

A Review on Supply Chain Risk and Behavioural Factors in Humanitarian Relief Operations Responding to Disasters

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ABSTRACT

Catastrophe management strives to minimize or prevent possible losses from hazards, ensure appropriate and timely aid for disaster victims, and accomplish fast and efficient recovery. Both supply chain management and its use in disaster assistance have been well studied. Even with the implementation of lean, just-in-time, and zero-inventory practices, traditional supply chain management has been unable to adapt to these disturbances due to its limited focus on cost reduction for stable operations. The purpose of this literature review is to provide strategies for improving humanitarian supply chain support operations in the face of a wide range of disasters. The analysis shows that the humanitarian organization has several difficulties and constraints when it provides aid to the victims. Disasters like earthquakes, floods, and COVID-19 often have a greater impact because of inadequate living conditions and building regulations. Disaster assistance requires a wide range of resources, including rescue operations, medical aid, food, housing, and long-term relief initiatives. The effectiveness of any relief attempt is highly contingent on how quickly supplies can be supplied. When it comes to a disaster relief operation, the kind and scope of the demand, along with the timing and location of the event, are all unpredictable. Subsequently, the study examines the risk obstacles to supplying essential resources to the impacted area. The survey study also discusses the use of agile and lean technologies for humanitarian and logistical management in the areas of cost and product delivery. This develops superior operational performance techniques for pre- and post-disaster phases. According to the study's findings, stakeholders should pay close attention to the logistical, operational, and material concerns in the management of the humanitarian supply chain.

Keywords: Humanitarian Supply Chain, Disaster, Humanitarian Logistics, Sustainable Supply Chain, Humanitarian Crisis, Risk Barriers, Agile, Lean Methodology.

1 Introduction

Preparing for a broad variety of probable outcomes makes catastrophe management one of the most challenging responsibilities. More people are being exposed to catastrophes or forced to cope with acts of violence, financial crises, and growing unpredictability, according to the management. Often, these individuals do not get the necessary help from their governments. Natural disasters brought on by human activity are more often referred to as catastrophes. Examples include natural calamities, malfunctioning technology, and infectious illnesses. Organizations that are not governments, religious organizations, and volunteers must all work together and coordinate their actions during times of disaster. The primary focus of a disaster management coordinator is to lessen the impact of crises via efficient preparation, response, recovery, and preventative measures.



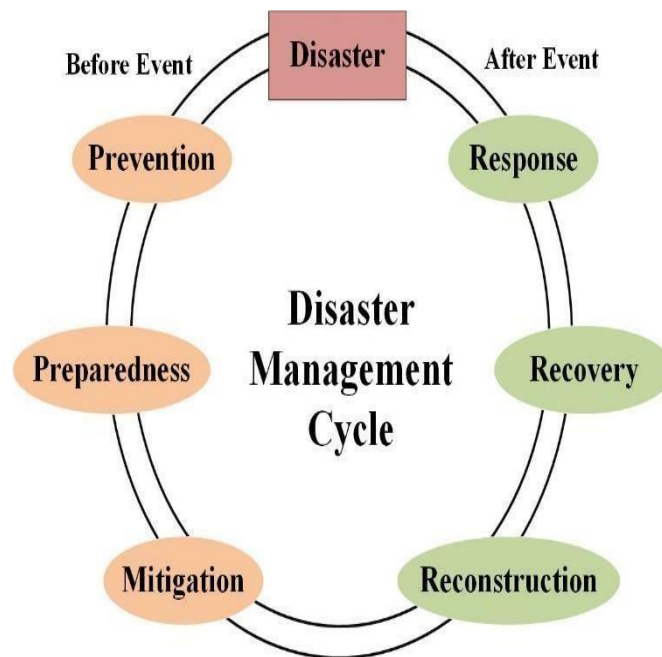


Figure 1: *Disaster Management Cycle*

The process through which governmental, corporate, and non-profit organizations prepare for disasters, react to them during and immediately after they occur, and work to recover from them is well exemplified by the cycle of disaster administration. The cycle's six stages are depicted in Fig. 1 and are as follows [1].

Prevention: Being proactive is the best response to a disaster. This means identifying potential risks and establishing safety measures to reduce their effects.

Mitigation: The goal of catastrophe preparedness and response is to minimize the number of victims. Measures may be taken both formally and informally.

Preparedness: People, communities, businesses, and organizations may all benefit from regularly planning for and exercising how they would respond to a crisis.

Response: A response is the chain of events that occurs following a disaster. It's possible to act quickly or over a longer period of time.

Recovery: The last step in catastrophe management is called "recovery." It may be completed in a matter of months or it could take years. The ultimate goal of this stage is to help people go back to normal or find a new normal when a disaster has struck their home, neighbourhood, community, company, or institution.

