Journal of International Trade, Logistics and Law, Vol. 12, Num. 1, 2026, 1-21

INFLUENCE OF LOGISTICS INFORMATION FLOW ON RESILIENT DISASTER RELIEF OPERATIONS: EVIDENCE FROM DISASTER RELIEF PRACTITIONERS IN HUMANITARIAN ORGANIZATIONS IN TANZANIA

Yohana Arsen RUTABA
University of Dodoma, Tanzania

Received: July 21, 2025 Accepted: Nov 27, 2025 Published: June 01, 2026

Abstract:
This research investigated the influence of logistics information flow on resilient disaster relief operations. The study employed positivism philosophy and utilized explanatory research design and guided by coordination theory. The study conducted in the regions of Dodoma, Dar es salaam and Kigoma in Tanzania, collecting data from humanitarian practitioners using questionnaire and interviews. The sample size is 192 from a population of 369, calculated using Slovin's formula. Data analysis was done using SPSS 27, involving both quantitative and qualitative methods, multiple linear regression model was used. The study found that logistics information flow has positive influence of resilient disaster relief operations. The results indicate that the logistics information flow variables (LOIF1–LOIF6) all exhibit statistically significant coefficients ($p = 0.000$), with the R-squared (0.78) and Adjusted R-squared (0.76). Timely and accurate information sharing- LOIF1 ($\beta = 0.351$, $p = 0.000$) has the strongest impact, followed by automated inventory tracking systems - LOIF4 ($\beta = 0.298$, $p = 0.000$) and transparent and structured information exchange between stakeholders - LOIF2 ($\beta = 0.289$, $p = 0.000$). The relatively lower coefficients of real-time inventory control - LOIF3 ($\beta = 0.231$, $p = 0.000$) and maintaining an integrated database of suppliers and HOs - LOIF5 ($\beta = 0.244$, $T = 4.36$, $p = 0.000$) indicate that while all factors contribute to resilience, their impact varies in magnitude. This study makes critical theoretical contributions by advancing the application of coordination theory within humanitarian logistics, particularly emphasizing the role of logistics information flow. This study significantly expands the empirical knowledge base on humanitarian logistics by demonstrating that logistics information flow is a determinant of resilient disaster relief operations. The findings of this study offer actionable policy implications that can significantly enhance Tanzania's disaster response systems. This study offers practical insights for humanitarian organizations aiming to strengthen disaster relief operations through improved logistics information flow. Building on Coordination Theory, future research should delve deeper into modeling information as a strategic resource—not merely a supportive function—in achieving resilience.

Keywords:
logistics information flow, resilient disaster relief operations, disaster relief practitioners and humanitarian organizations.

1. Introduction
In the past years it has been vivid that occurrence of disaster has affected much the lives of human due to delayed responses and ineffectiveness in the process of rescue and provision of relief supplies to the effected population. The occurrence of disaster and the repercussion to human lives have necessitated researchers and policy-makers attention onto instituting measures, models and procedures to minimize the disasters impact (Negi, 2022). Considering the devastating effect of the disaster, natural and manmade, the governments world are instituting agencies, departments, organizations that are responsible for ensuring proper coordination for rescue and provision of relief once the disaster strikes (Wankmüller and Reiner, 2019). In the efforts to developing mechanisms to solve the aftermath of disaster, there are also polices and regulation imposed as intervention for proper disaster relief operations (Dohale et al., 2022). The effectiveness in disaster relief operation has gained much attention to researcher, strategists and policy-makers worldwide, and this comes due to the fact that there are some inefficiencies in rescues and alleviating the suffering of the people once a disaster strikes and this is intensely marked sometimes due to poor coordination of service providers and coordination of resources.

Efforts to achieve effectiveness in disaster relief operation have been a huge issue globally and have been the major challenge for government and humanitarian organizations. It is evident that natural disasters globally pose significant challenges to supply chain management and logistics as linked to the necessary rescue efforts and distribution of relief supplies, with extensive studies highlighting the complexities and issues faced during relief operations (Aghsami et al., 2024).In recent years research studies has extensively analyzed response operations for major disasters in countries like India, Pakistan, and Malaysia, revealing key practices and challenges, particularly in post-disaster relief (Argollo da Costa et al., 2014; Argollo da Costa et al., 2015). These studies posed the severity of the disasters and emphasizes on the integration of the critical role of logistics in managing complexities such as financial constraints, materials flow, information flow, and waste management (Firdous & Ramish, 2023). Despite these insights, there remains a need for further research to enhance efficiency in humanitarian logistics as linked to relief operations and the studies have not adequately linked humanitarian logistics practices and resiliency of disaster relief operations.

Further to research contribution on scholars, relief efforts coordination and severity of disasters on lives has garnered attention from NGOs, international humanitarian organizations and governments (Altay et al., 2018; Dubey et al., 2019). Disasters are explained to challenge the ability of nations to protect people's lives (Altay & Green, 2006). As reported by Centre for Research on the Epidemiology of Disasters (CRED), in 2019 alone, around 395 natural disasters resulted in approximately 11,756 deaths, affected 95 million people, and incurred costs of nearly $130 billion (CRED, 2020). A similar trend was observed in 2018 with 281 events causing 10,733 fatalities (Dubey et al., 2019b). The statistics show that frequency of disasters occurrence has increased from 220 annually in the mid-1990s to around 360-420 per year currently.

Recent researches in Africa highlight the challenges and possible strategies for effective disaster relief operations. The studies narrated the key barriers include lack of planning, logistics, coordination, and public perception (Baidoo, 2018). Efforts to addressing these issues, some conducted studies proposed on improving training, stakeholder coordination, and increased funding (Okdinawati et al., 2019; Baidoo, 2018;). Information flows and information sharing with link to Information systems usage and utilization of ICT have been identified also as crucial parts for enhanced coordination and minimizing efforts duplication in relief operations (Gupta et al., 2016; Okdinawati et al., 2019). However, despite these numerous contributions, effectiveness in coordination remains a significant challenge (Gupta et al., 2016). There's a problem with slow response time, and study in Ghana revealed related problems with a link to resource availability, supplies management, and coordination among relief actors (Owusu-Kwateng et al., 2017). To improve disaster relief logistics, researchers propose frameworks with a focus on the relevant actors for each phase of disaster operations management, emphasized on the need for rapid, effective, and efficient response mechanisms (Owusu-Kwateng et al., 2017; Okdinawati et al., 2019).

The impacts of disasters as linked to effectiveness of disaster relief operations are also vivid in East African context as it affects humanitarian efforts. Disruption in supply chain after natural disasters necessitated robust business continuity plans (Kangogo et al., 2013). Concentrating on humanitarian logistics, if it is well-structured can play a crucial role in emergency responses, as shown by Kimori Osumo & Omwenga (2024), as the study highlights a positive link between logistics management practices and response outcomes, though it lacks specifics. Korir et al. (2023) in Uganda emphasize the importance of transport, order processing, information flow, and inventory management for effective disaster response. However, challenges like inadequate finances and logistics management persist (Orach et al., 2013).There disaster that impacted populations in Kenya, Rwanda, Uganda and Congo. The literature contribution from these nations intensifies the common challenges in relief operations like poor coordination of relief operations, resource and capacity to respond disaster rooted from preparedness and effective distribution of relief supplies and coordination of relief efforts (Bahal'Okwibale 2018; Shears & Garavan 2020; Sospeter 2023; Komorowski & Karume 2015; Agrawal 2013). Research also noted on the inefficiencies in information distribution and lack of specialized information systems specific of disaster operations coordination.

In recent years in Tanzania, recent disasters have had severe impacts, with floods from 2015 to 2020 resulting in 307 deaths, affecting 317,907 individuals, and destroying 50,588 houses. Regions like Mwanza, Morogoro, and Dar es Salaam have been significantly affected. For example, the 2015 rainstorm in Kahama resulted in 47 deaths, affecting 3,500 people and destroying 634 houses (PMO, UNDRR, 2022). Tanzania has also experienced notable maritime disasters, such as the MV Nyerere ferry tragedy in 2018 and the MV Spice Islander disaster in 2011 (PMO, UNDRR, and CIMA, 2019). The occurrence of these disasters proved the inefficiencies in disaster relief operation, rooting from preparedness and coordination efforts and collaborations between the stakeholders with vested interests in humanitarian actions. In the body of knowledge there are several literatures highlighting the importance of proper

coordination of efforts and relief operations, the studies in this context yet have not adequately linked humanitarian logistics factors with disaster relief operations and on the adaptability of the operations

The presented cases and studies underscore the critical need for effective disaster relief operations, including establishing communication infrastructures, conducting rescue missions, and providing essential first aid (Gopal et al., 2015). In Tanzania, challenges in managing relief operations, such as mobilization and coordination, are exacerbated by inadequate response capabilities, leading to delays and ineffective interventions. The stream of studies revealed that these issues are common globally, safe in the knowledge that complex emergencies tend to multiple stakeholders and that lack of coordination results in fragmented efforts and greater loss of human lives (Wang et al., 2023; Ngah et al., 2022). In other aspects climate change has also increased the frequency and intensity of disasters, this demands more adaptive and resilient logistical frameworks (Shen et al., 2023; Zhen et al., 2022). Humanitarian logistics practices must be adaptable and agile to effectively distribute relief supplies during disasters and coordination among supply chain actors in this part is essential for the success of humanitarian operations (Li et al., 2008; Zhang et al., 2019). Despite collaboration challenges due to differing organizational structures and priorities, efforts should be made to improve effectiveness and reduce duplication of efforts. Effective coordination and comprehensive contingency plans are essential for enhancing logistics preparedness and response in disaster relief operations. This specific study intends to examine the effect of humanitarian logistics factors on resilient disaster relief operations, with concentration given on the effects of logistics preparedness, logistics collaboration, logistics information flows and relief supplies distribution.

