

AN ANALYSIS ON DISASTER MANAGEMENT AND ITS PREPAREDNESS

Sharon Preethi M^a, M. Rekha^{a*}

^aPG Department of Accounting and Finance

^{a*}Assistant Professor, PG Department of Accounting and Finance

Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women, Chennai.

***Corresponding Author` rekha.m@sdbnvc.edu.in**

ABSTRACT

This study aims to investigate disaster management practice for fire station personnel, focusing on their preparedness level, responsibilities, and challenges that they encounter during response to disaster scenes. The data for analysis was collected from 450 employees of fire stations through questionnaires and interviews, showing promising prospects for analysis. A number of statistical tests were conducted, including complicated ones such as percentage analysis, cluster analysis, discriminant analysis, and others like descriptive analysis, percentage analysis, and multiple response analysis. This helped to find out significant factors that affect disaster management practice for the employees, as well as the role of demographic factors affecting preparedness and the effectiveness of current training programs that are implemented for disaster responses. It has found many significant areas that need improvement, especially pertaining to communication, coordination, and allocation of resources for fire stations. This study would ultimately contribute to improving disaster response preparedness and response for fire station employees by gathering significant insights that could lead to the formulation of better disaster response training programs for these departments.

KEYWORDS: *Emergency Response, Risk Assessment, Disaster Management, and Disaster Risk Reduction (DRR).*

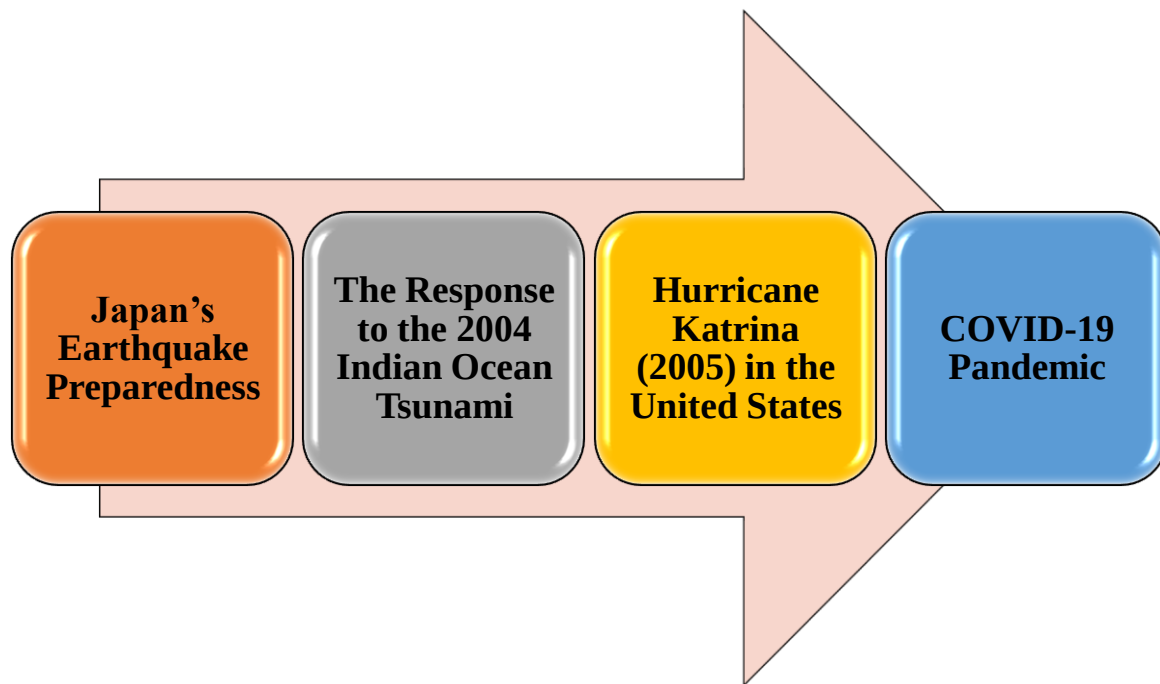
INTRODUCTION

The process of planning, responding to, and recovering from both natural and man-made disasters is termed disaster management. Effective disaster management is of vital value to saving lives, mitigating the impact of disasters, and enhancing the resilience of communities due to the rising scale of disasters. Preparedness is the key element of disaster management. Preparedness is the process of establishing the processes, guidelines, and plans necessary for ensuring an effective response to disasters. Preparedness covers assessing risks, allocating resources, public sensitization, and training rescue workers.

