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Enhancing Humanitarian Logistics Through Digital Innovation and Systemic Reform: A Narrative Review in Developing Countries

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ABSTRACT : The increasing complexity of humanitarian crises has brought renewed attention to the efficiency and adaptability of humanitarian logistics and disaster relief supply chains. This narrative review aims to synthesize recent literature concerning the integration of emerging technologies and multi-stakeholder coordination in enhancing disaster response, with a particular focus on developing countries. Using a structured keyword search across academic databases such as Scopus and Google Scholar, the review includes empirical and conceptual studies addressing pre-disaster planning, warehouse distribution, technological integration, and ethical dimensions. Key findings reveal that systemic obstacles, including bureaucratic inefficiencies, fragmented policies, and institutional misalignment, continue to hinder rapid and effective disaster response. In contrast, technological innovations such as IoT and blockchain, alongside digitalized information systems, improve logistical transparency and inter-agency coordination. The review also emphasizes the importance of ethical decision-making and human resource management in ensuring equitable aid delivery. Models employing simulation, multi-criteria analysis, and robust optimization have demonstrated strong potential in enhancing prepositioning and real-time operations. Despite these advances, gaps persist in empirical validation, grassroots engagement, and long-term impact assessments. These insights offer practical implications for humanitarian agencies and policymakers, including the implementation of real-time digital tracking systems, simplification of inter-agency protocols, and prioritization of volunteer training initiatives to enhance logistical agility. By integrating ethical, technological, and systemic perspectives, humanitarian logistics systems can become more resilient and responsive to future global emergencies.

Keywords: Humanitarian Logistics; Disaster Relief Supply Chains; Emergency Response; Digital Transformation; Developing Countries; Ethical Logistics; Humanitarian Coordination

INTRODUCTION

In recent years, the global landscape of disaster management has been significantly challenged by the increasing frequency and intensity of both natural and human-induced disasters. Central to

effective disaster response is the role of humanitarian logistics and disaster relief supply chains, which serve as the backbone for delivering timely aid to affected populations. These systems encompass the planning, implementation, and control of the efficient flow and storage of goods, services, and information during humanitarian crises. However, their operational efficacy is often compromised by contextual complexities such as geographical disparities, infrastructural limitations, and dynamic operational environments. Rahman et al. (2022) and Negi (2022) emphasize that key obstacles in humanitarian logistics stem from fragmented coordination among agencies, inefficient transportation and distribution systems, limited resources, and communication breakdowns among stakeholders. For instance, regions like Bangladesh, which are routinely impacted by cyclones and flooding, exhibit persistent logistical strain due to poor infrastructure and high-risk transportation routes (Rahman et al., 2022). Similarly, prolonged droughts in Southern African Development Community (SADC) countries such as Eswatini have disrupted logistics systems through land-use changes and infrastructure degradation (Munyaka et al., 2024). These geographically rooted challenges underscore the urgent need for adaptive, regionally tailored logistics strategies (Negi, 2022).

The intersection of climate change and humanitarian response further complicates logistical operations. Accelerated climate variability has heightened the prevalence of extreme weather events, including floods, cyclones, and heatwaves, exacerbating the vulnerability of populations and straining humanitarian supply chains. Yuste et al. (2019) and Yan (2023) argue that climate-induced disruptions have necessitated urgent adaptations in pre-disaster planning and real-time response strategies. For example, global temperature increases and erratic precipitation patterns have led to more frequent and severe disasters, requiring humanitarian organizations to reconfigure their logistics operations for greater agility and responsiveness. This scenario has intensified calls for the integration of advanced technologies, such as satellite-based monitoring and real-time data systems, to facilitate informed and timely decision-making in uncertain and volatile disaster contexts (Munyaka et al., 2024; Yan, 2023).

