



Climate-induced loss and damage in coastal areas: Evidence from Bagamoyo and Pangani districts in Tanzania



RESEARCH REPORT

October 2019

**Climate-induced Loss and Damage in coastal areas: Evidence from
Bagamoyo and Pangani districts in Tanzania**

Research Report

**Climate Action Network Tanzania
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Declaration

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Executive Summary

Introduction

Climate-induced loss and damage has recently emerged as one of the burning agenda in international climate change negotiations. Developing countries have been complaining on the increasing consequences of climate change impacts caused by massive industrial revolution since 1880s in the developed world and hence argued for reparation. The IPCC has already warned that the impacts might double in the low-adaptive capacity countries at the global warming of 2°C compared to 1.5°C. Responding to this matter, the UNFCCC through its COP19 in 2013 felt concerned and hence initiated a mechanism for loss and damage to find compensation solutions. However, one of the challenges among developing countries in international negotiations has been the insufficient evidence on the extent of loss and damage to accompany their arguments towards climate risk financing. In response to the scenario, CAN Tanzania took an initiative to undertake this research so as to contribute in aiding evidences to such negotiations in developing countries like Tanzania.

Objective

Being part of the climate resilience building project in Pwani and Tanga regions, the study endeavored to explore various climate-induced loss and damage evidences in the coastal communities in Tanzania with the aim of catalyzing debates on climate risk financing as countries prepare to participate in the UNFCCC's COP25.

Methodology

Both qualitative and quantitative data collection techniques such as household questionnaire interviews, focus group discussions, field observations, key informant interviews and storytelling were applied. Online climate change information sources were also consulted to enhance various findings and facilitate comprehensive understanding of the phenomena.

Key Findings

The study revealed that communities have attained a certain level of awareness on the loss and damage to their livelihoods on aspects like subsistence farming and fisheries. It was further observed that sea-level rise is reducing the size of land and turning into saline soils while increased temperature has shifted the fishing grounds into deeper seas.

Prolonged dry seasons in recent years have been detrimentally damaging cash and subsistence food crops while short-lived heavy rains have been causing flash flooding leading to damages of infrastructures. Eruption of new and increased frequency of diseases like Dengue and Malaria due to an increased spread of mosquitoes is extremely threatening the health of people and sometimes claiming lives of people. On the other hand, the ecological systems like mangrove forests and coral reefs are disappearing at an irreversible state hence affecting other socio-economic activities of coastal communities.

Despite of losses and damages, it has been found out that there is no compensation in place from either the government or local and international organizations apart from communal contributions and loans from village community banks to temporarily aid the affected members.

Recommendations

Immediate and long-term measures in coastal areas need to be introduced. These will include the government to formulate a coastal management policy and increase budget allocation for disaster management at central and local levels as more climate-stressors are expected in future. Furthermore, international climate financing should focus more on capacity building projects in coastal areas and smallholder socio-economic activities such as supporting construction of climate resilient infrastructures. Finally, civil societies, faith based, community based, local and international organizations within the country and specifically in these coastal communities should invest in new capacity building and climate resilience approaches like the Participatory Integrated Climate Services for Agriculture (PICSA), Participatory Assessment of Climate and Disaster Risks (PACDR) and Ecosystem based Adaptation (EbA).

Abbreviations

COP	Conference of Parties
CSOs	Civil Society Organizations
FBO	Faith-Based Organization
FGD	Focus Group Discussion
GHG	Greenhouse gases
GIS	Geographical Information System
GOT	Government of Tanzania
GPS	Global Position System
L&D	Loss and Damage
LGAs	Local Government Authorities
NGOs	Non-Governmental Organizations
SACCOSS	Savings and Credit Co-operative Society
TCCCR	Tyndall Centre for Climate Change Research
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania

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1.0 INTRODUCTION

Climate change and variability is no longer a story but rather a serious and obvious global challenge (IPCC, 2018). The Intergovernmental Panel on Climate Change (IPCC) established that the current rates of climate change are leading to changes in the frequency, intensity, spatial extent, duration and timing of weather and climate-related extremes (UNFCCC, 2018). Science has informed that climate change affects environment, socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones (Gulacha & Mulungu, 2016; IPCC, 2001).

