

## Managing Vulnerability to Climate Extremes in Africa:

### Some Policy Insights into Frequent Flooding in Dar es Salaam, Tanzania

Shingirirai S. Mutanga<sup>1</sup> and Barnabas Mwiruki<sup>2</sup>

The general trend of disasters in coastal cities has been towards an ever-increasing frequency of floods, which have claimed not only human lives, but also property and infrastructure. The city of Dar es Salaam has not been spared from these catastrophes over the past decades. This brief assesses the city's level of preparedness in adapting to climate extremes and how it is managing human vulnerability. Essentially, the policies, strategies, plans and structures needed to support disaster management in Tanzania are in place. However, it remains clear that the local authorities and key disaster stakeholders lack financial and technical support to properly implement the intended policies and strategic programmes set to cope with climate change hazards. As in many cities in the developing world, the lower-income communities (urban poor) who live in flood-prone areas, remain highly vulnerable as they face greater risk. In order to adapt to climate variability and change, key elements needed to help reduce vulnerability include the mainstreaming of research and development, strict adherence to and proper implementation of enacted programmes, and ensuring proper service delivery.

#### Introduction

Climate variability and change are already having a considerable impact on Sub-Saharan Africa, and they are expected to intensify over the coming decades.<sup>1</sup> The general trend of disasters in the region has been towards an ever-increasing frequency of flood occurrence since 1960,<sup>2</sup> with some countries which often experience the

longest dry spells witnessing the worst-ever floods. Namibia, and Tanzania's coastal city Dar es Salaam have recorded such extremes between 2008 and 2012.<sup>3</sup> Droughts and floods have claimed more victims than any other event during the same period,<sup>4</sup> with an estimated 1,5 million people being affected so far.<sup>5</sup>

Climatic threats are exacerbated by wider development pressures, which undoubtedly

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Climate variability and change are already having a considerable impact on Sub-Saharan Africa, and they are expected to intensify over the coming decades

compound the already complex socio-economic and ecological relationships. Among these are deforestation and unplanned urban development, which are known to have accentuated the hydro-meteorological hazards such as floods, and increased the vulnerability of human populations.<sup>6</sup> Using Dar es Salaam as a case study, this brief reflects on how Tanzania is building resilience and providing coping mechanisms for flood disaster reduction.

### Definition of terms

*Climate variability*, as defined by the United Nations' (UN) Food and Agriculture Organisation (FAO), refers to short-term deviation of climatic parameters of a region that vary from its long-term mean, due to internal processes such as volcanicity, earthquakes and external forces such as industrialisation, agricultural activities and urbanisation.<sup>7</sup> Often the climate of a given location at a specific time of the year might vary in terms of both the temporal and spatial scales.<sup>8</sup> This policy brief therefore pays special attention to the short-term rainfall deviations which have seen Dar es Salaam experiencing frequent catastrophic floods.

The term *vulnerability* in the context of climate change has been defined in different ways. The Intergovernmental Panel on Climate Change (IPCC) has defined vulnerability as:

the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. In this respect, vulnerability is seen as the function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.<sup>9</sup>

*Adaptive capacity* is the ability to plan, prepare for and implement adaptation measures. Factors that determine adaptive capacity of human systems include economic wealth, technology, infrastructure, information, knowledge, skills, institutions, equity and social capital.<sup>10</sup> Although adaptive capacity cannot be measured, it provides an indication of the level of preparedness in building the resilience of nations and communities to disasters.

Vulnerability also has a dynamic side to it – a change towards a more or less vulnerable state.<sup>11</sup> This brief adopts the notion of vulnerability from an adaptive capacity point of view: where weak adaptive capacity is an indicator of increased

vulnerability, while strong adaptive capacity means reduced vulnerability.<sup>12</sup> In essence, if communities display characteristics indicative of weak adaptive capacity they can be said to be vulnerable.