This study will specifically deal with the concept of disaster management and preparation, trying to understand the major components, challenges, and strategies involved. It will, therefore, try to explore various case studies, strategies, and frameworks, including the Sendai Framework for Disaster Risk Reduction, as used and

implemented from the year 2015 to the year 2030. This paper will also try to understand the involvement of various global and local actors, especially concerning disaster preparation and response, focusing on major vulnerable regions in the world.

CASE STUDIES IN DISASTER MANAGEMENT AND PREPAREDNESS



1. Japan's Earthquake Preparedness: Japan is renowned for possessing the most advanced level of disaster preparedness globally, built over decades of experience with earthquakes and tsunamis. The country invests significantly in its capacity to prepare for the disaster through an earthquake.

2. The Reaction to the 2004 Indian Ocean Tsunami: This disaster exemplified the importance of immediate response and coordination. The absence of an early warning system in these nations contributed to a great number of fatalities. The international community, nevertheless, showed unity in response to the incident, as countries and NGOs joined together in providing relief.

3. Hurricane Katrina (2005) in the USA: The inability of the nation to prepare appropriately for the devastating consequences of Hurricane Katrina underscored the need to have plans and resources at the disposal of nations in event of such catastrophes. This highlights the poor disaster preparedness of wealthy nations.

4. The COVID-19 Pandemic: The COVID-19 pandemic provided a worldwide emergency situation, and various locations worldwide were required to adapt and respond promptly. There was a particular emphasis on international cooperation, information sharing, and a state of health emergency.

THE ROLE OF TECHNOLOGY IN DISASTER PREPAREDNESS

In the modern world, technology is playing an ever-increasing role in disaster management, and this can be attributed to the following technologies:

- 1. Early Warning Systems:** The technology includes satellite technology, sensors, and mobile applications, which can aid in the early warnings related to disasters such as hurricanes, floods, and earthquakes.
- 2. Data Analysis and GIS Mapping:** Using GIS mapping, disaster-prone areas are marked, and the vulnerabilities are assessed along with the routes of evacuation.
- 3. Social media and Communication Platforms:** In disaster situations, social media platforms like Twitter and Facebook play a significant role in disseminating information, facilitating, and sharing timely updates with respect to relief activities.
- 4. Robotics and Drones:** Drones can be utilized for the delivery of medical products, assisting in rescue activities, or assessing damage in inaccessible areas.

DISASTER MANAGEMENT IN DIFFERENT SECTORS



- 1. Healthcare and Disaster Response:** The role of healthcare systems is vital in managing disaster situations, particularly medical emergencies that manifest as a result of pandemics and natural calamities. The response and effectiveness of healthcare systems can be analyzed through research, which can assist in bridging gaps pertaining to disaster response training for employees.

2. Disaster Management in Urban vs. Rural Areas: The opportunities that arise during disaster management may be vastly different for urban areas compared to rural areas. A study could be done to compare as well as contrast the management of disaster preparedness in these areas. It could also come up with disaster preparedness strategies for the two regions.

3. The Role of Education in Disaster Preparedness: Disaster preparedness education, ranging from schools to government agencies, has shown to be a significant force in disaster preparedness. A research question about the level of effectiveness disaster preparedness can achieve, especially for the general public, can be conducted. This can include an evaluation of the role of schools in educating the youth about disaster preparedness safety and preparedness.

OBJECTIVES

- To identify fire station personnel based on clusters of disaster preparedness and response patterns through cluster analysis.
- To determine the major variables that distinguish preparedness levels among groups using discriminant analysis.
- To identify the pattern of distribution of preparedness practices used by fire station employees through the analysis of percentages.

