

Disaster Risk Management and Emergency Response Legislations and Strategies Awareness in Tanzania: A Case of Dar Es Salaam City

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Abstract

This study evaluated major cities' compliance and awareness to the disaster management and emergency response legislations and strategies in Tanzania with a focus on Dar es salaam city that have experienced persistent undesirable disasters and emergencies that arise from both natural and manmade. The study also focused at actions and programs embarked by the Dar es Salaam City Governments (Ilala, Temeke, Ubungo and Kinondoni) to implement the established disaster and emergency response legislations and strategies in dealing with the challenges identified and their way forward.

The outcome of this research was contemplated to significantly assist individuals, community, the local government and other interested parties in dealing with disasters and emergencies, and enhance understanding and compliance and awareness to the disaster management and emergency response legislations and strategies urban and rural dwellers with disaster-resilient.

This study deployed descriptive research design and survey to gather information about the research problem under the study. The survey provided quantitative account of views of sampled population and their attitudes, and provided chance to test correlation among population variables of the population samples in which 105 respondents were conveniently selected for this study.

The study found that the majority of the population are aware the about the disasters that are likely to occur in their localities and their associated impacts both health and economic impacts, but however they are not satisfied with the strategies implemented by the government to deal with them. The study revealed that, the public officials responsible for emergency response and disaster management in Dar es Salaam are aware about the legislations and plans in dealing with disasters and emergency response but the compliance to them are below average due to various factors like resources constraints, insufficient personnel, low involvement of community, insufficient institutional coordination between emergency responders, insufficient infrastructures that affect response time to emergencies, inadequate urban land use planning and strategies and political influenced decision making.

The study proposed that the government have to review and follow up implementation of developed urban land use plans base on disaster risk assessment and management reports, to intensify and provide public awareness campaigns on disaster risk management and emergency response strategies, capacity building to government officials and emergency responders on new urban development technologies and enhance their knowledge and competencies, and to review and establish a coordinated emergency response plans in major cities and establishment of early warning systems with coordinated communication systems among responders.

Keywords: major cities, disaster management, emergency response, legislation compliance

1. Introduction

1.1 Background

Globally, cities have experienced security and safety challenges mainly attributed by various factors like demographic and settlement structures, geographical locations, nature of economic activities and political factors. Major cities in the world have been associated by human factors like terrorist attacks, industrial incidents, traffic accidents, fires, knife attacks and armed robbery.

On the other hand, African countries have faced with various safety and security incidents with significant impacts

and magnitudes the same as other parts of the world. Though there are other challenges that are different from those faced with developed world cities such as inadequate road infrastructures, sewage systems, inadequate electrical power supply and frequency power cut out, informal settlements associated with poor housing, informal economic activities with influx of youth from the rural to urban areas with no clear plans and goals. These challenges make the cities vulnerable with impacts of various disasters and emergencies that have significant impact to underprivileged sect of the population especially women, children and elderly.

With the foregoing highlights, Tanzanian Cities and urban are on the same line with disasters and emergencies challenges facing other cities in Africa and other parts of the world. In the past decades and recent times, Tanzania has been stroked by severe disasters and emergencies, both natural and manmade, that significantly resulted to social and economical losses, death and long and short-term morbidity (Koka, P.M, 2018).

Dar es Salaam city is among the fast-growing cities in Africa on various aspects, including industrialization, urbanisation, population, infrastructure and superstructures (Chikako. H, 2022). Nonetheless, the growth trends are threatened by increased adverse socio-economic and climatic changes, in conjunction with constant challenges like poor governance, inequality, unemployment, rural urban movement and poverty. The climatic changes have resulted to undesirable events including floods, extreme heat, and water scarcity.

Additionally, the population growth and rural to urban migration, with the majority of people forced to settle in unplanned and poor managed settlements that increases challenges during emergency response in case of emergencies that extend beyond the local communities to handle (Nzovu. B. K., 2023). Studies on compliance to disaster management and emergency response legislations and strategies become handy.

This study evaluated major cities' compliance and awareness to the disaster management and emergency response legislations and strategies in Tanzania with a focus on dar es salaam city that have experienced persistent undesirable disasters and emergencies that arise from both natural and manmade. The study also focused at actions and programs embarked by the Dar es Salaam City Governments (Ilala, Temeke, Ubungo and Kinondoni) to implement the established disaster and emergency response legislations and strategies in dealing with the challenges identified and their wayforwad.

1.2 Objectives

This study aimed to explore compliance requirements in disaster management and emergency response legislations, strategies and plans in Tanzania's major city of Dar es Salaam. The study evaluated established standards for assessing disaster management preparedness and emergency response capabilities of local governments (Ilala, Kinondoni, and Temeke) and Ilala Fire and Rescue Force station.

In determining the compliance level, the research determined the challenges faced in domesticating and implementing the legislations, policies, strategies and plans and their way forward. the results of this study is considered important as Tanzania major cities are prone to impacts of disasters from floods, earthquakes, health related disasters, fires, accidents both industrial and road, and terrorist attacks.

The outcome of this research was contemplated to significantly assist individuals, community, the local government and other interested parties in dealing with disasters and emergencies, and enhance understanding and compliance and awareness to the disaster management and emergency response legislations and strategies urban and rural dwellers with disaster-resilient.

1.3 Natural Disasters Reported in Tanzania 2014-2023

In the period between 2013 and 2023, a total of 34 natural disasters were reported in Tanzania among them were floods and storms. The currently disaster been the landslide and mudflow at Hanang District on December, 2023 that left behind more than 80 people dead and more that 150 people injured and mass destruction of settlements, farms and infrastructures. The country is regularly affected by weather hazards that lead to destruction, deaths, and thousands of people being forced to leave their homes., Tanzania was stroked by a cyclone, strong floods, and storm in 2019, while in 2020, a total of seven natural disasters, mostly floods, distressed the country and led to commotion and dislocation (Kamer, L., 2023).

Up to 30th December, fatality reported was 130 people, 139 injured and 1862 households completely destroyed, and 7244 houses were partially affected as the result of the heavy rain and floods that occurred in the region indicated in the Table 1 below (IFRC, 2024).

Table 1. Disaster affected regions at the end 2023

Region affected	Houses affected	Houses completely destroyed	Houses partially destroyed	Number of deceased
Manyara	1,150	108	1,042	89
Morogoro	1,227	908	319	3
Geita	1,070	303	767	16
Dar es salaam	2,201	72	2,129	14
Arusha	67	40	27	6
Zanzibar	2,916	213	2,702	1
Kagera	211	21	190	1
Kigoma	265	197	68	0
Total	9,107	1862	7,244	130

Dar es Salaam city while compared to other cities in Tanzania is relatively far in terms of population density, social services, proximity to various sectors such as infrastructures like roads and other systems that are more advanced compared to other areas in Tanzania (URT, 2012). As the demographic structure changes in the city, the pressure to the available infrastructure especial roads and other supporting services during the hit of disaster and emergencies increased.

A well-established disaster management and emergency response systems depend on how well the responsible organizations and institutions comply with the legislations and programs for disaster management and response. Emergency response facilities, skilled personnel, response structures and means of communications among emergency response actors are essential to effective response to disasters and emergencies in the cities (Asio, J. M. R. 2021).

Thus, in order to understand the compliance and implementation of the disaster management and emergency response legislations, plans and strategies by major cities in Tanzania there is a need to study and evaluate the level of compliance and awareness to the existing disaster management and emergency response legislations, plans and strategies and recommend the way forward to the challenges and shortcomings faced.

1.4 Legal and Policy Framework for Disaster Management and Emergency Response in Tanzania

Disaster Management responsibilities in Tanzania mainland is placed to the Disaster Management Unit (DMU), under the Office of the Prime Minister (OPM). Its functions and activities are carried according to the National Disaster Management Policy of 2004, the Disaster Management Act No. 7 of 2015 (DMA) and the Disaster Management regulations of 2017. The Disaster Management Act established the Tanzania Disaster Management Council with the roles of supervising the management and activities of the Unit (Figure 1.2). The council has a mandate to integrate Disaster Risk Reduction (DRR) initiatives into pertinent government plans, strategies, and policies (Drabek, T.E., 2003).