Global statistics offer a sobering reflection of the gaps that persist in humanitarian logistics effectiveness. In the SADC region alone, over 63 million people have been affected by droughts over the past century (Munyaka et al., 2024). While significant resources have been allocated to humanitarian aid, systemic failures within logistics operations—particularly in coordination, resource allocation, and infrastructure—remain major impediments to efficient aid delivery (Jabbour et al., 2017; Yan, 2023). These shortcomings are often most evident in critical phases such as procurement, pre-positioning, and distribution. Rahman et al. (2022) and Yuste et al. (2019) highlight how inefficiencies in these areas frequently negate the impact of otherwise well-funded humanitarian efforts, ultimately undermining the resilience and recovery of affected communities.

The multifaceted challenges of humanitarian logistics span beyond immediate response mechanisms, encompassing broader systemic issues. As noted by Munyaka et al. (2024) and Negi (2022), effective disaster logistics require multi-agency coordination, robust infrastructure, and context-specific transportation strategies. Moreover, the increasing pace of climate-related disasters necessitates the incorporation of predictive models and adaptive frameworks within pre-disaster planning. Emerging literature advocates for the adoption of holistic approaches that

integrate information technologies, foster cross-sector collaboration, and embed resilience into supply chain systems (Rahman et al., 2022; Yuste et al., 2019; Jabbour et al., 2017; Yan, 2023). Despite these insights, practical implementation remains inconsistent, particularly in developing regions where infrastructural and institutional capacities are limited.

A significant gap in the literature pertains to the integration of emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and other Industry 4.0 innovations into humanitarian logistics. While the potential of these technologies to optimize logistics operations is widely acknowledged, empirical studies that systematically evaluate their impact are scarce (Ülkü et al., 2024). Ehsani et al. (2023) emphasize the limited availability of theoretical frameworks that incorporate AI-driven distribution models or IoT-enabled monitoring systems in disaster settings. This lack of comprehensive models impedes the design of adaptive logistics systems tailored to the unique challenges of developing countries, where resource constraints and digital readiness vary considerably (Ulku et al., 2024).

In addition to technological integration, the role of multi-stakeholder collaboration in humanitarian logistics has not been adequately examined. While both formal and informal coordination mechanisms exist, studies assessing the effectiveness of cross-sector collaborations among governments, non-governmental organizations (NGOs), and military actors remain limited (Akhtar et al., 2012). Chari et al. (2021) and Fard & Papier (2022) underline the critical need for empirical evaluations of these collaborative frameworks, particularly in terms of communication efficacy, role delineation, and sustainability of joint operations. Evidence suggests that despite recognition of the importance of inter-organizational synergy, practical challenges such as unclear mandates and fragmented information flows continue to hinder operational coherence (Akhtar et al., 2012; Chari et al., 2021).

The present narrative review aims to synthesize existing literature on two pivotal themes: the integration of advanced technologies and the efficacy of multi-stakeholder collaboration in humanitarian logistics. Specifically, this review examines how AI, IoT, and other digital tools have been utilized to address logistical bottlenecks in disaster contexts, while also identifying areas where these technologies remain underutilized or poorly implemented (Ülkü et al., 2024). Furthermore, the review critically explores collaborative practices among key actors, investigating how inter-organizational partnerships enhance or hinder the delivery of humanitarian assistance (Akhtar et al., 2012; Chari et al., 2021; Fard & Papier, 2022).

The scope of this review is geographically focused on developing countries, where the interplay of socio-economic vulnerability, infrastructural deficits, and limited technological capacity presents unique challenges for disaster response. Ehsani et al. (2023) highlight the disparities in digital preparedness and infrastructure across regions, necessitating localized strategies for effective humanitarian logistics. This geographic focus allows for a more nuanced understanding of how global trends in technology adoption and collaborative governance manifest in resource-constrained environments. By targeting these settings, the review seeks to generate insights that are both theoretically grounded and practically relevant to stakeholders aiming to improve disaster response mechanisms.