1.2. Statement of the Problem

Protection of human lives and alleviating the suffering of the people in disastrous situation has been a primary concern for different governments and established humanitarian organizations in worlds (Bizzarri, 2012; Holthus et al., 2020). Efforts are undertaken to ensure proper coordination in humanitarian efforts. In Tanzania, several efforts have been undertaken to mitigate the impact of disasters, from creating public awareness campaigns that have fostered community engagement in rescue operations, establishment of international relief organizations, non-governmental organizations (NGOs) (Majamba, 2023; Msemo et al., 2021; Rutaba, 2023; Rutaba, 2022). The government of Tanzania has established Disaster Management Division under Prime Minister's office (PMO) for disaster relief coordination. The government has also enacted policies and Acts to support Disaster Risk Management (DRM) across various sectors, addressing issues like environment and climate change, public health, food security, and military support in public emergencies (Mboera et al., 2012; Daly et al., 2015; Majamba, 2023; Msemo et al., 2021). Despite these efforts, the frequency and severity of disasters continue to rise, revealing persistent gaps in disaster relief operations coordination and rescue efforts (Zain et al., 2023; Salam & Khan, 2020; Sahay et al., 2016).

Furthermore, despite the pressing need for improved disaster management, there has been limited empirical evidence and contribution to humanitarian logistics and disaster relief operations in Tanzania. Existing studies such as those by Masoud (2022) and Rutaba (2022, 2023) have explored various aspects of humanitarian logistics performance, challenges in disaster management, and logistics cooperation in effective disaster relief operations. For instance, Koka et al. (2018) examined disaster preparedness and the response capacity of regional hospitals, while Mbura (2014) focused on disaster management and persistent flooding. However, these studies have not adequately articulated the critical aspects of humanitarian logistics factors for adaptive and rapid disaster relief operations and clearly noted poor disaster relief operations which are clearly amplified by poor logistical coordination.

To improve disaster response and mitigation efforts in Tanzania, there is an urgent need to foster greater collaboration and engagement among government agencies, humanitarian organizations, and other stakeholders. This study will focus on examining the contribution of humanitarian logistics practices on resilient disaster relief operations, concentrating specifically on the effects of logistics preparedness, logistics horizontal and vertical collaboration and relief supplies physical distribution, with consideration being given to practitioners working in Humanitarian Organizations (HOs). By building on the findings of recent studies like those of Zain et al. (2023) and Salam & Khan (2020), which highlight the importance of logistics information systems and coordination in disaster relief, this research aims to identify gaps and propose solutions for enhancing disaster response capabilities. The study will also address how streamlined coordination logistics preparedness, logistics collaborations, and physical distribution of relief supplies, which remains a significant challenge in Tanzania, contribute to resilient disaster relief

operations. The outcomes of this research are expected to contribute to the development of comprehensive humanitarian logistics contingency plans, which are crucial for ensuring effective disaster relief operations in Tanzania (Rutaba, 2023; Rutaba, 2022; Kovács & Spens, 2007; Apte, 2010)). By focusing on these critical logistics factors, the study will provide actionable insights that can help mitigate the devastating impact of future disasters on the Tanzanian population.

1.2. Research Hypotheses

H_3 logistics information flow has positive significant influence on resilient disaster relief operations in Tanzania

2. Review of Related Literature

2.1. The Coordination Theory

According to Malone, (1988), coordination theory can be defined as a body of principles about how the operations, functions or activities of different actors can be coordinated. Coordination theory is like other interdisciplinary fields that arise by recognizing the commonalities in the problems that previously has been definitely separately considered. Malone and Crownston (1990) were the pioneers in emphasizing the importance of coordination theory. According to Jahreet al (2016), disaster relief responses necessitate inter-organizational coordination, which entails the recipient community involving the local engagement, the collaboration and coordination with local infrastructure, resilience, and a response chains that involve diverse stakeholders, such as corporations, humanitarian organizations, humanitarian agencies and government.

Coordination Theory suggests the feasibility of harmonizing different humanitarian organizations and their operations (McEntire, 1997; Seybolt, 1997). In the context of the humanitarian operations, a more specific and specialized framework should exist, that includes the information management, the mobilization of resources, accountability, functional tasks allocation, coordination & collaborations, and leadership provision (Minear, 2002).

Researchers argue that effective coordination is pivotal for delivering services proficiently (Karanja et al., 2015). The motivation behind stakeholder coordination is predominantly rooted in achieving effectiveness (Minear, 2002). Additionally, the imperative of minimizing duplicated efforts underscores the need for enhanced coordination in emergency response procedures for these organizations (McEntire, 1997). Parmar (2007) highlights the need for increased coordination and collaboration among responding organizations, while Maghsoudi (2018) finds that resource sharing and standardization positively impact the performance of humanitarian organizations. Nolte (2012) suggests that common incentives and a high degree of equality among aid organizations improve network coordination, and Wuni (2008) emphasizes the significance of inter-agency coordination in achieving efficient delivery of relief.

Coordination Theory is relevant to studying logistics information flow and relief supplies distribution, complementing both Stakeholder Theory and Resource Orchestration, hence it is relevant to objective three and objective four of the study. Theory by addressing specific aspects of coordination, collaboration, and integration of efforts among various stakeholders that are involved in disaster response. Effective preparedness requires the harmonization of activities across multiple stakeholders, such as humanitarian organizations, local authorities, and government agencies. Coordination Theory emphasizes the integration of logistics preparedness systems to improve communication, resource allocation, and task coordination. By enhancing inter-organizational collaboration, these systems strengthen logistics preparedness, ensuring aligned efforts and minimizing duplication. Additionally, it complements Resource Orchestration Theory by focusing on the strategic collaboration and integration of resources across organizations, optimizing their collective capacity to respond to disasters. This synergy ensures that logistics resources are structured, bundled, and leveraged efficiently, improving the resilience and efficiency of disaster relief operations and ensuring timely delivery of aid (Malone & Crowston, 1990; Jahre et al., 2016; Minear, 2002).

2.2. Empirical Literature Review

Disaster relief operations mostly depend on efficient logistics and information flow. Logistics Information Systems (LIS) play crucial roles in supporting distribution, communication, and tracing of goods and funds throughout all phases of disaster relief operations (Dubey et al., 2018). However, information flow impediments, such as data

collection, storage, processing, and sharing challenges, can impede coordination efforts in disaster relief operations (Day et al., 2009). To address these issues, cloud collaboration and distributed data centers have been proposed to improve connectivity and information sharing among relief organizations (Dubey et al., 2018). Humanitarian logistics differs from business logistics, requiring unique strategies and learning from business practices (Kovács & Spens, 2007). To optimize relief allocation, multi-objective optimization models based on disaster scenario information updates have been developed, aiming to balance efficiency and equity in resource distribution (Zhan et al., 2014). These advancements in logistics and information management are likely to contribute to more effective disaster relief operations.

Studies highlight the importance of coordinated efforts, trust, and information sharing among stakeholders to enhance swift responses and relief resource allocation (Ahmed et al., 2019. To address these issues, researchers recommend developing frameworks that focus on all relevant actors in disaster relief (Owusu-Kwateng et al., 2017). Additionally, the field of humanitarian logistics, which manages critical supplies and services in challenging environments, requires further research to improve effectiveness and efficiency despite its inherent complexity.

Recent systematic reviews of humanitarian logistics research have identified key trends and gaps in the field. Multiple studies highlight the need for more research on continuous aid operations, slow-onset disasters, and man-made catastrophes (Kunz & Reiner, 2012; Nasir et al., 2023). There is also a lack of focus on the disaster recovery phase and information needs for effective logistics support (Nasir et al., 2023; Leiras et al., 2014). Keyword and topic modeling analyses reveal evolving research priorities, from establishing HRL identity and disaster response in the late 2000s to coordination and facility location in recent years (Kim et al., 2022). However, empirical research remains underrepresented (Kunz & Reiner, 2012). To address these gaps, researchers recommend closer collaboration between academia and humanitarian organizations (Leiras et al., 2014) and the use of qualitative data analysis software for more comprehensive studies (Nasir et al., 2023).

Nasir et al., (2023), conducted a study on logistics information needs for sharing in Malaysian disaster management. The conducted study was exploratory study that used systematic reviews (guided by the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) review method) of journal paper published from published 2018 to 2022. The study intended to identify research trends in the context of humanitarian logistics and a systematic review of Scopus and the Web of Science turned up with 23 related studies. In the context of disaster relief operations the findings of the study revealed that little attention has been given to the study of the information needs of humanitarian logistics.