Resilience has different defining characteristics, including recovery, ability to retain the same state irrespective of the amount of change and, as applied to socio-ecological systems, could refer to the ability to build and increase the capacity for learning and adaptation.<sup>13</sup> This brief adopts the latter definition, which is closely linked to the system's adaptive capacity. Simply stated, the ability of the actors in a system to influence or manage their resilience is dependent on institutions and systems that learn and store knowledge.<sup>14</sup>

In the light of the increasing disasters and impacts of climate change, adaptation is not an option but a necessity. One of Africa's highest priorities is therefore to enable communities to adjust and adapt to their changing environments. Nonetheless, in many areas of the East African coast, Dar es Salaam being no exception, the risk of floods remains unexplored and the scope of the impending losses inadequately assessed. Often ad-hoc arrangements are made to 'salvage' the remains of a flood disaster. Many development plans and policy formations overlook the risk, the impending impact, and coping or mitigation strategies, despite the growing concerns about climate change. Some of the questions that may arise are: 'How can we build resilience to disaster risks?' 'How can we tap the knowledge base of our communities?' and lastly, 'How can we foster international cooperation in monitoring and mitigating flood hazards?'

This brief provides an overview of the extent of Dar es Salaam's vulnerability, its intervention programmes for flood disasters, its institutional and policy frameworks and its challenges, and provides some recommendations in an attempt to address some of the questions raised.

### Recurrence and severity of floods in Tanzania

Floods are one of the natural disasters which most highly affect the East African coast, Tanzania in particular. Many urban and rural communities are at varying degrees of flood risk which, if overlooked, may bring irreparable losses. It has been explained that floods are the main cause of climate-related hazards in the Greater Horn of Africa (GHA) region.<sup>15</sup> Flood risk is exacerbated by the increasing population

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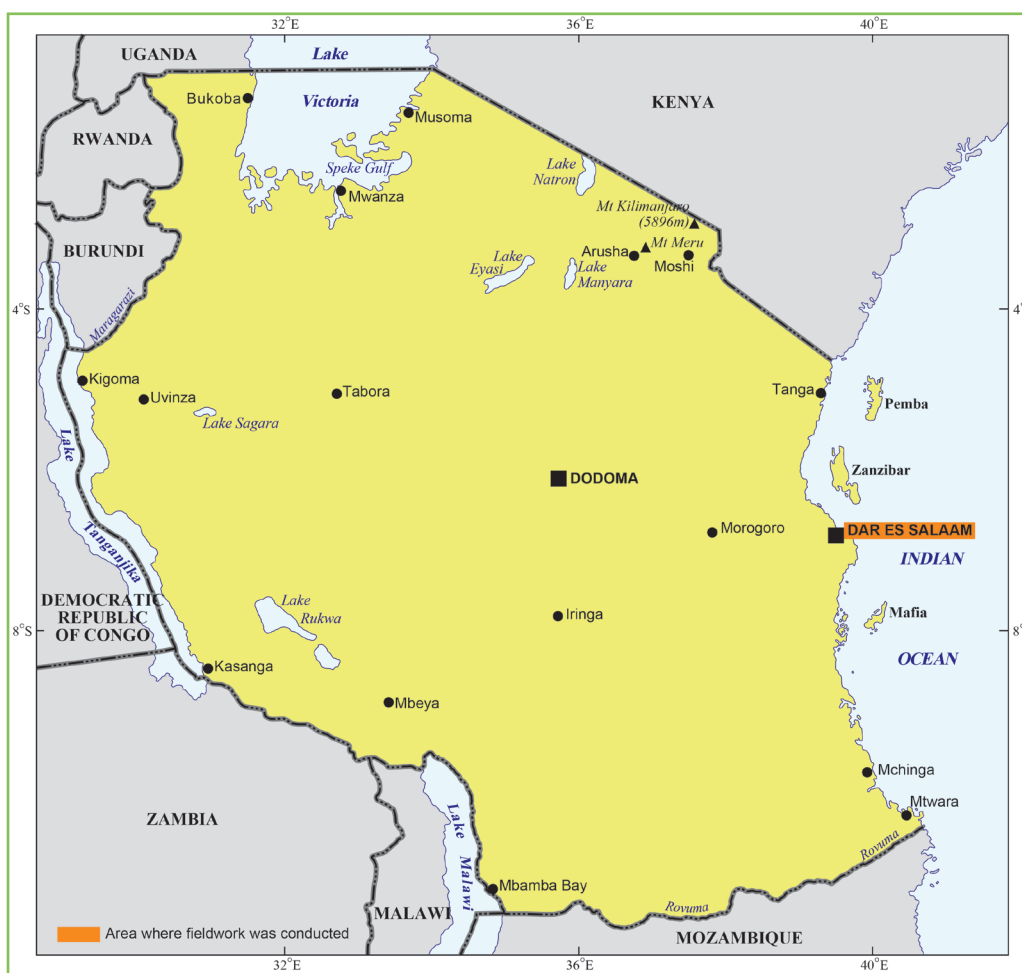


