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Logistics for Large-Scale Disaster Response: The Role of Humanitarian Disaster Relief Organisations in Niger-Delta Flood Prone State of Nigeria

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ABSTRACT

As disasters increasingly disrupt economic life and threaten human existence globally, this paper examines the essential steps in disaster logistics and humanitarian aid operations. It emphasizes that well-structured logistics management is crucial for the efficiency and effectiveness of humanitarian organizations, which serve as the relief arm of the global community and the frontline of assistance for those affected by natural and complex emergencies. Specifically, the flood-prone Niger-Delta region of Nigeria requires comprehensive humanitarian operations as a beacon of hope for rescue efforts.

KEYWORDS: *Large-scale disaster, humanitarian disaster relief organisations, Niger-Delta, flood, mitigation, disaster management*

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1. INTRODUCTION

In recent years, the world has experienced numerous significant disasters affecting societal safety. Growing concern has centered on large-scale disasters, primarily caused by natural forces. Some notable examples include Japan's earthquake and tsunami on March 11, 2011, Chile's earthquake on February 27, 2010, Haiti's earthquake on January 12, 2010, Thailand's flooding from July to December 2011 (Time,2011), and Nigeria's flooding from June to July 2012. The Haiti earthquake affected about three million people, resulting in approximately 217,000-230,000 deaths. Thailand's flooding impacted over 12.8 million people, with the World Bank estimating economic damages above $45 billion USD. Japan's disaster recorded over 15,842 deaths, with economic costs estimated at over $235 billion. Nigeria's flooding, according to the National Emergency Management Agency (NEMA, 2012), affected 30 of the 36 states, displaced 2.3 million people, destroyed 597,476 houses, and resulted in 363 deaths. The flooding also severely impacted agriculture and biodiversity and caused Nigeria to lose about 500,000 barrels of crude oil output per day, affecting the global market.

Large-scale disasters have significant global economic repercussions. For instance, Thailand's flooding affected Intel's operations, reducing their fourth-quarter 2011 revenue expectations from $14.7 billion USD to $13.7 billion USD. Similarly, Nigeria's flooding reduced crude oil supply in the world market.

In the event of a catastrophic disaster, immediate response and decisive action are crucial to mitigate consequences. Calls for assistance are directed to governmental and private aid organizations, which pledge and deliver aid in forms such as money, medical teams, medicine, food, water, sanitation equipment, engineers, shelter, and support personnel. Humanitarian and disaster relief supply chains mobilize resources, deliver them to disaster sites, and facilitate recovery efforts. According to

(FEMA,2012) an effective emergency management program involves examining potential emergencies and disasters, developing and implementing programs to reduce their impact, preparing for risks that cannot be eliminated, and prescribing actions to manage and recover from actual events. This process includes four phases: Mitigation, Preparedness, Response, and Recovery, collectively termed Disaster Management Operations.

In Nigeria, flooding is a major disaster due to rising sea levels from global warming and the saturated nature of wetlands. Floods disrupt socio-economic life and livelihoods, with devastating effects that some never recover from. According to Mmom and Aifeshi (2013), floods often result in hunger, famine, disease, and epidemics. Low-lying coastal regions, deltas, and small basins are particularly vulnerable. Delta State of Nigeria has frequently suffered from flooding, resulting in loss of human lives, submerged residences and streets, sewage pollution, health hazards, traffic obstruction, infrastructural damage, and economic losses (Udoh and Aniefiok, 2014; Okereke, 2007). Recently, humanitarian agencies and the government have focused on reducing the impact of floods. Aid logistics and supply chain management play crucial roles in this effort. Thomas and Kpezak (2005) define rescue operations as the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption, to alleviate the suffering of vulnerable people.