Reconstruction: Building upkeep and fixing. Due to the sometimes prolonged time range necessary for such projects, a broad range of actions, may be defined as various kinds of mitigation.

In order to properly manage disasters, legislative measures and programs must be developed to either mitigate the negative consequences of catastrophes on infrastructure, people, and businesses. Improvements in catastrophe prevention are made by preemptive planning and mitigation measures. When it comes to crisis response and catastrophe preparation, a community's level of development is vital. The

aftermath of a catastrophic event may be mitigated with the help of the disaster-management cycle. Possible topics include emergency procedures and restorative remedies.

2 Humanitarian Crisis in Various Disaster Situations

High mortality or malnutrition rates, the development of infectious illnesses and epidemics, and medical difficulties that impact a whole community or geographical region are all indicators of a humanitarian crisis. Possible contributors include a lack of safety in their living conditions, food, drink, and restrooms. Lack of protection in regions of the world with already entrenched inequality, poverty, and a dearth of basic necessities; a catalyst that worsens things: political events like military battles, coups, ethnic and religious persecution, etc., that result in humanitarian catastrophes and a dearth of essential amenities; Both natural catastrophes and political events, such as wars, coups, ethnic and religious persecution, etc., are contributing to an increase in the frequency and duration of humanitarian crises. When a crisis grows beyond the government's ability to manage its consequences, humanitarian help is essential to meeting the needs of those most in need. The prevalence of cardio metabolic risk variables in the Venezuelan population has been studied by Juan P. Gonzalez-Rivas *et al.* [2] during the CHC's 20-year history. The 2018-2019 malaria pandemic in South Kordofan state, located in southwestern Sudan, is described in depth in a study [3] by Nouh S. Mohamed *et al.* The media's portrayal of the fast spread of malaria is cause for grave alarm. To prevent, manage, and eventually eradicate malaria, knowledge of its risk factors is essential. Sumbal Javed *et al.* [4] found that SEA occurs often in war-torn regions. Many countries, including Bosnia, Cambodia, have since accused SEA of misconduct. In order to develop a theory of motivation in prosocial venturing, the research comprised an 8-month qualitative assessment of such ventures during the German immigration crisis described by Alexandra Mittermaier *et al.* [5].

2.1 Humanitarian Crisis During the Climate Change Requirement

The enormity of emergency situations over the last decade has put traditional disaster response strategies in jeopardy. Weather-related calamities almost often interrupt supply networks, putting people in need in jeopardy. The impoverished and displaced (refugees) in low- and affluent countries are particularly vulnerable to the present outbreak due to a lack of access to bathing, and health services. The area, according to Muhammad Mainuddin Patwary *et al.* [6], is home to a sizable and diversified community of individuals of all ages. Many people with noncommunicable, preexisting chronic diseases have picked up new infections. As a result, Rohingya refugees living in densely populated settlements (40,000 people per square kilometre) have difficulties implementing preventive measures (such as social isolation).

Traditional disaster response strategies have been compromised by the extent of humanitarian disasters during the last decade. When disaster strikes and supplies can't get to those who need them, they're in a dangerous position. Methods that take a systems view Given the growing number of climate- related humanitarian crises and the dismal forecasts for the planet's susceptibility to the consequences of climate change, integrating public-private partnerships is crucial. The impoverished and the displaced (refugees) in low- and middle- income nations are especially susceptible to the current epidemic because they lack access to facilities for bathing, sanitation, and hygiene. It may be difficult for a supply chain of this kind to estimate how fast victims would need assistance. Strong tropical storms like cyclones pose a threat to coastal areas. People may be able to return home sooner from temporary housing if damaged structures are rebuilt more quickly. Organizations on a global and national scale, including governments, militaries, civil society organizations, commercial corporations, and non-governmental organizations (NGOs), must work

together to coordinate humanitarian aid logistics management. Humanitarian help requires a broad variety of HSCs that can be deployed anywhere in the globe with little difficulty.