2.3. Conceptual Framework

This poses a conceptual framework on the relationship between the independent variables and dependent variables. Independent variable being humanitarian logistics to encompass humanitarian logistics preparedness, logistics vertical and horizontal collaborations, relief supplies physical distribution and dependent variable being resilient disaster relief operations (facilitate affected ones in a timely, agile and effective manner)

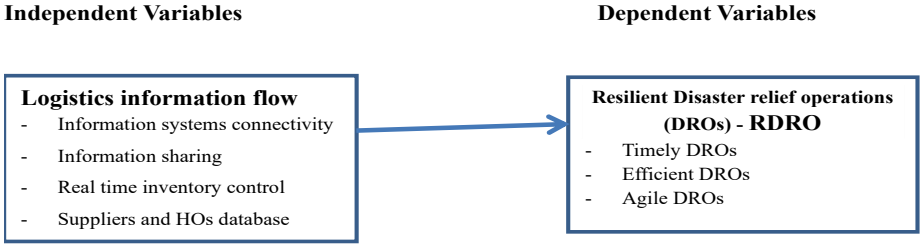

Figure 2.1: Conceptual Framework

Source: Researcher's own Construction (2024)

2.3. Hypotheses

Effective information flow is crucial for successful disaster relief operations. Information flow impediments in disaster relief operations can be categorized into data collection, information processing, and information sharing challenges ((Umar & Wilson, 2023). These impediments hinder coordination and resource flow during relief operation efforts. Transitional periods between disaster management phases are particularly vulnerable to

communication breakdowns, potentially disrupting product flows (Barber & Heaslip, 2013). Logistics management is a critical success factor in disaster management, accounting for 80% of relief operations (Kusumastuti et al., 2010). The key drivers of performance in relief logistics positively influence the success of relief operations (Bardhan & Dangi, 2016). To improve disaster relief effectiveness, organizations should focus on enhancing information systems connectivity, communication, facilitating smooth transitions between phases, and addressing the perspectives of disaster survivors and various stakeholders involved in relief efforts (Barber & Heaslip, 2013; Chari & Novukela, 2023). Dwiputranti et al., (2019) illustrated that acceptance and use of information technology in humanitarian relief operations can be evaluated by employing the Use of Technology (UTAUT) model and Unified Theory of Acceptance, with consideration of the factors such like effort expectancy, performance expectancy, social influence, and facilitating conditions. As on this respect and on undertaking the study, the following hypothesis is proposed for testing, H4

H4; logistics information flow has significantly positive influence of resilient disaster relief operation

3. Methodology

Based on the views from different researchers on research methodology, it is vivid that researchers need to plan on methodological choices of their study (Magigi, 2015). Table 1 summarizes the key methodological choices made for the study.

Table 2: Key methodological choices made for the study.

Issues	Choice
Philosophical position: positivism, critical realism, interpretivism, postmodernism, and pragmatism	*Positivism research philosophy*
Research approach: quantitative, qualitative and mixed	*Convergent parallel mixed approach*
Research setting: physical, social, cultural	*Tanzania (practitioners in humanitarian organizations located in Dodoma, Kigoma and Dar es salaam)*
Data collection: questionnaire, observation, interviews, group discussion, and documentary review.	*Questionnaire, interviews, and documentary review.*
Sampling approach:	*Proportionate stratification and purposive sampling*
Data analysis:	*Multiple linear regression and thematic analysis*

The study adopted a positivism philosophy, being useful in this study because of its main characteristics. The study collected data from large sample size instead of focusing on details of the research. According to Saunders et el., (2016), focusing on this philosophical undertaking, positivism philosophy helps in the examination of the association between two or more variables. In terms of design, the study adopted explanatory research design, from a mixed research approach to include quantitative and qualitative data and provide combined explanation. The study collected both forms of data during the study and then integrates the information in the interpretation of the overall results. Explanatory research design is relevant when researcher aimed to at explaining the relationships between variables (Creswell, 2012).

This study is conducted in Tanzania with the experience from humanitarian logistics and disaster relief practitioners working in humanitarian organizations located in Tanzania. The data were collected at from humanitarian practitioners from these Humanitarian Organizations (HOs) located in Tanzania, utilizing Google Search engine and as shown in the UNHCR's Humanitarian Situation Report of 2022, mostly of the Humanitarian Organizations are located in the regions of Dar es salaam, Dodoma and Kigoma. From preliminary analysis of the population of humanitarian practitioners, makes a population of 369. In this study, the target population comprises humanitarian practitioners from various humanitarian organizations and stakeholders actively engaged in humanitarian logistics and disaster relief operations. The practitioners from HOs present the units of analysis and unit of enquiry of the study. These practitioners from diverse HOs played a vital role in this study to as unit of enquiry by offering their valuable insights and opinions from professional perspectives on management of HOs and humanitarian supply chain management. Their extensive experience in disaster relief operations positions them as key contributors, ensuring the study's comprehensiveness and relevance to real-world practices.

The study selected a sample of 192 respondents to participate in the study, calculated using Slovin's formula. The strength of this formula is that it enables sampling the population with a degree of accuracy i.e. confidence levels in the statistical test and margins of error (Creswell, 2014; Magigi, 2015). In this respect, the study uses 5 % margin of error or confidence level. This sample comprised of procurement and logistics specialists, supply chain managers, supply chain specialists, warehouse officers, rescuers and health logistics practitioners from the humanitarian organizations. These practitioners make the unit of enquiry for the study. This study included a mapping of sixteen (16) Hos which were treated as strata and to ensure effective representation of all practitioners for all the identified HOs in the regions, the sample size of 192 practitioners were proportionally allocated for each stratum. Hence practitioners of each HOs of the sampling frame were chosen at the proportion of 0.520 (192/ 369).

Using probabilistic sampling techniques, the proportional stratification sampling approach were adopted to ensure adequate representation of the practitioners from identified HOs. According to Creswell (2012), the stratification sampling approach is used when the characteristics of a sample do not balance the population, considering several homogenous groups as supported by John, Mwakalobo and Bengesi (2019). Practitioners in each stratum (HOs) of the sampling frame were selected at the proportion of 0.520 (192/369). In ensuring fairness in selection within organization, systematic random sampling was used, selecting every second (2nd) practitioner in the preparedness list of practitioners, with correspond phone number and email addresses (where the questionnaire was shared online). As for non-probabilistic sampling procedures researcher used purposive sampling to choose the heads of HOs (key informers). The study employed variety of data collection tools, these tools enabled the researcher to collect adequate quantitative data and later for triangulate the information. The tools included the questionnaires and interviews. The study involved data collection process through distribution of copies questionnaire to all the respondents, observe the setting of the departments and interview schedule conducted to all respondents identified as head of units or organization.

The analysis of data in this study involved both quantitative and qualitative methods. Frequencies and percentages tables was used to analyze and interpret the numerical data. The analysis was guided by the research objective, and the data was coded, edited, and cleaned before being presented in a general table to facilitate further exploration. Descriptive statistics was used to analyze the demographic information of respondents for the qualitative data. The analysis of quantitative data conducted through Linear regression analysis. Linear regression analysis is a statistical method that used to estimate the relationship between one or more independent variables and a single dependent variable (Dupont, 2009). In this present study used Multiple Linear Regression to determine significant factors from potential explanatory variables.

Furthermore, thematic analysis used to address the qualitative information from the key informants. The thematic analysis is aimed to complement some of the weaknesses of the quantitative approach (Magigi, 2015). With this, Patton, (2002) suggests that, quantitative analysis may be too mechanical and unable to extract the feelings, emotions, and subjective response evidenced in social science. In this analysis, the researcher followed the procedure recommended by Saunders et al. (2016), namely, familiarize with collected data, apply the codes to the data, searching for themes and then identifying the relationships, and polishing themes and testing prepositions.

Table 3.3: Assessment of Variable Measurements

Variable	Definition	Measurement	Instrument
Logistics information flow	- Information sharing - Real time inventory control - Suppliers and HOs database (Kubasakova et al., 2014; Smagulova et al., 2020)	5-point Likert scale	Questionnaire and interview guide
Resilient Disaster Relief Operations (RDRO)	- Timely Disaster relief operations - Efficient Disaster relief operations - Agile Disaster relief operations (Hussain et al.,2022)	5-point Likert scale	Questionnaire and interview guide

Source: Researcher's own construction (2024).

It is mandatory to adhere to ethical issues when conducting research. Therefore, the procedure for data collection under this study embarked when research clearance from Mzumbe University is made available to the researcher. All the procedures including request for introduction letter and permission for conducting research wase adhered to prior to data collection procedure. The research study is also observing the ethical principle of Beneficence as the study is aimed to be carried out to benefit others while promoting their welfare and safety.
Additionally, the consent forms was provided to respondents which explained the main intention of the research and the usefulness of their participation toward the success of the exercise. Also, freedom of withdrawing from the study at any time if they wish to do so was stipulated in the consent form to ensure voluntary participation. The ways in which anonymity would be ensured was also clarified to the respondents to ensure confidentiality of the information provided. The originality of the document was assured through plagiarism check.