REVIEW OF LITERATURE

• **Aqtam, Iet al., (2024)** The researchers investigated how healthcare professionals in Palestine prepare for disaster management during pandemic situations. Social disturbance requires specialized management because emergency situations have become more frequent. Emergency health situations require government and health institutions to maintain their resilience because these events affect health and social systems and economic stability. The worldwide community establishes connections that allow local occurrences to produce worldwide effects which occurred during the COVID-19 pandemic. The research investigates how disaster management systems operate in hospitals throughout pandemic situations by studying nurse and doctor preparedness. The researchers conducted an online survey to collect data from Palestinian nurses and doctors who worked in government and private hospitals during their study period from late 2022. The study results show that participants possessed different knowledge levels because 67% of participants had never faced real disaster situations while 63% of participants had no disaster response training. The participants established emergency training as their main focus because they wanted to learn about emergency preparedness and mass casualty trauma response and triage disaster management systems. The study demonstrates that disaster management knowledge among hospital managers requires national

standards implementation and continuous medical education for healthcare professionals and skills assessment to bridge competence gaps. The study demonstrates that healthcare workers require standardized emergency training followed by ongoing professional development to establish emergency readiness.

- **Eneh, N. Eet al., (2024)**examines new forms of cross-jurisdictional collaboration between Nigeria and the U.S., specifically in disaster preparedness, using data analytics to inform disaster preparedness and resilience. The U.S. has well-developed disaster management systems that can be shared, as well as Nigeria's community approach to disaster preparedness, making for an effective cross-jurisdictional collaboration that can benefit both nations. The study identifies disaster data, infrastructure, data, and history analyzed using data analytics techniques to inform effective disaster preparedness. Integrating disaster preparedness strategies from the U.S., including technological innovations, and disaster preparedness techniques from Nigeria, including community involvement, new disaster preparedness models that can be applied globally are developed. And importantly, the study highlights effective cross-jurisdictional collaborations that can be implemented to promote disaster preparedness and contribute to disaster risk reduction globally.
- **Gunawan, G (2024)**the author undertakes data mining of available data from Indonesian government sources to ascertain incidents, preparedness, and response of disaster situations in coastal regions of Indonesia, which are prone to natural calamities such as tsunamis, floods, and natural storms. The findings were based on Scikit-learn and Tableau tools using Principal Component Analysis (PCA), cluster analysis, and combined approaches. However, it emerged that standalone cluster analysis offered better results than using the combined approaches. In fact, three clusters were formed, and the findings showed higher levels of preparedness and disaster intensity in those areas. The purpose of the research is to highlight the importance of disaster management and handling in the coastal provinces.
- **Kiran Bhatt et al., (2024)**focuses on the devastating earthquake that occurred in Japan, where many people were killed, and the ones who survived were displaced. However, this is just an example of the many disasters that have been witnessed across the globe over the last year, including the ones that happened due to wildfires in North America and droughts that have been reported in Europe. These disasters have been contributed to by climate change, which is bound to cause severe economic implications across the globe. Therefore, the effect of these calamities is well illustrated within those areas that have continuously been affected by wars. This is an issue of concern to many individuals due to the security threats that emanate from a blend of peace, climate, and conflicts. This calls for a piece of work that highlights possible opportunities that can be pursued while seeking to adopt the collective approach while developing an umbrella that covers disaster risk reduction that can connect theory to practice.

- **Lopez-Vargas, J. C et al., (2024)** study focused on coordination strategies used in logistics systems for regional disaster readiness, A case study from Latin America. This study presents an agent-based simulation model (ABM) to explore interorganizational coordination scenarios in local disaster preparedness, focusing on local actors and logistical processes as agents to compare different strategic coordination mechanisms. Developed in the Latin American context, the model specifically analyses a case study in Colombia. Three coordination mechanisms centralized, decentralized, and cluster-type are evaluated using three performance indicators: effectiveness, efficiency, and flexibility. Simulation results indicate that the decentralized scenario excels in efficiency and flexibility, while the centralized and cluster-type scenarios demonstrate higher effectiveness, achieving better coverage of requirements during the disaster preparedness stage. The ABM approach effectively evaluates this coordination mechanisms based on the analysed performance indicators. However, the study has limitations, as it applies the results to a single real case and focuses on hydrometeorological disasters such as flash floods, torrential rains, and landslides. The scope of decision-making is also restricted to key actors involved in local disaster management within a municipality. Despite these constraints, the proposed ABM model holds potential as a decision-making tool for policies and local coordination schemes in future disasters. Furthermore, the simulation tool can be adapted to explore diverse geographical scenarios and disaster types, demonstrating its versatility and broader applicability for further insights and recommendations.