Figure1: Geographical location of Dar es Salaam

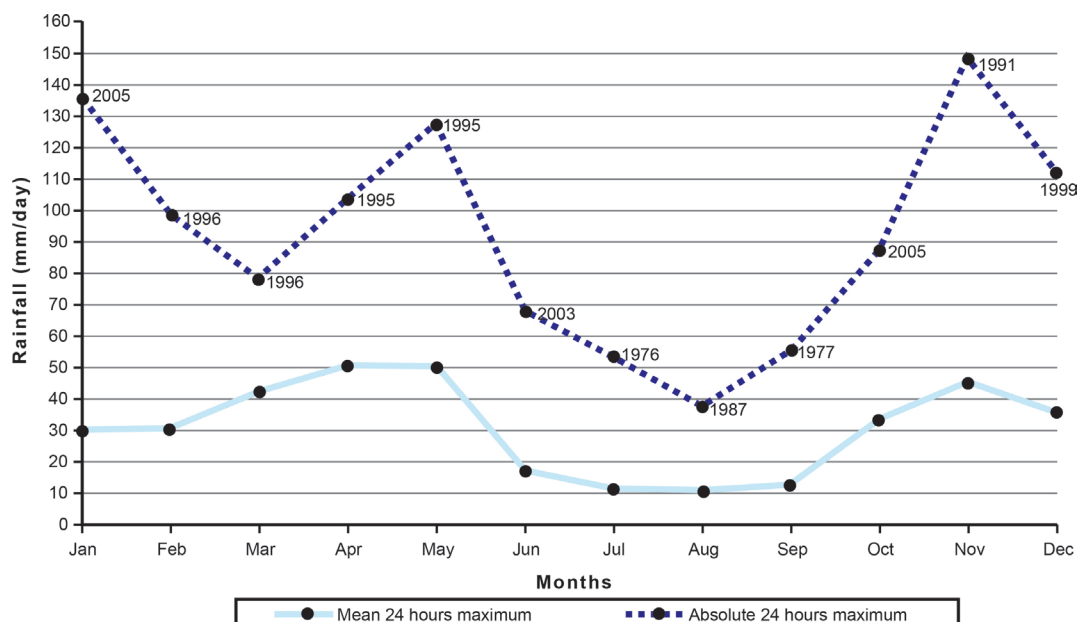
Source: Dar City Council, 2004.

and hence the ever-increasing encroachment of urban development into traditional flood-plain areas. This, together with the prevalent climate-change phenomena, means that it can be rightly expected that the future will hold more flood disasters than the past.<sup>16</sup> Some notable examples of the loss caused by floods in the region are the damage, both to life and property, experienced throughout the region during the 1997/1998 El-Niño associated floods,<sup>17</sup> and the 2011 floods that wrecked the coastal city of Dar es Salaam and claimed 23 lives.<sup>18</sup>

The city of Dar es Salaam is located in the eastern part of the Tanzanian mainland at 6051 S latitude and 39018 E longitude, covering an area of 1 350 square km. Dar es Salaam is one of the fastest-growing cities in Sub-Saharan Africa, with a population growth rate of approximately 8 per cent.<sup>19</sup> Over 70 per cent of the city's four million residents live in informal, unplanned settlements that lack adequate infrastructure and services.<sup>20</sup>

There are two rainy seasons in most parts of the East African coast. The short season runs from October to November and the long one from March to May each year. The timing of the rains, however, and the forecast precipitation amounts are becoming more and more uncertain due to climate change and seasonal variability. From a flooding perspective, rainfall amount and intensity are variables of concern. Rainfall intensity has shown an exponentially rising trend over the past 15 years (with records going back over 38 years of recorded history).<sup>21</sup> A recent example is the latest flood event which occurred in Dar es Salaam on 21–22 December 2011, which claimed about 13 lives. This flood, which heavily destroyed infrastructure and related developments, causing loss of millions of US dollars' worth of property, was claimed by the Tanzania Meteorological Agency to be the worst event in 57 years.<sup>22</sup> It is worth noting that this flood occurred during a short dry spell between the two rainy seasons in the region.