Further, the DMA provides the legal framework for the establishment of the National Disaster Risk Reduction Platform, the National Disaster Management Fund (NDMF), and the disaster management committees from the regional to the local levels (wards and villages) to implement DRR and humanitarian services. On the other hand, it is essential to highlight that, even though the DMA was enacted in 2015, it was not fully operational due to numerous factors that included politics, managerial, and inter-institutional motives until 2022 when the new Act was enacted and replaced it. Inclusive and state-of-the-art legislations, guidelines and procedures for effective disaster management and emergency response systems, are essential for strategic perfection of disaster management and emergency response systems in Israel Tanzania.

1.5 The Institutional Arrangements

Tanzania has developed various policies and institutional frameworks for various disasters management. Policies include Disaster Management Policy of 2004; Environmental Management Act of 2004; National Operational Guidelines for Disaster Management; Disaster Management Act of 2003 for Zanzibar; Zanzibar Disaster Management Policy; Second National Strategy for Growth and Reduction of Poverty (NSGRP II); National Adaptation Programme of Action (NAPA, 2010); National Climate Change Strategy (2012); Guidelines for Integrating Climate Change Adaptation into National Sectoral Policies and the Disaster Management Act, 2022.

Figure 1 below indicates the arrangement for disaster management in Tanzania Mainland that the role of each part has been outlined in the National Disaster Management Policy and Search and Rescue Plan.

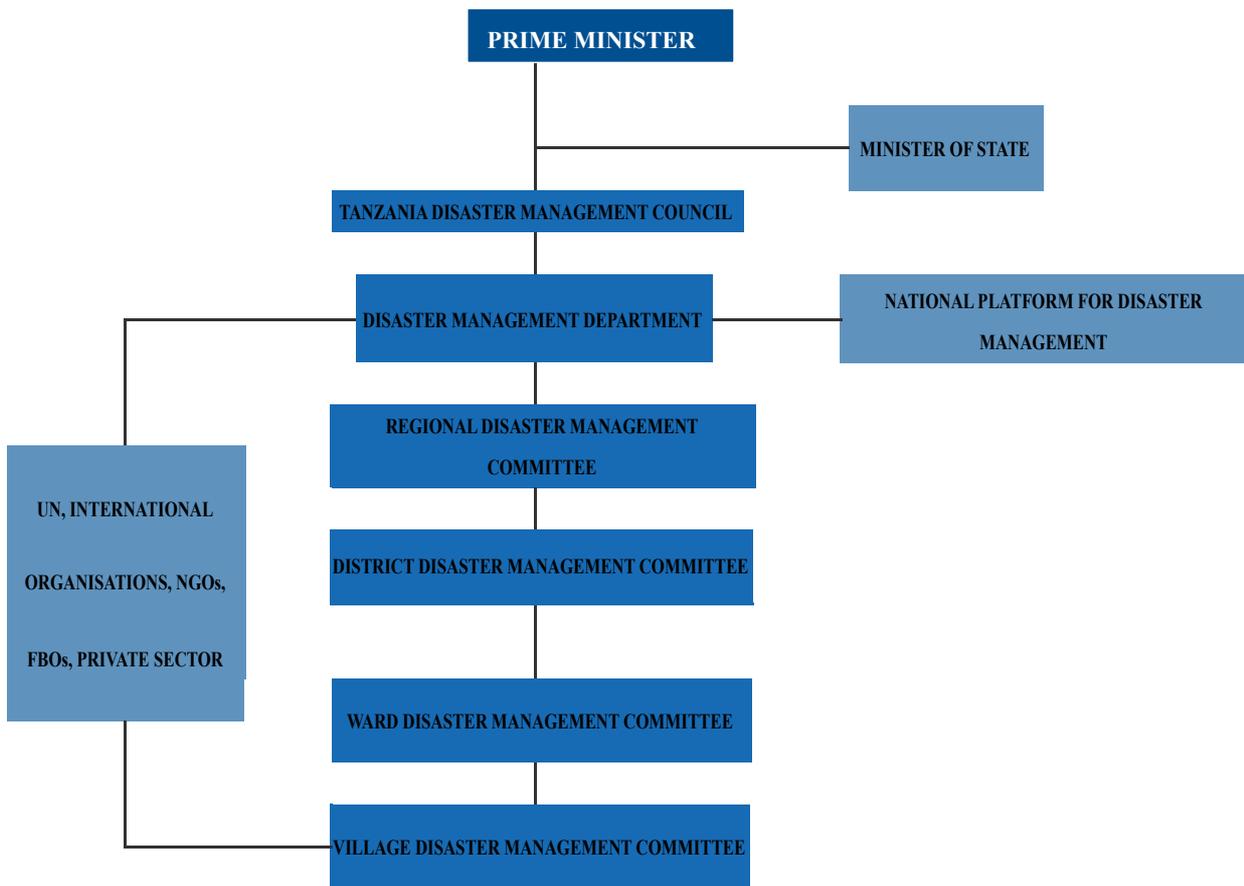


Figure 1. Disaster management governance structure in Tanzania

Source: Disaster Management Unit, Government of Tanzania 2019

The Disaster Management Act (DMA), 2022, sets out a comprehensive legal framework for disaster risk management in Tanzania. It provides for the establishment of a national focal point for coordination of disaster risk reduction and management in the country through the Tanzania Disaster Management Agency (TDMA), acting as the central planning, coordinating, and monitoring institution for the prevention, mitigation, preparedness, response and post disaster recovery, considering all potential disaster risks. Currently this role is covered by the Prime Minister Office (PMO). The Tanzania Disaster Management Council (TADMAC) advises the Minister responsible for disaster risk management or any sector ministry on any disaster-related matter in the country detailed in the act.

In addition, disaster risk management in Tanzania is governed by the National Disaster Management Policy (2004) that has the overall goal to operationalise an effective and efficient disaster management system that aimed at minimizing possibilities of loss of life, property, and environment.

Other disaster management policy tools include the National Operational Guidelines for Disaster Management, National Disaster Preparedness and Response Plan (2022), Tanzania Emergency Preparedness and Response Plan (TEPRP) (2012), Tanzania Disaster Communication Strategy (TDCS) and National Disaster Management Strategy 2022 – 2027 (2022) and National Disaster Communication Strategy (TDCS) of 2022. The implementation of these plans intends to have effective and significant coordinated responses to disasters and emergencies in the community across the country.

Also, there have been initiatives for capacity building in 20 districts between 2011 and 2018 that have Emergency Preparedness and Response plans (Kapucu, N., 2005). However, the initiatives are slowly implemented and not extended to other districts, as well as incorporating multi disaster response plans into those plans.

National Operational Guidelines for Disaster Management (2014) sets responsibilities/ mandates of various stakeholders in responding to various disasters. The guidelines cover the broad areas of mitigation, preparedness, response, and recovery by identifying the most common hazards in the country and earmarked Leading and Supporting Agencies in handling them. Each Lead Agency is responsible for activating its own plans.

Further Tanzania has developed the National Emergency Preparedness and Response Plans (2012) that provide guidelines for coordination and response to various disasters and emergencies at all levels. The plan aimed at facilitating the coordination for the delivery of resources and services necessary to deal with the consequences of emergencies or major disasters. The plan intended to deal with emergencies and major disasters that create needs and cause suffering that the affected community(s) cannot respond without assistance, and that requires an extraordinary commitment of national resources.

Moreover, the Tanzania Disaster Relief Committee (TANDREC) is operational since 1990s at the national levels and its members are Permanent Secretaries from Ministries of Finance, Home Affairs, Water and Livestock, Defence, Lands, Agriculture, Planning, Education, Communication, Works, Community Development, Energy and Minerals and CEOs of Tanzania Meteorological Agency (TMA), Fire and Rescue Force and Food Security Department as early warning institutions. Its main function is to oversee and coordinate activities of the Government designed to secure effective prevention of disasters, preparedness, and operations in an event of a disaster.