RESEARCH METHODOLOGY

The information collection process used to make decisions. The present information of the study uses publication research and interviews and surveys and additional research methods as its research methodology. The research study describes its content through descriptive research methods. For this study researchers used purposive sampling as their sampling method. The responses were collected from 450 people across all age cohorts. The researchers used a structured questionnaire to collect participant responses. Primary data served as the foundation for this research study. The researchers implemented Percentage analysis together with cluster and discriminant analysis as their statistical methods. The researchers collected secondary data from multiple sources including journals and websites which they later consolidated.

DATA ANALYSIS

CLUSTER AND DISCRIMINANT ANALYSIS

TABLE 1 FINAL CLUSTER CENTRES

Factors	Cluster						
	Preparedness Experts	Experienced Responders	Knowledge Seekers	Supportive Leaders	Emergency Planners	Public Educators	Field Practitioners
Disaster Preparedness	3.45	2.55	4.27	3.35	3.10	3.69	3.12
Preparedness Knowledge	3.15	2.74	4.38	3.98	2.95	3.84	3.17
Disaster Response Skills	3.49	2.70	4.30	3.32	3.43	2.59	3.54
Disaster Experience	3.78	2.47	4.44	4.15	3.06	3.59	3.10
Post-Disaster Competency	3.60	2.83	4.35	3.62	3.19	3.93	3.04
Disaster Support	2.23	2.63	4.42	3.97	4.04	3.55	2.90
Disaster Knowledge	4.20	2.18	4.27	4.14	3.70	2.34	3.22

Source: Primary Data

Interpretation

Preparedness Experts

This group is characterized by a high knowledge level on disaster preparedness as well as low levels of engagement in the provision of assistance as a disaster. They are therefore categorized as disaster preparedness experts.

Experienced Responders

This group comprises persons who are capable in the response to disaster, yet lack knowledge regarding disaster. They are therefore called experienced responders.

Knowledge Seekers

The individuals in this group possess high disaster experience, but their preparedness knowledge and disaster understanding are lower. The members of this group are characterized as training-oriented knowledge seekers.

Supportive Leaders

This group is characterized by people who have a lot of experience but lower skills in disaster response. Such persons are also described as being supportive leaders.

Emergency Planners

This category of respondents demonstrates excellent performance in disaster support activities but is poor in terms of preparedness knowledge, thereby being referred to as the emergency planners.

Public Educators

This group ranks high on post-disaster response competency and lower on disaster response skills. This group is referred to as the public educators.

Field Practitioners

These individuals may have good disaster response abilities but no involvement in giving support in this area, which is called the field practitioner cluster.

TABLE 2

ANOVA

Factors	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Disaster Preparedness	18.316	6	0.273	443	67.061	0.000
Preparedness Knowledge	25.349	6	0.233	443	108.910	0.000
Disaster Response Skills	18.667	6	0.464	443	40.229	0.000
Disaster Experience	28.001	6	0.266	443	105.103	0.000
Post-Disaster Competency	18.987	6	0.317	443	59.945	0.000
Disaster Support	39.510	6	0.271	443	145.684	0.000
Disaster Knowledge	30.790	6	0.267	443	115.343	0.000

Source: Primary Data

Interpretation

In order to check whether there are any significant differences among the clusters, the results of the analysis of variance (ANOVA) were performed. Table 2 shows the results of the ANOVA for all

seven factors. The F-ratio shows the degree of variation among the clusters. An F-statistic is considered significant at the 5% level of probability if the corresponding probability value is less than 0.05. In this study, all the factors are found to be statistically significant at a 1% level of probability, as the p-value is 0.000 for all the factors. This shows that the clusters are homogeneous from within, while the clusters are heterogeneous from the point of view of the differences between them.