Through this narrative synthesis, the paper seeks to contribute to the academic and policy discourse on humanitarian logistics by elucidating the transformative potential of technological and collaborative innovations. Ultimately, the goal is to inform the development of more responsive, resilient, and adaptive logistics frameworks that can effectively address the evolving nature of humanitarian crises, particularly in the Global South.

METHOD

The methodological framework adopted in this narrative review was carefully designed to ensure the comprehensive and critical inclusion of relevant literature in the field of humanitarian logistics and disaster relief supply chains. The process involved a systematic yet flexible approach that aligns with the standards expected in reputable academic publications while accommodating the exploratory nature of narrative synthesis. This section elaborates on the literature search strategy, databases consulted, keyword identification, inclusion and exclusion criteria, types of studies considered, and the evaluation and selection process.

To begin with, the literature search was conducted using a range of multidisciplinary academic databases to capture the breadth and depth of research across both logistics and humanitarian domains. The primary databases utilized included Scopus, Google Scholar, ScienceDirect, and SpringerLink. These platforms were selected for their comprehensive indexing of peer-reviewed articles and their relevance to topics in supply chain management, disaster management, operations research, and public policy. The search was conducted between January and March 2025, with the retrieval of studies published between 2010 and 2024. This time frame was selected to reflect the most current developments in humanitarian logistics while still allowing for historical context in foundational studies.

Keyword identification was a critical step in the literature retrieval process. Guided by established practices in the field, the review employed a combination of core and auxiliary terms to encompass the various dimensions of humanitarian logistics. The main keywords included "humanitarian logistics," "disaster relief," "humanitarian supply chain management," "emergency response," "disaster management," "procurement," "transportation," "coordination," and "resource allocation" as referenced in Raillani et al. (2020), Jabbour et al. (2017), and Argumedo-García et al. (2021). To broaden the scope and incorporate contemporary challenges and innovations, additional search terms such as "resilience," "agility," "sustainability," and "digitalization" were integrated. This approach was particularly effective in identifying studies that explored the incorporation of new technologies and platform-based logistics strategies within emergency response operations.

The inclusion criteria for this narrative review were developed to ensure the selection of studies that directly addressed the research objective. Articles were included if they provided empirical or conceptual insights into humanitarian logistics and disaster relief supply chains. Specifically, the review prioritized studies that presented frameworks, models, or evaluations related to logistics

practices in emergency settings. Additionally, articles were required to be published in peer-reviewed journals or academic book chapters, written in English, and situated within the context of disaster-prone or developing regions. The inclusion of literature from developing countries was essential in aligning with the review's geographical focus, which aimed to explore logistics systems under conditions of infrastructural limitation and socio-economic vulnerability.

Studies were also assessed based on methodological robustness. Articles needed to clearly articulate the research design and employ valid methodological approaches suitable for analyzing logistics phenomena in complex disaster environments. As a result, research adopting quantitative, qualitative, or mixed-methods designs was considered, including case studies, simulation models, survey-based analyses, and ethnographic fieldwork. Particular attention was given to studies that demonstrated methodological transparency and offered generalizable findings or replicable models.

Exclusion criteria were equally important in narrowing the review to only the most relevant and credible sources. Studies were excluded if they focused solely on conventional commercial logistics without direct reference to humanitarian or emergency settings. Opinion pieces, editorials, and publications lacking empirical data or theoretical grounding were also removed from consideration. In addition, research that addressed highly localized logistical issues without broader implications or applicability beyond the specific context was omitted, unless the study presented a unique methodological or analytical contribution. This ensured that the review did not incorporate anecdotal evidence or studies lacking in academic rigor.

The literature selection process began with an initial screening based on titles and abstracts. This preliminary phase was conducted to eliminate studies that were clearly unrelated to the core topic. Articles that passed this stage underwent a full-text review, during which their methodological soundness, relevance to the review questions, and contribution to the field were critically evaluated. To enhance transparency and replicability, the selection process was informed by the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), even though the review itself did not adopt a formal systematic review structure. The PRISMA framework served as a reference for documenting the inclusion and exclusion process, thus reinforcing the methodological rigor of the study.