The range of impacts are anticipated to accompany the increase in atmospheric GHG and associated temperature rise that will increase the rate of sea level rise; increase in glacial, permafrost, Arctic and Antarctic ice melt; more rainfall in specific regions of the world and worldwide; more severe droughts in tropical and subtropical zones; increasing heat waves; and more intense hurricane and cyclone activity (Warner et al., 2018).

Despite their insignificant contribution to the total GHG in the atmosphere, developing countries have been the major victims of the climate change-related socio-economic and biological damages as well as irreversible losses. In such context, these countries argue that the existing frameworks meant to promote mitigation and adaptation are inadequate, and this suggests an urgent call for an international mechanism to deal with loss and damage in particular and residual climate change impacts in general (James et al., 2014). Thus, in 2013 during the COP 19, the United Nations Framework Convention on Climate Change responded to these calls and established the Warsaw International Mechanism (WIM) to address loss and damage from the impacts of climate change in developing countries.

The reviewed literature has portrayed that climate-related damages and the related economic costs have been constantly increasing tremendously since 1970s and even more so in the last two decades (Hirsch et al., 2017). Such trends are scientifically well documented and closely associated to both an increase in extreme weather events and long-term changes in climate variables in the framework of climate change. In light of these findings and increasing evidence on the ground, governments in vulnerable countries as well as economic decision-makers, investors, farmers, humanitarian aid agencies and many others started relatively early on searching for ways to better understand, minimize and address climate-induced loss and damage, in order to keep economic costs as low as possible (Hirsch et al., 2017).

The risks associated with impacts of climate change are already evident in all socio-economic sectors that are essential for Tanzania's livelihood and sustenance, including water resources, energy generation, food security, ecosystems/biodiversity and human health (URT, 2012). In the most vulnerable communities, the impacts of climate change have posed a direct threat to people's survival. The University of Oxford in cooperation with the Tyndall Centre for Climate Change Research (TCCCR) conducted a research on the changing climate of Tanzania. Their report revealed that there is a mean annual temperature increase of 1.0°C since 1960 and statistically significant decreasing trends in annual rainfall (Hirsch et al., 2017).

In order to accelerate negotiations of developing countries in international climate agenda such as the UNFCCC Conference of Parties (COP) towards proper climate financing for climate adaptation and minimize the losses and damages, the topic of loss and damage has become a research agenda in these countries so as to come up with vivid evidences.

In Africa and Tanzania in particular, loss and damage research agenda is still at an infant stage. Cases of climate-related losses and damages have been reported through both print and soft media platforms but neither scientifically investigated nor documented. For instance, flooding, droughts, and diseases are major climate change related stressors that have been touching different parts of the country, including coastal areas of the Indian Ocean for quite some time (Roy et al., 2018). This might have been affecting both regional and international climate financing in the country. The current study by Climate Action Network Tanzania therefore strives to contribute to the diminution of science gap so that Tanzania develops a strong voice in the international climate-related losses and damages. This study is imperative for preparations of the upcoming Santiago Climate Change Conference, which will feature the 25th session of the Conference of the Parties (COP 25) to the UNFCCC and meetings of the UNFCCC subsidiary bodies in early December 2019.

1.1. Research objectives

General Objective

The overall objective of this study was to explore the climate-induced loss and damage in Bagamoyo and Pangani districts in Tanzania.

Specific Objectives

Specifically, this study aimed to:

- (i) assess the extent to which coastal communities are vulnerable to climate-related stressors;
- (ii) examine the existing and adopted community adaptive measures in anticipation of unusual climate events;
- (iii) investigate the loss and damage caused by the impacts of climatic events and changes in the community; and
- (iv) identify the financing options available to compensate the costs of loss and damages in the community.