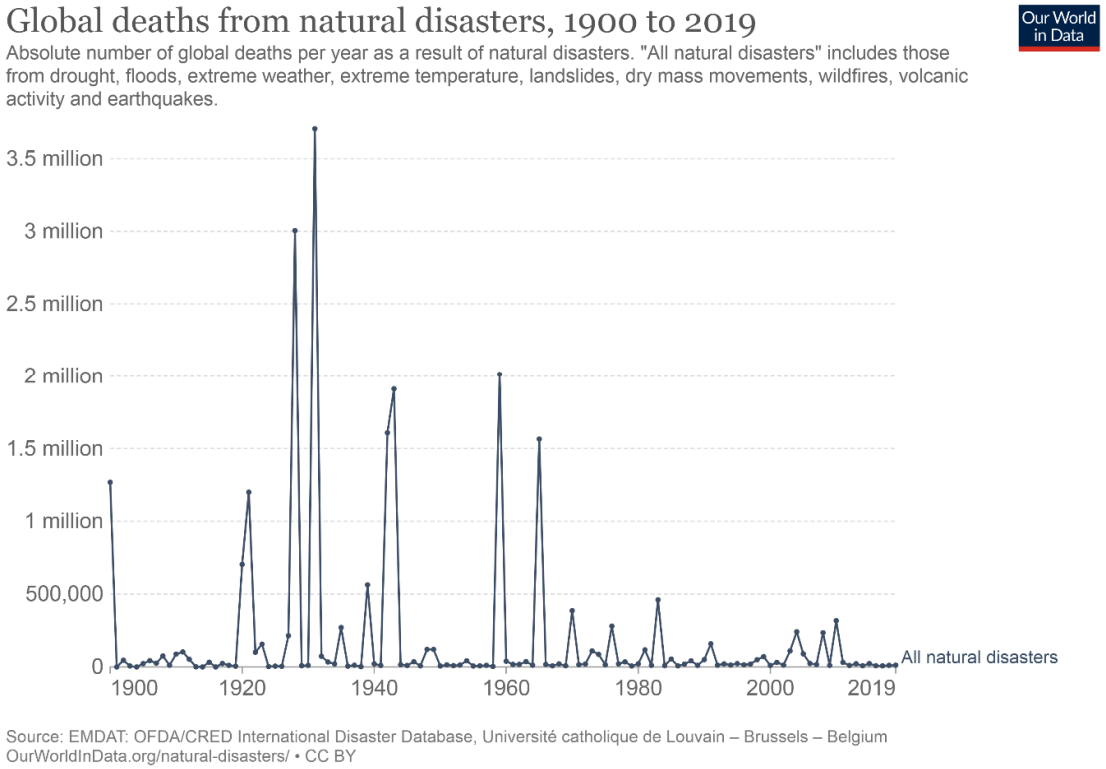

Fig.1 : Global Death from Disasters 1900 – 2019

2. Global Disaster Costs

Natural disasters cause significant destruction and financial costs in addition to their catastrophic effects on human life. The rising expenses are evident when considering the global economic cost over time in absolute terms. Since 1970, global gross domestic products (GDP) have expanded more than fourfold, especially in wealthier nations. Consequently, the absolute economic consequences of any given disaster today are expected to be higher than in the past.

From 1998 to 2017, countries affected by disasters reported direct economic losses totaling $2,908 billion, with climate-related disasters accounting for $2,245 billion, or 77% of the total. This marks an increase from the $1,313 billion in losses, or 88%, reported between 1978 and 1997.

The primary goal, therefore, becomes utilizing available resources effectively to meet the urgent task of saving lives and property. As Thomas (2003) noted, "logistics plays a key role in disaster response operations; it serves as a link between procurement and distribution, and between headquarters and the field, and is crucial to the effectiveness and responsiveness of major humanitarian programs such as health, food, shelter, water, and sanitation." Van Wassenhove (2006) observed that logistics accounts for 80% of the requirements for efficient

and effective relief operations, emphasizing the critical importance of supply chain management for successful humanitarian efforts. Recognizing the vital role of disaster management, several experts (Rawls and Turnquist, 2012; Altay and Green III, 2006; Morteza et al., 2015; and FEMA, 2012) agree that it encompasses four distinct phases: mitigation, preparedness, response, and recovery.

Furthermore, flooding from torrential rains and dam bursts is a significant issue in Nigeria. Edward-Adebiyi (1997) reported that the Ogunpa disaster, which claimed over 200 lives and caused property damage worth millions of Naira, resulted from urban flooding. Nzeribe-George et al. (2014) stated that flood disasters have claimed more lives and caused more property destruction than any other type of disaster. Flooding in Nigeria has displaced millions, destroyed businesses, closed academic institutions, polluted water resources, and increased the risk of diseases, as evidenced by the flooding that affected Delta State University, Oleh campus.

The table below shows reports of some flood disasters in Nigeria and the number of people affected (Baiye, 1998; Nwaubani, 1991; Edward, 1997).