TABLE 3
NUMBER OF CASES IN EACH CLUSTER

Cluster	Preparedness Experts	43.000
	Experienced Responders	19.000
	Knowledge Seekers	112.000
	Supportive Leaders	89.000
	Emergency Planners	77.000
	Public Educators	32.000
	Field Practitioners	78.000
Valid		450.000
Missing		0.000

Source: Primary Data

Interpretation

As depicted in Table 3, the data has been grouped into seven unique clusters. Cluster 1, identified as Preparedness Experts, consists of 43 individuals. Cluster 2, identified as Experienced Responders, consists of 19 individuals. Cluster 3, identified as Knowledge Seekers, consists of 112 individuals. Cluster 4, identified as Supportive Leaders, consists of 89 individuals. Cluster 5, identified as Emergency Planners, consists of 77 individuals. Cluster 6, identified as Public Educators, consists of 32 individuals. And finally, Cluster 7, identified as Field Practitioners, consists of 78 individuals.

TABLE 4
TEST OF EQUALITY OF GROUP MEANS

Factors	Wilks' Lambda	F	df1	df2	Sig.
Disaster Preparedness	0.524	67.061	6	443	0.000
Preparedness Knowledge	0.404	108.910	6	443	0.000
Disaster Response Skills	0.647	40.229	6	443	0.000
Disaster Experience	0.413	105.103	6	443	0.000
Post-Disaster Competency	0.552	59.945	6	443	0.000
Disaster Support	0.336	145.684	6	443	0.000
Disaster Knowledge	0.390	115.343	6	443	0.000

Source: Primary Data

Interpretation

The test for equality of the means of the groups provides convincing statistical support for the significant differences in the means of the seven cluster groups. For instance, the factors of disaster support, disaster knowledge, and preparedness knowledge are seen to have very high F-values.

TABLE 5
EIGEN VALUES

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	4.532 ^a	62.9	62.9	0.905
2	1.222 ^a	17.0	79.9	0.742
3	0.988 ^a	13.7	93.6	0.705
4	0.348 ^a	4.8	98.4	0.508
5	0.110 ^a	1.5	99.9	0.314
6	0.005 ^a	0.1	100.0	0.071

Source: Primary Data

Interpretation

a. First 6 canonical discriminant functions were used in the analysis.

Canonical correlation is the multiple correlation between the predictor variables and the discriminant function. In Table 5, the specific results for each discriminant function obtained can be seen. With a canonical correlation of 0.905, it can be noted that the model explained 62.9 percent of the variance in the grouping variable.

TABLE 6
WILKS' LAMBDA

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 6	0.027	1592.986	42	0.000
2 through 6	0.151	836.925	30	0.000
3 through 6	0.334	484.093	20	0.000
4 through 6	0.665	180.365	12	0.000
5 through 6	0.897	48.210	6	0.000
6	0.995	2.234	2	0.327

Source: Primary Data

Interpretation

Wilks' Lambda evaluates the statistical significance of the discriminant function. The table displays results which show the function to have high significance because its p-value falls below 0.005.

TABLE 7

CLASSIFICATION RESULTS

Cluster Number of Case			Predicted Group Membership							Total
			1	2	3	4	5	6	7	
Original	Count	Preparedness Experts	40	0	0	0	1	0	2	43
		Experienced Responders	0	19	0	0	0	0	0	19
		Knowledge Seekers	1	0	107	1	2	0	1	112
		Supportive Leaders	2	0	4	79	2	0	2	89
		Emergency Planners	0	0	0	1	74	0	2	77
		Public Educators	0	0	0	0	0	31	1	32
		Field Practitioners	2	1	0	0	0	0	75	78
	%	Preparedness Experts	93.0	0.0	0.0	0.0	2.3	0.0	4.7	100.0
		Experienced Responders	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
		Knowledge Seekers	0.9	0.0	95.5	0.9	1.8	0.0	0.9	100.0
		Supportive Leaders	2.2	0.0	4.5	88.8	2.2	0.0	2.2	100.0
		Emergency Planners	0.0	0.0	0.0	1.3	96.1	0.0	2.6	100.0
		Public Educators	0.0	0.0	0.0	0.0	0.0	96.9	3.1	100.0
		Field Practitioners	2.6	1.3	0.0	0.0	0.0	0.0	96.2	100.0

a. 94.4% of original grouped cases correctly classified.