1.2. Rationale

The IPCC has stated clearly that coastal areas are among the vulnerable environments especially in developing countries. Increasing temperature intensifies the exposure of small islands, low-lying coastal areas and deltas to the risks associated with sea level rise for many human and ecological systems, including increased saltwater intrusion, flooding and damage to infrastructure. Risks associated with sea level rise are higher at 2°C compared to 1.5°C (IPCC, 2018, p. 8). Tanzania has an approximate of 15 million people settling within the coast of the Indian Ocean covering five regions of Tanga, Coast, Dar es Salaam, Lindi and Mtwara (URT, 2012) and 15% of the country's total land area lies in the coast of the Indian Ocean. The coastline stretches for 1,424 km from Jasini village in Tanga on the North to Ruvuma River in Mtwara, in the Southern part. Climate-induced loss and damage in these areas was not yet studied before the current intervention. As Tanzania and other developing countries prepare to participate in international climate negotiations this year (COP25 2019), CANTZ through its climate resilience building project in these coastal regions has conducted this research as a way of gathering loss and damage evidences in these areas.

2.0 METHODOLOGY

2.1. Description of the study area

The study focused on Bagamoyo and Pangani districts in the coast region in Tanzania. It particularly involved the Kaole and Mlingotini villages located within the shores of Bagamoyo District as well as Mkwajuni and Pangani Mashariki in Pangani district. Bagamoyo and Pangani are neighbour districts along the Indian Ocean coastline. Pangani district lies between longitudes $5^{\circ}35'48.70''\text{S}$ and latitudes of $38^{\circ}49'19.27''\text{E}$ while Bagamoyo district lies in the East between 37° and 39° and between 6° and 7° in south of the equator.

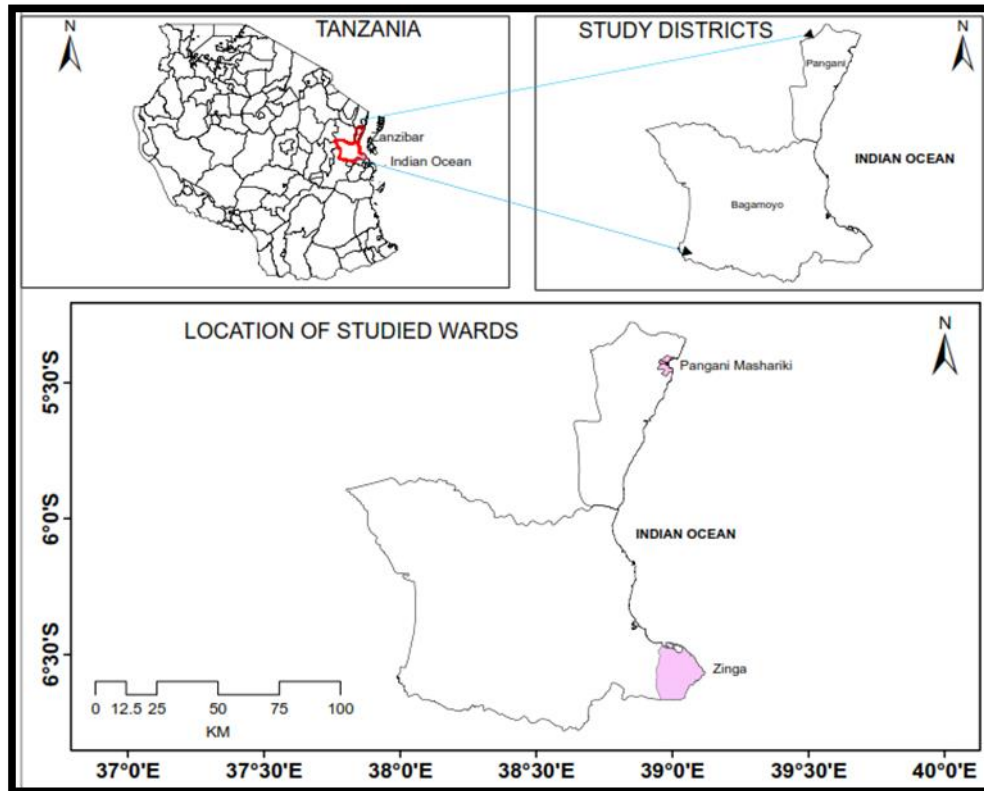


Figure 1: A Map describing location of the study area

Climate

Bagamoyo and Pangani districts have similar climatic condition being classified as tropical which is usually characterized by two rainfall seasons, a summer with plenty of rainfall and winter season with very little amount of rain (Msuya et al., 2013). The average annual rainfall and temperature ranges from 1015mm to 1214mm and 26.6°C to 27.0°C respectively.