2.2 Humanitarian Assistance and Disaster Recovery Operations

However, it may take longer for humanitarian aid from outside the affected area to reach remote areas. In recent years, there has been a rise in HADR (humanitarian assistance and disaster relief) consciousness across the globe. In order to minimise unmet demand, environmental risks, and emergency expenses while increasing satisfaction among survivors, Strong tropical storms, such as cyclones, pose a threat to coastal areas. Time spent away from residences during evacuations may be cut short if repairs can be made more quickly. Ascertaining the ease of access, affordability, and speed of service. Literature beta and Monte Carlo models are analysed by Rafael Diaz *et al.* [7]. The models are able to reflect the immediate and long-term costs of rebuilding operations due to the inclusion of stochastic components on predicted flows of materials, manpower, and equipment. While inspecting the post-flood restoration work. The transition to the recovery phase is fraught with potential pitfalls, as outlined by Rizwan Akbar Ali *et al.* [8]. Humanitarian relief and disaster response (HADR) missions are being used more often by the military forces of the ANZUS governments bordering the Asia-Pacific area, as detailed in a report by Vanessa Newby *et al.* [9]. The problems FEMA had in organizing Manas Pradhan *et al.* [10] present a prototype MQTT-based federation between military and civilian ICT systems. Decision attributes for transport network disaster recovery planning are proposed by Milad Zamanifar *et al.* [11] using a structured method. The aforementioned features may be used by transport network designers and disaster management as crucial criteria for post-disaster decision support systems. Military aid, as argued by Joanne Clifford *et al.* [12], may help in the short-term, but it doesn't improve local capacities or accommodate catastrophe victims' wants and requirements in the long-run. In light of the persistent ecological challenges brought on by climate change, humanitarian Shelter and Settlement (S&S) solutions are more important than ever. Humanitarian S&S efforts should aim to solve people's housing needs in their entirety, rather than just providing a service or a cash subsidy for accommodation. Increased material availability and quality via assistance with housing, shelter, and associated service systems and supply chains.

3 Humanitarian Supply Chain Management

There has been an increase in humanitarian aid projects in response to recent natural and man-made calamities. Due to recent catastrophes like the COVID-19 pandemic, as well as war, earthquakes, and floods, the need of humanitarian supply chains (HSC) has only increased. Organisations on a global and national scale, including governments, militaries, civil society organisations, commercial corporations, and non-governmental organizations (NGOs), must work together to coordinate humanitarian aid logistics and supply chain management. Many worldwide, adaptable, and mobile humanitarian supply chains (HSCs) are needed [13]. Supply networks are flexible enough to adjust to changes in demand, supply, or the potential for damage during transport. A large quantity of data is produced and consumed by HSC's main players, and it must be collected in a dynamic environment. Although natural disasters are occurring less often, and the economy is growing. It may be difficult for a supply chain of this kind to estimate how fast victims would need assistance. Strong tropical storms like cyclones pose a threat to coastal areas. People may be able to return home sooner from temporary housing if damaged structures are rebuilt more quickly. Organizations on a global and national scale, including governments, militaries, civil society organizations, commercial corporations, and non-governmental organizations (NGOs), must work together to coordinate humanitarian aid logistics and supply chain management. Humanitarian help requires a broad variety of

HSCs that can be deployed anywhere in the globe with little difficulty. The humanitarian supply chain management flow is shown in Fig. 2.

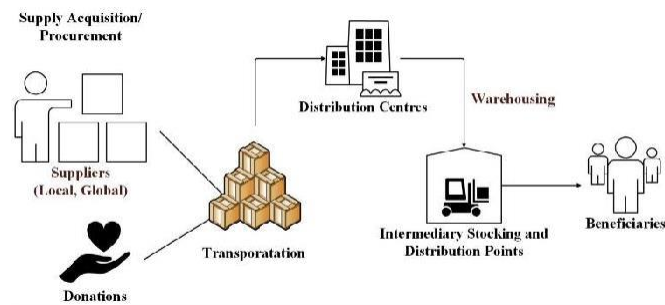


Figure 2: Humanitarian Supply Chain Management

3.1 Pillars of Humanitarian Supply Chain

A strong supply chain is necessary for providing humanitarian relief, such as food, clothing, shelter, and transportation, and the components of the distribution network are the same for all supply chains [14].

Planning: - Planning for networks, inventories, and capacities is essential at all granularities, from the strategic to the operational. The Indian Army, for instance, stores provisions in multiple warehouses and maintains these supplies depending on war and weather projections. The capacity and network are being set up in line with the prognosis so that the relief supplies may go to the victims as soon as feasible.

Procurement: - After the planning is finished, the resources are acquired and replenished. Sourcing management involves both planning and implementation.

Logistics: - Third-mile logistics are the processes that get aid from a warehouse to people in need. Logistics in the first mile are those that take place between the point of origin and the distribution centers. Transportation between storage facilities based on demand projections and supply plans is an example of second-mile logistics.

Warehouse: - Depending on demand, products are kept in a variety of storage conditions, including cold storage, frozen storage, and ambient storage.

Finance: - Keeping track of all bought items, resources, and facilities.

Human Resource - HR is necessary for the management, execution of the supply chain.