Sources: Primary Data

Interpretation

Table 7 displays a summary of the classification results, indicating the accuracy levels exhibited while using the variables for predictions about group membership. The discriminant analysis test shows that a very high success rate is achieved, including 93% for community preparedness experts, 100% for experienced responders, 95.5% for knowledge seekers, 88.8% for supportive leaders, 96.1% for emergency planners, 96.9% for public educators, and 96.2% for field practitioners. The high percentages prove that the analysis is reliable, 94.4% of variables being originally classified correctly, confirming that respondents were correctly grouped.

KEY FINDINGS

Percentage analysis

Percentage analysis – demographic profile

- Male respondents are more than female respondents. (93.6%)
- Age category between 21-30 are worked in fire station the most. (54.4%)
- Married employees are more than the unmarried employees. (52.4%)
- Most of the employees are graduated. (55.3%)
- Most of the employees are earning monthly income between Rs.15,001 to Rs.30,000. (28.9%)

Percentage analysis – employees experience towards the disasters

- Most of the employees have attended the courses rather than the workshop. (66.2%)
- Most of the employees have participated in disaster rescue simulations. (87.3%)
- Most of the employees have experienced the disaster relief training. (75.6%)
- Most of the employees have experienced the disaster responses. (74%)
- Most of the employees are willing to participate in disasters relief missions. (56.2%)
- Most of the employees had an experience in handling the disasters. (78.9%)
- Most of the employees has an experience of over 5 years in this field. (49.1%)
- Most of the employees have participated in 1-5 disasters at least. (40.2%)

CONCLUSION

The aim of the study was to examine the disaster preparedness and responses among fire station employees through percentage analysis, cluster analysis, and discriminant analysis. The percentage analysis indicated a high level of preparedness among the employees, which is based on the employees' awareness and commitment to the practice. There was a gap identified in the areas of regular training, communication, and resources available to the employees.

Cluster analysis proved to be an effective tool to classify the fire employees based on their levels of preparedness. There were significant differences identified in the levels of preparation among the fire employees working in fire stations.

Moreover, it has been noted that discriminant analysis was carried out to identify the important variables, such as training, coordination, and communication, which are considered to be the most critical factors in differentiating between preparedness groups. Thus, the findings of the research have brought about important implications that can be helpful in improving the process of developing effective disaster management systems in fire services organizations.

REFERENCES

1. Aqtam, I., Shouli, M., Al-Qoroum, S., Shouli, K., & Ayed, A. (2024). Evaluating Disaster Management Preparedness among Healthcare Professionals During Pandemics: Palestinian Context. *SAGE Open Nursing*, 10, 23779608241283698.
2. Eneh, N. E., Bakare, S. S., Akpuokwe, C. U., & Adeniyi, A. O. (2024). Cross-jurisdictional disaster preparedness: A Nigeria-USA data-analytical approach. *World Journal of Advanced Research and Reviews*, 21(2), 1822-1829.
3. Gunawan, G. (2024). Disaster Event, Preparedness, and Response in Indonesian Coastal Areas: Data Mining of Official Statistics. *International Journal of Computing and Digital Systems*, 16(1), 249-264.

4. Kiran Bhatt, Anirudh Prem, Sanjay Pattanshetty, and Helmut Brand (2024), Disaster Risk Reduction: Need for Collective Approach-Based Policy Measures, institute for security and development policy, Issue Brief January 8, 2024.
5. Lopez-Vargas, J. C., Meisel, J. D., Cárdenas-Aguirre, D. M., & Medina, P. (2024). Coordination mechanisms applied to logistical systems for local disaster preparedness: a Latin American case. *Journal of Humanitarian Logistics and Supply Chain Management*.