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LITERATURE REVIEW

Disasters' impact on supply chains and countermeasure strategies: an overview of the academic literature' nature[1]

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ABSTRACT

Goal: This paper investigates the nature of the academic literature on the disasters' impacts on Supply Chains (SC) and the strategies adopted to minimize their adverse effects.

Design / Methodology / Approach: Based on a Systematic Literature Review (SLR), we conduct a bibliometric analysis of 129 documents to assess the significant publications' characteristics regarding year, trend topics, journals, authors, papers more cited, keywords co-occurrence, disasters, SC type, and preliminary identification of disasters' impacts and countermeasure strategies.

Results: The results show that most studies address natural disasters (e.g., floods, earthquakes, pandemics), and a significant number of documents refer to the food SC. Our findings indicate that the main impacts are: SC instability, supplies shortages, transport and distribution disruption, production and operation disruption, cash flow problems, and productivity reduction; and the main strategies: agility, the collaboration between SC links, organizational flexibility, information sharing, financial and inventory management, digital transformation, government policies, and benchmarking.

Limitations of the investigation: This is a qualitative study with a preliminary examination of the topic through bibliometric results, and for this reason, the content analysis of the documents is outside the scope of the paper.

Practical implications: The findings of this study provide preliminary insights for SC practitioners into the main countermeasures strategies performed to respond to the SC impacts during a disaster.

Originality / Value: The results contribute to a holistic perspective of the topic, which involves the main features of existing studies in the literature.

Keywords: Disasters; Supply Chain Strategies; Literature Review; Bibliometric Analysis.

INTRODUCTION

Supply Chain (SC) disruptions are caused by unplanned events that interrupt the normal flow of materials and information within an SC (Craighead et al., 2007; Bier et al., 2020). Such disruptions

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can be caused by disasters or fluctuations in the regular operations of the supply chain (Bier et al., 2020; Singh et al., 2020). For instance, in 2020, 389 disasters affected 98.4 million people worldwide and cost US$ 171.3 billion (CRED, 2021). During disasters, SCs face impacts such as instability in production and inventory (Lim and Tan, 2018), transportation disruption (Davies et al., 2017), supply and demand fluctuation (Pratama et al., 2021), damage to premises, equipment, and vehicles (Asgary et al., 2012), and coordination problems (Cardoso et al., 2021; de Oliveira et al., 2020). Being prepared for such disruptions is challenging; however, it is possible to mitigate the eventualities through contingency plans and effective strategies to increase SC responsiveness (Abe and Ye, 2013; Boyacı-Gündüz et al., 2021; Cordeiro et al., 2021a).These SC strategies involve activities that are fundamental to the normal flow of the operation, such as strategic purchases (Lamenza et al., 2019), social media and digital platforms (Cordeiro et al., 2021b; Eckhardt et al., 2022), information sharing (Ding et al., 2021), and collaboration with stakeholders (Cundell et al., 2020). Considering that disasters represent a relevant impact on SCs and societies (Singh et al., 2020), this paper aims to investigate the academic literature's nature on the disasters' impacts on SC and countermeasure strategies. Thus, the research adopted a Systematic Literature Review (SLR) to develop a bibliometric analysis, offering an overview of the main characteristics and trends of publications. The bibliometric analysis provides a quantitative way of dealing with the literature on a particular topic. In addition, some bibliometric analysis tools provide an overview of the research patterns (Zupic and Čater, 2015).The paper is organized as follows. After this introductory section, Section 2 presents the research methodology used in this study. Next, Section 3 shows the results obtained through the bibliometric analysis. Finally, Section 4 presents the conclusions, limitations, and future research directions.

METHODOLOGY

The SLR is a research method used to review, update, criticize and improve knowledge on a specific topic, identifying the strengths and weaknesses of a given subject, as well as existing gaps and contradictions (Torraco, 2016).