Table 1a: Some flood in Nigeria and the people affected (Source: http//www.emdat.be/esult-country retrieved on 09/02/2013)

DATE	NO OF PEOPLE AFFECTED
August 1988	300,000
11 September 1994	580,000
10 0ctober 1998	100,000
27 August 2001	84,065
5 September 2003	210,000
10 September 2009	150,000
13 September 2010	1,500,200

Besides, we also note the impacts of the economic damages of flood that occurred during 1985-2011 in terms of monetary cost as shown in the table below:

Table 1b: Some flood in Nigeria and the monetary cost

DATE	COST(US Dollar in thousands)
23 September, 1985	8,000
11 September, 1994	66,500
15 August, 2000	1,900
20 September, 2000	4,805
27 August, 2001	3,000
5 September, 2003	2,570
7 August, 2005	147
28 August 2011	30,000
13 September 2011	1,500

The necessity for vendors to cut costs was highlighted in a study on robust optimization using mixed-integer linear programming for the LNG (Liquefied Natural Gas) supply chain (Arun et al., 2020). They identified the uncertainty in manufacturer supply parameters, classifying them as interval-based uncertain. To validate their model, they used a CPLEX solver of GAM and developed a Cuckoo Optimization Algorithm (COA) to solve it. By comparing vendor profit and robust cost, they evaluated the ideal robustness level.

To address cost concerns, Doufour et al. (2018) proposed an optimal logistics service network architecture for humanitarian response, aiming to reduce overall expenses. Through modeling, statistical analysis, and optimization methods, they found that adding a regional distribution hub in Kampala was cost-effective, resulting in an average cost reduction of around 21%.

Kaveh et al. (2022) stated, "The paramount goal of disaster relief programs is to save lives, reduce financial loss, and accelerate the relief process." Their study introduced a bi-level two-echelon mathematical model designed to minimize pre-disaster costs and maximize post-disaster relief coverage. The model utilized a geographical information system (GIS) to classify disaster areas and determine the optimal number and location of distribution centers while minimizing inventory costs for relief supplies. A simulation method estimated the demand for relief supplies, revealing that relief operations are more challenging and costly at night compared to the day.

Bochem and Hang (2022) observed that multiple resource allocation strategies before and after disasters are critical research issues in disaster rescue. Response planning for sudden-onset disasters must consider the inherent uncertainties of the catastrophe and potential secondary hazards. They investigated resource allocation optimization in natural disasters involving multiple secondary hazards, proposing a two-stage stochastic optimization model. This model simulated the random occurrence and severity of multiple natural hazards to optimize the allocation of rescue teams, warehouse items, and medical resources, achieving their objective effectively.

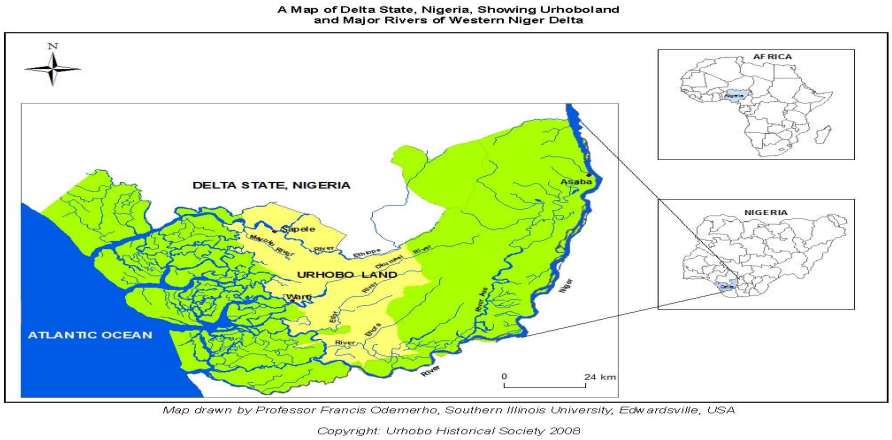

Figure 3: A map of Delta State showing Urhobo Land and Major Rivers of Western Niger Delta

The Nigerian authorities initially managed excess run-off through contingency measures, but in September 2012, water reservoirs overflowed, and dams had to be opened to relieve pressure in both Nigeria and neighboring Cameroon and Niger Republic. This incident led to the destruction of riverbanks, severe property loss, the collapse of social infrastructure, and the destruction of roads, farmlands, crops, and livestock. On September 29, the UN Office for the Coordination of Humanitarian Affairs reported that the flood had affected 134,371 people, displacing and killing 148. By the end of October, over 7.7 million people had been affected, over 2.1 million displaced, around 363 reported dead, and more than 618,000 houses destroyed (NEMA, 2012).

3. 2022 flood worst in Nigeria's history

The flood disaster of 2022 surpassed that of 2012 in severity. The Director General of the National Emergency Management Agency (NEMA), Mustapha Habib Ahmed, described the 2022 flooding as "the worst in the history of Nigeria" during a session with the special Ad-hoc Committee of the House of Representatives investigating the utilization of Ecological Funds. He remarked, "Distinguished Chairman, as predicted, the 2022 flood hit the country with devastating consequences, impacting thousands of communities and wreaking havoc across all 36 states of the Federation and the Federal Capital, Abuja."