Also, The Tanzania Urban Resilience Program (TURP) was established in 2016 as a partnership between Tanzania, the World Bank Group, and the UK Department for International Development (DFID) to support national and local governments in strengthening management of urban climate risk. Officially launched on May 31, 2017, TURP is now driving renewed engagement and deeper dialogue between the Bank and the Tanzania on climate resilience with a comprehensive strategy addressing risk identification, risk reduction, and emergency preparedness (TURP, 2018).

2. Research Methodology

2.1 Study Design

This study deployed descriptive research design and survey to gather information about the research problem under the study. The survey provided quantitative account of views of sampled population and their attitudes, and provided chance to test correlation among population variables of the population samples (Creswell and Creswell, 2018).

2.2 Study Scope

The scope of this study focused on Dar es Salaam due to its population and their characteristics. Dar es Salaam disaster management and emergency response practices reflect on other cities in Tanzania as the disaster legislations are the same in all regions of Tanzania. Also, it's rare to see the real practice of Disaster Management outside Dar es Salaam, the Government focus is on Dar es Salaam as when the disaster hit, even a small accident like building collapse could have larger magnitudes and multiplying effects to other areas.

2.3 Participants

Convenient sampling technique was used to sample 105 (One hundred five) respondents to participate in the survey in this study. This sampling technique was used due to its merit over the others as it is non probability and respondents were selected and contacted bas on their availability and conveniences (Creswell and Creswell, 2018). The participants were the dwellers of the study area and experts from emergency responders and disaster management departments were selected by using Delphi technique. As Dar es Salaam Dwellers are made up of various levels with busy schedule, this technic assisted to select the relevant respondent with significant information towards the goal of this study.

2.3.1 Demographic Features

Table 2 below indicates the profile of the participants that were involved in the survey conducted in Dar es Salaam and to the university students that were conveniently sampled and lived in Dar es Salaam for at least one year (Creswell, 2014). As seen, 85% of the respondents are in formal settings (Office - 42% and Academic institutions - 33%) while the rest 25% are from informal sector or doing they are engaged other than office works like businesses.

Most of the respondents belong to the age bracket 18-30 years old. In terms of members of the household, there are more families with at least 4-6 members. The information presented above describes a typical community living in a highly urbanized area in developing countries like Dar es Salaam. The findings indicate that 60% of all

respondents are in the working age (31-50 years) and 25% are in their schooling age. Most of them are male (65%) while compared to female (35%) (Table 2).

Table 2. Demographic features

Occupation/ location	Frequency	Percentage
Student/lecturer	35	33
Office	44	42
Informal sectors	26	25
Sex		
Male	72	69
Female	33	31
Age		
20 - 30 years old	25	24
31 - 40 years old	27	26
41 - 50 years old	36	34
51 years old above	17	16
Members in their Household		
1-3	31	30
4-6	62	59
7-10	12	11
Total number of respondents	105	100

2.4 Research Instrument

This study used and customized REACH Initiative to adopt the survey questionnaire combined with content analysis of various literatures that are related to the focus of this study. The questionnaires were firstly distributed to 20 respondents by using Google Survey Tool to test its viability and relevancy. The use of Delphi Technique ascertained the consistency of the instrument used in this study. The overall coefficient score of 0.978 was capitulated as much better compared to targeted score of 0.70. To make sure the results are reliable and valid, the wording and grammar of the questionnaire were checked and scrutinized to simplify them to a more understandable and easier to respond on time basing on the expertise, experience and skills of the respondents. The survey questions were formulated by using four ten points Likert Scale that made it easy for respondents to respond on time and facilitated analysis of the results.

2.5 Statistical Analysis

To search for the level of compliance and awareness of disaster management and emergency response legislations, the simple statistics techniques were used specifically rate of recurrence count, weighted mean, percentage, and T - test. The statistics were tabulated in simple form for easy interpretation and count, group and describe of which the IBM Statistical Package for Social Sciences (SPSS) 26 was used to analyse the collected information and data. The informal scheduled interviews were conducted to authenticate discrepancies on the responses and explain noted misunderstandings and uncertainties to their responses.

Further, Google Survey Tool has largely assisted in collection and computation of percentages and preparation of graphs and pie charts that have been used to elaborate the findings.

3. Research Findings and Discussion

The focus of this study was to ascertain the level of compliance and awareness of disaster management and emergency response legislation in Tanzania's major cities a case of Dar es Salaam. Survey questionnaires were distributed to various respondents based on the sample selections.

3.1 The Implication of the Institutional Arrangements for Disaster Management and Emergency Response in Tanzania

The report published by the United Nations Office for Disaster Risk Reduction (UNDRR) in 2020 that focused on risk sensitive budget review for Tanzania, indicated that in the National budget of the financial year 2018/19 there were 226 projects and activities related to disaster management that were managed by 176 departments under 28 ministries, offices or commissions at national level and 29 regions indicated in the table 3 below (URT, 2018).

Table 3. Identified projects/activities related to Disaster management

Level	Institutions/Regional secretaries	Departments	Projects or activities
National	28	48	93
Regional	29	128	133
Total			226

In addition, as it has been noted in the previous section that, there are several government institutions and departments that have been established and mandated to deal with emergencies and disasters in Tanzania that contradict each other in the practice. With 176 departments budgeting for the same issues might lead to misallocation of funds and hinder emergency response operations by the first responders. Each department has their own goals and strategies that are not well coordinated with other departments.

Further, by having several institutions with the similar roles or obligations, might lead to delay of emergency response operations due to insufficient resources to the immediate institutions especially first responders like rescue services and fire fighting. This was born or realization that although some structures and systems already existed, a more robust and standardized approach is required to upgrade and integrate their activities and capacities and to focus on disaster risk reduction and preparedness measures, rather than on emergency response.

Also, there are radios and television programs aired in the national media including public and private media that are prepared and jointly conducted by Information Officers and Officers from disaster departments, the target groups are ordinary people both urban and rural that are likely not aware of the message conveyed.

That, Disaster risk reduction and disaster management initiatives need to be integrated into all community development planning and set them to be the responsibility of all institutions rather than live it to the subsectors alone. The indigenous initiatives and disaster response mechanisms are needed to be strengthened through modern and integrated initiatives for disaster management and emergency response systems. Otherwise, the challenges faced of low understanding of the depth and impacts of various disasters by the responsible authorities and departments will persist and the resources set for implementing various plans and strategies will be wasted.

3.2 Potential Disasters Likely Occur in Dar es salaam

Though there are common types of hazards that can occur in all zones like are disease outbreaks, drought, floods, earthquakes and pests, Dar es Salaam City is vulnerable to be affected by both human made and natural disasters. Human made are like fire outbreak, road accidents, power failure, proliferation of unplanned settlements, environmental degradation and pollution, marine accidents, collapse of buildings, hazardous material spill, civil disorder, aircraft accidents, industrial disasters and terrorism. While natural disasters are like flood, drought, cyclones, earthquakes, lightning, landslides, tsunami, strong winds, beach erosion, epidemics (cholera, rift valley fever, bird flu, food poisoning, swine flu, etc), animal disease outbreak (anthrax, beak quarter, foot and mouth disease, lumpy skin etc) and pest infestation.

The following are the result obtained from the online survey conducted to Dar es Salaam residents about their awareness to specified disaster and emergencies that has stroke and may happen to areas like Dar es Salaam.

3.2.1 Awareness to Disasters and Emergencies

The findings on awareness to disasters and emergencies are as indicated in Table 3 and Figure 1 below in which the third indicator scored the highest weight of mean (2.92) while indicator 5 that is about existence of risk reduction initiatives scored 1.93 that connotes the awareness is moderate among the respondent. Practically 50% of all respondents are aware of various disasters and emergencies that might strike in their localities and they are familiar on how they might affect them and their environment, while about 80% of all respondents were not aware

about the implemented disaster risk reduction strategies and priorities in their localities.