This research applies the eight steps for an SLR proposed by (Thomé et al., 2016), which are described as follows:

1. Planning and formulating the problem: The SLR intends to answer the research question: What are the characteristics of publications on the disasters' impact on SC and SC strategies?
2. Searching the literature: the research considers the bibliographic search in the Scopus and Web of Science (WoS) databases to reduce the source bias (Thomé et al., 2016). The search considers three keywords' groups (Figure 1) to search titles, abstracts, and keywords. Group 1 focuses on the SC. Group 2 brings SC impacts and related strategies, policies, and practices. The W/5 and NEAR/5 are proximity operators used to specify the maximum number of words that separate terms. In this case, the words from groups 1 and group 2 must be joined in a set of 5 words. Group 3 encompasses disasters terminologies based on (IFRC, 2021) and (CRED, 2009).

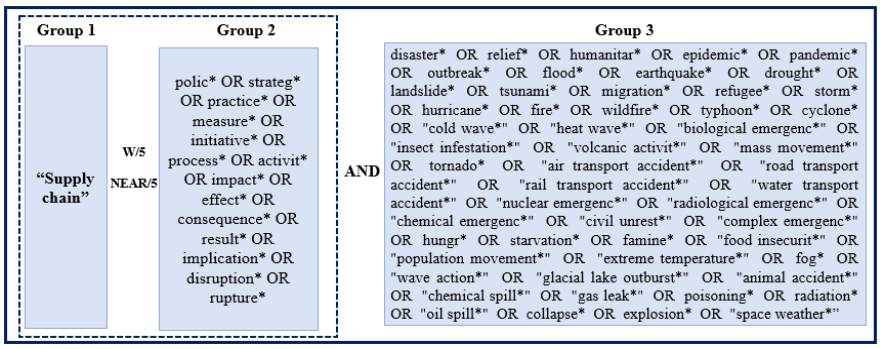

Figure 1. SLR Keywords
Source: Authors (2022)

The search returned 2,516 documents on July 6, 2021. After that, we adopted a filter to remove duplicated abstracts in the two databases and documents in languages other than English. Then, the abstracts were analyzed according to the following inclusion and exclusion criteria. Figure 2 summarizes the SLR.

- Inclusion criteria: papers discussing the disaster's impacts on SCs; papers presenting countermeasure strategies for SCs disruptions caused by disasters.
- Exclusion criteria:

o Abstracts reading: research outside the context of disasters; research that does not identify disaster impacts on the SCs; research that does not identify strategies to minimize these impacts.

o Full-text reading: disruptions in the SCs not caused by a disaster (e.g., lack of raw materials); does not identify disaster impacts in the SCs (e.g., environmental impacts); mathematical models (e.g., facility location, profit maximization); methodologies to support logistical activities.

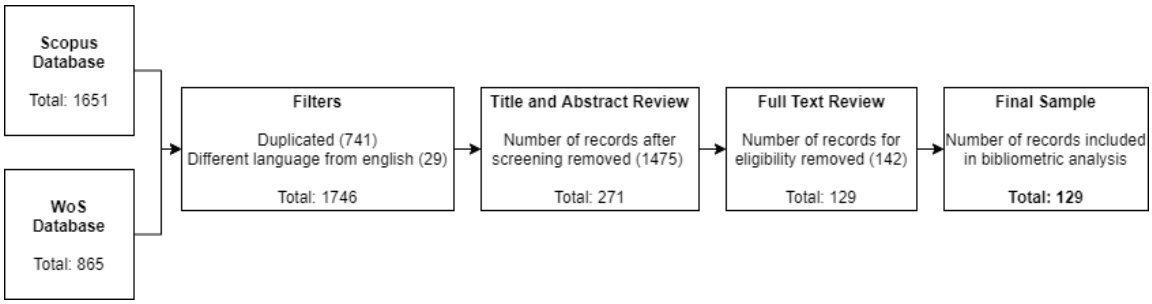

Figure 2. Searching the literature
Source: Authors (2022)

3. Data gathering: the research identifies and compiles data related to publication characteristics and specificities such as the evolution of publications per year, trend topics, journals, authors, papers more cited, keywords co-occurrence, disasters, SC type, and preliminary identification of disasters' impacts and countermeasure strategies;
4. Quality evaluation: the research provides a detailed description of the SLR to ensure quality evaluation. Moreover, two researchers are responsible for reviewing the selected documents, and they obtained an acceptable agreement index of 94,9% (Krippendorff, 2018).
5. Analysis and synthesis: the research perform a bibliometric analysis using the Bibliometrix package of the "R" software, VOSviewer software, and descriptive analysis of the findings.
6. Interpretation of the results: the paper discusses the consequences of the findings for the topic of disasters' impact on SC and SC strategies;
7. Presentation of the results: the research describes the results within this paper;
8. Updating the review: the research suggests the update of the SLR as future research.