He reported that "612 persons lost their lives, 3,219,780 were affected, 1,427,370 were displaced, and 2,776 sustained various degrees of injuries." Furthermore, "181,600 houses were partially damaged, 123,807 houses were completely destroyed, 176,852 hectares of farmland were partially destroyed, and 392,300 hectares of farmland were totally destroyed." The agency has warned that similar flooding could occur next year.

Floods generally have negative effects on the GDP of the manufacturing, wholesale, and retail sectors, while they tend to positively impact the GDP of the construction sector. Additionally, the magnitude of the indirect effects of floods varies depending on whether assets, facilities, or equipment incur damage.

4. Disaster Management Operations

The terms "disaster" and "emergency" have been defined in various ways by different people. However, most definitions agree that disasters and emergencies are events causing social disruption and involving high levels of uncertainty. Dynes describes them as extreme environmental uncertainties requiring effective coordination among many stakeholders (Dynes, 1970). From an operational perspective, Jamison et al. (2012) and Roland et al. (2016) define a disaster as:

"A social phenomenon that occurs when a hazard intersects with a vulnerable community, overwhelming its ability to cope, and causing serious harm to the safety, health, welfare, property, or environment of people. It may be triggered by natural phenomena within the geophysical or biological environment, or by human actions or errors, whether malicious or unintentional, including technological failures, accidents, and terrorist acts."

Van Wassenhove (2006) describes a disaster as a "disruption that physically affects a system as a whole and threatens its priorities and goals," which may begin suddenly or slowly. Additionally, scholars like Thomas and Kopezak (2005) define disaster management as "activities such as planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption, to alleviate the suffering of vulnerable people."

Similarly, Roland et al. (2016) define an emergency as:
"A present or imminent event that requires prompt coordination of actions concerning persons or property to protect the health, safety, or welfare of people, or to limit damage to property or the environment."

From these definitions, we can infer that disasters are events causing emergencies that necessitate swift intervention to prevent losses in human lives and infrastructure.

5. Types of Disaster

Not every earthquake, fire, flood, or tsunami is classified as a disaster. An event, whether natural or man-made, is termed a disaster when it affects a community or country to such an extent that their efforts and resources are insufficient to cope, necessitating external aid and assistance. An incident is considered a disaster if it meets one of the following criteria (Stromberg, 2007 and Wong, 2013):

- 10 or more lives lost
- 100 or more injuries or displacements
- A state of emergency declared by the affected country's government
- A call for international aid by the affected country's government

Ahmet and Hatice, in their paper on disaster classification, noted that different types of disasters require different approaches in humanitarian aid operations (Ahmet and Hatice, 2015). They classified disasters into the following categories:

- Rapid onset natural disasters such as earthquakes, tornadoes, storms, and floods
- Rapid onset man-made disasters such as terrorist attacks and industrial accidents
- Slow onset natural disasters such as droughts and epidemics
- Slow onset man-made disasters such as economic crises and refugee crises

Rapid onset natural disasters are particularly dangerous and often require a swift response, resulting in devastating and destructive effects on the community within a short period. In contrast, slow onset disasters require long-term aid and development projects. For instance, most floods are unpredictable, like the 2012 Nigerian flood disaster, which resulted in significant loss of life and property destruction. Starvation and famine are slow onset disasters that affect wide areas and can cause numerous deaths over time, although they do not damage property or infrastructure. Therefore, aid operations must be carefully planned and executed based on the nature and type of disaster.

6. Disaster Management

Awareness of disaster management has been growing over the past decade due to the increasing frequency of natural disasters resulting in the destruction of lives and properties. Isik et al. (2012) stated that "Disaster management aims at reducing the damage of disasters," emphasizing that it encompasses planning and coordination of all activities related to damage reduction, preparedness, response and first aid, and the restoration-restructuring process.

Gogen (2004), Schulz (2008), and Koseoglu (2011) agree that disaster management must include planning for disasters, assessing available resources, evaluating requirements, and creating possible scenarios. They observed that effective disaster management should aim to reduce human, physical, and economic losses, alleviate suffering in the immediate environment, and accelerate the reconstruction process. They highlighted that logistics practices are the most crucial components of disaster management.