4. Presentation of Findings

4.1. Demographics of the Respondent

The demography of the respondents is mainly based on the variables which were intended to describe the characteristics of respondents in terms of humanitarian organization region, humanitarian organization category, location, age group, experience and specialization in disaster relief operations. According to Saunders et al. (2016), these data are used to explain how opinions and behaviors differ, and to check the extent to which the data represent the total population. The summary of the respondent's demographics is presented in Table 4.1. The respondents who filled the questionnaire were the practitioners from humanitarian organizations located in Dodoma, Kigoma and Dar es salaam. Both technical and support staff were involved. Concerning this, some of the respondents were having a relief procurement background, humanitarian supply chain background, relief operations background, and disaster management background. Moreover, after receiving the response from each practitioner, the researcher computed the average scores. Since the scale of the questionnaire was range from 1 to 5; the average scores were rounded to zero decimal place. Besides, the demographic data were also averaging based on their scales and rounded to zero decimal place.
The demography of the respondents shows that most of them (39.6 %) come from the HOs located in Dar es Salaam Region, followed by Dodoma Region (32.3 %), and Kigoma Region (28.1 %). Dar es Salaam Region is leading in terms of respondents because 39.6% of practitioners in HOs of the sampling frame are located in this region. Kigoma Region is the last leading because only 28.1% of practitioners in HOs of the sampling frame are located in the Region. The study found that most of the HOs in Kigoma have head office located in Dar es salaam.
Besides, the distribution of actual respondents based on the practitioners' HOs categories shows that the Non-Government (Local) category is leading by 41.1% followed by Non-Government (International) (35.9%), and Government (22.9%).

Table 4.1: Regions and number of practitioners

S/N	Region	Number Of Practitioners	Sample Size
1	Dodoma	119	62
2	Dar es Salaam	146	76
3	Kigoma	104	54
	Total	**369**	**192**

Furthermore, the respondents‟ age was of all categories in which 9.9%, 53.1%, 29.2%, 7.8% and 0 %were in the range of 18 to 27, 28 to 37, 38 to 47, 18 to 27, and above 57 years respectively. This shows that the respondents were of different ages in which a minimum range between 18 to 27 and a maximum was above 57 years. Besides, the majority of respondents were aged between 28 to 37 years and 38 to 47 years. These results suggest that most of the respondents were middle-aged and elderly. According to Kiage (2013), middle-aged and elderly employees have adequate experience that can provide the required information. Hence, the present study involved participants of all range of ages which are representative of the total population.

Experience in the working environment is very important in having the right knowledge (Goel, 2016). However, one way of enhancing knowledge is through the time spent performing certain organizational activities. Basing on this view, the study assessed the level of respondent's experience in disaster relief operations working with HOs. The experience was assessed in term of the number of years the respondent has spent in disaster relief operations and humanitarian logistics. Findings on experience in disaster relief operations and humanitarian logistics revealed that 24.0% of respondents had experience between of more than 10 years, 46.4% of respondents had experience between 5-10 years, 28.1% of respondents had experience between 3 to 5 years, and 1.6% of respondents had the experience below 3 years. Having experience of 5 years or more indicates that the respondents had been involved in disaster relief operations and humanitarian logistics. Thus, this confirmed that the respondents of this study have adequate experience of the problem investigated by the current study. This finding was also observed by Tan and Wong (2015) who indicate the relationship between experience and organizational performance.

Table 4.2: Demographic Characteristics of Respondents (N = 192)

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Age Group	18 – 27 Years	19	9.9%	9.9%	9.9%
	28 – 37 Years	102	53.1%	53.1%	63.0%
	38 – 47 Years	56	29.2%	29.2%	92.2%
	48 – 57 Years	15	7.8%	7.8%	100.0%
	Total	**192**	**100.0%**	**100.0%**	
Work Experience	0 – 3 Years	3	1.6%	1.6%	1.6%
	3 – 5 Years	54	28.1%	28.1%	29.7%
	5 – 10 Years	89	46.4%	46.4%	76.0%
	More than 10 Years	46	24.0%	24.0%	100.0%
	Total	**192**	**100.0%**	**100.0%**	
Type of Organization	Government	44	22.9%	22.9%	22.9%
	Non-Government (Local)	79	41.1%	41.1%	64.1%
	Non-Government (International)	69	35.9%	35.9%	100.0%
	Total	**192**	**100.0%**	**100.0%**	
Organization Location	Dodoma	62	32.3%	32.3%	32.3%
	Dar es Salaam	76	39.6%	39.6%	71.9%
	Kigoma	54	28.1%	28.1%	100.0%
	Total	**192**	**100.0%**	**100.0%**	
Practitioner Specialization	Rescuer	16	8.3%	8.3%	8.3%
	Supply Chain	40	20.8%	20.8%	29.2%
	Logistics Officer	24	12.5%	12.5%	41.7%
	Relief Officer	31	16.1%	16.1%	57.8%
	Relief Operations Coordinator	30	15.6%	15.6%	73.4%
	Medical Supply Specialist	18	9.4%	9.4%	82.8%

Distribution Officer	33	17.2%	17.2%	100.0%
Total	**192**	**100.0%**	**100.0%**	

4.2. Examination of Data Entry, Missing Data, and Outliers

The initial data analysis was conducted to identify errors in the data set in the form of data entry, missing data, and outliers. This is because errors in the data set may compromise subsequent analysis and results. To ensure data were entered correctly, a double-check approach was performed. The first check was done by verifying all entries for a case-by-case. The second check was conducted and verified using descriptive statistics including mean, standard deviation, and frequency distribution. These are listwise deletion, pairwise deletion, and mean substitution (Kline, 2011; Schinka et al., 2003). No missing data were detected and there were no cases of outliers.

4.3. Descriptive Statistics: Mean. Standard Deviation, Skewness and Kurtosis

Descriptive statistical measures were employed to detect the data and to test the normality. In this regard, the preliminary tools used for this purpose were the mean, variance, standard deviation, kurtosis, and skewness. The standard deviation depicts the extent to which the scores in a dataset cluster around the mean. In this case, when the value of the mean is above neutral, it indicates the positive perception of respondents on the variable. Skewness appears in three forms (left: skew < 0, normal: skew ~ 0, and right: skew > 0). According to Kline (2011), an acceptable range for normality is the value between -1 to 1. However, normality is not only tested by skewness alone but also by kurtosis. Kurtosis is defined as a measure of whether the data are flat relative to a normal distribution. Similarly, the acceptable range for normality is the value between -1 to 1 (Kline, 2011). However, some studies accept kurtosis and skewness values between -2 and +2 (Kline, 2011) and -3 and +3 for kurtosis (Balanda & MacGillivray, 1988).

The descriptive statistics for Logistics Information Flow variables indicate a generally favorable perception of information exchange and communication mechanisms within organizations. The mean values for all six items range between 3.99 and 4.30, suggesting that respondents agree on the adequacy of logistics information flow. LOIF1 (4.30) recorded the highest mean score, implying that organizations have well-structured mechanisms for sharing logistics-related information. Similarly, LOIF2 (4.18) and LOIF4 (4.14) suggest that information dissemination is timely and accessible. However, LOIF6 (4.00) and LOIF3 (3.99) have the lowest mean values, which may indicate room for improvement in ensuring that all logistics information is consistently available and effectively utilized across different levels.

The skewness values, ranging from -1.15 to -0.89, indicate a left-skewed distribution, suggesting that most responses lean towards higher agreement on the effectiveness of logistics information flow. Kurtosis values between 1.08 and 1.62 reflect a moderate peakedness in distribution, reinforcing the consistency in responses. These findings suggest that organizations should maintain and enhance logistics information flow mechanisms to support efficient decision-making and operational coordination. Additionally, efforts should focus on addressing gaps in specific areas, particularly improving the accessibility and real-time availability of logistics data to ensure a seamless flow of information across supply chain networks.

As for the level of agreement, timely and accurate information sharing (LOIF1), the majority of respondents (44.4%) agree, and 20% strongly agree that timely and accurate information sharing enhances coordination and improves response planning. A notable proportion (29.4%) remained neutral, with only 2% disagreeing. The general consensus that timely and accurate information sharing is crucial for effective coordination aligns with research emphasizing that information flow is a critical enabler of operational efficiency in humanitarian logistics. The neutral responses may indicate either a lack of direct experience or perceived variability in the effectiveness of information flow across different contexts or organizations. Nevertheless, this suggests that the value of accurate information exchange in enhancing operational effectiveness is well recognized.

Transparent and structured information exchange (LOIF2), 42.2% of respondents agree, and 17.9% strongly agree that transparent and structured information exchange reduces redundancy in disaster response. A substantial proportion (31.3%) is neutral, and 4% disagree. This result indicates a broad acknowledgment of the role that clear, transparent, and organized information exchange plays in reducing inefficiencies, such as redundancy in response efforts. The neutral responses may reflect uncertainty about how information is currently structured or exchanged in

various organizations, suggesting room for improvement in terms of clarity and systematic processes. Nevertheless, the positive response is indicative of the potential for improving disaster response effectiveness through structured information flow.

Real-time inventory control (LOIF3), the majority of respondents (44.6%) agree, and 19.8% strongly agree that real-time inventory control provides up-to-date insights into stock levels, facilitating rapid deployment of resources. Only 4% disagree, and 28.9% are neutral. The strong agreement highlights the critical role of real-time inventory control in ensuring that organizations are able to respond rapidly and appropriately to crises. The neutral responses suggest some variation in the perception of real-time control's effectiveness, possibly due to variations in the technological infrastructure or inventory management systems employed by different organizations. The findings reinforce the importance of up-to-date data in enhancing decision-making and operational readiness.