RESULTS AND DISCUSSIONS

The analysis of the document type reveals that 75% of them are articles, 8% are conference papers, and 7% are reviews. The other documents are divided into notes, proceedings papers, short surveys, and other publications. Figure 3 presents the evolution of the number of publications per year.

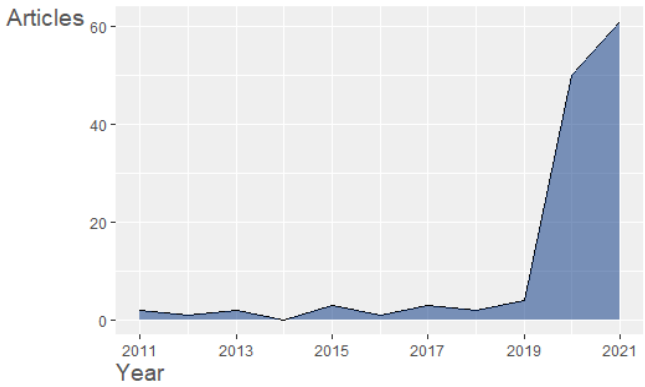

Figure 3. Publications per year
Source: Designed from Bibliometrix (2021)

The high number of publications in 2021 (61 documents) can be explained by the COVID-19 pandemic - a biological disaster - which is supported by an analysis of trend topics in Figure 4.

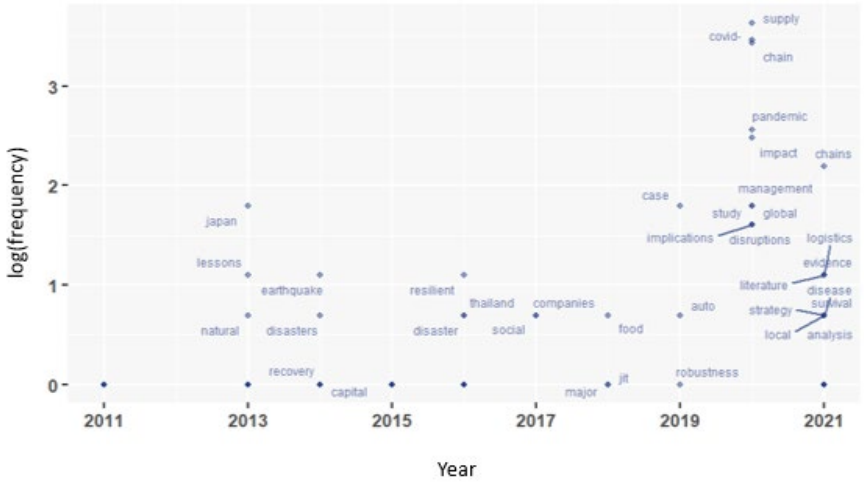

Figure 4. Trend topics
Source: Designed from Bibliometrix (2021)

Figure 4 reveals that publications are addressing terms like "covid" and "pandemic" increased since 2020. The COVID-19 pandemic has severely impacted all SC and sectors (Singh et al., 2020), including the food SC (Bassett et al., 2021; Mahajan and Tomar, 2021; Rukasha et al., 2021), personal protective equipment (Aljadeed et al., 2021; Scala and Lindsay, 2021), medical and pharmaceutical items (Cundell et al., 2020, Miller, 2011; Bookwalter, 2021), construction sector (Assaad and El-adaway, 2021), manufacturing sector (Garlick et al., 2020; Okorie et al., 2020), automobile sector (Hsieh et al., 2016; Iwase, 2011).

In addition to the impacts on SC activities, the COVID-19 pandemic also highlighted significant social challenges, for example, food insecurity. Food demand and, consequently, food security are strongly affected due to mobility restrictions, and reduced purchasing power strongly affects vulnerable population groups (Siche, 2020).