3.2 Humanitarian Supply Chain in Flood Disaster

Floods and other catastrophes caused by nature, as well as man-made disasters, may inflict a great deal of suffering, but the humanitarian supply chain is critical in alleviating that suffering. However, due to data ambiguity and conflicting agendas, a reliable humanitarian supply network is required. According to the results, people in charge of the supply chain for humanitarian assistance should make an effort to incorporate stakeholders, maintain open communication, and set long-term goals. Munir Zarina Abdul *et al.* [15] hypothesized that flexibility, collaboration, and cooperation were critical to the efficacy of the humanitarian supply network during the flood catastrophe in a particular rural region of Kelantan province, the Republic of Malaysia. According to the findings, the two most critical factors influencing the effectiveness of the humanitarian supply chain are agility and coordination. Fabiana Santos Lima *et al.* [16] examine the firms that are contracted to buy urgently essential components.

3.3 Humanitarian Supply Chain in Covid-19 Epidemic

The current COVID-19 outbreak has killed millions of people, halted worldwide trade, and cost businesses billions of dollars. The World Bank calls a 5.2 percent drop in GDP the "deepest global recession in

decades." There were two major waves of the COVID-19 epidemic. Costs associated with supply chains, especially transportation costs for pandemic help, might be minimised by using a multi-criteria sustainable planning approach, as proposed by Behnam Malmir *et al.* [17]. The costs of supplying resources may need to be weighed against the costs of deprivation when managers are given a realistic understanding of both. During a pandemic, Sudhanshu Joshi *et al.* [18] identify and explain important components that may increase HA's effectiveness. The findings of the literature search were interpreted using Fuzzy-Delphi analysis, which allowed us to home down on the most pertinent information. Thirty proposals from nations that have housed refugees and other victims of armed conflict were assessed by Yara M. Asi *et al.* [19] using a multi-stage process. During COVID-19, Shahla Jahangiri *et al.* [20] propose a hybrid strategy for usage in Iranian hospitals' emergency rooms to prioritise important supplies in the humanitarian distribution chain.

4 Risk Barriers to the Operationalise of humanitarian Supply Chain Management

Disaster risk reduction (DRR) is an important aspect of worldwide aspect to address the problem since climate change increases the chance of natural catastrophes. Dwivedi *et al.* (2018) [21] provide an excellent example. Managing an ESC include tasks like as stocking supplies, keeping the lights on, and getting the information out fast and properly when an emergency occurs. In a crisis, disruption risks, a catch-all phrase for operational effectiveness concerns, may have an influence on the creation and administration of an ESC. If not all of these risks are mitigated, the effect of naturalcatastrophes may be exacerbated. This research investigates the issues of managing humanitarian supply networks in developing nations prone to natural catastrophes. Surajit Bag *et al.* [22] use Fuzzy Total Interpretive Structural Modelling (TISM) to identify the most urgent impediments, categorize them, and construct their contextual interrelationships. Vishwas Dohale *et al.* [23] analyzed the COVID-19 distributionto see what is blocking HSC in India. The results reveal that "lack of government funding and support, a shortage of experienced and skilled rescuers, and shortage of modern technology utilization" are the major obstacles preventing the HSC from operating more efficiently during the COVID-19 outbreak, in contrast to previous pauses.

Munir Zarina Abdul *et al.* [24] hypothesized that flexibility, collaboration, and cooperation were critical to the efficacy of the humanitarian supply network during the flood catastrophe in a particular rural region of Kelantan province, the Republic of Malaysia. According to the findings, the two most critical factors influencing the effectiveness of the humanitarian supply chain are agility and coordination. Fabiana Santos Lima *et al.* [16] examine the firms that are contracted to buy urgently essential components.

Soap and other personal hygiene products need a dependable distribution network. Karina Reiter and her colleagues [25] researched flood risk management in Austria as a consequence. Sarina Yusoff *et al.*'s [26] research attempts to document the many ways in which people cope with thehuman impacts of floods. In light of the findings, social support, employee participation in flood control, and post-storm adaption activities were all stressed as essential. HaidarAbbas *et al.* [27] devised a study to determine what hinders HSCs from sustaining their efforts over time.

4.1 Human Factors in Humanitarian Supply Chain Management

Strategic human resource management may be the "soft side" of management, but it is essential to the efficient running of humanitarian supply chains. Effective management of humanresources is crucial to the ability of aid organizations to anticipate, avoid, and react to emergencies. Yeganeh Gheibi *et al.* [28] conducted a study to learn more about the methods andmotivations of high-profile athletes' participation in the distribution of humanitarian aid. Interview information on 25 micro-activities was organized into the managerial, legal, human, cultural, and communication-technological categories.If vital supply chain assets

like transportation networks and storage facilities for goods and equipment are destroyed, the humanitarian supply chain might be disrupted. Marzieh Amirhoseini *et al.* [29] investigate and manage any unforeseen occurrences. Here's Suzi Zeti, the first of her kind. Success or failure of Malaysian humanitarian organisation is linked to human resource management, as examined by Mat Jusoh *et al.* [30]. Since HRM backed SQM, the effects were felt everywhere. Isaac Sakyi Damoah *et al.* [31] analyse the CSFs of humanitarian distribution network management (HSCM) with an emphasis on flood catastrophe management (FCM) in Maharashtra. Seventy-four criteria were identified as crucial for managing flood catastrophes under the HSCM framework. Aliza Sharmin *et al.* [32] looked at the relationships between CSFs for coping with a variety of situations. Its effectiveness was recently shown in Bangladesh, when floods and a pandemic happened simultaneously.