Automated inventory tracking systems (LOIF4), a large portion of respondents (45.7%) agree, and 15.4% strongly agree that automated inventory tracking systems enable swift adjustments in stock management during crises. Only 4.3% disagree, and 26.9% are neutral. The favorable responses highlight the value of automation in improving inventory tracking, enabling quicker and more accurate adjustments in supply management. The neutral responses might reflect concerns about the accessibility or implementation challenges associated with automated systems, particularly in low-resource settings. Overall, these findings emphasize that automation can play a key role in improving efficiency and flexibility in logistics operations during humanitarian crises.

Integrated database of suppliers and humanitarian organizations (LOIF5), 48.3% of respondents agree, and 17.7% strongly agree that maintaining an integrated database of suppliers and humanitarian organizations enhances coordination and resource access during emergencies. 25.1% are neutral, and 3.4% disagree. This strong agreement suggests that an integrated database is perceived as a crucial tool for facilitating coordination and accelerating access to necessary resources. The neutral responses may indicate that some respondents are uncertain about the specific implementation or accessibility of such databases, but the overall trend highlights that integration of key logistical information enhances operational efficiency, especially in resource-constrained environments.

Centralized database for decision-making (LOIF6), 44.6% of respondents agree, and 19.8% strongly agree that a centralized database improves decision-making by providing comprehensive information on resources and partner capabilities. 26.8% remain neutral, and 3.9% disagree. The data reflects a general consensus that centralized databases are valuable in enhancing decision-making. The centralization of information allows for a more holistic understanding of available resources and partners, thereby improving coordination and reducing the risk of operational gaps. The neutral responses may indicate that some participants are unsure about the practical challenges or limitations associated with creating and maintaining such databases, particularly in diverse or complex humanitarian environments.

The responses suggest that Logistics Information Flow (LOIF) is widely considered a fundamental component in enhancing efficiency, responsiveness, and coordination in humanitarian logistics. The findings point to a high value placed on the timely and accurate sharing of information, the need for transparency, real-time inventory control, and automated systems in crisis situations. Additionally, the importance of integrated and centralized databases for facilitating coordination and improving decision-making is clearly recognized. While the overwhelming agreement on the importance of these systems reflects a consensus on best practices, the neutral responses indicate that some logistical challenges and implementation hurdles may exist. Variations in technological capacity, infrastructure, and organizational readiness to adopt such systems could account for the differences in perception, suggesting that while the benefits of these systems are acknowledged, their practical application may require more attention, particularly in regions with limited resources.

Humanitarian organizations should focus on improving and standardizing information-sharing protocols, ensuring transparency, and leveraging automated and real-time tracking systems for enhanced responsiveness. Additionally, creating integrated and centralized databases will further streamline coordination efforts and support effective decision-making. For practitioners, these results imply a need for investing in technology and training to ensure that information systems are robust, accurate, and accessible in times of crisis. Further research could explore the challenges and barriers to implementing these information systems, particularly in low-resource settings or regions with limited technological infrastructure. Longitudinal studies could also examine the long-term impact of improving logistics information flow on overall humanitarian logistics performance.

Table 4.13a: Descriptive Statistics on level of agreement of respondents (N=192)

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Timely and accurate information sharing among logistics partners enhances coordination and allows for more effective response planning in humanitarian operations (LOIF1)	0 (0%)	4 (2.0%)	59 (29.4%)	89 (44.4%)	40 (20.0%)
Transparent and structured information exchange between stakeholders reduces redundancy in disaster response (LOIF2)	0 (0%)	8 (4.0%)	63 (31.3%)	85 (42.2%)	36 (17.9%)
Real-time inventory control provides humanitarian organizations with up-to-date insights into stock levels, ensuring rapid deployment of needed resources (LOIF3)	0 (0%)	8 (4.0%)	57 (28.9%)	88 (44.6%)	39 (19.8%)
Automated inventory tracking systems in crisis situations allow for swift adjustments in stock management (LOIF4)	0 (0%)	9 (4.3%)	56 (26.9%)	95 (45.7%)	32 (15.4%)
Maintaining an integrated database of suppliers and HOs enables faster coordination and access to essential resources during emergencies (LOIF5)	0 (0%)	7 (3.4%)	51 (25.1%)	98 (48.3%)	36 (17.7%)
A centralized suppliers and HOs database improves decision-making by providing comprehensive information on available resources and partner capabilities (LOIF6)	0 (0%)	8 (3.9%)	54 (26.8%)	90 (44.6%)	40 (19.8%)

Table 4.13 b: Descriptive Statistics and Normality Testing for Logistics Information Flow Variables (N=192)

Item	Mean	SD	Variance	Skewness	Kurtosis
LOIF1	4.30	0.79	0.624	-1.15	1.62
LOIF2	4.18	0.84	0.705	-1.08	1.41
LOIF3	3.99	0.88	0.774	-1.00	1.28
LOIF4	4.14	0.82	0.673	-1.09	1.35
LOIF5	4.11	0.91	0.829	-0.94	1.19
LOIF6	4.00	0.95	0.902	-0.89	1.08

Source: Data from Survey (2024)

Table 4.14: Influence of Logistics Information Flow on Resilient Disaster Relief Operation

Resilient Disaster Relief Operation	Coef.	SE Coef.	T	P
LOIF1	0.351	0.045	7.80	0.000
LOIF2	0.289	0.051	5.67	0.000
LOIF3	0.231	0.049	4.73	0.000
LOIF4	0.298	0.054	5.51	0.000
LOIF5	0.244	0.056	4.36	0.000
LOIF6	0.273	0.053	5.14	0.000

R-Sq = 0.78 Adjusted R-squared (R^2 adj) is 0.76

The results in table above indicate that logistics information flow has a significant and positive influence on resilient disaster relief operations. All six logistics information flow variables (LOIF1–LOIF6) exhibit statistically significant coefficients ($p = 0.000$), suggesting that effective information sharing enhances disaster response resilience. The R-squared (0.78) and Adjusted R-squared (0.76) indicate that the model explains 76%–78% of the variation in disaster relief resilience, underscoring the crucial role of timely and accurate information exchange in improving operational outcomes. Among the predictors, LOIF1 ($\beta = 0.351$, $T = 7.80$, $p = 0.000$) has the strongest impact, followed by LOIF4 ($\beta = 0.298$, $T = 5.51$, $p = 0.000$) and LOIF2 ($\beta = 0.289$, $T = 5.67$, $p = 0.000$), suggesting that certain aspects of information flow—such as data accuracy, real-time updates, and communication effectiveness—are particularly influential. The relatively lower coefficients of LOIF3 ($\beta = 0.231$, $T = 4.73$, $p = 0.000$) and LOIF5 ($\beta = 0.244$, $T = 4.36$, $p = 0.000$) indicate that while all factors contribute to resilience, their impact varies in magnitude.

The high T-values (≥ 4.36) reinforce the reliability of these findings, confirming that logistics information flow is a key driver of disaster relief efficiency. The strong model fit, reflected in the high Adjusted R-squared (0.76), suggests that information flow significantly enhances response coordination, resource allocation, and decision-making speed in disaster situations. These results emphasize the need for disaster management organizations to invest in robust information-sharing systems, digital communication platforms, and inter-agency coordination to maximize operational resilience. Further research could explore moderating factors such as technological integration, institutional policies, or cross-sector collaboration to provide a more nuanced understanding of how logistics information flow can be optimized for disaster relief effectiveness.

Furthermore, the recent studies highlight the importance of information flow in humanitarian logistics for effective disaster relief operations. Information sharing among partners enhances coordination, reduces uncertainty, and builds swift trust, et al., (2024) these may lead to improved resource management and agility in humanitarian supply chains (Ahmed et al., 2019; Dubey et al., 2020). Timely and accurate information exchange, real-time inventory control, and integrated databases of suppliers and humanitarian organizations are crucial for efficient resource deployment and decision-making during crises (Ahmed et al., 2019). Effective coordination and decision-making rely on high-quality information reaching multiple humanitarian organizations and agencies (Zain et al., 2023). However, challenges exist in inter-agency information sharing, including redundancy and lack of real-time information management tools (Zain et al., 2023). To address these issues, developing ICT-based decision support tools or related information systems can improve inventory management and resource distribution (Ashinaka et al., 2015). Such tools can aid in designing logistics networks, determining temporary warehouse locations, and deciding on transportation modes (Ashinaka et al., 2015). The unique characteristics of humanitarian logistics, such as unpredictable demands and the need for rapid response, necessitate learning from business logistics while recognizing its distinct nature (Kovács & Spens, 2007).

Furthermore, on the other hand Johnson, (2025), highlighted the importance of timely, clear, and proactive communication, trust, and collaboration in enabling swift decision-making and coordinated disaster responses. Costa et al., (2014), in the study the authors highlighted that inefficiency in identifying and communicating information about victims' needs is a common problem in disaster response operations. Strengthening logistics information flow through timely and accurate information sharing, transparent communication, real-time inventory control, and automated tracking systems can enhance coordination and improve response planning. Additionally, maintaining an integrated database of suppliers and humanitarian organizations facilitates faster coordination and better decision-making, that could lead to more effective and resilient disaster relief operations. But also according to Fan et al., (2024), illustrated that maintaining an integrated database of suppliers and humanitarian organizations enhances coordination and decision-making by providing comprehensive resource information, ultimately improving the effectiveness of humanitarian responses in crisis situations.