Isik et al. (2012) also noted, "In disaster management studies, security, communication, psychological support, sheltering, water-sanitation, transportation, food, and health modules are the foundations of the emergency action plans. Effective disaster management requires communication between these modules, and their priorities can shift depending on the disaster. Each module has its own standards."

7. Stochastic Optimization Approach

Today, numerous scientists researching natural disasters are focusing on the aspects of uncertainty and randomness. Balcik et al. (2008) employed a rolling-horizon approach to address demand and supply uncertainty

in crisis situations. They associated travel costs on different arcs with various vehicle types to denote vehicle-road compatibility. If a road was unsuitable for a specific vehicle, the cost of traversing that arc was set at a high value, prompting policymakers to consider transportation infrastructure and omit unfavorable routes.

Chang et al. (2007) examined the placement and distribution of disaster rescue supplies in flood emergencies, considering diverse flood scenarios within an uncertain demand environment. However, their research primarily concentrated on a particular large metropolis flood disaster and neglected to adequately address vehicle scheduling.

Salmeron and Apte (2010) developed a two-stage stochastic optimization model for budget allocation planning for relief assets. Their model covered "help pre-positioning" in the first stage, which involved expanding resources such as warehouses, hospitals, and shelters, and addressed logistics amid demand and cost uncertainty in the second stage. However, their model did not consider the relationship between relief locations and the potential for inventory destruction.

Stepanov and Smith (2009) investigated optimal routing procedures for evacuation planning, developing an evacuation model through simulation and integrated optimization. Their study focused on multi-objective route optimization to reduce travel times, traffic congestion, and the need for simulation techniques in regional evacuation management.

Lim et al. (2012) employed an optimization strategy to minimize the number of evacuees by considering the shortest routes. They utilized a greedy algorithm to assess maximum flow and scheduling techniques for evacuations, aiming to enhance rescue efforts by optimizing evacuation routes, traffic patterns, and schedules.

Na et al. (2012) examined journey time and evacuation processes using a bio-objective model to optimize route assignment considering secondary evacuation. Their model, solved through an approximation approach, aimed to equally minimize trip time and was validated through numerical exercises.

Ali and Nakade (2014) proposed a stochastic programming approach to manage supply chain disruptions in the face of demand and disruption uncertainty. Their approach accounted for inventory costs, purchasing costs, and last-minute orders using the Monte Carlo sampling approach to sample specific probability distributions of stochastic parameters.

Wapee et al. (2014) conducted a time-constrained study on humanitarian aid logistics, aiming to establish distribution hubs for emergency supplies in flood-prone areas. Their approach integrated facility location and inventory decisions as a mixed integer programming problem to reduce the overall cost of relief operations.

Falasca and Christopher (2011) investigated a two-stage procurement strategy for humanitarian aid, considering uncertainties surrounding catastrophe aid efforts. Their model aimed to minimize anticipated demand shortages and overall procurement costs by addressing various logistics restrictions, relief uncertainties, and operational constraints.

Barzinpour and Esrnaeili (2014) and Okonta and Olaomi (2023) employed a multi-objective relief chain site distribution model to address disaster management issues in urban settings. Their model incorporated humanitarian and cost-based objectives using a multi-objective mixed integer linear programming approach.

Sha-Lei and Nan (2011) focused on emergency location-allocation in a multi-supplier, multi-affected area, and multi-relief anti-multi-vehicle emergency logistics network to reduce overall trip time and unmet demand percentage. They used goal programming to achieve their objectives.

Rennemoet. al. (2014) contributed to the logistics of humanitarian aid by developing a methodology to enhance decision-making effectiveness. Their mathematical models aimed to maximize the utility of aid distribution while addressing the challenges of catastrophe response.

8. Disaster Logistics/Humanitarian Aids

The concepts of disaster logistics and humanitarian aid are inherently linked and mutually reinforcing. All humanitarian aid operations encompass logistical practices, including voluntary contributions in finance and manpower. The efficacy of such aid is contingent upon the political and military circumstances of both the donors and the host countries. According to Oloruntoba and Gray (2006), the priorities of donors and the coordination plans on the ground significantly influence humanitarian aid operations.

The efficiency and effectiveness of humanitarian aid operations hinge on the prompt delivery of relief materials to the point of need, ensuring that the right quantity and type of materials reach the intended recipients. The

United Nations Disaster Response and Coordination Team (2006) emphasized the importance of efficiency and cost considerations in this process, alongside preparedness, procurement, transportation, tracking, storage, inventory management, and customs clearance. They also underscored the necessity of cooperation between government and non-governmental organizations in disaster logistics operations.

Given the potential challenges such as inadequate infrastructure, logistical bottlenecks, and political barriers, various transportation models may be required to facilitate these operations effectively.