Table 3. Awareness to disasters and emergencies

Indicators	WM	Interpretation
1 Awareness of the different kinds/ types of disasters and emergencies	2.56	Aware
2 Knowledge of various disasters (storm, earthquake, tsunami, diseases, etc.)	2.83	Aware
3 The causes of disasters (nature, God, climate, poverty, human errors, etc.)	2.92	Aware
4 The causes of disasters affect the area your locality	2.52	Aware
5 Existence of a Risk reduction strategies in the area	1.93	Moderately Aware
Average	2.71	Aware

* 1.00-1.49=Not Aware; 1.50-2.49=Moderately Aware; 2.50-3.49=Aware; 3.50-4.00=Very Much Aware

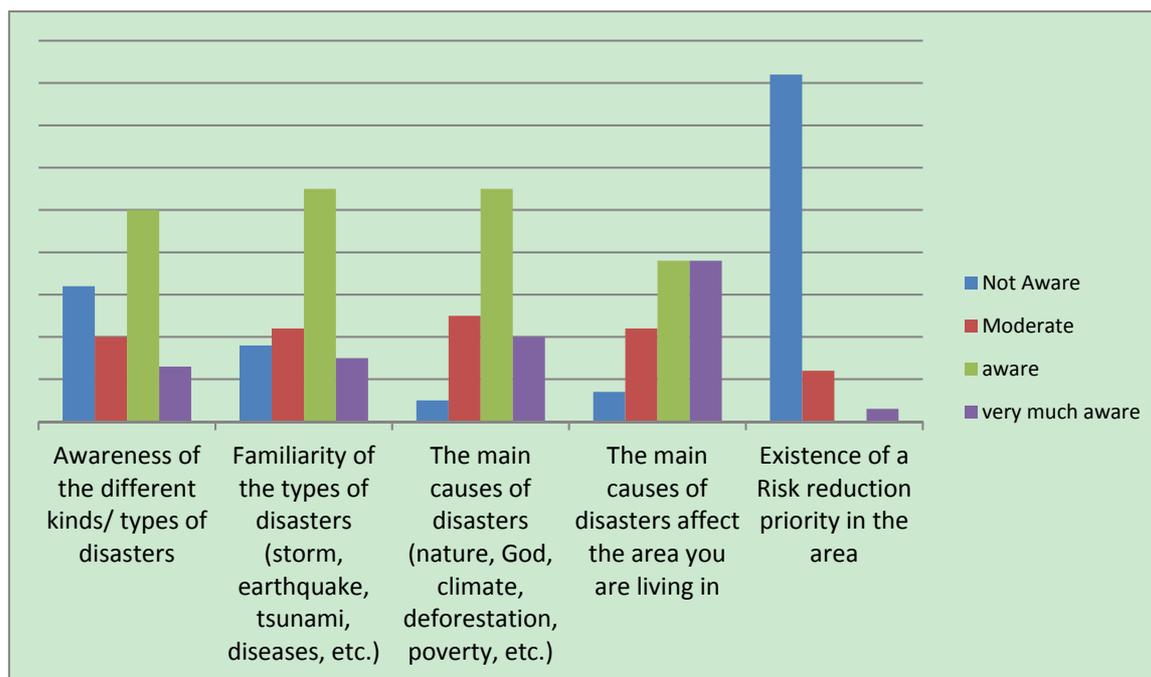


Figure 1. Awareness to disasters and emergencies

3.2.2 Awareness to the cause of disasters and emergencies

Further, the respondents were asked about their awareness on the causes of various disasters and emergencies in which majority (40.6% and 16.7%) of the responses indicated that disasters are result of nature and climate while 27.2% agreed that human errors are also the sources of disasters and emergencies and 15.6% pointed out that poverty and lack of knowledge can play a role in causing disasters and emergencies as indicated in the figure below.

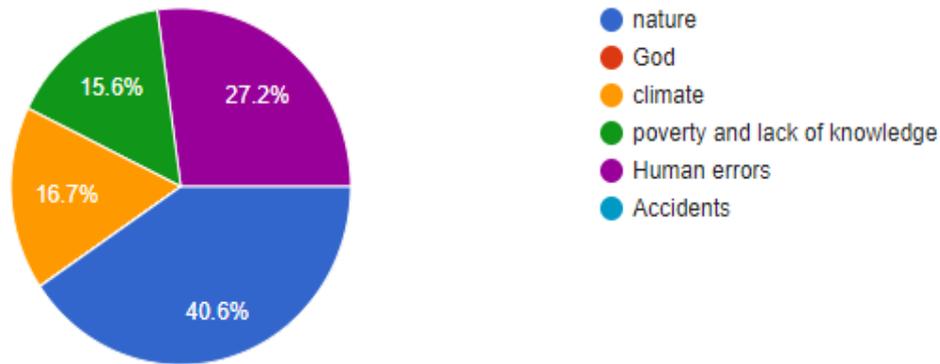


Figure 2. Results awareness to the sources of disasters and accidents

3.2.3 Awareness on disasters and emergencies that are likely to occur in localities

The result in the Figure 3 below indicates that more than 70% of the respondents are aware about the disasters and emergencies that are likely to affect them in their residents and in their surroundings, while insignificant number indicated the low probability of the disasters and emergencies will affect them. These results are supported by their level of awareness on the cause disasters and emergencies that have or are likely to affect them.

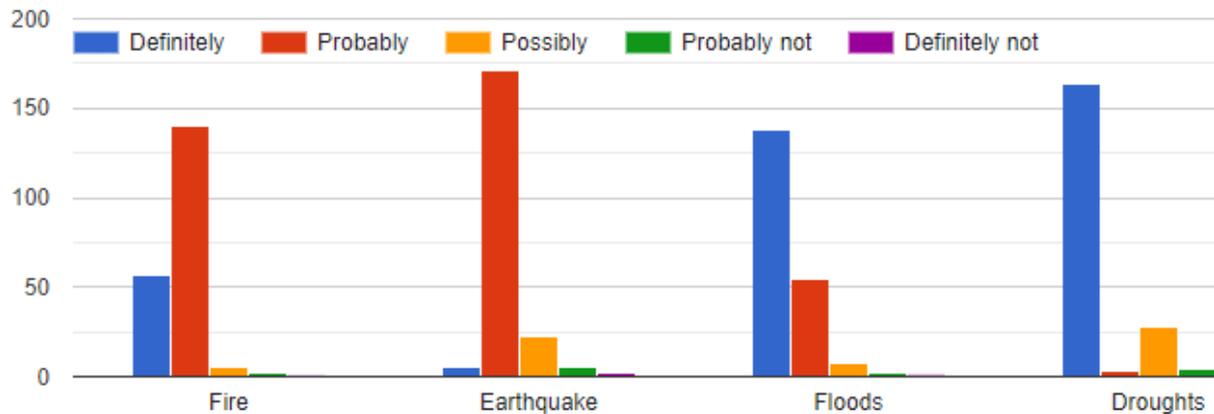


Figure 3. Awareness on disasters and emergencies that are likely to occur in localities

3.2.4 Awareness on the health impacts of accidents and disasters

Figure 4 below indicates the understanding of the respondents about the health impacts of disasters and emergencies. The result revealed that the majority 96% (indicator 3) were aware that water contamination and water shortage can be the major health issue if disasters hit and that their concerned about the result of water shortage in their localities especially the outbreak of diseases.

In addition, the information collected form Ilala and Kinondoni municipal revealed that floods and heavy rain that are recurring disasters in their municipals, caused spread of diseases like cholera, diarrhoea, typhoid and skin diseases, while fire, road accidents and street thefts have caused severe injuries to their residents.