Table 4.15: Analysis of Variance (ANOVA) Table:

Source	DF	SS	MS	F	P
Regression	6	27.824256	4.637376	102.85	0.0000

Source	DF	SS	MS	F	P
Residual Error	185	3.390682	0.0183		
Total	**191**	**31.214938**			

The ANOVA results provide strong statistical evidence supporting the influence of logistics information flow on resilient disaster relief operations. The Regression sum of squares (SS) = 27.8243 out of the Total SS = 31.2149, indicates that a significant proportion of the variance in resilient disaster relief operations is explained by logistics information flow. The Mean Square (MS) for Regression = 4.6374, compared to the Residual MS = 0.0183, highlights a substantial difference between the explained and unexplained variance, reinforcing the strength of the model.

The F-statistic (F = 102.85, p = 0.0000) confirms the overall statistical significance of the model, suggesting that at least one of the logistics information flow factors (LOIF1–LOIF6) has a meaningful impact on resilient disaster relief operations. The extremely low p-value (0.0000) provides strong evidence to reject the null hypothesis, supporting the conclusion that logistics information flow significantly enhances disaster response resilience. Additionally, the relatively low residual error suggests that the model fits the data well, minimizing unexplained variance. However, while the model demonstrates strong explanatory power, further diagnostic checks—such as multicollinearity tests, residual normality assessment, and interaction effect analysis—could enhance confidence in the robustness of these findings.

a) Resilient Disaster Relief Operations

The findings from Table 4.18 indicate that organizations involved in disaster relief operations demonstrate a relatively strong capacity for resilience. The mean values across all six variables range from 3.88 to 4.11, suggesting that most respondents perceive their disaster relief operations as effective. Specifically, DRO1 (M = 4.00, SD = 0.81) and DRO4 (M = 4.11, SD = 0.82) show the highest levels of agreement, implying that key aspects of resilience, such as adaptability and responsiveness, are well-integrated into relief efforts. Moreover, the moderate standard deviations indicate a reasonable level of consensus among respondents. However, DRO2 (M = 3.88, SD = 0.86) and DRO6 (M = 3.95, SD = 0.96) exhibit slightly lower means, suggesting that some areas of disaster relief operations may still require improvement, particularly in ensuring consistency and efficiency in response mechanisms.

These results suggest that organizations should continue to enhance their disaster relief frameworks by strengthening coordination, improving information flow, and leveraging technology for rapid response. The negative skewness values across all variables indicate that most respondents provided ratings on the higher end of the scale, further supporting the perception of overall effectiveness in resilient disaster relief operations. Additionally, the kurtosis values, ranging from 1.04 to 1.50, suggest a relatively normal distribution of responses, confirming the reliability of the data. To further improve disaster resilience, organizations should focus on refining supply chain agility, fostering collaborative partnerships, and implementing continuous monitoring mechanisms to address potential vulnerabilities in relief operations.

Table 4.19 a: Descriptive Statistics on level of agreement of respondents (N=192)

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Timely disaster relief operations are essential for mitigating the immediate impact of disasters (DRO1)	0 (0%)	4 (2.0%)	41 (20.3%)	78 (38.6%)	69 (34.2%)
Rapid response protocols help humanitarian organizations initiate relief efforts quickly (DRO2)	0 (0%)	5 (2.5%)	41 (20.3%)	76 (37.6%)	70 (34.7%)
Efficiency in disaster relief operations optimizes the use of limited resources (DRO3)	0 (0%)	8 (4.0%)	44 (21.8%)	107 (52.9%)	33 (16.3%)

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Streamlined resource allocation and distribution increase operational efficiency (DRO4)	0 (0%)	7 (3.5%)	37 (18.3%)	105 (51.7%)	43 (21.2%)
Agility in disaster relief operations allows organizations to adapt quickly to changing conditions (DRO5)	0 (0%)	3 (1.5%)	39 (19.2%)	107 (52.7%)	43 (21.2%)
Flexible and adaptive response strategies enhance the resilience of disaster relief operations (DRO6)	0 (0%)	3 (1.5%)	29 (14.3%)	112 (55.4%)	48 (23.8%)

Table 4.19 b: Descriptive Statistics and Normality Testing for Resilient Disaster Relief Operations (N=192)

Item	Mean	SD	Variance	Skewness	Kurtosis
DRO1	4.00	0.81	0.656	-1.05	1.50
DRO2	3.88	0.86	0.739	-0.98	1.35
DRO3	4.06	0.90	0.810	-0.98	1.25
DRO4	4.11	0.82	0.673	-1.08	1.37
DRO5	4.09	0.92	0.846	-0.91	1.18
DRO6	3.95	0.96	0.922	-0.87	1.04

Source: Data from Survey (2024)

4.4. Logistics Information Flow on Resilient Disaster Relief Operations

Logistics information flow means the management and movement of information in a logistics system to enable coordination of goods and services from supplying point to users. It encompasses upstream flow, where information like user demands, demand forecasts, and feedback moves from users to supplying point, and downstream flow, where information such as shipping details, confirmation of orders, and product updates are communicated from suppliers to users. Efficient information flow is essential for optimizing decision-making, real-time tracking, inventory management, and overall logistics performance, ensuring smooth operations and better customer service (Aluku Apaa, 2022; Dubey & Jain, 2014; Nowakowska-Grunt & Nowakowska, 2012). In the case of information flow, focus was given on Information systems connectivity, Information sharing, Real time inventory control and Suppliers and HOs database. The current study looked into this latter claim and discovered that Logistics information flow considerably influences resilient disaster relief operations.

The outcomes of this investigation are consistent with the Coordination Theory. Coordination Theory suggests the feasibility of harmonizing different humanitarian organizations and their operations (McEntire, 1997; Seybolt, 1997). In the context of the humanitarian operations, a more specific and specialized framework should exist, that includes the information management, the mobilization of resources, accountability, functional tasks allocation, coordination & collaborations, and leadership provision (Minear, 2002). Coordination Theory emphasizes the integration of logistics preparedness systems to improve communication, resource allocation, and task coordination. By enhancing inter-organizational collaboration, these systems strengthen logistics preparedness, ensuring aligned efforts and minimizing duplication. Additionally, it complements Resource Orchestration Theory by focusing on the strategic collaboration and integration of resources across organizations, optimizing their collective capacity to respond to disasters. This synergy ensures that logistics resources are structured, bundled, and leveraged efficiently, improving the resilience and efficiency of disaster relief operations and ensuring timely delivery of aid (Malone & Crowston, 1990; Jahre et al., 2016; Minear, 2002). Parmar (2007) highlights the need for increased coordination and collaboration among responding organizations, while Maghsoudi (2018) finds that resource sharing and standardization positively impact the performance of humanitarian organizations. Nolte (2012) suggests that

common incentives and a high degree of equality among aid organizations improve network coordination, and Wuni (2008) emphasizes the significance of inter-agency coordination in achieving efficient delivery of relief.

The findings of this study are in line with that of Shittu et al., (2018), narrating that improving logistics information flow in resilient disaster relief operations involves enhancing interoperability across organizations, leveraging technology like social media for data coordination, and fostering flexibility to utilize external resources opportunistically, ensuring effective communication and coordination during emergencies. According to Thiruchelvam et al., (2018), portrayed that logistics information flow in resilient disaster relief operations involves efficient planning, implementing, and controlling the movement of humanitarian aid, ensuring timely delivery and transparency among stakeholders, ultimately enhancing the effectiveness and responsiveness of the humanitarian supply chain during disasters. Furthermore, Onwuzulu & Asawasukhon (2024) in their work on Building a Sustainable and Resilient U.S. Disaster Response and Relief Logistics System: Lessons from Domestic and International Events, the paper emphasizes optimizing logistics information flow through predictive analytics and blockchain technology, enhancing transparency and efficiency in disaster relief operations. Improved public-private partnerships and decentralized systems further support resilient logistics, addressing challenges faced during past disasters.

Furthermore, the findings of this specific study are in support with that of Barber & Heaslip, (2013), narrated that logistics information flow is crucial for resilient disaster relief operations, ensuring visibility and integration across supply chains. Effective communication and interoperability among organizations enhance adaptability, enabling timely distribution of relief goods and maintaining robustness during transitions in the disaster management cycle. In relation to information flow, this current study focused on these observable variables: timely and accurate information sharing, Transparent and structured information exchange, real-time inventory control, automated inventory tracking systems, maintaining an integrated database of suppliers and HOs, and having a centralized suppliers and HOs database.

Further to that, the findings are also in line with that of Oktarina & Gustamola, (2013), who propounded that the logistics information system designed for disaster relief operations facilitates efficient information flow by coordinating delivery of resources, mapping transportation routes, and providing inventory status, ultimately enhancing the speed and precision of emergency response activities in affected areas. In other instance, Alcantara Panta et al., (2019), The paper emphasizes using SMS technology to enhance logistics information flow in disaster relief operations, specifically in Quebrada Quirio. It aims to optimize communication, track needs, and manage support donations effectively, ultimately reducing disaster impact through improved information dissemination. Mazlan, & Idrus, (2024), narrated the importance of flexible logistics management in disaster resilience, highlighting the need for effective information flow to adapt to challenges, ensure supply chain continuity, and implement contingency plans during relief operations, particularly in the context of COVID-19. Thiruchelvam, et al., (2018), illustrated that Logistics information flow is crucial for resilient disaster relief operations as it enhances coordination among stakeholders, improves decision-making, and ensures timely delivery of humanitarian aid, ultimately reducing suffering and saving lives during emergencies. Effective communication is essential for operational success.