5 Humanitarian And Logistics Management

Effective management of human resources is crucial to the ability of aid organizations to anticipate, avoid, and react to emergencies. Yeganeh Gheibi *et al.* [28] conducted a study to learn more about the methods and motivations of high-profile athletes' participation in the distribution of humanitarian aid. Interview information on 25 micro-activities was organized into the managerial, legal, human, cultural, and communication-technological categories. Experimental and targeted improvements in humanitarian management. Mohammad Asif Salam *et al.* [33] use the 2010 Haiti earthquake to make lessons about logistics management in humanitarian disasters. Based on the results, humanitarian groups need to coordinate their efforts more closely. Our interviews suggested there was a lack of communication and collaboration between civilian and military authorities, leading to wasted time and money. Denise *et al.* [34] examine the international response to COVID-19 via a U.S. perspective. Articles are compiled from periodicals and dailies throughout the United States between February and July of 2020. This archive of presentations from COVID-19 might be valuable to researchers. Research on the manifestations and consequences of complexity in HL was conducted by Sarah Schiffing and coworkers [35] using the concept of complex adaptive systems. Humanitarian activities in Pakistan and Haiti are examples of the intricacies of problems that affect many people. Using online robust principle components assessment (RPCA) and a long-short-term memory (LSTM) recurrent network, Donovan Fuqua *et al.* [36] provide a model for regulating fuel use in the midst of two regional humanitarian crises. Management from Austria. Findings emphasized the significance of social support, employee engagement in flood control, and post-storm adaptation efforts. To identify the factors that prevent HSCs from maintaining their efforts over time, Abbas H *et al.* [27] designed a research.

5.1 A. Humanitarian Logistics Disaster Relief Supply Chain Operations

A well-oiled supply chain for disaster relief is essential for the rapid delivery of commodities to areas devastated by catastrophes (both natural and man-made). This helps the healing process go quickly. Many scholarly works have been written on the logistics of disaster relief supply chain management. Wapee Manopiniwes *et al.* [37] lay out a plan of action for managing humanitarian activities in the aftermath of floods. Having a strategy in place that details how the various links in the relief supply chain interact with one another is crucial at this time. As a response to the problem of finding a temporary depot during catastrophes, location-routing was developed. The study's authors, Jiang Xiang Zhu *et al.* [38]. The proposed system employs a fuzzy interval to ensure that essential resources are not depleted during an emergency, protecting lives and reducing property loss. Zerine Tasnim *et al.* [39] studied the disaster supply chain management procedures involved in Bangladesh's relief efforts. This research used a thematic analysis strategy. The proposed method uses fuzzy intervals to guarantee that disaster-stricken areas have an

adequate supply of emergency supplies at all times. Zerin Tasnim *et al.* [39] investigated disaster supply chain management practices in Bangladeshi relief operations. In order to verify the data collected from the linked articles and weblogs, we conducted interviews with supply chain professionals. Although it's often considered the "soft side" of management, strategic human resource management is crucial to the smooth operation of humanitarian supply chains.