Regarding publication sources, Table 1 indicates that the Agricultural Systems journal stands out with 4 publications. In addition to the analysis of specific journals, the topic has been addressed by journals from different areas, for example, social sciences and disaster risk reduction. These findings reinforce that the theme is multidisciplinary, considering different research perspectives.

Table 1. Publication sources.

Journal	Documents
Agricultural Systems	4
International Journal of Production Economics	3
International Journal of Disaster Risk Reduction	3
Sustainability	3
Food Control	3
Animals	2
Applied Economic Perspectives and Policy	2
Canadian Journal of Agricultural Economics	2
China Agricultural Economic Review	2
Cogent Social Sciences	2
Others	103

Source: Authors (2021)

Concerning the authors' profile, Figure 5 shows the authors who most publish on the topic. Few authors have more than one publication, providing evidence of the low continuity of research on the theme in the area. Nevertheless, there is a continuity of publications by some authors. Also, Table 2 shows the documents with the highest number of citations in total and per year.

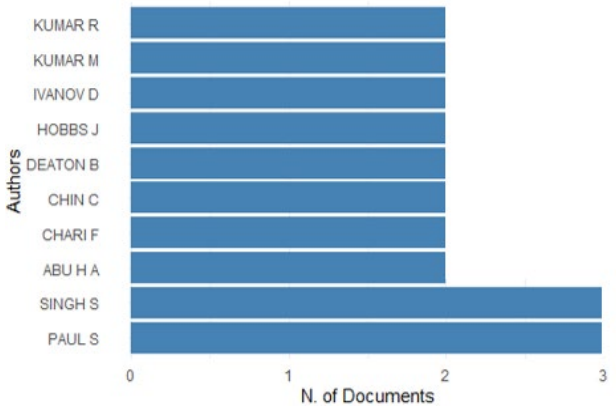

Figure 5. Most published authors

Source: Designed from Bibliometrix (2021)

Table 2. Citations per author

Authors	Total	Average per year
Hobbs (2020)	166	83.0
Park et al. (2013)	119	13.2
Haraguchi and Lall (2015)	94	13.4
Siche (2020)	66	33.0
Singh et al. (2020)	59	59.0
Asgary et al. (2012)	51	5.1
Ivanov and Dolgui (2021)	43	43.0
Sharma et al. (2020)	39	19.5

Source: Authors (2021)

About the most cited documents, Hobbs (2020) addresses the implications of COVID-19 in the food SC, involving demand-side and supply-side shocks, as well as long-term changes brought about by the pandemic. Park et al. (2013) discuss the response of manufacturing

companies to disasters (earthquake, tsunami, and nuclear disaster) in Japan. The authors address the process of restoring SCs disruptions and present lessons in terms of disaster planning and responses. Haraguchi and Lall (2015) assess the impact of floods on the global economy and propose measures related to risk in the SC.

Figure 6 presents the occurrence of the keywords related to the disasters' impacts on SC (e.g., SC disruption, panic buying, food waste, drug shortages; prices; shocks; consumer behavior) and SC strategies (e.g., agility; risk management). Besides, terms explicitly related to the food SC (e.g., food security, food system). Impacts on food SCs involve labor scarcity, price increases, and production interruptions. Also, food supply disruptions decrease the food security of the vulnerable communities (Chodur et al., 2018).

