021). Frequently Asked Questions on Human Rights and Climate Change. https://www.ohchr.org/sites/default/files/Documents/Publications/FSheet38_FAQ_HR_CC_EN.pdf

Waltman, L., van Eck, N. J., & Noyons, E. C. M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of*

Informetrics, *4*(4), 629–635. https://doi.org/10.1016/j.joi.2010.07.002

Wang, Y., Guo, C. H., du, C., Chen, X. J., Jia, L. Q., Guo, X. N., Chen, R. S., Zhang, M. S., Chen, Z. Y., Wang, H. D., The Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China, China University of Geosciences (Beijing), Beijing 100083, China, Development and Research Center of China Geological Survey, Beijing 100037, China, Shanghai Jiaotong University, Shanghai 200030, China, Xi'an Jiaotong University, Xi'an 710049, China, & China Institute of Water Resources and Hydropower Research, Beijing 100038, China. (2021). Carbon peak and carbon neutrality in China: Goals, implementation path and prospects. *China Geology*, *4*(4), 720–746. https://doi.org/10.31035/cg2021083

World Bank. (2015). Rapid, Climate-Informed Development Needed to Keep Climate Change from Pushing More than 100 Million People into Poverty by 2030. https://www.worldbank.org/en/news/feature/2015/11/08/rapid-climate-informed-development-needed-to-keep-climate-change-from-pushing-more-than-100-million-people-into-poverty-by-2030

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, *39*(1), 93–112. https://doi.org/10.1177/0739456X17723971

How to cite this article: Wang, Y., & Lotfi, M. (2024). How climate change and modern slavery interact in the supply chain: A conceptual model development through a systemic review. *Business Ethics, the Environment & Responsibility*, *00*, 1–24. https://doi.org/10.1111/beer.12722

APPENDIX 1

56 SELECTION STUDIES

Publication year	Author	Title	Journal name
2023	Ishaya, B. J.; Paraskevadakis, D.; Bury, A.; Bryde, D.	A systematic literature review of modern slavery through benchmarking global supply chain	Benchmarking
2020	Berg, L.; Farbenblum, B.; Kintominas, A.	Addressing exploitation in supply chains: Is technology a game changer for worker voice?	Anti-Trafficking Review
2022	Geng, R.; Lam, H. K. S.; Stevenson, M.	Addressing modern slavery in supply chains: An awareness-motivation-capability perspective	International Journal of Operations and Production Management
2023	Kunz, N.; Chesney, T.; Trautrims, A.; Gold, S.	Adoption and transferability of joint interventions to fight modern slavery in food supply chains	International Journal of Production Economics
2017	Fischman, K.	Adrift in the sea: The impact of the business supply chain transparency on trafficking and slavery act of 2015 on forced labor in the Thai fishing industry	Indiana Journal of Global Legal Studies
2022	Stringer, T.; Payne, A. R.; Mortimer, G.	As cheap as humanly possible: Why consumers care less about worker welfare	Journal of Fashion Marketing and Management
2023	Zhao, Z. Y.; Hao, Y. X.; Chang, R. D.; Wang, Q. C.	Assessing the vulnerability of energy supply chains: Influencing factors and countermeasures	Sustainable Energy Technologies and Assessments
2019	Goldstein, A. J.	Attracting the earth: Climate justice for charles fourier	Diacritics
2017	Gerrard, M. B	Climate change and human trafficking after the Paris agreement	University of Miami law review
2021	Fracarolli Nunes, M.; Lee Park, C.; Shin, H.	Corporate social and environmental irresponsibilities in supply chains, contamination, and damage of intangible resources: A behavioural approach	International Journal of Production Economics
2013	Eitzinger, A.; Läderach, P.; Gordon, J.; Benedikter, A.; Quiroga, A.; Pantoja, A.; Bruni, M.	Crop suitability and climate change in Jamaica: Impacts on farmers and the supply chain to the hotel industry	Caribbean Geography
2020	Flynn, A.	Determinants of corporate compliance with modern slavery reporting	Supply Chain Management
2021	Natarajan, N.; Brickell, K.; Parsons, L.	Diffuse drivers of modern slavery: From microfinance to unfree labour in Cambodia	Development and Change
2023	Szablewska, N.; Kubacki, K.	Empirical business research on modern slavery in supply chains: A systematic review	Journal of Business Research
2020	Jackson, B.; Decker Sparks, J. L.	Ending slavery by decarbonisation? Exploring the nexus of modern slavery, deforestation, and climate change action via REDD	Energy Research & Social Science
2020	Hok, D. C.; Natta, P. M.; Acuff, O.; Zaharatos, G.	Eradicating forced labour in global supply chains	Global Trade and Customs Journal
2023	Uddin, M. J.; Azmat, F.; Fujimoto, Y.; Hossain, F.	Exploitation in Bangladeshi ready-made garments supply chain: A case of irresponsible capitalism?	International Journal of Logistics and Assessment