8.1. Stages of Disaster Logistics/Humanitarian Emergency Logistics

Disaster logistics/humanitarian emergency logistics activities in humanitarian aid operations are performed in four phases. Consider the figure below.

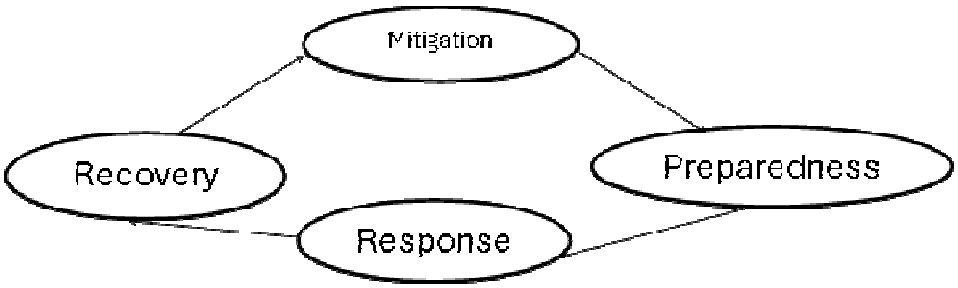

Figure 4: stages of Disaster

Mitigation: This refers to the sustained efforts aimed at diminishing or eradicating long-term risks posed to individuals and property by hazards and their consequences (FEMA, 2012). Addressing the escalating costs of disasters in recent years necessitates ongoing action to alleviate risks to individuals and property from hazards and disaster impacts. Mitigation serves as the initial phase of disaster operations, categorized by emergency management as the period before a disaster or emergency event occurs. It is also perceived as a continuous endeavour that should be seamlessly integrated into other phases of emergency management. The primary objectives of mitigation should encompass:

a. Safeguarding individuals and structures.
b. Minimizing the expenses associated with response and recovery efforts.

Combining mitigation activities with hazard analysis facilitates the identification of:

- Events occurring within the community.
- Potential event occurrences.
- Impacts on casualties, damage, disruptions to essential services, and potential recovery costs. Therefore, it is imperative for communities and state governments to devise various mitigation measures and implement them to mitigate potential disasters.

Preparedness: This entails establishing the capacity to anticipate and respond to any hazard, as well as recover from it (FEMA, 2012). It may not always be feasible to completely mitigate all hazards that pose threats to life and property. Consequently, preparedness measures are devised to mitigate the potential impact of any hazard by taking proactive actions before an emergency event transpires. Preparedness may involve the development of emergency operations plans (EOPs) addressing identified hazards, risks, and response measures. It also encompasses:

a. Designating facilities for emergency utilization.
b. Identifying necessary resources and supplies for emergency situations.

The Response Phase: This involves the implementation of emergency operations to save lives and protect property by reducing or eliminating hazards, evacuating potential victims, providing essential necessities such as food, water, shelter, and medical care, and restoring critical public services. Response actions commence as soon as a disaster becomes apparent or occurs. Activities within this phase include:

- Provision of emergency assistance to victims.
- Restoration of critical infrastructure.
- Ensuring the continuity of critical services. Local governments bear the primary responsibility for safeguarding their populace. During emergencies, local government authorities conduct situation assessments and respond promptly with immediate actions to preserve lives and property. Coordinated and timely assessments enable local governments to:
  - Prioritize activities.

- Allocate scarce resources effectively.
- Solicit further assistance from other aid partners or the state.

Accurate information obtained through timely assessments provides insights into:

- Lifesaving needs such as evacuations and search and rescue efforts.
- Infrastructure conditions, road accessibility, transportation requirements, utilities, and communication systems.
- Required medical facilities and fire services.
- Existing hazards and imminent risks.
- Reports of displaced individuals.

Recovery: This involves the reconstruction of communities to enable individuals, businesses, and governments to resume normal operations, protect against future hazards, and foster a return to normalcy (FEMA, 2012). The primary objective of this phase is to restore the community to its pre-disaster state. Recovery efforts commence immediately after the disaster occurs, aiming to reinvigorate economic activities and rebuild community facilities and housing.

While local governments undertake initial emergency responses, state and federal governments should be duly briefed and prepared to provide assistance, including temporary housing, repairs, replacement of belongings, and medical aid to affected individuals and families. These activities may entail the provision of disaster unemployment benefits. Upon completion of short-term recovery tasks, such as clearing roads, securing supplies and shelters, and restoring essential services, long-term recovery efforts begin, often spanning months or even years. Long-term recovery involves comprehensive revitalization efforts for businesses, public infrastructure, and the community economy. Given the extensive scope of this phase, securing financial and other forms of assistance from federal government agencies, as well as seeking a presidential disaster declaration, is advisable. It is also crucial to consider measures to mitigate future disaster damages.