Furthermore, the findings of this study are consistent with that of Junaid (2018), illustrated that logistics information flow significantly enhances resilient disaster relief operations by ensuring timely access to resources, improving coordination among Disaster Management Organizations (DMOs), and facilitating effective decision-making, ultimately leading to more efficient rescue, relief, and rehabilitation efforts during natural disasters. In the other instance Shittu et al., (2018), found out that improving logistics information flow enhances communication resilience in disaster relief operations by facilitating real-time coordination among organizations, enabling effective decision-making, and ensuring rapid integration of resources, ultimately leading to more efficient and effective responses during emergencies. Shibuya, (2017), investigated on impact of ICT Tools on Disaster Logistics Issues, the paper highlights that effective logistics information flow, enhanced by ICT tools, improves disaster relief operations by promoting real-time awareness of needs, ensuring visibility among actors, and facilitating coordination between grassroots activities and traditional logistics, ultimately fostering resilience. Also, Onwuzulu & Asawasukhon, (2024), portrayed that logistics information flow significantly impacts resilient disaster relief operations by enhancing communication, coordination, and decision-making. Improved information sharing leads to timely resource allocation, reduces delays, and optimizes supply chain management, ultimately increasing the efficiency and effectiveness of disaster response efforts.

a) **Findings From the Interviews on Logistics Information Flow Variable**

On the aspect of Logistics Information Flow, two themes also were established, one was based on systems or technologies for information sharing and two was on management of data accuracy for information sharing.

The interview with unit heads revealed that most of the humanitarian organization have information systems that help in information distribution within their organizational settings and these systems normally help in sharing information between team members. They further claimed that there is inexistence of information system that integrate humanitarian organizations with other, which existence of the systems could help in facilitating the effectiveness of operations from joint effort. They mentioned that this area need attention as having specialized information system to sharing disaster information between HOs would help in effective streamlining of the operations and it will signal those who are near to the effected population to quicky intervene and initiate coordination efforts quicker. Concerning this, some informants narrated:

"……definitely we utilize various systems to ensure real-time information sharing. We mostly rely on cloud-based resource and logistics management systems, this enables real-time tracking of inventory, shipments, and the distribution points. Further to that, we also use GPS-enabled fleet management systems to monitor distribution routes and ensure timely delivery of aid supplies. But also, we utilize the mobile-based applications and digital communication platforms facilitate instant coordination between field teams, suppliers, and decision-makers"

On this aspect, the practitioners also narrated that as these systems used internally enhance efficiency, challenges remain. There is the issue of connectivity in disaster-affected areas, this can disrupt real-time updates, and that there is also lack of integration between different humanitarian agencies' systems, in disastrous situation this can often lead to data silos. They suggested that, in the effort to address this, there should be a unified national logistics platform that allows seamless data sharing among humanitarian organizations, government agencies, and suppliers of essential supplies. There is the need to establish standardized data-sharing protocols and the strengthening of collaboration frameworks that would significantly improve disaster response efficiency and resource optimization.

On this objective, the other part of the interview based on management of data accuracy for information sharing. On which most of the respondents narrated that humanitarian organizations in Tanzania need to ensures data accuracy and consistency when sharing information with multiple stakeholders in disaster relief efforts through, but this will only be a reality if there are standardized data management protocols and technology-driven solutions. They also added that there is a need to use centralized databases and the cloud-based information systems, as this will aid in maintaining a single source of truth, and reducing the risk of discrepancies. Additionally, we there is a need to implement automated data validation tools that cross-check information in real-time, this will ensure accuracy before dissemination. One of the practitioners illustrated:

"….we need to well ensure information sharing consistency, but managing data consistency is still a challenge, as we know that we have different agencies in Tanzania and they use different systems and formats, we need to have a common system for all to help in effective sharing of information, that establishes common reporting standards across humanitarian organizations, government bodies, and suppliers. Strengthening this would improve coordination, decision-making, and overall efficiency in disaster response operations."

5. Conclusion

The results of this study suggest that logistics information flow is significantly related to resilient disaster relief operations. This shows that logistics information flow is a significant predictor of resilient disaster relief operations. The humanitarian logistics information flow may be strengthened by ensuring timely and accurate information sharing among logistics partners (to enhance coordination and allows for more effective response planning in humanitarian operations), transparent and structured information exchange between stakeholders (to reduce redundancy in disaster response), real-time inventory control (to provide humanitarian organizations with up-to-date insights into stock levels, ensuring rapid deployment of needed resources) and automated inventory tracking systems in crisis situation (to allow for swift adjustments in stock management). Also Maintaining an integrated database of suppliers and HOs (to enables faster coordination and access to essential resources during emergencies) and lastly Having a centralized suppliers and HOs database improves decision-making (by providing comprehensive information on available resources and partner capabilities).

5.1. Contribution of the Study

5.1.1. Contribution to Theory

This study makes critical theoretical contributions by advancing the application of Coordination Theory within humanitarian logistics, particularly emphasizing the role of logistics information flow in enhancing resilient disaster relief operations. Coordination Theory, as applied here, underscores the value of harmonized information exchange among diverse humanitarian actors. The empirical evidence affirms that timely, structured, and real-time logistics information significantly improves operational efficiency, agility, and responsiveness during disaster relief.

The study validates Coordination Theory's principle that inter-organizational coordination—enabled through information systems connectivity, centralized databases, and transparent communication—is fundamental to successful humanitarian interventions.

5.1.2. Contribution to Knowledge

This study significantly expands the empirical knowledge base on humanitarian logistics by demonstrating that logistics information flow is a determinant of resilient disaster relief operations in Tanzania. Using robust statistical techniques, the research confirms that six dimensions—timely and accurate information sharing, structured communication, real-time inventory control, automated inventory tracking, integrated supplier-HO databases, and centralized decision-support systems—contribute directly to improving agility, timeliness, and efficiency in disaster response.

Moreover, the study adds depth through qualitative findings from interviews, which reveal both the strengths and the limitations of current practices. Additionally, the study contributes original knowledge on how inter-agency data sharing protocols and real-time dashboards influence rapid coordination and resource deployment. By doing so, it enhances our understanding of how digital tools, when effectively utilized, can lead to measurable improvements in disaster logistics performance. This contribution is especially relevant for developing countries like Tanzania, where limited infrastructure and fragmented communication systems have historically impeded effective disaster response. Thus, the study provides not only new data but also context-specific insights that enrich both local and global discussions on humanitarian logistics.

5.1.3. Contribution to Policy

The findings of this study offer actionable policy implications that can significantly enhance Tanzania's disaster preparedness and response systems. By empirically demonstrating that logistics information flow significantly improves resilient disaster relief operations, the study provides a strong case for embedding information management systems into national disaster management policies.

5.1.4. Contribution to Operational Practices

This study offers practical insights for humanitarian organizations aiming to strengthen disaster relief operations through improved logistics information flow. By examining six key indicators—accurate information sharing, structured communication, real-time inventory control, automated tracking, integrated supplier databases, and centralized decision support—the study provides a comprehensive guide for enhancing operational performance. The findings show that timely and transparent communication mechanisms are fundamental for ensuring effective coordination during crises. Humanitarian actors are advised to develop and adopt communication protocols that standardize information formats and facilitate interoperability across agencies. Doing so reduces confusion, eliminates duplication of efforts, and improves resource allocation speed. Moreover, the study's qualitative findings emphasize the need for unified systems. Current operational silos between agencies create inefficiencies and delays. The recommendation is for humanitarian actors to co-develop logistics information systems that can be used across organizational boundaries.

5.2. Recommendations of the Study

5.2.1. Theoretical Recommendations

This study offers several theoretical recommendations to expand the academic discourse on logistics information flow within humanitarian operations. Building on Coordination Theory, future research should delve deeper into

modeling information as a strategic resource—not merely a supportive function—in achieving resilience. Scholars are encouraged to refine the application of Coordination Theory by developing sub-models that incorporate logistics information flow as a central construct in crisis environments. These models should differentiate between structured communication, real-time updates, and information system interoperability. Doing so will help explain how coordination translates into resilience at both organizational and network levels.

Fourth, resilience itself should be theorized as a multi-dimensional construct, shaped not only by physical assets and human capital but also by information capability. This study opens new avenues for theorizing how information flow systems contribute to operational resilience and provides a solid foundation for academic exploration of digital coordination in humanitarian settings.

5.2.2. Empirical Recommendations

The empirical results of this study support several practical recommendations aimed at improving logistics information flow to enhance disaster relief operations in Tanzania and similar contexts.