2.2. Data Collection tools

2.2.1. Household Questionnaire Interviews

The study involved both closed and open questions which were structured to achieve the objectives. After familiarizing with key questions and pilot coding of the answers, data collection process followed. This ensured that all questions were properly asked and answered by the target group. The random sampling of 139 households was studied whereby 70 households came from Bagamoyo and

69 were obtained from Pangani district. The target individuals for the questionnaire were household heads.

Table 1: Households sample size

DISTRICT	VILLAGE/MTAA	HOUSEHOLDS	PERCENTAGE
BAGAMOYO	Mlingotini	33	23.7
	Kaole	27	19.4
	Kaole-Bondeni	2	1.4
	Kaole-Shaurimoyo	7	5.0
PANGANI	Mkwajuni	34	24.5
	Pangani Mashariki	35	25.2
TOTAL		139	100.0

2.2.2. Key informant interviews

Structured and in-depth questions about loss and damage cases were discussed with key informants. This included district technical officers, political and administrative leaders, and old (70+) members of the community within the study area. The questions allowed a free flow of ideas and information in a conversation way between the interviewee and interviewer.

2.2.3. Focus Group Discussion (FGD)

To acquire more detailed and supplementary information needed, four gender balanced FGDs were conducted involving representatives among local leaders, extension workers, fishermen, and farmers. The Village leaders assisted in selecting participants for discussions whereby a group was made of 7 to 10 people.

2.2.4. Actual Field Observation

The study correlated all discussed and interviewed questions with the actual field observation. Most of the mentioned areas with damage and loss as a result of climate change were visited and observed by the researchers. GPS coordinates and photographs of the damaged boreholes, water springs, paddy farms and mangrove forests covered by water because of sea level rise were recorded and properly documented.

2.2.5. Story telling

In line with the group discussions, key informant interviews and field observations, historical stories by some of the interviewed people from the study area were recorded and documented. The story telling focused on the current status on the resulted loss and damage, the trend of changes and their impacts to human livelihood in the study area.

2.2.6. Online Climate Information Sites

The study also extracted some online scientific information to make comparison with filed findings for comprehensive understanding of the phenomena. Electronic gadget carries collection of facts, be it text denoting to full text databases, digital journals, image collections, other multimedia products and numerical, graphical or time based in commercially obtainable title that has been published in online or network setting were extracted (Kenchakkanavar, 2016). The study also utilized online sites like climate risk data platform, Global Integrated Drought Monitoring and Prediction System, Climate Prediction Center-African Desk and the World Agrometeorological Information Services.

3.0 FINDINGS

3.1. Socio-economic characteristics of the area

3.1.1. Literacy

Literacy status is an important aspect while studying various challenges affecting the community. In Africa, literacy may contribute to low capacity of adaptation to the impacts of climate change as well as ability to mitigate damages and losses. The study found that majority of household heads in these coastal communities have primary education and below as their highest level reached (See Figure 2).