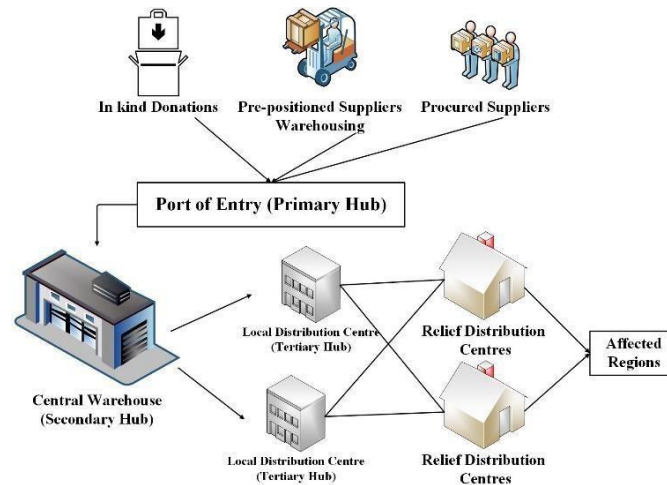


Figure 3: Disaster Relief Operations

Figure 3 depicts the catastrophe assistance logistical operations. They can quickly assess what has to be thought about in order to develop a sustainable DSCM strategy for humanitarian help. In-depth research on quality management in emergency and humanitarian assistance is provided by Sachin Modgil *et al.* [40]. Kerala's rescue workers were able to better coordinate and communicate thanks to satellite big data analytics performed on a cloud computing platform on top of real-time meteorological information and geographical data [41]. In-depth qualitative interviews are conducted with key on-the-ground stakeholders by Felix Chari *et al.* [42] to identify risks in the Cyclone Idai relief supply chain. The importance of this research rests in the fact that it will help humanitarian supply chain managers prepare for the fortification of their networks in the event of calamities. Anqi Lin *et al.* [43] and Jia Shu *et al.* [44] look into this issue by noting that the supply needs at each affected location are unknown but may be provided by a large number of relief facilities; this poses a significant network design problem for humanitarian assistance. In this study, the Rammasun typhoon of 2014 serves as a case study to illustrate the model's value. The pragmatic approach to performance evaluation in humanitarian operations provided by Ali Anjomshoae *et al.* [45] acknowledges the need for multidimensional performance assessment and addresses imprecision and ambiguity in evaluation methodologies. A multi-stage hierarchical fuzzy inference system (FIS) was developed to handle ambiguous and inaccurate performance measures. Time window chosen at random to optimize the preservation of essential supplies and the prevention of further fatalities in places hit by catastrophe. The management of catastrophe supply chains during relief operations in Bangladesh was studied by Zerin Tasnim, [39]. Supply chain experts were polled, and their responses were cross-referenced with data culled from scholarly journals and blogs. Strategic human resource management, or the "soft side" of management, is crucial to the smooth operation of humanitarian supply chains. Lack of conventional operating processes and general standards led to subpar material selection, erratic distribution, and disregard for local customs in recent catastrophic hygiene kits. During and after a natural catastrophe, Sachin Agarwal *et al.* [46] proposed a mathematical model for decision-making.

5.2 Supply Chain Agility in Humanitarian Relief Operations

Every minute saved is a life saved, thus humanitarian organisations responding to disasters require a set of criteria to follow when organising their logistical approach. Humanitarian agencies, when faced with a catastrophic event, must act swiftly to devise a strategy for saving as many lives as possible with limited resources. Agile practises have been likened in the academic literature to other time-sensitive areas, such as emergency response and humanitarian aid. Cooperation may lead to more effective use of resources including time, money, and materials. Kabra and Ramesh (2016) [47] investigated the factors that motivate individuals to assist in disaster management and identified ways in which this scenario may be improved. The existing system's restrictive character can reportedly only be addressed via collaborative effort and open dialogue. It will promote state-of-the-art IT infrastructure to be set up for emergency situations. Therefore, effective crisis management requires communication and cooperation among all involved parties. The SC has to be restructured, revamped, and updated so that it can react more rapidly and efficiently in times of crisis [48]. The ability of an organization to quickly modify its supply chain (SC) strategy and operations in light of new data, circumstances, or regulatory obligations is one definition of agility. Organizations and groups assisting in disaster relief. Routine monitoring, review, and analysis may help lower the risk of catastrophic accidents in the workplace.

Rameshwar Dubey *et al.* [49] investigate the moderating effects of intergroup leadership (IGL) and AI-driven big data analytics capabilities (AI-BDAC) on information aligning (IA), cooperative (CO), as well as supply channel agility (SCAG). This study's surprising findings add theoretical complexity to the current discussion over how humanitarian supply networks could adapt to technology advancements. Assistance must always be close at hand. In order to better understand how self-organization and its elements might improve supply chain agility in the context of humanitarian assistance operations in Uganda, Henry Mutebi *et al.* [50] conducted research. For crisis management, the authors (Mosayeb Dashtpeyma, *et al.* [51]) provide a ranking and scoring of the features of chain networks. Fuzzy set theory is used in this method to provide a more objective and less subjective assessment. Institutional and cultural influences on the responsiveness of third-party logistics providers in the supply chain are examined by Benjamin R. Tukamuhabwa *et al.* [52]. Business leaders may use the findings to prioritise removing the external obstacles to supply chain agility. Lai-Wan Wong *et al.* [53] suggest that the effectiveness and malleability of SC re-engineering might be affected by the use of AI for risk management. We may simulate a number of scenarios and address crucial problems with the help of artificial intelligence that would be infeasible using traditional methods of technology study, development, and application. We used the multi-construct agility hypothesis along with our results from the non-linear model interactions.