Flood risk is exacerbated by the increasing population and hence the ever-increasing encroachment of urban development into traditional flood-plain areas



**Figure 2:** Mean and absolute 24-hour maximum rainfall for the period 1971–2009

Source: Kebede, A. S. & Nicholls, R. J., 2010. *Population and assets exposure to coastal flooding in Dar es Salaam, Tanzania: Vulnerability to climate extremes.*

### Flood-risk mapping in Dar es Salaam

Flood-risk information when projecting future development is critical, as it projects a number of detrimental consequences, both social and economic. As indicated in Figure 3, the highly flooded or worst affected areas are around urban Dar es Salaam. This qualifies Kebede’s analysis on Dar es Salaam’s vulnerability to sea-level rise. The study has shown that 8 per cent of the city lies in low elevation zones below 10m, inhabited by more than 143 000 people, with assets worth approximately US\$ 168 million.<sup>23</sup> Therefore, construction of settlements and other infrastructure within the low elevation zones, compounded by the changing climate and high variability, increases the vulnerability and risk to floods in the city.

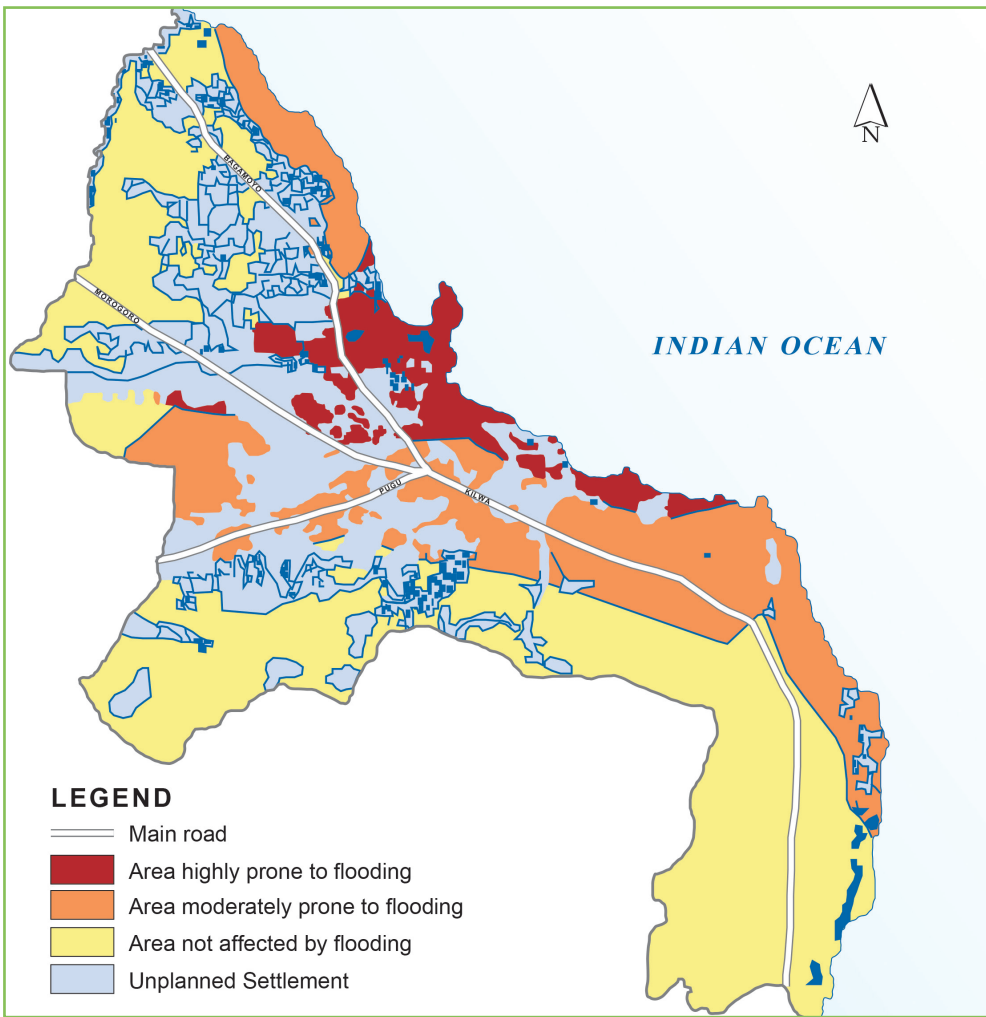
As an example, one would not expect that the physical planning department of the relevant municipality would allow the construction of residential blocks in areas like Msasani-Bonde la Mpunga, in Dar es Salaam city, an area known to be a natural waterway and a flood basin, without any significant improvement in drainage systems. Nonetheless, with the rising urban poverty, it is not surprising to see the rapid increase of unplanned settlements within the flood-prone areas, thus increasing the vulnerability of the urban poor.