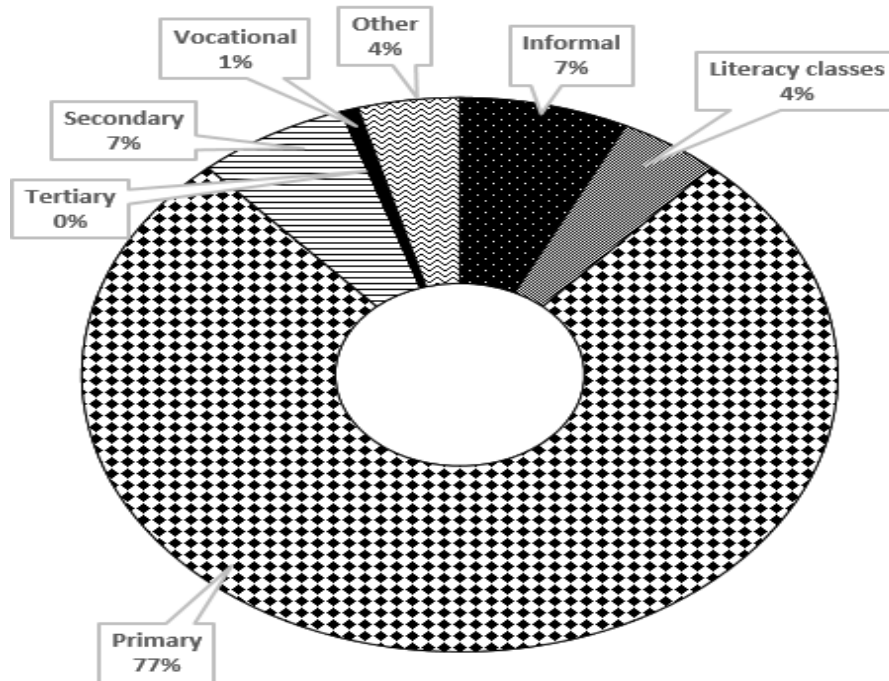


Figure 2: Which highest level of education did you attain?

These findings portray the reality in poor countries including Tanzania where access to schooling was limited in some decades after attaining independence. As a result, these people have faced limited awareness over challenges like climate change and other disasters. It should be noted that, illiteracy in any way do affect the way people opt for different economic activities as well as choice for various adaptation strategies to mitigate climate-related loss and damage.

3.1.2. Community livelihoods

Community engagement in various socio-economic activities is usually influenced by geographical and weather characteristics. Pangani and Bagamoyo districts are located exactly at the shores of the Indian Ocean where majority of the population is expected to involve in fisheries as their major livelihoods. This is in line with the findings of this study which revealed that majority of the respondents in the study area reported that they largely deal with smallholder fishing and farming activities to earn their living. This is due to the fact that majority of them did not achieve higher formal or technical education that could guarantee them access to formal and technical employments. On the other hand, because these communities have continued to becoming more urbanized and influenced by Dar es Salaam and Tanga cities, majority of households engage in small

businesses (retail shops and food vending) (See Figure 3). Additionally, Robertson & Midway (2019) stated that small-scale marine fisheries in Tanzania provide for the main source of subsistence for coastal communities, yet due to poor management, they have been overexploited for decades. On the other hand, Robertson et al (2018) estimated that near shore marine smallholder fisheries provide the main source of protein for nearly 9 million people in coastal villages of Tanzania.