6 Leagile performance Of Humanitarian Aid in Supply Chain Network

Those who really care urge HOs to put donations to good use. The principles of "lean management" (LM) may be applied to the problem of resource allocation. There are many requirements that must be met before HOs may lawfully adopt LM. The choice between lean and agile practises is unnecessary, since they may coexist in the same supply chain. Using agile and lean techniques guarantees a steady emergency supply chain. But where exactly in the humanitarian logistics chain flexibility and efficiency will be most effective is not yet obvious. One key area of inquiry into lean and agile is the effectiveness with which HSCs acquire and use their resources. Jyoti L. Mishra *et al.* [54], using the Theory of Constraints (TOC) and dynamic capacity, highlight the issue of waste as a topic that may benefit from the combined expertise of academics and HO professionals. Upadhyay *et al.* [55] studied the effectiveness of lean and agile strategies for HSC catastrophe recovery. The results show that combining the two concepts is the best way to reduce supply

waste and enhance the adaptability of the HSC procedure. Lean and agile integration may help you take advantage of economies of scale, which can help you save money.

6.1 Comparison Survey Study of Agile and Lean Strategy on the Humanitarian Supply Chain

Over the last two decades, the death toll from natural disasters has increased by a factor of three. In the aftermath of a disaster, humanitarian supply chains (HSCs) work to save as many lives as they can with the fewest resources necessary. Lean and agile have been the subject of substantial research because to their potential to aid HSCs in the rapid and efficient deployment of resources throughout the disaster life cycle. This is because there is no cohesive body of literature or body of research to draw from. The different facets of humanitarian supply chain management are summarized in this study. Table 1 provides a concise overview of the current state of the art in watermarking methods, as well as a summary of performance, potential problems, and suggestions for further research. The results of this survey will be invaluable to researchers studying the effectiveness and flexibility of vital humanitarian activities in a variety of fields and contexts. Waste is an area of study that can only be addressed by the combined efforts of academics and HO practitioners, as pointed up by Jyoti L. Mishra *et al.* [54], who apply the Theory of Constraints (TOC) and dynamic capacity to bring attention to the problem. Upadhyay *et al.* [55] compared lean and agile approaches in HSC to examine disaster preparedness and recovery. The study concluded that both ideas contribute to less supply waste and more HSC process flexibility. Costs may be reduced by taking advantage of economies of scale, which can be achieved via lean and agile integration. Artificial intelligence allows us to simulate several situations and solve critical issues that would be impossible with more conventional approaches to technology research, design, and implementation. The worldwide spread of COVID-19 has reportedly been devastating. In light of what we've learned from this pandemic, researchers are now systematically evaluating studies that compare different approaches to mounting an effective HSC response to future pandemics. Challenges, such as a lack of readiness, arose during the COVID-19 outbreak. Potential damage may be mitigated and social susceptibility reduced by making the right choices and taking the right measures at the right times throughout the crisis management cycle. Numerous research on the possible uses of lean and agile in HSCs have been done due to the lack of clarity and predictability in disaster response data. With regards to disaster response and recovery, this research assesses and classifies the literature on HSCs in respect to the lean and agile paradigms. In particular, the benefits of lean and agile approaches during the responsiveness phase are highlighted. In light of what we've learned from this pandemic, researchers are now systematically evaluating studies that compare different approaches to mounting an effective HSC response to future pandemics. Challenges, such as a lack of readiness, arose during the COVID-19 outbreak. Potential damage may be mitigated and social susceptibility reduced by making the right choices and taking the right measures at the right times throughout the crisis management cycle. Numerous research on the possible uses of lean and agile in HSCs have been hindered due to the lack of clarity and predictability in disaster response data. With regard to disaster response and recovery, this research assesses and classifies the literature on HSCs with respect to the lean and agile paradigms. In particular, the benefits of lean and agile approaches during the responsiveness phase are highlighted. This is because there is no cohesive body of literature or body of research to draw from. The different facets of humanitarian supply chain management are summarized in this study. Table 1 provides a concise overview of objectives and tools adopted in the literature for assessment, management and implementation of agile/lean tools.

Table 1: *Comparative Study of Lean and Agile in Humanitarian Logistics Relief Operation*

Year	Author	Objective
2020	Muhammad Shafiq et al [56]	Lean Readiness Assessment Model for Humanitarian Organizations to Evaluate Their Readiness for Adopting Lean Management
2020	Waqar Ahmed et al [57]	Determine the quality management implementation and market orientation (MO) impact on supply chain strategies.
2021	Amjad Hussain et al [58]	Assessing the responsiveness and road-mapping initiatives of relief operations to build resilience in DROs.
2022	Rakesh Nayak et al [59]	In a local government of a disaster-stricken area with a developing economy, handle humanitarian logistics and supply chain management (HLSCM).
2022	Nyile Erastus Kiswili et al [60]	Analyze the impact of waste management and supply chain responsiveness on Kenyan humanitarian aid groups.