All articles were organized and managed using a digital reference manager, which enabled systematic tracking of citations, duplicates, and thematic categorizations. The final set of selected articles was synthesized thematically to align with the two primary foci of the review: the integration of advanced technologies in humanitarian logistics and the role of multi-stakeholder collaboration in enhancing disaster response efficacy. Each theme was further subdivided based on recurring subtopics, such as digital infrastructure, decision-support systems, inter-agency communication, and public-private partnerships. This approach allowed for the aggregation of both empirical findings and theoretical insights into coherent analytical categories, suitable for discussion in subsequent sections.

In summary, the methodological strategy employed in this review was designed to comprehensively capture and critically evaluate the existing literature on humanitarian logistics in the context of disaster response. By leveraging robust search protocols, clear selection criteria, and structured evaluation processes, the review ensures the inclusion of high-quality studies that offer substantive contributions to the understanding of logistics performance, technological innovation, and collaborative governance in humanitarian settings. The specific focus on developing countries enriches the analysis by foregrounding the contextual factors that shape logistics effectiveness in regions most vulnerable to disasters. In doing so, this methodology lays a strong foundation for generating insights and recommendations that are both contextually grounded and globally relevant.

RESULT AND DISCUSSION

The literature review revealed several key themes that are central to the enhancement of humanitarian logistics and disaster relief supply chains. The following sub-sections detail the main findings, organized around four thematic categories: pre-disaster planning, warehouse and distribution management, the role of technology and digitalization, and the ethical and social dimensions of logistics. These themes were identified based on a comprehensive synthesis of empirical and conceptual studies retrieved from global databases, applying the keyword strategy and methodological filters outlined in the previous section.

In the realm of pre-disaster planning, the concept of prepositioning has been widely recognized as a vital strategy for mitigating uncertainty and improving response times during humanitarian emergencies. Several studies have focused on optimizing the strategic location of prepositioned facilities to ensure the efficient deployment of relief items. Munyaka and Yadavalli (2020), for instance, introduced a transportation-based optimization model specifically designed for conflict-affected regions, enabling rapid and targeted responses. The authors demonstrate that integrating transport analysis into facility location decisions leads to more resilient logistics configurations. Complementing this, Agarwal et al. (2021) proposed a mathematical model that connects pre- and post-disaster planning, offering a holistic view of logistics management. Their model supports strategic decision-making regarding stock placement and highlights the interdependence of preparedness and response phases.

Further sophistication in prepositioning strategy is evident in the adoption of robust optimization and simulation approaches. Yang et al. (2021) presented a robust optimization framework that accommodates demand uncertainty across different categories of relief supplies. This model emphasizes the value of flexibility and responsiveness in logistics systems that must operate under unpredictable disaster conditions. Ashkezari et al. (2024) expanded on this by incorporating game theory into simulation models to better align stakeholder interests and optimize pre-disaster decisions. Their integrated framework accounts for location, allocation, and routing, reinforcing the importance of cohesive and coordinated planning across all logistics functions.

Regarding warehouse and distribution management, the literature highlights the growing use of multi-criteria decision-making methods to select optimal warehouse locations. Cergibozan and Gölcük (2024) utilized a fuzzy best-worst method to assess critical factors such as proximity to disaster zones, transportation infrastructure, and operational costs. Their findings underscore how sophisticated evaluation techniques can lead to context-sensitive warehouse siting decisions. Similarly, Timperio et al. (2017) introduced a decision support framework that synthesizes strategic logistics criteria, facilitating the identification of efficient warehouse locations that enhance operational readiness during disasters.