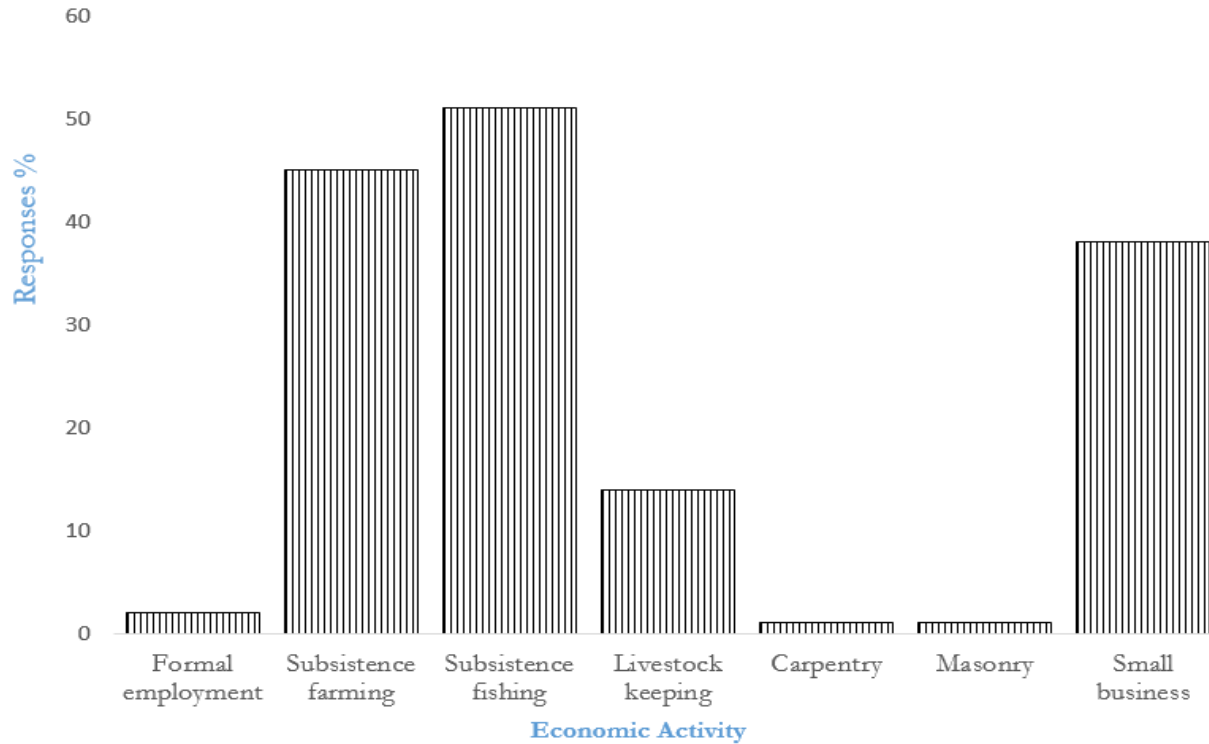


Figure 3: Which livelihoods does your household earn income?

Such findings in figure 3 are important for studying the impacts caused by climate change extremes in these coastal communities. It should be noted that all the income generating activities are entirely subsistence and climate-sensitive. The local technology applied in production of these livelihoods is still low and cannot support them for climate adaptation. Smallholder and rain-fed farming is a famous economic activity across major parts of Tanzania. Figure 4 has revealed that communities in the study area involve mostly in production of cassava, maize, rice, coconut and cashew for household consumption.

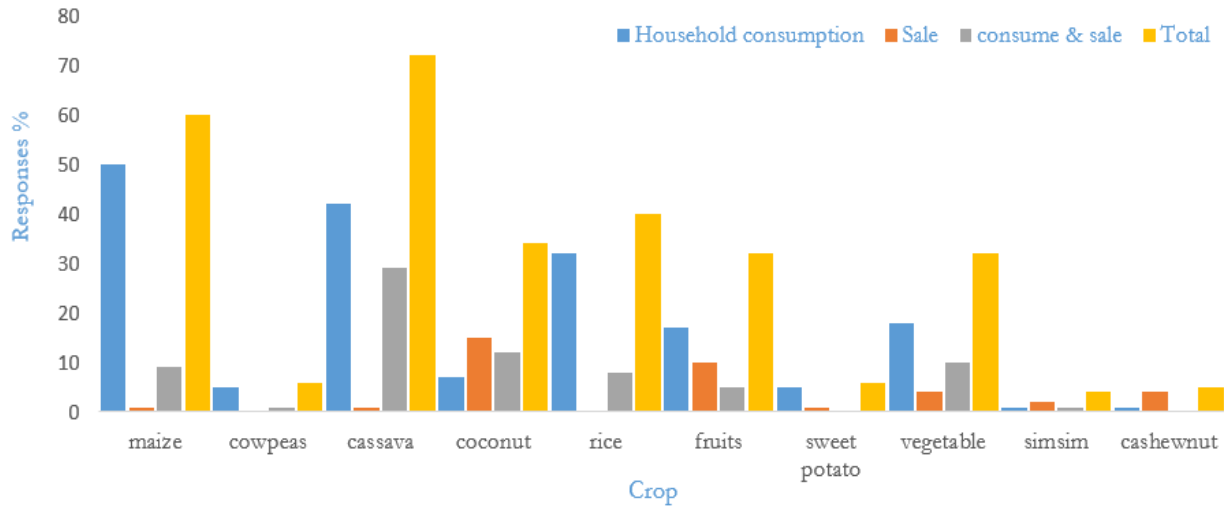


Figure 4: Which crops do you grow for consumption and or sale?