APPENDIX 1 (Continued)

Publication year	Author	Title	Journal name
2020	Giuliani, E.; Nieri, F.	Fixing "bad" capitalism: Why CSR and pro-good initiatives may not be enough	Critical Perspectives on International Business
2021	Bales, K.; Sovacool, B. K.	From forests to factories: How modern slavery deepens the crisis of climate change	Energy Research & Social Science
2021	Cameron, E. C.; Hemingway, S. L.; Cunningham, F. J.; Jacquin, K. M.	Global crises: Gendered vulnerabilities of structural inequality, environmental performance, and modern slavery	Human arenas: An Interdisciplinary Journal of Psychology, Culture, and Meaning
2018	Nolan, J.; Bott, G.	Global supply chains and human rights: Spotlight on forced labour and modern slavery practices	Australian Journal of Human Rights
2019	Crane, A.; LeBaron, G.; Allain, J.; Behbahani, L.	Governance gaps in eradicating forced labour: From global to domestic supply chains	Regulation and Governance
2017	LeBaron, G.; Lister, J.; Dauvergne, P.	Governing global supply chain sustainability through the ethical audit regime	Globalizations
2021	Decker Sparks, J. L.; Boyd, D. S.; Jackson, B.; Ives, C. D.; Bales, K.	Growing evidence of the interconnections between modern slavery, environmental degradation, and climate change	One Earth
2021	Godde, C. M.; Mason-D'Croz, D.; Mayberry, D. E.; Thornton, P. K.; Herrero, M.	Impacts of climate change on the livestock food supply chain; a review of the evidence	Global Food Security
2023	Bodendorf, F.; Wonn, F.; Simon, K.; Franke, J.	Indicators and countermeasures of modern slavery in global supply chains: Pathway to a social supply chain management framework	Business Strategy and the Environment
2021	Boyd, D. S.; Perrat, B.; Li, X.; Jackson, B.; Landman, T.; Ling, F.; Bales, K.; Choi-Fitzpatrick, A.; Goulding, J.; Marsh, S.; Foody, G. M.	Informing action for United Nations SDG target 8.7 and interdependent SDGs: Examining modern slavery from space	Humanities & Social Sciences Communications
2022	Farley, M.	Making the connections: Resource extraction, prostitution, poverty, climate change, and human rights	The International Journal of Human Rights
2015	Gold, S.; Trautrims, A.; Trodd, Z.	Modern slavery challenges to supply chain management	Supply Chain Management
2021	Shilling, H.-J.; Wiedmann, T.; Malik, A.	Modern slavery footprints in global supply chains	Journal of Industrial Ecology
2018	Stevenson, M.; Cole, R.	Modern slavery in supply chains: A secondary data analysis of detection, remediation and disclosure	Supply Chain Management
2022	Han, C.; Jia, F.; Jiang, M.; Chen, L.	Modern slavery in supply chains: A systematic literature review	International Journal of Logistics Research and Applications
2022	Ahmed, S.; Chapple, L.; Christ, K.; Osborne, S.	Modern slavery risk disclosures in business operations and supply chain	Advances in Environmental Accounting and Management
2021	Brown, D.; Boyd, D. S.; Brickell, K.; Ives, C. D.; Natarajan, N.; Parsons, L.	Modern slavery, environmental degradation and climate change: Fisheries, field, forests and factories	Environment and planning. E, Nature and space (Print)
2020	Hays, D.	My Brother's keeper: A framework for a legal obligation to respect human rights in global supply chains	George Washington Law Review
2021	Sheu, J. C.; Torres, M. I. M.; Gordon, M. R.; Nguyen, P. T.; Coverdale, J. H.	Potential impact of climate change on human trafficking: A narrative review	The Journal of Nervous and Mental Disease
2020	Wilhelm, M.; Kadfak, A.; Bhakoo, V.; Skattang, K.	Private governance of human and labour rights in seafood supply chains – The case of the modern slavery crisis in Thailand	Marine Policy
2020	Jackson, B.; Boyd, D. S.; Ives, C. D.; Decker Sparks, J. L.; Foody, G. M.; Marsh, S.; Bales, K.	Remote sensing of fish-processing in the Sundarbans Reserve Forest, Bangladesh: An insight into the modern slavery-environment nexus in the coastal fringe	Maritime Studies
2022	Bag, S.; Dhamija, P.	Research progress on working conditions in supply chains: A comprehensive literature review and future research propositions	TQM Journal
2017	Nakano, K.	Screening of climatic impacts on a country's international supply chains: Japan as a case study	Mitigation and Adaptation Strategies for Global Change