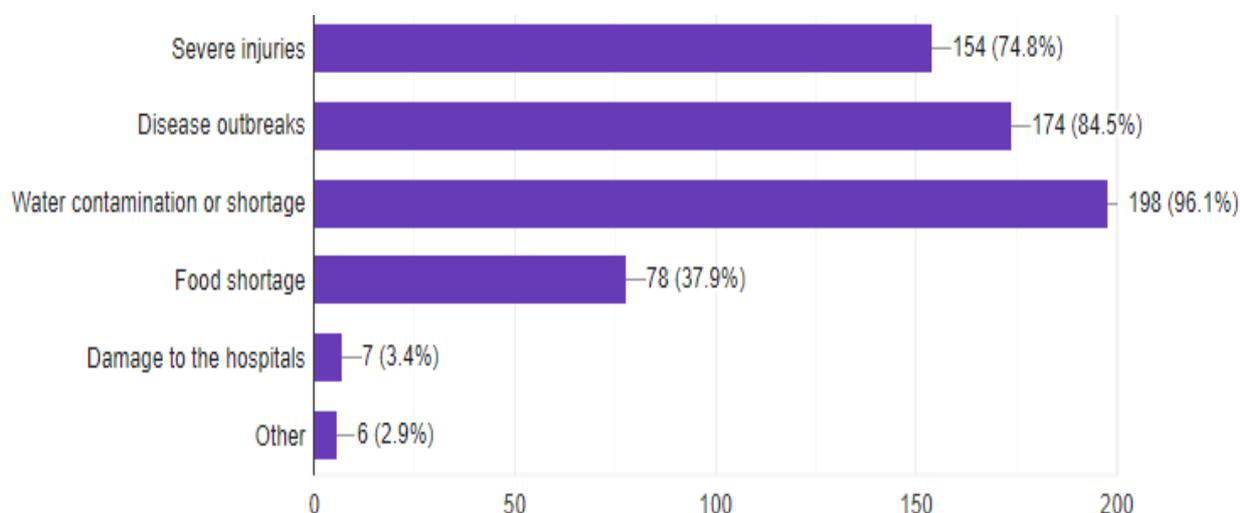


Figure 4. Awareness on the health impacts of accidents and disasters

3.2.5 Compliance level on disaster emergency response initiatives

Table 5 below presents the respondents’ compliance and awareness levels to disaster management programs. Indicator 1 scored the highest mean in the section A of the table, disaster prevention and mitigation that showed compliance. Indicator 4 scored the least mean, “moderately complied” on the same scale.

The overall score of the parameters under this indicator, level of compliance is moderate, which indicate that the responsible institutions for disaster management and emergency response are aware of their areas to play but their actions or compliance is moderate that imply the sampled population is not satisfied with programs implemented to reduce disaster risks and improve emergency response systems.

Further, these findings have been supported by the observed documentations in the offices visited of Ilala, Kinondoni, Ubungu, Fire and Rescue Forces Offices of Dodoma and Ilala Municipal. Other documents and reports obtained in the website of those Institutions visited were also reviewed for the purpose of accomplishing this study.

Table 5. Compliance level on disaster emergency response initiatives

Indicators	WM	Interpretation
<i>Disaster Prevention and Mitigation</i>		
1) carry out of disaster risk assessment	2.86	Complied
2) Developed and established of early warning systems	2.56	Moderately Complied
3) Developed tools on disaster risk assessment	1.82	Moderately Complied
4) Increasing the involvement of communities and local groups in disaster management and emergency response planning	1.88	Moderately Complied
<i>Disaster Preparedness</i>		
1) Conduct of disaster reduction and risk researches	2.29	Moderately Complied
2) Developed and regular review of contingency plans	1.94	Moderately Complied
3) Existence of procedures on disaster and emergency information sharing mechanisms	2.05	Moderately Complied
<i>Disaster Response</i>		
1) Established institutional arrangements for disaster management and emergency response operations	2.66	Moderately Complied
2) Improved skills in search, rescue and retrieval operations	2.62	Moderately Complied

3) Incorporated disaster risk reduction elements in planning and management of human settlements	2.05	Moderately Complied
Average	2.29	Moderately Complied

In addition, it was found that one of Strategic Objectives for Ubungo Municipality (2017/2018 – 2021/2023) was to have improved Emergency and Disaster Management strategy. However, there was no any strategy and budget set to realize that objective (Ubungo Municipal, 2023). This is the indication that, disaster management and Emergency response is not the priority or even in the minds of the Dar es Salaam City governments as the same scenario is observed at Ilala, and Kinondoni and the Dar es Salaam City Council Strategic Plan 2019/2020 - 2023/2024. The same findings were observed at Ilala and Kinondoni Fire and Rescue Force Offices where there were no established fire hazards registers for their areas.

3.2.6 Relationship matrix between the respondents’ profile, disaster awareness and level of compliance

The relationship matrix among profiles, awareness to disaster, and respondents’ compliance level is as shown in Table 7 below. As indicated, in terms of profile, the locality has a fair connection with the compliance level in disaster preparedness program, $r(203) = .418, p = .000$ and disaster rehabilitation and recovery program $r(203) = .406, p = .000$. Disaster awareness is also somewhat correlated to the compliance level on disaster prevention and mitigation programs $r(204) = .494, p = .000$, disaster response program $r(203) = .450, p = .000$, disaster recovery and rehabilitation program $r(203) = .513, p = .000$; and disaster preparedness program $r(203) = .406, p = .000$. These connote that locality; levels of awareness and compliance to disaster programs show a relationship to some degree to each other. These findings also prove that if the respondent has a high response to the disaster, the similar also occurs to the individual conformity or compliance.

Table 6. Relationship matrix between the respondents’ profile, disaster awareness and level of compliance

	1	2	3	4	5	6	7	8	9
Location	1								
Sex	.015	1							
Age	.196*	-.047	1						
Number of household members	.154	-.023	-.023	1					
Disaster Awareness	-.081	-.070	.030	.095	1				
Prevention and Mitigation Programme	-.093	.038	.058	-.112	.493*	1			
Disaster Preparedness Programme	.419*	.026	.169	-.044	.405*	.627*	1		
Disaster Response Programme	.165	-.032	.144	-.166	.440*	.587*	.629*	1	
Rehabilitation and Recovery Programme	.405*	-.308	.164	.027	.511*	.484*	.767*	.665*	1

* $p < .05$

3.2.7 Emergency Response Capacities

The disaster Management and emergency response operations in Tanzania are generally guided and coordinated by PMO at national level and various institutions that have solely or partial responsibilities to deal with disasters and accidents depending to their areas of jurisdiction like the Fire and Rescue Force, Police Force, TASAC and regional governments under the departments responsible for security, planning and disaster management (TRCS, 2024).

The capacities and resources needed for effective and efficient systems for disaster and emergency response systems have been set and elaborated in the Tanzania National Disaster Risk Reduction Strategy 2022-2027, National Disaster Communication Strategy (TDCS) of 2022, National Disaster Preparedness and Response Plan 2022, and District Emergency Preparedness and Response Plans, that aimed at having coordination and guidelines for effective response and recovery after emergencies and disasters.

3.2.8 Distribution and Capacity of Fire and Rescue Services

It is the responsibility of the fire and rescue services to provide fire fighting and rescue services to the public

whenever such services are required (URT- DMA, 2022). It is expected that the fire and rescue services to be available 24 hours a day and seven days per week (Payne 2014). The national standards for emergency response state, “a given number of appliances should reach an area in a given time, depending upon its risk. Hence the duty of the fire services is to find optimal locations of their fire stations and how to distribute the fire personnel, taking the local geography, incident patterns and road network into account”

During this study, Fire and Rescue Force Stations in Ilala, Kinondoni and Temeke were visited for the purpose of evaluating their capacities and challenges faced in delivering their services. Their capacities are as indicated in the table 7 below.

Table 7. Firefighting and rescue capacity (fire stations)

Municipal/ City	Number of fire stations	Minimum number of required fire engines	Actual number of operational fire engines	Staff as per establish ment	Actual number of personnel	Reason for the number of operational vehicles being less than the required number
Ilala	1	50	6	300	150	Budget constraints and ageing of appliances
Kinondoni	2	60	4	360	135	The municipals have significant number of trained and equipped fire fighters. The main reason for non-compliance is attributed to financial constraints facing local authorities. The current strategic placement of Fire Stations throughout the City will in most cases ensure an 80%+ attendance time in terms of “Speed” of response.
Temeke	2	60	4	360	140	
Ubungu	0	50	0	300	0	

3.2.9 Emergency response time

The table 8 below indicates the agreed emergency response time for emergencies in various localities (UK, 2021). It was found that though incidents like fire and road accidents are happening within reasonable distance from Fire and Police Stations, the response times recorded were beyond the predetermined time.

