

A Review of Sustainable Disaster Relief Chain Literature

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Abstract— The purpose of this paper is twofold. First, to provide insights into research trends in sustainable disaster relief chains. Second, to identify themes and future research direction for advancing theory. Eleven themes were identified which have implications for advancing sustainable disaster relief operations. The categorical analysis intends to explain how aspects related to identified themes impact and pose opportunities for sustainable disaster relief operations. The findings revealed that sustainable disaster relief supply chain management is an understudied yet gradually growing field of research. The recovery phase is particularly less studied from the sustainable disaster relief operations standpoint. This paper outlines a research agenda to inspire researchers focusing on advancing theory and impactful research on sustainable disaster relief operations.

Keywords— *Sustainability, Disaster Relief, Systematic Literature Review*

I. INTRODUCTION

The number of people in need of disaster relief assistance and protection is expected to reach 279 million in 2022, which is significantly higher than the previous year's record-breaking figure of 235 million [1]. Due to the conflict in Ukraine, the international situation has been aggravated by more than 12 million people in need of assistance as well as the resulting compromised global food supply [1]. A further complicating factor is the ongoing COVID-19 pandemic and the adverse impact of climate change on developing countries. In light of these complexities, humanitarian and disaster relief operations have become increasingly studied [2–5].

These emergencies have placed enormous strain on the disaster relief sector and pose grave worries regarding the sustainability of disaster relief efforts [6]. Due to the massive global volume of disaster relief operations, the sector is anticipated to become one of the largest contributors to environmental pollution [7]. To alleviate this, the sustainability and long-term effects of disaster relief chain operations have drawn considerable attention in recent years. Disaster Relief Organizations (DROs) are increasingly being accountable for their relief chain footprint and are increasingly obliged to maintain sustainability [8]. Donors and stakeholders in DROs have prioritized sustainability

agendas and concerns in light of the rising worry about climate change [9]. Increasingly, funders and stakeholders in HOs have started to prioritize sustainability agendas in light of mounting climate change concerns. To address this call, a growing yet limited number of scholars in disaster relief have been attempting to incorporate sustainability agendas into the relief chain.

However, the question of what constitutes sustainability and which programming aspects lead to sustainability in disaster relief remains unanswered. The long-term ramifications of the relief chain are relatively hard to trace and analyze. This complexity stems from the multifaceted dimensions of sustainability of disaster relief operations. A lack of clarity over which impacts, for example environmental and social, should be included in the sustainability of disaster relief operations, as well as how reliably and by what measures DROs should evaluate sustainability has remained unaddressed [7]. Due to this complexity research on relief chain sustainability and environmental impact is challenging.

Sustainable disaster relief operations studies have seen an uptick, despite the complexity of the topic [7,10,11]. Several studies have borrowed concepts and ideas from the sustainable supply chain management literature [12,13]. Among the notable research on sustainable disaster relief operations is that of Papadopoulos et al. [14] and Cao et al. [15], who studied sustainable relief chain networks. Kunz and Gold [7] advocated the development of sustainable disaster relief framework. With the advancement of technology over the last few years, an increasing amount of emphasis has been placed on applying industry 4.0 technologies to achieving sustainable disaster relief operations [16].

In view of the scattered literature on sustainable disaster relief operations and because sustainability has become a recent pressing issue in the disaster relief sector, a structural analysis is required to offer a thorough picture of the field and develop research agenda that would inspire researchers focusing on advancing theory and impactful research on sustainable disaster relief operations. To date, however, to the best of our knowledge, no systematic review has carried out a thematic analysis of sustainable disaster relief operations literature to

understand the trends and unleash potential research opportunities. The present study thus synthesizes the literature on sustainable disaster relief operations and conducts categorical classification and analysis to address this gap in the literature.