(Continues)

APPENDIX 1 (Continued)

Publication year	Author	Title	Journal name
2014	Ronnback, K.	Slave ownership and fossil fuel usage: A commentary	Climatic Change
2021	Bubicz, M. E.; Barbosa-Povoa, A. P. F. D.; Carvalho, A.	Social sustainability management in the apparel supply chains	Journal of Cleaner Production
2020	Trautrims, A.; Schleper, M. C.; Cakir, M. S.; Gold, S.	Survival at the expense of the weakest? Managing modern slavery risks in supply chains during COVID-19	Journal of Risk Research
2023	Kar, S.; Pal, A.; Basu, K.; Sarkar, A.; Sarkar, B.	The effect of renewable energy and corporate social responsibility on dual-channel supply chain management	Energies (Basel)
2021	LeBaron, G.; Lister, J.	The hidden costs of global supply chain solutions	Review of International Political Economy
2023	Parvez, M. A.; Rana, I. A.; Nawaz, A.; Arshad, H. S. H.	The impact of brick kilns on environment and society: A bibliometric and thematic review	Environmental Science and Pollution Research International
2013	Fahimnia, B.; Sarkis, J.; Dehghanian, F.; Banihashemi, N.; Rahman, S.	The impact of carbon pricing on a closed-loop supply chain: An Australian case study	Journal of Cleaner Production
2017	Jiang, X.; Green, C.	The impact on global greenhouse gas emissions of geographic shifts in global supply chains	Ecological Economics
2020	Mackay, M.; Hardesty, B. D.; Wilcox, C.	The intersection between illegal fishing, crimes at sea, and social well-being	Frontiers in Marine Science
2022	Allam, Z.; Bibri, S. E.; Sharpe, S. A.	The rising impacts of the COVID-19 pandemic and the Russia–Ukraine war: Energy transition, climate justice, global inequality, and supply chain disruption	Resources (Basel)
2021	LeBaron, G.	The role of supply chains in the global business of forced labour	Journal of Supply Chain Management
2018	Fox, M.; Mitchell, M.; Dean, M.; Elliott, C.; Campbell, K.	The seafood supply chain from a fraudulent perspective	Food Security
2022	Murray, J.; Mora, C. J.; Malik, A.	Towards an emissions and modern slavery impact accounting model	Environmental Science & Technology
2020	Bethany, J.; Jessica, L.; Decker, S.; Chloe, B.; Doreen, S. B.	Understanding the co-occurrence of tree loss and modern slavery to improve efficacy of conservation actions and policies	Conservation Science and Practice
2021	Guerrero, A. M.; Jones, N. A.; Ross, H.; Virah-Sawmy, M.; Biggs, D.	What influences and inhibits reduction of deforestation in the soy supply chain? A mental model perspective	Environmental Science and Policy
2020	Vijeyarasa, R.	Women, work and global supply chains: The gender-blind nature of Australia's modern slavery regulatory regime	Australian Journal of Human Rights