Table 8. Emergency response time

Risk Category	First Appliance	Second Appliance	Third Appliance
Special Risk	Pre-determined attendance		
A	5 minutes	5 minutes	8 minutes
B	5 minutes	8 minutes	
C	8-10 minutes		
D	20 minutes		

***A Risk** (City centres and large industrial areas), **B Risk** (Built up areas such as large towns), **C Risk** (Suburbs and housing estates), **D Risk** (Mainly rural areas)

Source: Dorset Fire Brigade’s Fire Risk Category Review 2023

The report of fire incident at Kariakoo that happened in 2022 from Ilala Fire Station at indicated that the average response time for each fire appliances attended that incident was 35 minutes. Among the challenge identified for late response was inadequate infrastructure that was attributed by poor urban planning and land use (UNISDR, 2019). Dar es Salaam Road networks, market places and city centre structures are not conducive for emergency responders especially during high time.

3.3 Challenges Facing the Compliance to Disaster Management Strategies

3.3.1 Risk Identification Process

To develop a comprehensive emergency response plan and preparedness there is a need to have a well-defined risks and hazards register that provides the clearly indicate and indicate the risks/hazards trend, level and their evolution. Their thresholds, whether high, medium, could be significantly used in preparation of mitigation measures and establishment of disaster and emergency response plans.

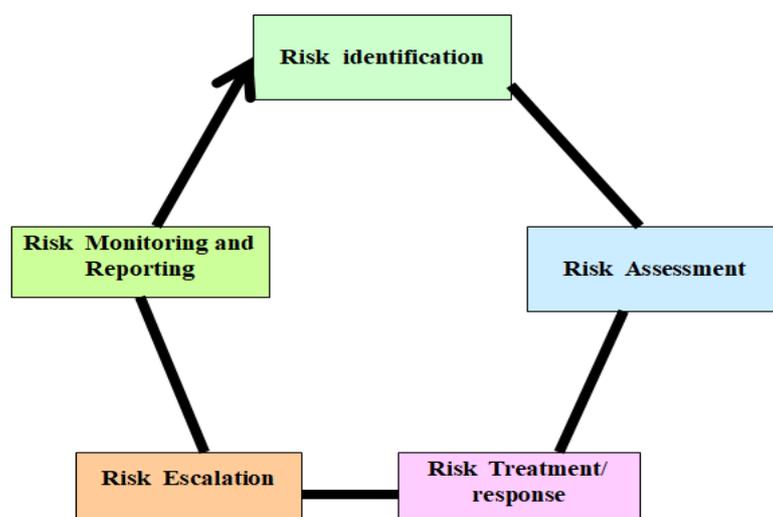


Figure 5. Risk assessment circle

This study found that the local governments conducted disaster risks in their areas of jurisdiction and prepare risk registers as per government directives for each region to prepare its risk registers and prepare emergence response plans (Prime Minister’s Office, 2022). Though all 3 (100%) municipals visited have their district risk registers, they were inadequately cover risks/hazards that are likely to affect them.

Further, it was found that, the risk identification process is insignificant as the registers covers general risks based on their general knowledge. International Federation of Red Cross (2023) has categorized risks in a framework that can enable to set and plan for response when the risks

materialize as indicated in the figure below. The risk identification process needs to be responsive in upcoming risks so to have plans with clear analysis of strategies and actions for monitoring and response.

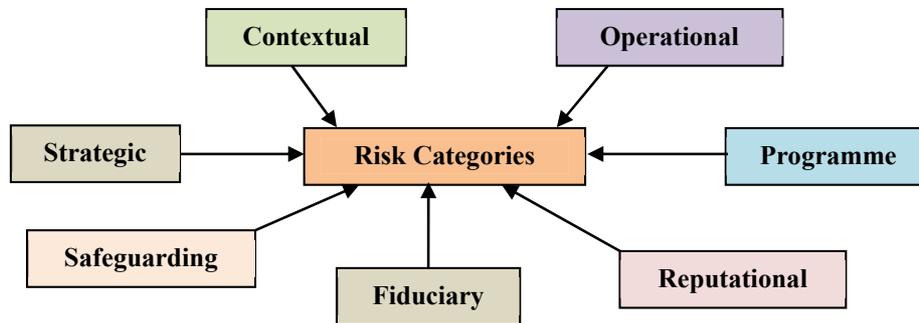


Figure 6. Disaster risks and hazards categorization

By identifying the disaster risks properly and documentation can facilitate the preparation of emergency response plans and reduce the impacts of the disasters and emergencies to the affected communities (Mercycorps, 2011). The process, when properly followed, will enable to rank the risk and mapping of the same accordingly and plan for resources and capabilities that might be required to respond and resilience. But however, the risk identification and assessment in the local government is affected by inadequate data and information about the hazards and the population that are likely to be affected.

Thus, though the risk analysis is carried out by various key players that are involved in the disaster and emergency response while playing their roles in the disaster and emergency response preparedness and recovery, they do have minimum risk and hazards supervision and monitoring, that lead to inefficient and inadequate early warning systems and timely response actions action (UN-GA Resolution 46/182).

“Each State has the responsibility first and foremost to take care of the victims of natural disasters and other emergencies occurring on its territory. Hence, the affected State has the primary role in the initiation, organization, coordination, and implementation of humanitarian assistance within its territory.” GA Resolution 46/182

3.3.2 Inadequate Urban Land Use Planning and Strategies

This study found that, the implementation of Property and Business Formalization Program (MKURABITA) was officially started in 2004 to formalize properties and business assets in the informal sector into legally held and formally operated entities in the formal sector of the economy. It was noted that from July 2022 to May, 2023 fourteen thousand land titles were issued at Dar es Salaam that is equivalent to 34% of the target (URT, 2023). The reports for urban planning and strategies indicate progress in land use planning, but the institutional and structural capacity constraint and a insufficient of statistics, current urban strategies and plans are often out of date, institutional tasks are unclear, compliance and enforcement is weak, and progress in establishing and implementation of new strategies and plans are slow compared to the situational demands.

Further, this challenge has affected the response time (Total response time is the minutes and seconds elapsed from the time of call to the arrival of the first appliance to the incident) to emergencies and accidents in the urban areas have been affected especially fires and other emergencies that require quick responders (NFPA 1710), as the response time to fires has a direct correlation to the amount or magnitude of the incidents to the properties and risk to life (Challands, N, 2014). The quicker the responders arrive at the scene, the less the damage to properties, though there is no clear correlation between number of injuries and fatalities to response time in the reported incidents at Dar es Salaam.

3.3.3 Inadequate Emergency Response Supporting Infrastructure

This study found that there is no National Search and Rescue Plan that would have been used for coordinating incidents and disasters that require search and rescue like floods, earth quakes, marine going vessels accidents or aeronautical accidents. Currently there is only a draft for such document and the information provided by the PMO is that their competitive nature among the key players for search and rescue and unevenly distribution of resources among them.

In addition, there is unevenly and inappropriate storm water drainage systems and waste management in major cities and towns in Tanzania. As the result, in the event of heavy rain for short time, the cities are highly affected and response activities are hampered and increase the risk spreading the disaster and emergency impacts to more areas and victims (Inter-Agency Standing Committee -IASC, 2016).

Further, as noted above, a comprehensible and broad perception on hazards and risks that might lead to disaster or emergency with significant and sufficient demand to call for a integrated disaster and emergency response actions is essential to the total emergency response and planning process (Lamond et al., 2012).

3.3.4 Political Practice and Influence

It was reported by the three municipals that the interference from political leaders and Management in the planning and implementation of various programs have significantly affected the compliance to disaster management legislations and strategies in their municipals. For example, the National Disaster Management Strategy (2022-2027) indicates allocation of funds for local governments (1 for Ilala, 2 for Kinondoni and 3 for Ubungu) to the selected established strategies of which the findings indicated that they were partially implemented as indicated in Table 9. the trend analysis revealed that Ilala Municipal has achieved 44%, Kinondoni 39% and Ubungo Municipal has achieved by 18% of the selected strategies from the National Disaster Management strategies (2022-2027).