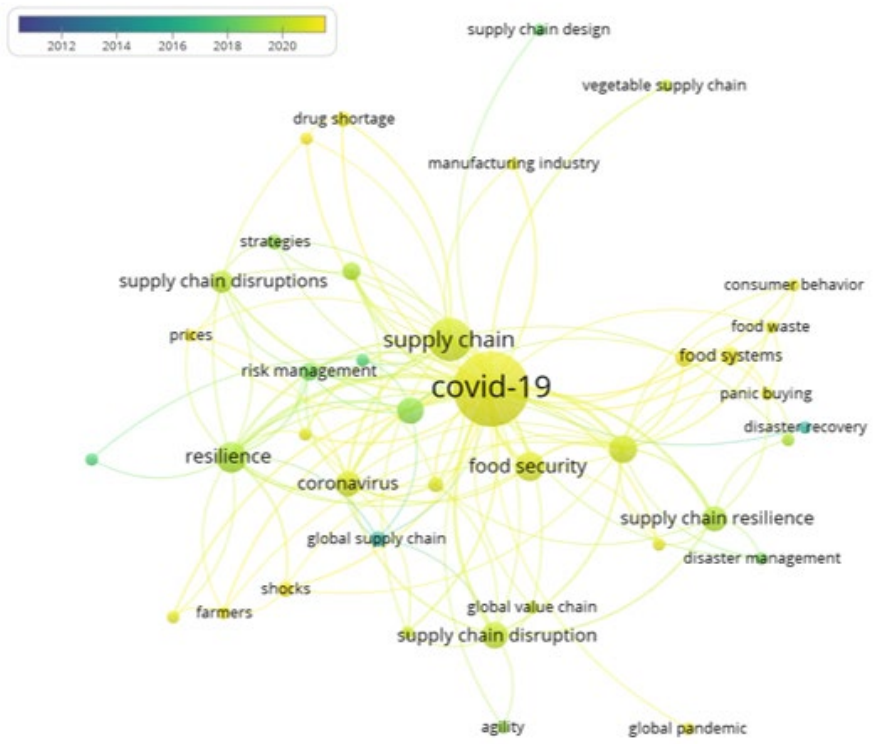

Figure 6. Keywords map
Source: Designed from Bibliometrix (2021)

Figure 6 also highlights the temporal analysis of keywords. It is noted that before 2019 the keywords were more general in terms of the supply chain, impacts, and strategies (e.g., global value chains, disaster recovery, supply chain design, risk management, disaster management, supply chain resilience). From 2019 onwards, the keywords are related to the COVID-19 pandemic. It is noteworthy that 107 (83%) documents address the COVID-19 pandemic. The pandemic caused an unprecedented global disruption, where most companies were unprepared (Ali et al., 2021).

Figure 7 presents the disaster type covered by the documents per year. The values in parentheses represent the number of documents that deal with the disaster in a specific year (e.g., in 2013, only one document covers floods). The sum of documents is greater than 100%, as some documents address more than one type of disaster (e.g., Gunessee et al. (2018) that address earthquake-tsunami and flood).

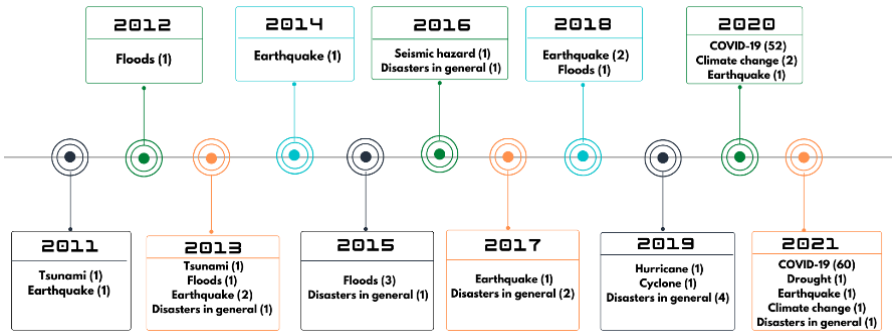

Figure 7. Disaster type
Source: Authors (2021)

Figure 7 illustrates the frequency of occurrence of studies related to specific disasters. It is interesting to note that some disasters frequently appear in the timeline, for example, earthquakes. Earthquakes cause enormous short-term damage, negatively impacting production assets, public infrastructure, business development (Abe and Ye, 2013), roads, railways, bridges, air transport, navigation (Davies et al., 2017), electricity, and water supply (Ding et al., 2021). Some mitigation strategies highlighted are a collaboration between the public and private sectors (Abe and Ye, 2013), resilient design, interdependency planning, mutual assistance agreements (Davies et al., 2017), greater operational efficiency, cash flows optimized, and information sharing (Ding et al., 2021).

One can cite other documents that address earthquake impacts on SCs, as well as mitigation policies that are also handled by other studies (Miller, 2011; Park et al., 2013; Olcott and Oliver, 2014; Gunessee et al., 2018; Lim and Tan, 2018; Hendricks et al., 2020). The high number of documents dealing with earthquakes occurs because natural disasters are highly unpredictable events, and the impacts on the SC can be significant if companies do not have sufficient resilience (Gunessee et al., 2018).