II. METHOD

We conducted a Systematic Literature Review (SLR) to identify publications related to sustainable disaster relief operations by employing the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology outlined in Higgins et al. [17]. We develop our SLR by keeping in mind the general principles for conducting a structured literature review in the supply chain domain [18]. We chose the specific steps of the PRISMA methodology for this review since it is based on systematic and explicit protocols and procedures to find, select, and critically analyze the relevant papers to incorporate into the review. PRISMA involves an iterative process of selecting and reviewing papers to develop a final collection of relevant articles for review. It increases the reliability of the review by utilizing predefined procedures for reducing bias and extracting research trends and issues. PRISMA has become a well-established and highly used systematic review method in the literature.

SLRs typically have two goals: First, they summarize previous research by identifying patterns, themes, and issues [3]. Secondly, this helps to determine the conceptual content of the topic and contributes to theory development [19]. In general, a systematic review involves the following steps, which we have followed when developing our systematic review; identifying gaps and defining the goal of the structured literature review, establishing inclusion and/or exclusion criteria for identifying relevant literature, retrieving a sample of potentially relevant literature, selecting pertinent literature and apply inclusion and/or exclusion criteria, analyze and synthesize identified literature, report descriptive and thematic findings. Fig. 1 presents our SLR process using the PRISMA method.

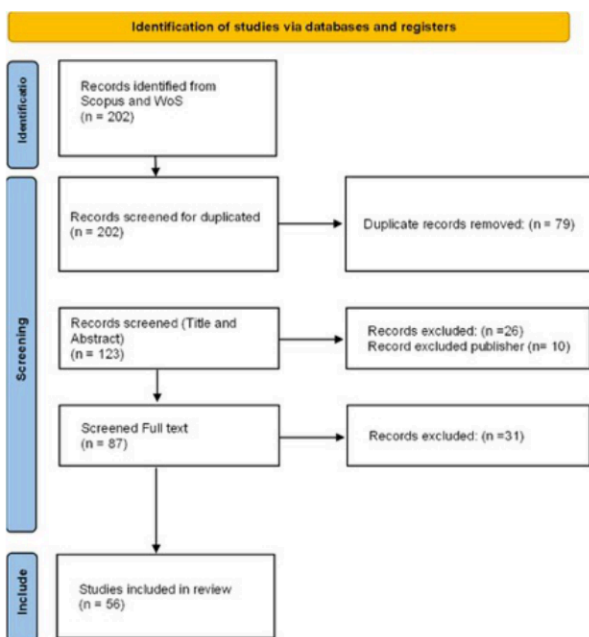


Figure 1. SLR process

We identified papers from the Scopus and WoS database. These databases were selected as they encompass a comprehensive range of refereed journals belonging to major publishers. After combining the results from both databases, we were left with a list of 202 articles. By eliminating duplicate entries, we were able to narrow the field to 123 papers. We next conducted a preliminary assessment of the 123 papers based on their titles and abstracts to verify that the papers satisfied our review criteria and that sustainability was included in their scope. We excluded 36 papers by screening the title and abstract and we were left with 87 papers for full-text screening. Finally, we analyzed the full text of the remaining articles to remove any unrelated ones. In the end, we were left with a total of 56 papers in our selection. This final sample consisted of 56 studies published between 2013 and 2022. The year 2013 corresponds to the first paper selected using our keyword combination and inclusion/exclusion criteria.

III. RESULTS

A. Distribution of reviewed papers over time

The identified papers comprise 56 articles published between 2013 and 2022. Sustainability in disaster relief operations was initially explored by researchers like Green et al. [20]. More recently, Kunz and Gold [7] have also contributed to this field of study. An increasing number of sustainability studies have emerged since then (see the distribution of papers per year in Fig. 2). There are two phases of the development trend in this literature: a) an early dissemination phase from 20013 to 2018, and b) a development phase from 2018 to 2022, with a substantial upward trend in the number of publications per year.



FIGURE 2. NUMBER OF JOURNAL PAPERS PER YEAR

B. Distribution of reviewed papers by journals and country

Table 1 lists journals that have published more than two sustainable disaster relief operations studies. Journal of Humanitarian Logistics and Supply Chain Management has published the most articles on sustainable disaster relief operations (15 articles), followed by Production and Operations Management (9 articles), Annals of Operations Research (3), and Journal of Cleaner Production (3 articles). Additionally, more than half of the total publications (32 out of 56) are concentrated in five journals dominating the sustainable disaster relief operations research field.

disaster relief in the context of developing countries. This suggests that there is a need for more research on developed countries as well as an investigation into empirical evidence of barriers and enablers in the development sector. This is significant since the majority of emergencies evolve into development programs which are usually centred on sustainability and funded by the developed world.