This cyclical process of emergency disaster operations underscores the importance of mitigating, preparing for, and responding to eventualities effectively, thereby safeguarding lives and property. Continuously repeating these activities fosters improvement and resilience in disaster management practices.

9. Importance of Humanitarian Logistics

Humanitarian logistics, as discussed in earlier sections, pertains to the processes and systems responsible for mobilizing people, resources, skills, and knowledge to assist vulnerable individuals affected by natural disasters and complex emergencies (Meshach et al., 2018; Japhet B, 2018; Omvir, S. 2017; Yiping, J. et al., 2012). It encompasses various activities such as transportation, procurement tracking and tracing, customs clearance, warehouse management, and last-mile delivery.

Humanitarian logistics plays a crucial role in disaster operations:

- It acts as a bridge and unifying force between disaster preparedness and response, procurement and distribution, as well as between headquarters and field operations.
- It serves as the linchpin of disaster effectiveness and the swiftness of response in large-scale humanitarian rescue efforts.
- By facilitating the systematic tracking and tracing of disaster activities, humanitarian logistics enables the collection of data that can be analyzed for post-event learning. This analysis helps in assessing the cost, timeliness, or shortages inherent in disaster operations.

The foundation of an efficient disaster response lies in humanitarian logistics. In the immediate aftermath of a natural or man-made disaster, humanitarian organizations are actively engaged in delivering essential relief supplies to affected areas, including provisions such as food, shelter, medicine, clothing, and vital services. Visual representations of relief supply delivery are provided in figures 5 and 6.

Figure 5: Food for the flood displaced persons.

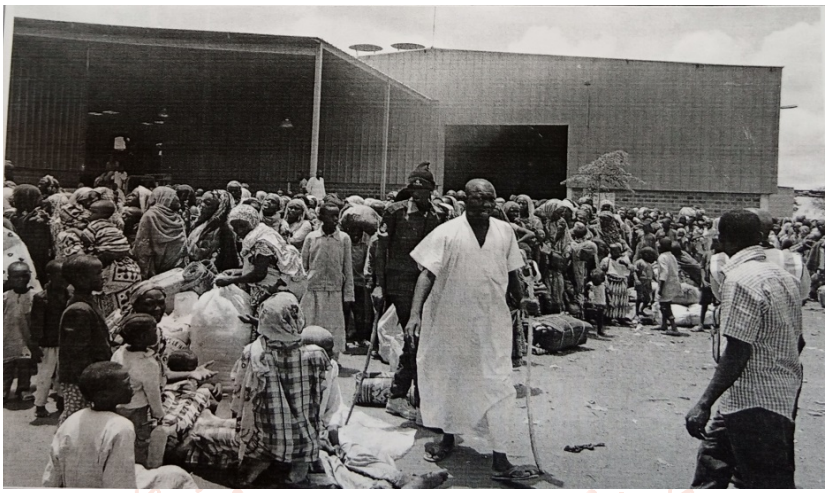

Figure 6: Camp for the flood displaced persons

9.1. Humanitarian Organizations and their Missions

The escalating number of fatalities, injuries, and displacements has emerged as a significant concern both within our nation and globally. Each year, national disasters, encompassing events such as earthquakes, famines, and floods, result in the temporary displacement of approximately five million individuals worldwide. Specifically in Nigeria, the terrorist group Boko Haram, operating in the North-east region, displaces over 20,000 people annually. This situation has exacerbated the challenges faced by humanitarian disaster agencies, which continually collaborate with the government to establish refugee camps. Serving as the frontline of aid for individuals affected by natural and complex emergencies, humanitarian organizations, including non-profit and non-governmental entities, prioritize minimizing loss of life and property and alleviating human suffering. They serve as conduits through which government relief materials are distributed, complemented by donations from foundations, individuals, and the private sector.

Key humanitarian organizations involved in relief efforts include the World Health Organization (WHO), the United Nations High Commissioner for Refugees (UNHCR), the International Federation of Red Cross (IFRC), the Red Cross Society of Nigeria (RCSN), various Non-Governmental Organizations (NGOs), the Federal Emergency Management Agency (FEMA), and the National Emergency Management Agency (NEMA). These organizations provide essential relief materials such as food, shelter, medicine, clothing, and services immediately following natural or man-made disasters. (Refer to the diagram above for further details.)