7 Discussion of the Review Study

Emergency management (sometimes known as "disaster management") aims to reduce the destructive impact of emergencies and other catastrophic occurrences. Natural disasters may strike any region or population at any moment. The effects of disasters may be mitigated by prevention, early reaction, and full recovery. Any nation may be hit by a natural disaster, but the poor would be less able to assist their kids and families get back on their feet fast. Research into the humanitarian supply chain, which aims to mitigate disaster damage, has made significant strides in recent years. Humanitarian supply networks need resilience in the face of environmental instability and competing agendas. A system's "resilience" is its ability to recover quickly from disruptions. Humanitarian supply chains (HSC) may be used to lessen the impact of distribution disruptions caused by disasters like the current COVID-19 epidemic.

The worldwide spread of COVID-19 has reportedly been devastating. As a result of the lessons learnt from this pandemic, researchers are now systematically evaluating trials that compare different approaches to reacting to a pandemic with a strong HSC. Inadequate planning was one source of trouble during the COVID-19 pandemic. The research concludes that these obstacles to HSCM's growth may be overcome using a mix of mathematical and decision-making models. The Bibliometrix R package and the Biblioshiny shiny app are used by certain academics to do bibliometric assessments of HSC studies. Last but not least, humanitarian logistics makes it easier to provide aid to those who need it. Managers in distribution use demand forecasting and supply chain management to respond as quickly as possible to emergencies. Potential damage may be mitigated and social susceptibility reduced by making the right choices and taking the right measures at the right times throughout the crisis management cycle. Numerous research on the possible uses of lean and agile in HSCs have been done due to the lack of clarity and predictability in disaster response data. In light of the lean and agile recovery paradigms, this study reviews the existing research on HSCs and classifies it accordingly. In particular, the benefits of lean and agile approaches during the responsiveness phase are highlighted.

8 Research Problem Definition of The Study

Tsunamis and seismic events are particularly harmful to human cultures. Natural disasters include floods, mudslides, and earthquakes, whereas man-made disasters include industrial mishaps, chemical spills, and building collapses. Those affected by a catastrophe have a better chance of surviving the crisis and getting their lives back on track if relief and recovery materials get to them as quickly as possible. A well-oiled supply

chain is invaluable. An efficiently run supply chain will consistently and quickly provide "the right materials" in the "right quantity" to the "right people." The humanitarian aid business, both for-profit and non-profit, may benefit from HSCM. HSCM is more difficult than conventional supply chain management. HSCM necessitates the collaboration of several parties because to the deteriorated infrastructure, constrained energy, and overstretched public transport links. There are several parties involved in providing aid, including recipients, government agencies, and service providers. Multiple pandemics and epidemics throughout history have wiped out whole people, economies, and cultures. The supply chains used by humanitarian organizations must be resilient in the face of environmental uncertainty and conflicting agendas.

9 Motivation and Contribution of the Study

Trust in the government and humanitarian groups' capacity to react adequately to the crisis was challenged as the second wave of the pandemic wreaked havoc on health and humanitarian situations in all of India's states. The disruption of essential services such as healthcare, nutrition, education, and child protection had a disproportionately negative impact on children. During the pandemic, UNICEF was instrumental in raising and delivering humanitarian funds. There are already 64 mass thermal scanners at airports and 11 at seaports, and 461,000 healthcare workers have received 11.5 million pieces of personal protective equipment. By the end of 2021, the government's 385 RT-PCR devices and 100 RNA extraction machines would have performed an estimated 15.4 million tests. As part of the humanitarian supply chain (HSC), emergency supplies are produced, delivered, and distributed before, during, and immediately after a catastrophe. The HSC's responsiveness may be owed in part to the organization's willingness to take an agile strategy. The findings suggest that applying agile principles to supply chain management might improve services aimed at controlling the spread of infectious illnesses.

10 Conclusion and Future Scope

Several academic works on humanitarian SCM have been published in recent years. Humanitarian SCM literature in the context of humanitarian aid operations with fluctuating demand rates and unpredictability has not been included in any of these assessments. Many natural catastrophes, including floods, COVID-19, cyclones, and wars, have motivated researchers to analyze the humanitarian supply chain's reaction. Relief goods like medical supplies, food, water, and temporary shelter all come within the scope of humanitarian distribution chain management. Communication, transparency, and coordination issues hinder the ability of humanitarian agencies to react to crises. Management teams may improve their effectiveness by deliberate practice of skills that contribute to strategic management. Rare illness pandemics are nothing new. How and why SCs were impacted by COVID-19, Drug distribution, vaccine procurement, and first aid in emergencies are just a few of the subjects covered here. The length of time that transit was halted varied from country to country. There were outages and supply problems in a number of locations. It's possible that demand has dropped for certain items while rising dramatically for others. Humanitarian assistance and disaster response networks need to be able to quickly adapt to changing circumstances. Future research in this area appears to be promising as the researchers are now very much interested in SCM's potential implications for reliable service provision in epidemic/ disaster zones.

11 Publisher's Note

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