The overall distribution of the sustainability dimensions demonstrates that more than half of the papers (54%) investigated all three dimensions of sustainability (or unspecified). The social and economic dimension of sustainability was the focus of 14% of the studies, followed by environmental (9%), and social dimensions (4%).

V. FUTURE RESEARCH

1) *Packaging waste management*

Our analysis uncovered a lack of studies addressing waste management in disaster relief operations [21]. Despite technological advances, the COVID-19 pandemic and global supply chains for relief products have elevated the excessive use of non-biodegradable packaging materials and related waste [22]. Globally, more than eight million tons of pandemic-related plastic waste and personal protection equipment have been created, with the disaster relief and medical sectors producing a large quantity of the waste [23]. For example, Food for Peace procured over 15 million polypropylene bags just during the 2019 fiscal year [23]. This raises the essential issue of how disaster relief actors might limit the impact of packing waste or transforming it into an opportunity to serve beneficiaries [24]. Although other disaster relief efforts have a greater environmental impact, such as relief carbon footprint [25], packaging enhancements are deemed faster and feasible but still have a substantial potential impact [26].

To achieve the above objective, more theoretical and empirical research is needed to examine how to develop consistent standards for cleaner packaging across stakeholders responsible for funding and administering disaster relief assistance and aligning procurement criteria accordingly. Further research is required to quantify the packaging waste, assess the life-cycle impacts, and explore alternatives to the current relief commodity packaging. More research is required to explore a right balance of safety, handling, and environmental protection when employing reusable or biodegradable materials or paper-based packaging.

2) *Sustainable supplier management*

Although a few studies addressed sustainable sourcing and procurement in disaster relief operations, none have specifically tackled sustainable supplier management problems [27]. Environmental and social objectives are mostly neglected in existing supplier management studies indicating a lack of a systematic list of sustainability criteria for selecting DROs suppliers [28]. This is especially important since minimizing the environmental effect of the relief chain substantially requires close collaboration with qualified suppliers that rigorously monitor the environmental implications of their products and services [29].

However, as disasters are generally characterized by complexities such as uncertainties in demand, supply, and transportation, the integration of sustainability with supplier selection problems under uncertain parameters is very challenging. Uncertainty is an inherent component of disaster relief and must be addressed with the utmost urgency and efficiency to prevent delays in responding to victims. Uncertainty commonly arises from unknown variables such as uncertainty about beneficiary demand and the items needed to provide relief, loss of partial or total suppliers, and uncertainty about the network's capacity, reliability, and travel time [28].

In spite of these complexities, DROs are expected to develop ambidextrous capabilities by establishing contingency plans for failures of suppliers and transportation networks while also taking into account sustainability objectives [30–32]. Thus priorities and resource allocations to achieve sustainability become a prime objective of disaster relief aid [30]. To achieve this goal, developing decision-making tools along the line of studies such as [13,33–35] for selecting suppliers becomes imperative. Future research is required to develop a decision support model for sustainable supplier selection in disaster relief under uncertainty.

VI. CONCLUSION

This paper provides a systematic review of sustainable disaster relief supply chain management papers published from 2013 to 2022. To the best of our knowledge, this study is the first systematic literature review addressing sustainability agendas in disaster relief logistics. This is noteworthy given the significant increase in academic research published on sustainable disaster relief since 2018, as well as mounting donors and stakeholder push toward addressing sustainability in disaster relief operations. We performed a systematic review of relevant published research papers on sustainable disaster relief operations to accomplish our goal. Our study examined 56 full research papers, all of which were classified under eleven key themes that evaluate sustainability development in sustainable disaster relief chain. More theoretical and empirical research is needed to advance the maturity and impact of the field towards leveraging network orchestration and choreography, packaging waste management, performance measurement and sustainable supplier management.

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