10. Flood Vulnerability of Niger-Delta States

The Niger-Delta encompasses approximately 12% of Nigeria's total land area, situated in the southern region and extending from the Nigeria-Cameroon border in the east to Ondo state in the west. Bounded to the north by Enugu, Ebonyi, Anambra, Kogi, and Ekiti States, its southern boundary is formed by the Atlantic coast. With a population exceeding 48 million in 2015 (Amanagabara et al., 2015), the Niger-Delta region receives more than 90% of the water from the Niger-Benin River System and 100% of the water from streams originating in the Delta Region.

Due to its topography, the area is highly susceptible to flooding. A study by Amanagabara et al. (2015) revealed that 580 rivers in the region are prone to flooding, potentially impacting 2,148 communities. Furthermore, the study noted that in the event of flooding in three out of the nine Niger-Delta States, approximately 4,660,842 individuals, including children and the elderly, are at risk. Consequently, humanitarian disaster relief organizations face significant challenges in addressing the needs of the Niger-Delta Region.

11. Challenges in Humanitarian Disaster Logistics

This paper aims to shed light on several challenges and issues that significantly hinder humanitarian aid operations, acting as obstacles to effective disaster relief activities:

- **Limited Resources:** Insufficient funding, resources, technology, and technical expertise severely hinder the capabilities of disaster management organizations.
- **Lack of Political Commitment:** The absence of political prioritization for disaster management can adversely affect its efficacy.
- **Varied Magnitude of Disasters:** The scale and severity of disasters dictate the level of demand and relief materials required, making it challenging for agencies to budget and manage resources effectively.
- **Infrastructure Limitations:** Inadequate capacity at airports and ports to handle large-scale disaster operations, along with deficiencies in loading equipment and storage facilities, pose logistical challenges.
- **Poor Infrastructure Conditions:** Deteriorating conditions of railways and highways, coupled with freightage restrictions on tunnels and bridges, impede the transportation of relief materials.
- **Communication Breakdown:** Inadequate communication networks during disaster operations hamper coordination among humanitarian agencies and hinder access to crucial information from affected communities.
- **Physical Obstructions:** Destruction and debris resulting from disasters, such as floods and landslides, obstruct movement and delay the timely delivery of relief materials, leading to uneven distribution.
- **Risk to Personnel:** Loss of life among humanitarian aid workers during rescue operations, exacerbated by inadequate staffing and expertise.
- **Corruption:** Corruption poses a significant challenge to humanitarian organizations, with donations intended for disaster relief often being misappropriated or diverted by individuals or political entities for personal gain.

These challenges underscore the complexities and obstacles faced by humanitarian aid organizations in providing effective assistance during disasters. Addressing these issues requires concerted efforts from governments, organizations, and communities to ensure better disaster preparedness, response, and recovery.

12. Conclusion/Recommendations

This paper has examined large-scale disasters and underscored the critical importance of efficient disaster logistics implementation in emergency rescue operations. Logistics management plays a pivotal role in determining the efficiency and effectiveness of humanitarian aid operations. The study has framed emergency activities within four distinct phases: Mitigation, Preparedness, Response, and Recovery. These phases form a cyclical process, with repeated activities fostering efficiency and continual improvement. Notably, humanitarian logistics functions as a connecting force between disaster preparedness and response, procurement and distribution, as well as headquarters and field operations.

As we recognize humanitarian organizations as the frontline responders for individuals impacted by natural and complex emergencies, their core objective remains the minimization of loss of life and property, along with the alleviation of human suffering. Given the vulnerability of the Niger-Delta region to frequent flooding, these organizations face significant challenges in fulfilling their missions. Potential obstacles such as funding constraints, inadequate communication networks, transportation issues, lack of political prioritization for disaster management, and corruption all undermine the efficiency of humanitarian organizations in fulfilling their mandates.

In light of these observations, we propose the following recommendations:

- Humanitarian relief organizations should adopt a proactive approach in securing funding from local, state, federal governments, and international bodies, ensuring legal protection for these funds during program execution.
- Enhanced technological solutions should be developed to facilitate effective communication, particularly during disaster operations, to provide timely updates on their activities.

- Investments should be made in the establishment of warehouses, procurement of equipment, and diverse transportation modes to bolster humanitarian disaster operations.
- Governments should institute a comprehensive life insurance scheme for all humanitarian disaster organizations, acknowledging the risks and hazards they face during rescue operations.

Implementing these recommendations can significantly enhance the capabilities and resilience of humanitarian organizations in addressing the multifaceted challenges posed by large-scale disasters.

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