### Tanzania’s institutional framework

Dar es Salaam city is governed by the City Council of Dar es Salaam and the municipal councils of Ilala, Temeke and Kinondoni. The City Council has a coordinating role and attends to issues in the three municipalities. The municipalities are under the ‘mother’ Ministry of Regional Administration and Local Government. Although the disaster matters are dealt with by each municipal council, above these is the Dar es Salaam Regional Administration. Furthermore, because of the cross-cutting nature of the disaster issues, the central government has established a Disaster Management Department in the Prime Minister’s Office which attends to all disaster issues and incidents at all administrator levels.

A specialised entity dealing with flood disaster warnings and advisories in the country is the Tanzania Meteorological Agency (TMA). The agency provides weather forecasts and extreme weather warnings. Cloud evolution is monitored through satellite technology, and subsequent warnings and advisories are disseminated to the public as needed, through various stakeholders such as the mass media and the Disaster Management Department within the Prime Minister’s Office.





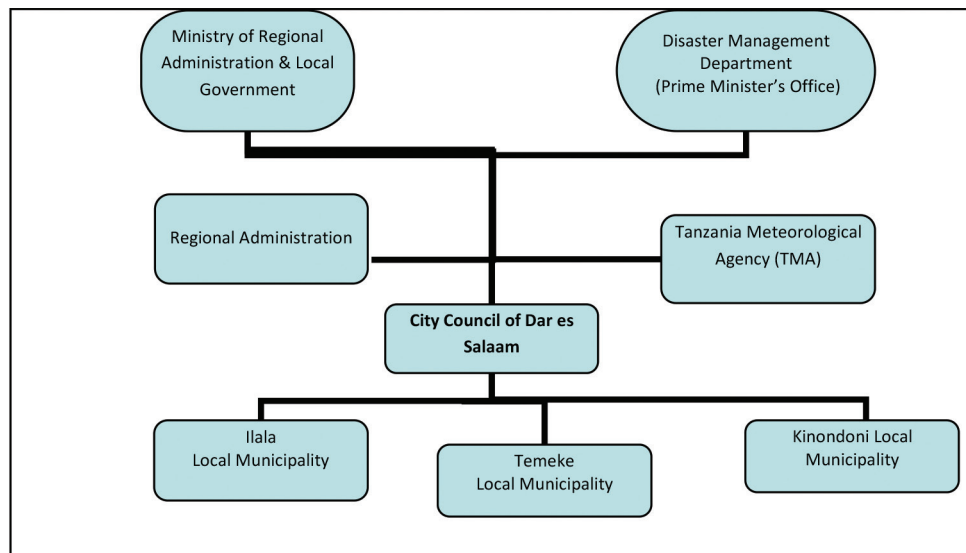
**Figure 3:** Flood hazard map on poor urban settlements of Dar es Salaam

Source: Ardhi University, 2010



**Figure 4:** Flooded houses in Dar es Salaam on 21 December, 2011

Source: Bongo5 media, 2011



**Figure 5:** Tanzania's key stakeholders for disaster management

Authors' compilation

### Available policy mechanisms

In order to address matters pertaining to climate change and disaster risk management, several policies and legislations have been enacted in this respect, at both national and local level.

At national level, the following are the working policies:

- i. Ratification of the UN Framework Convention on Climate Change (UNFCCC) (1996),
- ii. National Environmental Policy (1997),
- iii. National Human Settlements Development Policy (2000),
- iv. Tanzania National Disaster Policy (2004). This outlines and stipulates levels of disaster management structures in the country. It is a national operational guideline for disaster management.