Also, Figure 7 shows that in the years 2020 and 2021, there is a significant number of documents that address COVID-19. The COVID-19 pandemic has had negative implications for commercial businesses, including restaurants, aviation, logistics, and industries. Furthermore, the pandemic negatively impacted the employment and income of many families, global world stocks, items prices, and economic growth (Al-Mansour and Al-Ajmi, 2020). To minimize impacts on the SCs, contingency plans need to be developed. Also, it is necessary, for example, to monitor marketing and sales activities, maintain accounting and financial registers, maintain stock levels to a minimum (Al-Mansour and Al-Ajmi, 2020). Pratama et al. (2021) highlight the impacts of the COVID-19 pandemic on global SCs: operation disruption, supply and demand disruption, cash flow problem, changes in consumer behavior, and risk of uncertainty. Mitigation strategies include financial management, digital transformation, network relationship, government policy, orientation, and information.

Figure 8 presents the SCs types most covered by the documents. The food SC is the most mentioned among the documents, which reinforces the high importance of the food SC has for developing economies (Swinnen and Vos, 2021), and the survival and health of societies (Boyacı-Gündüz et al., 2021).

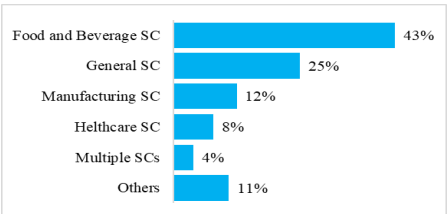

Figure 8. SC type
Source: Authors (2021)

The COVID-19 pandemic, for example, highlighted the vulnerability of food systems in response to disasters. Some impacts are highlighted: interruptions in international trade due to movement restrictions, labor shortages, reduced productivity, the decline in production, interruptions in distribution channels, and the supply of capital inputs and services (Van Hoyweghen et al., 2021). Besides the internal impacts on the SC, the COVID-19 pandemic also represents a threat to global food security due to income loss and reduced capacity to access food (Swinnen and Vos, 2021). Strategies that represent food SC resilience involve structure, government facilitation, and the ability of food companies to adapt to shock and changing market conditions (Swinnen and Vos, 2021).

Due to natural disasters and political risks, the manufacturing SC suffers large-scale disruptions [Okorie et al., 2020]. During the COVID-19 pandemic, the negative impacts highlighted the risks of interruptions in the manufacturing SC such as time constraints, supply and demand fluctuation, complexity in repurposing product and infrastructure, human resources constraints. Business continuity strategies involve, for example, building organizational flexibility, digital technology, and benchmarking (Okorie et al., 2020).

In the healthcare SC, disasters, including pandemics, can disrupt the supply of medical and pharmaceutical products (Cundell et al., 2020). With increased global demand and disruption to transport, the COVID-19 pandemic has resulted in a shortage of drugs needed to treat illnesses, in addition to a shortage of personal protective equipment such as masks and gowns (Cundell et al., 2020). Among the strategies to minimize the impact of interruptions in the healthcare SC, we can highlight strengthening existing supplier relations, seeking alternative suppliers, and enhancing collaboration with suppliers (Cundell et al., 2020).

The automotive industry is an elaborate network that involves moving vehicles and parts from suppliers, manufacturers, wholesalers, distributors, and retailers to end customers (Hsieh et al., 2016). Lim and Tan (2018) assess the impacts of the Malaysian Kumamoto earthquake on auto industry inventories. The authors emphasize consequences such as production stoppages, inventory problems, market supply deficit, chain reaction with other suppliers, and planning issues. The strategies to minimize these impacts are strengthening the supplier-customer relationship, improving risk assessment during supplier selection, and using multiple sourcing (Lim and Tan, 2018).