The effectiveness of distribution systems also varies significantly between developed and developing countries. Wilson et al. (2018) found that developed nations often leverage advanced technology and integrated information systems to monitor key performance metrics, including delivery time, inventory availability, and cost-efficiency. In contrast, Baraka et al. (2017) provided a case study from the SADC region illustrating that logistical performance in developing countries is frequently constrained by limited infrastructure and inadequate resources. Their study identified key indicators of inefficiency, such as prolonged lead times, high transport costs, and inconsistent adaptability to field conditions. This global comparison demonstrates the value of data-driven monitoring systems and highlights the need for investment in digital infrastructure in resource-limited settings.

The role of technology and digitalization in transforming humanitarian logistics has become increasingly prominent. Technologies associated with Industry 4.0 are being progressively adopted to enhance operational efficiency and coordination. Ehsani et al. (2023) reported that IoT devices are being used to track the location and condition of relief goods in real-time, enabling organizations to respond more precisely to dynamic field requirements. The integration of blockchain technology, as documented by L'Hermitte and Nair (2020), has further advanced transparency and security in logistics transactions. These systems safeguard data integrity and improve resource distribution accountability by ensuring tamper-proof records of all logistical activities. Shayganmehr et al. (2021) noted that such technologies also foster swift trust among stakeholders, which is crucial in high-pressure disaster scenarios where rapid coordination is essential.

Beyond the integration of specific tools, digitalization has significantly impacted the visibility and coordination of humanitarian supply chains. Iqbal and Ahmad (2022) emphasized that adopting unified information systems enhances the flow of critical data among humanitarian actors. Their findings suggest that digital systems not only reduce communication barriers but also streamline operations, allowing faster and more informed responses to evolving crises. Digital monitoring enables real-time evaluation of supply chain performance and resource utilization, ultimately reinforcing accountability and operational transparency. This growing body of evidence suggests that digital platforms should be considered essential infrastructure in modern humanitarian logistics planning.

Ethical and social considerations also play a crucial role in the design and implementation of humanitarian logistics systems. Fiorini et al. (2021) highlighted that ethical decision-making is vital to ensuring that relief distribution is equitable, non-discriminatory, and responsive to the needs of

vulnerable populations. Their study demonstrated that ethical standards serve as guiding principles in operational procedures, helping mitigate bias and promoting fairness in resource allocation. Heaslip et al. (2019) further argued that ethical frameworks enhance the legitimacy of humanitarian interventions and strengthen public trust, especially in contexts where perceptions of fairness and justice are critical.

In parallel, human resource management (HRM) and volunteer training have been widely acknowledged as pivotal components of effective logistics operations. Fiorini et al. (2021) discussed the "human side" of humanitarian logistics, emphasizing the importance of responsive human resource governance. They noted that volunteer training and capacity-building initiatives significantly influence operational success. Well-trained personnel are more likely to uphold ethical standards, execute logistical tasks efficiently, and coordinate effectively within complex multi-actor environments. Heaslip et al. (2019) supported this view, finding that continuous training programs enhance the competencies of humanitarian workers and improve inter-organizational collaboration. As such, strategic HRM integration and robust training protocols are essential to improving logistical responsiveness and minimizing operational errors.

Overall, the results of this narrative review highlight the multifaceted nature of humanitarian logistics and underscore the importance of interdisciplinary approaches to improving supply chain performance in disaster contexts. Pre-disaster planning through optimization and simulation, informed warehouse siting using multi-criteria methods, and advanced technologies like IoT and blockchain all contribute to more agile and transparent logistics systems. Simultaneously, ethical governance and the human capital dimension of humanitarian operations remain central to ensuring that logistics practices are not only efficient but also socially responsible. The global comparison between developed and developing countries underscores the contextual variability of logistical challenges and reinforces the need for tailored, context-sensitive solutions supported by empirical evidence. These findings will serve as the foundation for the subsequent discussion section, which aims to interpret the implications of these results for future policy and practice in humanitarian logistics.