At the local level, the following are working policies:

- i. The Sustainable Dar es Salaam Project, and the Strategic Urban Development Plan (SUDP), started in 1992,
- ii. Community Infrastructural Upgrading Programme (CIUP), started in 2001,
- iii. African Urban Risk Analysis Network (AURAN) Project, Phases I and II, started in 2004.

### Flood vulnerability and adaptation challenges

Despite the identified institutional and policy framework, the Government of Tanzania, like that of many other developing countries, has a

low adaptive capacity in terms of flood disaster preparedness and management, as indicated in Table 1. The table reflects some widespread strengths and weaknesses in disaster prevention and mitigation strategies, preparedness, emergency responsive capacity and sustainable recovery options in Dar es Salaam. Socio-economic changes characterised by rapid and unplanned growth, urbanisation and coastal migration have resulted in high population densities, and the resulting overburdened infrastructure certainly increases the population's overall exposure to coastal flooding.

According to the 2002 census, Dar es Salaam has a population of 3 497 940 people, with the number exposed to floods being 143 000.<sup>24</sup> When projected to 2070, the exposed population will be 210 000, which represents an 85 per cent increase over the 30 000 estimated in 2005.<sup>25</sup> This shows the possible threat posed by flood disaster due to urban population growth in the midst of climate change.

Some of the adaptive measures in place include seasonal displacement, raising the foundations of main buildings and toilets, and building walls in front of doors and windows. There are also some community initiatives, such as the construction of storm-water drainage systems and the establishment of a special committee for dialogue with the government. Nevertheless, given the severity of some of the climate conditions such as those causing the December 2011 floods, these measures are far from adequate to cope with the catastrophe.

One of the strategic responses of the Government of Tanzania to the need to reduce

future growth in exposed areas has been to steer development away from low-lying areas that are threatened by sea-level rise and floods. Implementation of such a policy has not been effective, as evidenced by many newly unplanned shops and houses being erected in low-elevation coastal zones. The enforcement of such a policy is equally a challenge, given the sporadic nature of informal settlements that spring up and dominate urbanisation in the city. According to World Bank reports, Tanzania's policy towards informal settlements has vacillated over the past decades: slum clearance was initiated during the 1960s, but ceased due to financial constraints; squatter area upgrading projects were abandoned when the World Bank ceased funding them.<sup>26</sup>

Certainly these informal settlements have mushroomed to unprecedented levels. Following the floods of late 2011, the government has once again embarked on demolishing settlements or houses built in areas susceptible to floods, while

providing them with temporary shelters elsewhere. Such a project requires massive capital investment, but the Disaster Management Committee in collaboration with the Town Planning Office lacks adequate funding and technical capacity, not only for rehousing of inhabitants but also the demolition of houses in the flood-prone areas.

The urban poor live in the flood-prone areas and face greater risk. They have lower adaptive capacity to climate catastrophes; often they have less access to information, scant resources to withstand adverse impacts, and fewer safety nets. In addition, among many other problems, salt water intrusion has been identified as one of the key challenges, particularly in Msasani Bonde laMpunga. Salt water is corroding the foundations and walls of houses. Despite these challenges, the poor are still reluctant to leave these flood-prone areas, yet they have little assurance that their homes and belongings will be safe in the case of evacuation.

**Table 1: An overview of Dar es Salaam's flood vulnerability in view of some adaptive capacity indicators**

Indicators of Adaptive Capacity	Low	Medium	High	Comments
Planning for flood disasters	√			Often ad-hoc arrangements in response to floods; attention is mostly on droughts which occur inland more than floods in coastal regions.
Economic growth		√		Tanzania stands out as a model of sound economic performance, with a growth rate of over six per cent in 2011 and 2012. <sup>27</sup> Nonetheless, the growth has failed to benefit those who make up 80 per cent of the country's (mostly poor) population. Hence these remain vulnerable to flood disasters.
Financial resources	√			Most projects are donor funded. Slum clearance or squatter upgrading projects in flood-prone areas have been abandoned due to financial constraints.
Technology resources & human capital	√			According to the UNs' report on emergencies, disaster preparedness and response, <sup>28</sup> lack of access to technology and skills within ministries, departments and agencies is an area of major concern.
Institutions		√		Technically speaking, the policies, strategies, plans and structures needed to support disaster management in Tanzania are in place. However, careful analysis reveals widespread weaknesses in disaster prevention and mitigation strategies, preparedness, emergency responsive capacity and sustainable recovery options.
Population growth & increased vulnerability			√	There is a projected 85 per cent increase in population living in Dar es Salaam hence more areas exposed to floods. <sup>29</sup>
Flood frequency & severity			√	With the increased frequency of floods and the worst floods since 1957 having been experienced in 2011, the lack of sufficient good-quality observational local climate data hinders accurate planning for and early warnings of floods.