Further, the interview conducted at these municipals revealed that political influence was the major challenge (86%) faced in the implementation of their plans and strategies. Other challenges are Interference between Dar es Salaam City Council and all Municipal Councils, low compliance to by laws by the community, limited financial and human resources, unreliable sources of funds for disaster management programs from local authorities, insufficient monitoring and evaluation subjected to initiatives made, and High number of poor families living below 1 USD per day (Ubungo Municipal Director, 2023).

That the political influence and practice have affected decision making in the infrastructure planning in major cities as there are unplanned infrastructures like buildings, roads and ongoing construction projects which do not consider precautions against disasters and emergencies.

Table 9. Implementation status of national disaster management strategy at Dar es Salaam

SN	Objective	Strategies/Target	Intended budget	Status		
				1	2	3
1	To increase understanding of disaster risks at all levels.	Conduct periodic comprehensive disaster risk assessments at all levels, starting where possible from the priorities identified by the country risk profile.	500,000,000	30	25	10
2	To enhance disaster prevention, mitigation and preparedness capacity at all levels for community resilience.	Developing guidelines for mainstreaming DRM issues into sectoral development plans, strategies, budgets and programmes to enhance mitigation, prevention and preparedness measures at all levels.	270,000,000	40	40	15
		Develop multi-hazard or hazard specific DRR strategies, preparedness and response plans based on scientific disaster risk assessment whenever possible at all levels.	750,000,000	75	60	55
3	Facilitate creation of stakeholders' platforms, networks and mechanisms for DRM Information sharing.	Reliable and affordable up-to-date DRR information to all stakeholders available by June 2025.	50,000,000	60	60	30
4	To strengthen disaster response capacity and relief services at all levels.	National and local multi-sector disaster rapid response teams established and capacitated by 2025.	100,000,000	60	55	15
		National and sector specific contingency	500,000,000	70	45	10

		plan developed and operationalized based on the risk knowledge acquired through the disaster risk assessment studies where possible in quantitative terms by 2027.				
5	To strengthen capacity for build back better in recovery for community resilience.	Develop guidelines and standards for disaster recovery. Conduct immediate post disaster review and develop lesson learned for incorporation into future disaster Management measures.	100,000,000	20	20	15
6	To strengthen governance on disaster risk management at all levels.	Institutionalize mechanisms, polices and legal framework to guide, coordinate and oversee DRM at all Administrative levels Inculcate culture of compliance with principles, laws and regulation regarding disasters risk management from primary school to higher learning institutions	600,000,000	15	15	5
			100,000,000	5	5	5
Total average				44	39	18

*1 = Ilala, 2 = Kinondoni, 3 = Ubungo

4. Recommendations and Conclusion

4.1 Recommendations

This section presents the findings on way forward on challenges determines during this study that suggest mean to rise the compliance level to disaster management and emergency response legislations and strategies for major cities in Tanzania as follows.

- 1) To review, develop land use planning based on risk assessments by incorporating disaster risk reduction and effects of climate change into the regulations for land use and urban settlement plans (Rasmussen, M. I., 2013). It was recommended that, the Government need to ensure the suburban and rural areas land uses and settlements are reflected in the cities plans to minimize movement of people from rural to urban (Kruks Wisner, 2006).
- 2) Impose and enforce controls on building types, uses, occupancy rate in populated areas and ensures that the amended and established regulations do not ignore the vulnerabilities in the existing structures, to mitigate risks and hazards (Sakijege et al., 2014). Also, to enhance the capacity of town planners and authorities with responsibilities of overseeing disaster management and fire fighting to conduct regular fire and safety inspections in major projects and domestic housings to ensure safety is guaranteed from the beginning of construction to the use of the buildings.
- 3) Improve informal settlements and encourage safe and sound structures and buildings that were previously developed and constructed without proper precautions to safety and emergency response when the need arises. Promote resilient design, safer construction and strengthening of non-engineered buildings, using low-cost techniques and locally available materials.
- 4) To establish, operate and keep land use plans and records on vulnerable and building database and monitor hazards prone parts of the city of Dar es Salaam and other cities so the disasters and emergencies are timely noted and dealt. This effort is recommended so to have mechanisms that deal with reduction of disasters risks and strengthen the ability of vulnerable population in coup with the changing climate and construction industry.
- 5) It was noted by respondents in the survey that there is a need to intensify and provide public awareness campaigns on disaster risk management and emergency response strategies. The communities have to be informed in safe buildings construction, land uses, town settlement planning and support the government efforts on climate change programs and reduction of disasters and other emergencies impacts.

6) Further, the technical support officers at all levels in the local government structures need the capacity building on new urban development technologies and enhance their knowledge and competencies in promoting compliances to legislations, strategies and plans that aimed at urban planning and disaster risk management and emergency response. Build local citizen awareness to monitor and report unsafe building practices and constructions to improve compliance.

7) This study found that there are several task teams and government officials and legislations that were established and tasked to conduct technical inspections and advices on project developments be it infrastructure development or building constructions (Dickson, E., 2020). It is recommended that each municipal council to have a well-informed task force for disaster risk management that work in cooperation with ministries officials responsible for urban planning and emergency response.

8) Collaboration and coordination of initiatives that of international in nature like climate change programs initiatives with the local or national initiatives and programs. These programs will eventually yield the desired results if the private partners are involved and integrated well with public initiatives (World Bank, 2020).

9) Integrate and strengthen the legal compliance culture and tradition to young generation from primary schools to high schools. The syllabus needs to be reviewed and include disaster risk management and emergency response programs in schools and colleges as indicated in figure 6.

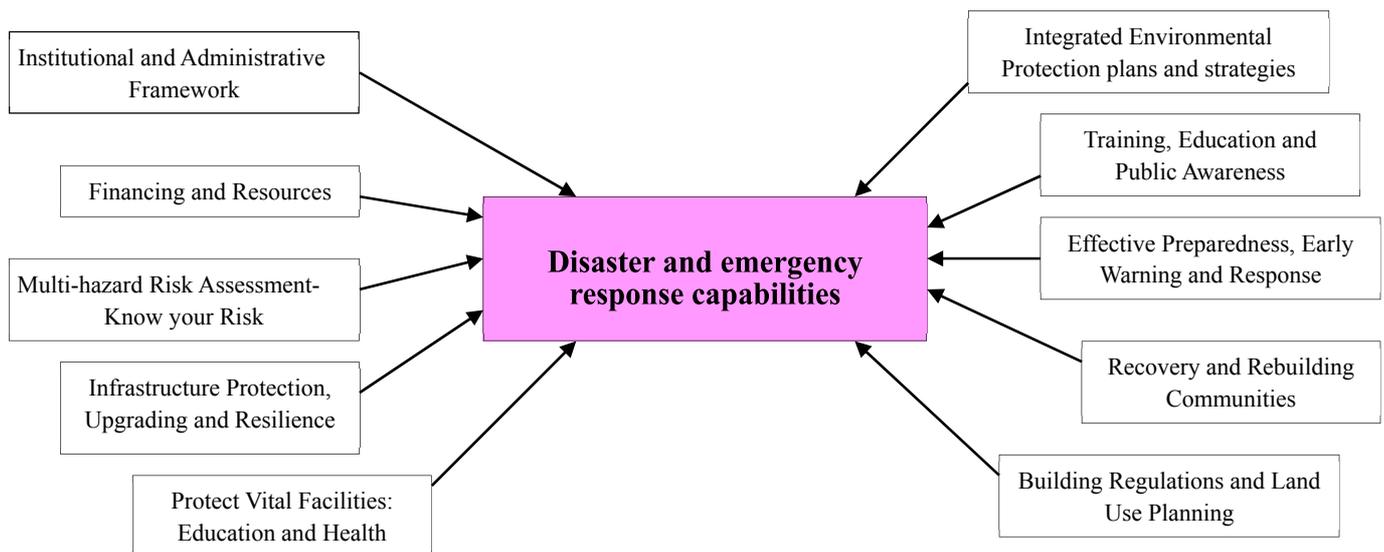


Figure 6. Disaster management and emergency capability indices

4.2 Conclusion

Despite the fact that Tanzania has decades of experience in both natural and manmade disasters and other accidents, it has not engaged or developed significant disaster management and emergency response systems to deal with them to date. There is a considerable backflow amid prospective disasters and emergencies and the existing response plans with day-to-day emergencies like fire, road and industrial accidents and extend to major disasters like floods, mudslides, earthquakes and hurricanes. By having possibilities and experience in numerous disasters and emergencies in both rural and urban areas, it is deliberately significant for Tanzania’s major cities to encourage theoretical, managerial, political, legal, and financial management amendments with the intention of developing and preparing effective disaster management and emergency response systems that are well aligned to established legislations, strategies and agreed international standards.