The dominance of cassava (*Manihot esculenta*) and other tuber crops have been recognized as one of the adaptation mechanisms to climate change. Paavola (2008) in his study established that regional agricultural statistics indicate that farmers adjust their practices to climate variability. Smallholder farmers under this study reported that they prefer to grow cassava in years with low amount of rainfall.

3.2. Community vulnerability to climate-related stressors

3.2.1. Climate stressors in the study area

Climate science has projected a number of climate stressors that may result into losses and damages across the globe especially in poor and developing countries. However, they differ from one locality to the other. This study established an interest to learn from the local knowledge and experiences about climate-related coastal hazards that affect the livelihoods of the coastal communities in Tanzania. All respondents admitted to have witnessed a number of climate-related hazards including recurring floods, drought, heavy winds, storms and eruption of diseases in recent years (See Figure 5).

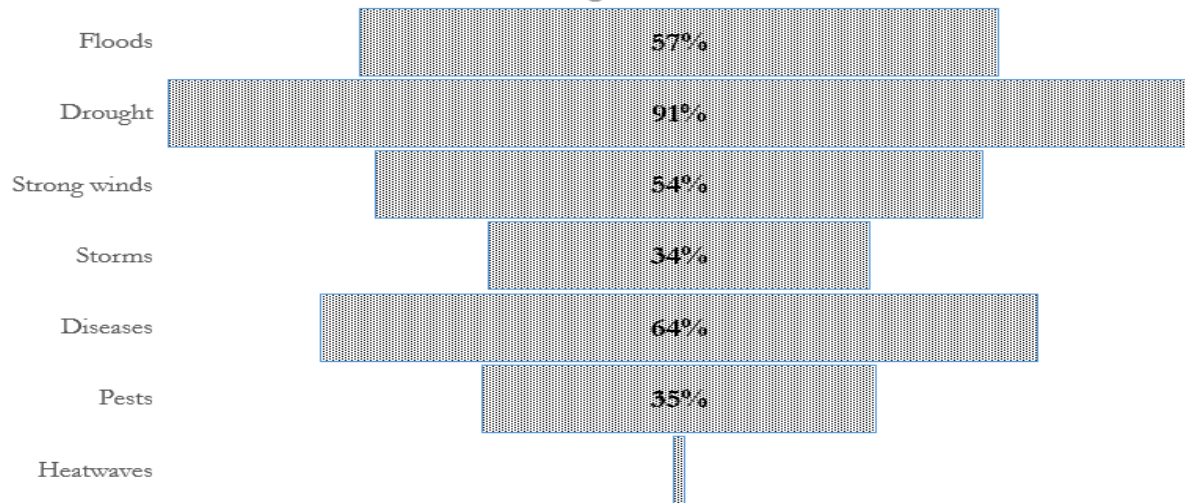


Figure 5: Which climatic hazards usually affect your community

The level of awareness and climate illiteracy of the interviewees might have affected their responses, but the truth remains clear that much reduction in the annual amount of rains has resulted into drought-like condition. They also reported that diseases like malaria and cholera are troublesome in the community and that short and heavy rains usually are accompanied with flooding in lowland areas along the coast of Indian Ocean. Furthermore, majority of fishers in these communities complained for the increase of strong winds especially in the Indian Ocean causing loss of life and difficulties in their fishing activities (See Figure 6).