Subsequently, the urban poor who live in flood-prone areas remain highly vulnerable, as they face greater risk

## Conclusion

The general trend of disasters in the coastal cities has shown an ever-increasing frequency of floods, which have claimed not only human lives but also property and infrastructure. The city of Dar es Salaam has not been spared these catastrophes over the past decades, while population growth increases its vulnerability to the repeated natural disasters. The available key institutions and structures developed to address flood disasters, such as the City Planning and Disasters Management departments, it remains clear that these lack the financial and technical support to properly implement the intended policies and strategic programmes set to cope with climate change hazards. Subsequently, the urban poor who live in flood-prone areas remain highly vulnerable, as they face greater risk. As in many other cities in the developing world, lack of a long-term approach, weak institutional capacity, absence of enforcement of laws and regulations, combined with the very high rate of urban growth and resource constraints mean that Dar es Salaam has a low adaptive capacity to the scourge of floods.

To help reduce vulnerability to climate variability, key elements needed are change mainstreaming, good financial investment, technical support, research and development, strict adherence to and proper implementation of enacted programmes, and proper service delivery.

The multifaceted challenges described in this brief require well-organised, multi-sector early warning and preparation systems for emergencies. More importantly, intervention programmes which analyse and seek to reduce the impact of hazards and disasters should learn from the past, and evaluate the strengths, weaknesses, opportunities and threats involved. This would play a key role in planning for future changes in climate, facilitating proactive adaptation to new hazards and informing ongoing adaptation to familiar evolving hazards.

## Recommendations

It is imperative to enhance awareness of climate change and disaster management by mainstreaming these topics in society, school and college curricula, and also to incorporate them in all social and economic planning in order to avoid ad-hoc and ineffective disaster mitigation.

There should be a flood disaster platform in the country which would input the scientific

research into the politically based framework organs. At this moment there are very few science-based initiatives dealing with climate change and disaster resilience, coping or adaptation. There needs to be deliberate and steadily funded research on these issues.

Strict adherence to government-approved physical plans is an absolute necessity. Breach or disrespect of such plans through dubious methods must be avoided with every effort and means.

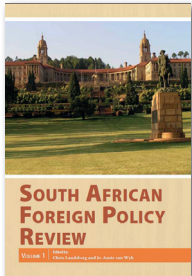
The report on Urban Poverty and Climate Change in Dar es Salaam has appraised the need to improve the quality of life of poor residents by providing them with basic services such as clean water, improved storm-water drainage, sanitation facilities, and better health care.<sup>50</sup> Efforts made in this direction will reduce both current and future vulnerability to climatic variability and change.

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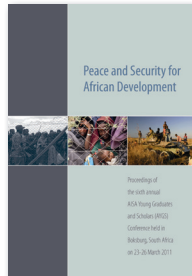
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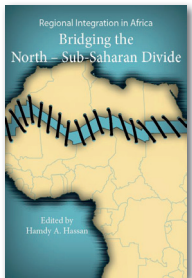
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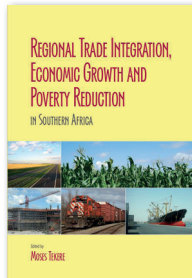


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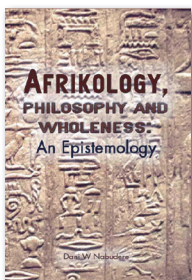


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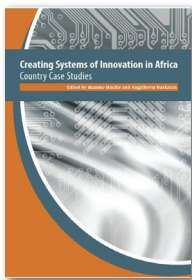


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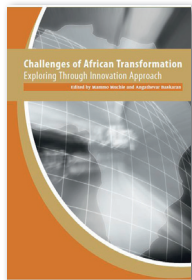


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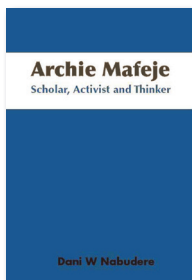


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