The multiple SC category involves documents that address more than one type of supply chain, for example, electronic, automobile, and food SCs (Liu et al., 2020); medical, food, and manufacturing SCs (Marquez et al., 2021). Other SCs include specific SCs, for example, the construction sector [Assaad and El-adaway, 2021], vaccines [Snowdon et al., 2021], airline industries (Belhadi et al., 2021), engineering sector (Khalfan and Ismail, 2020), tourism sector (Ngin et al., 2020), toilet paper (Paul and Chowdhury, 2020). It is essential to mention that in some documents (25%), there is no specification of the SC type; they address the SC in general.

In general, interruptions in the normal flow of activities, the high negative impact, and losses resulting from the occurrence of disasters can threaten the financial state of companies (Marszewska, 2016). The effects of disasters on operations highlight the interdependent nature of the global SC and the importance of disaster risk reduction (Abe and Ye, 2013).

SC risk management had never seemed more important than today when global SCs were heavily affected by the COVID-19 pandemic (Yang et al., 2021). Although companies with a global SC have advantages such as cost reduction, a greater variety of supplies, and access to international customers, they also face more significant uncertainties and risks and are prone to SC disruptions (Ding et al., 2021).

To reduce the impacts of disasters on SCs, operational, tactical, and strategic strategies are needed (Kim and Bui, 2019]). Operational strategies must be implemented in the disaster response phase and involve, for example, effective communications, damage assessment. Tactical strategies include investing in maintenance, hardening and upgrading infrastructure, and emergency supplies. Finally, strategic strategies involve investing in pre-disaster stages (mitigation, adaptation, and planning) and building relationships with diverse stakeholders to support recovery.

CONCLUSIONS

This paper brings a bibliometric analysis of the academic literature discussing the disasters' impact on SCs and SC strategies. Based on the SLR procedures, we analyze trends in the 129 documents obtained from the Scopus and Web of Science databases, according to bibliometric aspects regarding the year, trend topics, journals, authors, papers more cited, keywords co-occurrence, disasters, SC type, and preliminary identification of disasters' impacts and countermeasure strategies.

The results reveal that disasters' impact on SCs and countermeasure strategies has been debated for some time. As of 2019, the number of publications on the subject has increased. We notice that the topic is covered by different journals and authors, making the theme dispersed in the academic field. The analysis of trend topics shows a high number of publications covering the COVID-19 pandemic. The COVID-19 pandemic is the most recent global disaster and severely affects SCs in different sectors.

Concerning the disaster type addressed by the documents, the documents that deal with natural disasters (e.g., floods, earthquakes, tsunami, and pandemics) stand out since, generally, natural disasters are unpredictable events and the impacts on the SCs can be significant for companies. Still, there is a need to assess the impacts of man-made disasters (e.g., terrorist attacks, wars, fires) to assess differences and similarities between impacts and policies considering the type of disaster.

Regarding the type of chain analyzed, most documents (43%) address the food SC. This pattern shows the importance of the food chain for the economy of countries and the need to ensure the availability of food to meet demand during crises and disasters. Other SCs are also covered, such as healthcare SC, manufacturing SC, automobile SC.

Also, the bibliometric analysis allows the preliminary analysis of the documents which provides some disaster impacts on SCs: SC disruption, ripple effect, panic buying, supplies shortages, SC instability (price, inventory, supply, demand, human resources), changes in consumer behavior, mobility restrictions, income reduction and unemployment, infrastructure constraints, transport and distribution disruption (e.g., roads and railways), services unavailability (e.g., electricity and water), production and operation disruption, business and economic decline, cash flow problems, and productivity reduction. Besides, the documents present disaster' countermeasure SC strategies: agility; risk management, a collaboration between SC links, alternative suppliers, resilient design, interdependency planning, operational efficiency, organizational flexibility, cash flows optimized, information sharing, financial management, digital transformation, government policies, orientation and information, inventory management, and benchmarking.

The findings indicate the remarkable increase of research focusing on the disasters' impact on SC and SC strategies. The results constitute a first analysis on the subject, considering that it presents descriptive characteristics of the studies, which can influence the development of more detailed and specific studies. We suggest future research incorporate existing studies in other databases. Future research may address the impact of human-made disasters on SCs. Also, future studies can analyze impacts and strategies in category format (e.g., demand-side, supply-side, infrastructure). Finally, future researchers can use tools to analyze the relations between multiple variables (impacts and strategies).

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