References

Abdallah, T. (2014). Parliamentary broadcasting in Tanzania: Case study of Tanzania Broadcasting Corporation. *OUT*.

- Abdeen, F. N., Fernando, T., Kulatunga, U., Hettige, S., & Ranasinghe, K. D. A. (2021). Challenges in multi-agency collaboration in disaster management: A Sri Lankan perspective. *International Journal of Disaster Risk Reduction*, 62, 102399. <https://doi.org/10.1016/j.ijdr.2021.102399>
- Bearman, C., Hayes, P., & Thomason, M. (2023). Facilitating teamwork in emergency management: The team process checklist. *International Journal of Disaster Risk Reduction*, 94, 103775. <https://doi.org/10.1016/j.ijdr.2023.103775>
- Celikler, J. M., & Kern, E. (2022). Factors influencing communication structures and processes in disaster management teams – fields of action and design options. *International Journal of Disaster Risk Reduction*, 78, 103153. <https://doi.org/10.1016/j.ijdr.2022.103153>
- Challands, N. (2014). The relationships between fire service response time and fire outcomes. *Fire Technology*. New Zealand Fire Service.
- Chikako, H. (2022). Cities matter: Putting cities at the centre of climate action in Africa. *C40 Thought Leadership blog*. Retrieved from <https://www.c40.org/news/cities-at-centre-of-climate-action-africa/>
- Chuvieco, E., Aguado, I., Jurdao, S., Pettinari, M. L., Yebra, M., Salas, J., ... (2014). Integrating geospatial information into fire risk assessment. *International Journal of Wildland Fire*, 23(5), 606-615. <https://doi.org/10.1071/WF12052>
- Comfort, L., Wisner, B., Cutter, S., Pulwarty, R., Hewitt, K., Oliver-Smith, A., ... (1999). Reframing disaster policy: The global evolution of vulnerable communities. *Global Environmental Change Part B: Environmental Hazards*, 1(1), 39-44. [https://doi.org/10.1016/S1464-2867\(99\)00005-4](https://doi.org/10.1016/S1464-2867(99)00005-4)
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.
- Curnin, S. (2018). Collaboration in disasters: A cultural challenge for the utilities sector. *Utilities Policy*, 54, 78-85. <https://doi.org/10.1016/j.jup.2018.08.002>
- Curnin, S., Owen, C., Paton, D., & Brooks, B. (2015). A theoretical framework for negotiating the path of emergency management multi-agency coordination. *Applied Ergonomics*, 47, 300-307. <https://doi.org/10.1016/j.apergo.2014.10.014>
- De Cicco, G. (2014). Risk and disaster management - The importance of making cities resilient. *AWID News and Analysis*. Retrieved from <https://www.awid.org/news-and-analysis/risk-and-disaster-management-importance-making-cities-resilient>
- Drabek, T. E. (2003). Strategies for coordinating disaster responses. Natural Research and Applications Information Center, University of Colorado, Boulder, CO.
- Hamudi Ismail Majamba, H. I. (2022). An examination of the humanitarianism - disaster management nexus in Tanzania's policy and legal framework. *Huria Journal*, 29(1), 24-53.
- IASC Task Team. (2016). Emergency Response Preparedness. United Nations.
- International Federation Red Cross (IFRC). (2024). Emergency appeal - Operational strategy, Tanzania, Africa | Floods and landslides 2023.
- Kamer, L. (2023). Number of natural disasters reported in Tanzania 2014-2020. Statista. Retrieved February 14, 2024, from <https://www.statista.com/statistics/1246600/number-of-natural-disasters-reported-in-tanzania/>
- Kapucu, N. (2005). Interorganizational coordination in dynamic context: Networks in emergency response management. *Connections*, 26(2), 33-48.
- Koka, P. M., Sawe, H. R., Mbaya, K. R., et al. (2018). Disaster preparedness and response capacity of regional hospitals in Tanzania: A descriptive cross-sectional study. *BMC Health Services Research*, 18(1), 835. <https://doi.org/10.1186/s12913-018-3609-5>
- Kruks Wisner, G. (2006). After the flood: Crisis, voice and innovation in Maputo's solid waste management sector. Doctoral dissertation, Massachusetts Institute of Technology, Cambridge, MA.
- Lamond, J., Bhattacharya, N., & Bloch, R. (2012). The role of solid waste management as a response to urban flood risk in developing countries, a case study analysis. *WIT Transactions on Ecology and the Environment*, 159, 193-204.
- McMaster, R., & Baber, C. (2012). Multi-agency operations: Cooperation during flooding. *Applied Ergonomics*, 43(1), 38-47. <https://doi.org/10.1016/j.apergo.2011.03.006>

- Mercy Corps. (2011). Community based flood risk management initiatives. In Learning from flood risk reduction projects in Jakarta presentation in the consultation workshop preparation of a global handbook for urban flood risk management, Jakarta, 25-26 May 2011.
- Mushi, N. (2018). *Fire safety management* (2nd ed.). Arusha: Fire and Rescue Force.
- Nzovu, B. K. (2023). Urbanism climate change and community adaptations in the Horn of Africa. *Horn of Africa Bulletin*. Life & Peace Institute, Uppsala, Sweden.
- O'Brien, A., Read, G. J. M., & Salmon, P. M. (2020). Situation awareness in multi-agency emergency response: Models, methods and applications. *International Journal of Disaster Risk Reduction*, 48, 101634. <https://doi.org/10.1016/j.ijdr.2020.101634>
- Perry, R. W., & Lindell, M. K. (2004). *Preparedness for emergency response: Guidelines for the emergency planning process*. Blackwell Publishing.
- Purkiss, J. A., & Li, L. (2013). *Fire safety engineering design of structures*. CRC Press.
- Rasmussen, M. I. (2013). The power of informal settlements. The case of Dar es Salaam, Tanzania. *Planum—The Journal of Urbanism*, 1, 26.
- Sakijege, T., Sartohadi, J., Marfai, M. A., Kassenga, G., & Kasala, S. (2014). Government and community involvement in environmental protection and flood risk management: Lessons from Keko Machungwa, Dar es Salaam, Tanzania. *Journal of Environmental Protection*, 5, 760-770. <https://doi.org/10.4236/jep.2014.59078>
- UN General Assembly. (1991). Resolution 46/182.
- UN International Strategy for Disaster Reduction (UNISDR). (2009). Terminology on disaster risk reduction. Geneva: UNISDR. Retrieved from <https://www.unisdr.org/we/inform/publications/7817>
- United Republic of Tanzania. (2022). *National disaster management strategy 2022 – 2027*. Prime Minister's Office, Disaster Management Division.
- Woong, L. D. (2019). Collaboration and performance in disaster and emergency management: Focusing on South Korea. *International Journal of Disaster Risk Reduction*, 35, 101116. <https://doi.org/10.1016/j.ijdr.2019.101116>
- World Bank. (n.d.). Tanzania urban resilience program. Retrieved from <https://www.worldbank.org/en/programs/tanzania-urban-resilience-program>

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Authors contributions

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