The findings from this review affirm the multidimensional nature of humanitarian logistics and the intricate interplay between operational, technological, and systemic factors that influence its performance. The reviewed literature highlights recurring systemic barriers, including rigid bureaucracies, policy inconsistencies, and institutional fragmentation, which continue to impede the effectiveness of disaster relief supply chains. These challenges are especially pronounced in developing regions where infrastructure and governance structures may be underdeveloped or strained.

Systemic barriers represent a persistent theme in humanitarian logistics, as supported by multiple empirical accounts. Rahman et al. (2022) provide a stark illustration of how complex bureaucratic procedures in coastal Bangladesh significantly delay the delivery of humanitarian aid. The presence of conflicting responsibilities and overlapping mandates among local and national agencies often leads to delays that compromise the timeliness and effectiveness of emergency responses. Similarly, Negi and Negi (2020) report that in India, logistic operations are frequently hindered by tensions between governmental regulations and on-the-ground operational requirements. These frictions

result in a breakdown of coordination, exacerbating the logistical burden during critical periods of response. In a broader institutional context, Chari et al. (2021) emphasize the lack of synchronization between key actors—including government agencies, non-governmental organizations, and military units—as a major factor in diminishing logistical efficiency. Such findings underscore that systemic barriers are not isolated problems but are deeply interconnected, affecting coordination, planning, and delivery across the humanitarian supply chain.

In response to these barriers, literature has proposed various models and frameworks that integrate procurement, transport, and information sharing to streamline operations. Falasca and Zobel (2011) introduce a two-stage procurement model designed to reduce bureaucratic delays and improve responsiveness by combining procurement and transportation planning. This model addresses the fragmentation of procurement procedures and enables more adaptive decision-making under dynamic conditions. The strategic benefit of such models lies in their potential to align logistical functions with the urgency and unpredictability of disaster scenarios. Complementarily, Wankmüller and Reiner (2021) argue for greater cross-sectoral coordination facilitated through role clarity and integrated communication systems. Their findings point to the need for shared protocols and data infrastructures that allow for real-time access to logistical information by all relevant stakeholders. These approaches converge on a common solution: the necessity of institutional reforms that prioritize interoperability and transparency.

The results of this review also reveal the significant potential for technological interventions to mitigate some of the systemic inefficiencies identified. As outlined by Ehsani et al. (2023) and L'Hermitte and Nair (2020), the adoption of Industry 4.0 technologies such as IoT and blockchain can provide real-time tracking, ensure data authenticity, and foster trust among stakeholders. These tools not only enhance operational visibility but also contribute to the decentralization of logistics decision-making, thus reducing reliance on hierarchical structures that often slow down response efforts. Furthermore, the work of Iqbal and Ahmad (2022) demonstrates how digital systems can bridge communication gaps, synchronize data streams, and enhance the accuracy of resource allocation. When integrated effectively, these technological systems present an opportunity to reconfigure humanitarian logistics into more agile and responsive networks.

However, the adoption of these innovations is contingent on contextual readiness, which varies significantly between high-income and low-income settings. The case studies by Wilson et al. (2018) and Baraka et al. (2017) reveal a stark contrast in infrastructure, digital capabilities, and institutional support. In developed countries, logistics systems benefit from well-established data infrastructures, enabling measurable performance through indicators like delivery time and stock availability. Conversely, in developing contexts, logistical operations are often constrained by poor infrastructure and unreliable communication systems. These disparities suggest that technological solutions must be adapted to local capacities and accompanied by investments in foundational systems.

Beyond operational and technological perspectives, the discussion of humanitarian logistics must also grapple with its ethical and human dimensions. Fiorini et al. (2021) and Heaslip et al. (2019) highlight the ethical imperatives that underlie logistical decision-making, especially in the allocation of scarce resources. The equitable distribution of aid, respect for vulnerable populations, and non-

discriminatory practices are not only moral obligations but also practical necessities for sustaining legitimacy and trust. Ethical frameworks guide logistics practitioners in prioritizing needs, mitigating biases, and ensuring transparency throughout the supply chain. These ethical considerations become particularly salient in contexts of extreme scarcity, where every decision carries profound implications for human well-being.