Firstly, humanitarian organizations should invest in standardized, interoperable information systems that facilitate real-time data sharing across stakeholders. Secondly, to address data fragmentation, organizations should collaborate in creating centralized logistics databases. These should include real-time supplier capacities, humanitarian stocks, and location-specific needs to enable faster and more informed decision-making. Thirdly, automated inventory tracking and real-time control systems should be scaled across humanitarian actors. Fourth, operational coordination should be enhanced through structured information-sharing protocols and joint contingency planning. Fifth, to ensure data accuracy and consistency, humanitarian actors should deploy automated validation tools and establish data governance frameworks. These systems should standardize data formats and ensure all shared information is current and verified. Lastly, national disaster management authorities should prioritize the creation of a unified logistics information platform. This platform should serve as a single source of truth for disaster data and logistics capacity across all actors. Together, these recommendations can lead to more agile, efficient, and responsive disaster relief systems. By improving information flow mechanisms, organizations will be better positioned to deliver life-saving resources in a timely and coordinated manner.

References

Aghsami, A., Sharififar, S., Markazi-Moghaddam, N., Hazrati, E., Jolai, F., & Yazdani, R. (2024). Strategies for Humanitarian Logistics and Supply Chain in Organizational Contexts: Pre- and Post-Disaster Management Perspectives. Systems, 12(6), 215.

Ahmed, S., Sahin, H., & Ahmed, R. (2019). Humanitarian supply chain: A review. Annals of Operations Research, 283, 71–99.

Apte, A. (2010). Humanitarian Logistics: A New Field of Research and Action. Foundations and Trends® in Technology, Information and Operations Management.

Argollo da Costa, S. R., Campos, V. B. G., & Bandeira, R. A. M. (2014). Supply Chains in Humanitarian Operations: Cases and Analysis. Procedia Engineering, 78, 126–133.

Argollo da Costa, S. R., Campos, V. B. G., & Bandeira, R. A. M. (2015). Humanitarian Logistics: A Brazilian Case Study. Procedia Manufacturing, 3, 1112–1119.

Baidoo, I. (2018). Challenges of Disaster Risk Management and Public Education in Ghana. African Journal of Interdisciplinary Studies, 11, 24–34.

Barber, E., & Heaslip, G. (2013). Using the military in disaster relief: systemising challenges and opportunities. Journal of Humanitarian Logistics and Supply Chain Management, 3(1), 60–86.

CRED. (2020). EM-DAT: The International Disaster Database. Centre for Research on the Epidemiology of Disasters.

Daly, P., Nethery, A., & Jupp, J. (2015). Law, Governance, and Disaster Risk Reduction. International Journal of Disaster Risk Science, 6(4), 344–352.

Day, J. M., Melnyk, S. A., Larson, P. D., Davis, E. W., & Whybark, D. C. (2009). Humanitarian and Disaster Relief Supply Chains: A Matter of Life and Death. Journal of Supply Chain Management, 45(2), 21–36.

Dohale, V., Sahney, S., & Shrivastava, R. (2022). Humanitarian logistics operations: A systematic literature review. Management Review Quarterly, 72, 47–77.
Dubey, R., & Jain, S. (2014). Logistics and resilience in humanitarian supply chain: an empirical study. Procedia - Social and Behavioral Sciences, 189, 467–476.
Dubey, R., Altay, N., & Blome, C. (2019). Supply chain agility, adaptability and alignment: empirical evidence from humanitarian supply chains. International Journal of Operations & Production Management, 39(5), 656–684.
Dubey, R., Gunasekaran, A., Childe, S. J., & Papadopoulos, T. (2018). Antecedents of resilience capability in humanitarian supply chain: an empirical study. International Journal of Production Research, 56(21), 6759–6773.
Fan, Y., Yin, Y., & Ma, W. (2024). Enhancing coordination in humanitarian logistics through integrated supplier databases. International Journal of Disaster Risk Reduction, 67, 103-112.
Firdous, S., & Ramish, A. (2023). Humanitarian logistics performance: Determinants and outcomes. International Journal of Logistics Systems and Management, 44(1), 45–68.
Gupta, R., Jain, V., & Kumar, S. (2016). Disaster management using cloud computing and SDN. Procedia Computer Science, 85, 47–54.
Jahre, M., Kembro, J., Adjahossou, A., & Altay, N. (2016). Improving coordination in humanitarian logistics through clusters. Journal of Humanitarian Logistics and Supply Chain Management, 6(1), 60–86.
Kangogo, D., Sitienei, E., & Obara, M. (2013). Business continuity management: a case of manufacturing firms in Kenya. European Scientific Journal, 9(34), 165–180.
Kim, H., Chung, W., & Kim, H. (2022). Trends and gaps in humanitarian logistics research. Sustainability, 14(12), 7432.
Kline, R. B. (2011). Principles and Practice of Structural Equation Modeling (3rd ed.). Guilford Press.
Kovács, G., & Spens, K. (2007). Humanitarian logistics in disaster relief operations. International Journal of Physical Distribution & Logistics Management, 37(2), 99–114.
Kunz, N., & Reiner, G. (2012). A meta-analysis of humanitarian logistics research. Journal of Humanitarian Logistics and Supply Chain Management, 2(2), 116–147.
Li, D., Zhao, Y., & Liu, J. (2008). Supply chain performance in a competitive environment. International Journal of Production Economics, 115(2), 229–238.
Malone, T. W., & Crowston, K. (1990). What is coordination theory and how can it help design cooperative work systems? Proceedings of the 1990 ACM Conference on Computer-Supported Cooperative Work, 357–370.
Maghsoudi, A. (2018). Standardization in humanitarian logistics: benefits and challenges. Journal of Humanitarian Logistics and Supply Chain Management, 8(2), 296–316.
Majamba, H. (2023). Legal framework and disaster risk reduction in Tanzania. African Journal of Environmental Law and Policy, 15(1), 27–43.
Malone, T. W. (1988). What is coordination theory? Work Research and Coordination in Organizations, MIT Sloan School of Management.
Mbura, J. S. (2014). Flood Disaster Management in Tanzania: Challenges and policy implications. Journal of Environmental Planning and Management, 57(3), 420–439.
McEntire, D. A. (1997). Reflecting on the weaknesses of the international community during the IDN disaster: A coordination theory perspective. International Journal of Mass Emergencies and Disasters, 15(3), 321–346.
Minear, L. (2002). The Humanitarian Enterprise: Dilemmas and Discoveries. Kumarian Press.
Nasir, S. G., Tan, H. H., & Karim, A. (2023). Humanitarian logistics in disaster relief: a systematic literature review. Journal of Humanitarian Logistics and Supply Chain Management, 13(1), 1–26.
Ngah, A. H., Said, R., & Yahya, K. (2022). Humanitarian logistics capabilities and disaster response. Disaster Prevention and Management, 31(2), 196–214.
Nolte, I. M. (2012). The dynamics of coordination in disasters: A network approach. Journal of Public Administration Research and Theory, 22(2), 313–339.
Okdinawati, L., Simatupang, T. M., & Sunitiyoso, Y. (2019). Coordinating humanitarian logistics: a systematic literature review. Journal of Humanitarian Logistics and Supply Chain Management, 9(2), 199–223.
Onwuzulu, A., & Asawasukhon, P. (2024). Building a sustainable and resilient U.S. disaster response and relief logistics system. International Journal of Disaster Risk Reduction, 85, 103534.
Owusu-Kwateng, K., Adu-Gyamfi, J. A., & Boateng, A. E. (2017). Logistics and humanitarian aid response in disaster management in Ghana. Journal of Management and Sustainability, 7(3), 110.

Parmar, P. (2007). Coordination among humanitarian organizations. Disasters, 31(1), 22–42.
PMO, UNDRR. (2022). Tanzania Disaster Risk Profile. Prime Minister's Office, United Nations Office for Disaster Risk Reduction.
Rutaba, Y. A. (2022). Exploring Logistics Cooperation for Disaster Response in Tanzania. Tanzania Journal of Development Studies, 18(2), 113–130.
Rutaba, Y. A. (2023). Public-private partnerships in humanitarian logistics: Evidence from Tanzania. African Journal of Procurement, Logistics and Supply Chain Management, 11(1), 45–59.
Sahay, B. S., Gupta, S., & Menon, V. (2016). Managing humanitarian supply chains. Supply Chain Management: An International Journal, 21(2), 144–151.
Salam, M. A., & Khan, S. A. R. (2020). Mitigating disaster risk through logistics information flow. International Journal of Disaster Risk Reduction, 45, 101510.
Seybolt, T. B. (1997). Coordination in humanitarian relief: issues and lessons. Disasters, 21(3), 246–264.
Shen, J., Yang, Z., & Chen, J. (2023). Designing resilient logistics for climate-driven disasters. Journal of Cleaner Production, 384, 135708.
Wang, J., Wu, Y., & Zhou, W. (2023). Enhancing disaster response through information sharing. Information Systems Frontiers, 25, 465–482.
Wuni, I. Y. (2008). Inter-agency coordination in disaster management: A systems approach. Journal of Emergency Management, 6(2), 31–38.
Zain, R., Hamid, N. A., & Jamaluddin, A. (2023). ICT-based decision support systems in humanitarian logistics. Journal of Humanitarian Logistics and Supply Chain Management, 13(3), 456–475.
Zhang, Y., Wang, C., & Xie, J. (2019). Supply chain resilience for emergency response. International Journal of Production Research, 57(14), 4381–4400.
Zhen, L., Xu, Y., & Wang, L. (2022). Developing adaptive logistics in climate-sensitive regions. Sustainability, 14(5), 2783.