Parallel to ethical concerns is the vital role of human resource management (HRM) in facilitating effective logistics operations. As noted by Fiorini et al. (2021), the competence and adaptability of personnel directly influence the success of humanitarian missions. Investment in volunteer training and the establishment of responsive HRM systems are essential to equipping field staff with the necessary skills and judgment to operate under pressure. Heaslip et al. (2019) further assert that well-trained personnel are instrumental in implementing ethical standards and enhancing inter-organizational coordination. Despite the centrality of HRM, many humanitarian organizations continue to underinvest in personnel development, resulting in gaps in preparedness and operational efficiency. Addressing this deficiency requires not only funding but also a cultural shift that recognizes human capital as a strategic asset.

The implications of these findings for policy and practice are substantial. As Rahman et al. (2022) and Chari et al. (2021) argue, harmonizing policies across institutions and streamlining bureaucratic processes are critical steps toward building resilient humanitarian logistics systems. Policies should support the development of interoperable systems, standardized communication protocols, and flexible procurement mechanisms that can be activated rapidly during crises. Furthermore, the insights provided by Thompson and Anderson (2021) in the context of pandemic response illustrate the urgency of integrating digital solutions into logistics planning. These solutions should not merely be appended to existing systems but embedded as core components of logistics architecture.

Despite the advances documented in the literature, notable limitations persist. One key limitation is the scarcity of empirical studies that examine the implementation of integrated models and technological tools in real-world humanitarian operations. While simulation-based models and theoretical frameworks abound, their practical translation into field operations remains limited. Additionally, the generalizability of case studies is constrained by regional specificity and context-dependent variables. This underscores the need for more comparative research that evaluates interventions across diverse settings. Future research should also explore the intersectionality of systemic, technological, and ethical factors, moving beyond siloed analyses to develop comprehensive, multi-dimensional models.

Another research gap lies in the limited exploration of community-level logistics systems and bottom-up approaches. Much of the existing literature focuses on macro-level strategies, often overlooking the role of local actors and grassroots networks in disaster response. Expanding research into community-based logistics can yield insights into adaptive practices that are often more attuned to local realities. Finally, there is a pressing need for longitudinal studies that assess the long-term impacts of logistics interventions, particularly in protracted crises where the boundaries between emergency response and development become blurred. These studies would

offer valuable perspectives on sustainability and resilience in humanitarian logistics, which are increasingly relevant in an era marked by chronic and compound disasters.

CONCLUSION

This narrative review has highlighted the complex, multidimensional nature of humanitarian logistics and disaster relief supply chains, especially within the context of developing countries. Key findings reveal that systemic challenges, such as rigid bureaucracy, policy misalignment, and inter-agency fragmentation, continue to obstruct timely and effective disaster response. Technological innovations, including IoT, blockchain, and integrated information systems, offer promising tools to address inefficiencies, improve real-time coordination, and increase operational transparency. Furthermore, ethical governance and strategic human resource management have been identified as pivotal to ensuring fairness, accountability, and responsiveness in aid delivery.

The urgency of these challenges is further amplified by the increasing frequency of climate-induced disasters, underscoring the need for adaptive logistics models and robust pre-disaster planning. Prepositioning strategies, multi-criteria warehouse selection, and game-theory-based simulations emerged as critical components of preparedness. Policy reforms aimed at harmonizing inter-agency procedures and investing in digital infrastructure are essential for enhancing system resilience.

To overcome persistent limitations, future research should focus on empirical studies that test integrated models in field operations, explore community-level logistics systems, and assess the long-term sustainability of logistics interventions. Enhancing grassroots capabilities and conducting longitudinal evaluations will provide deeper insights into resilient, locally grounded logistics systems. Ultimately, this review advocates for a synergistic approach that combines structural reform, digital innovation, and ethical commitment to strengthen humanitarian logistics in the face of growing global challenges.

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