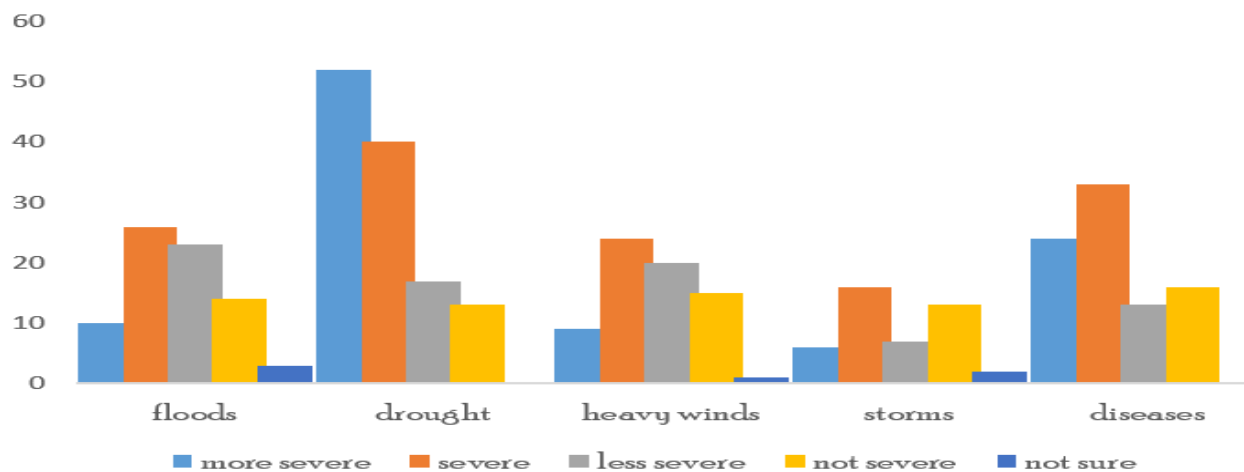
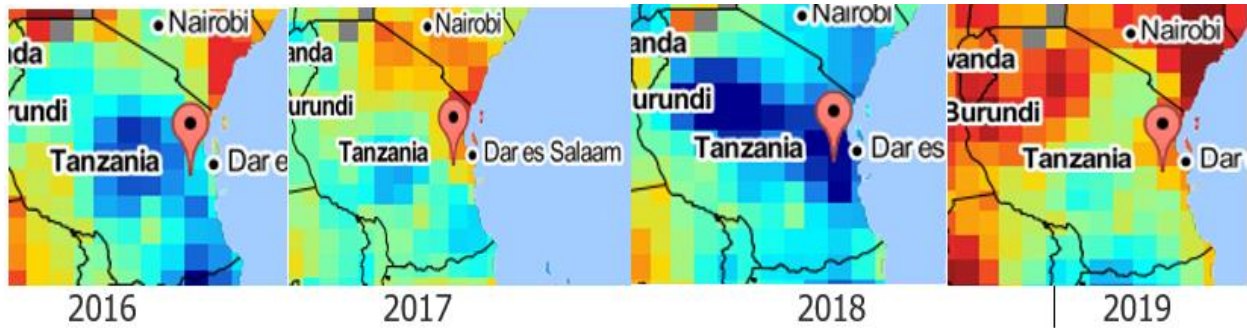


Figure 6: How severe are the climate-stressors you just mentioned?

According to the indigenous knowledge of respondents, reduced amount of annual rainfall which marks the incidence of drought (See Figure 6) has been more severe as compared to other stressors. On the other hand, occurrence of new diseases which were never experienced before, strong winds in the Indian Ocean, and floods also are becoming severe among these coastal communities.



Key

Dry Condition				
D0	D1	D2	D3	D4
Abnormally Dry	Moderate Drought	Severe Drought	Extreme Drought	Exceptional Drought

Wet Condition				
W0	W1	W2	W3	W4
Abnormally Wet	Moderate Wetness	Severe Wetness	Extreme Wetness	Exceptional Wetness

Figure 7: SPEI Global Drought Monitor showing drought conditions in Tanzania (Source: <http://spei.csic.es/map/>)

Findings from the study suggest that communities have not diverged from various global climate monitors on the situation of climate stressors in Tanzania’s coast areas. Mild drought conditions (See Figure 7) was detected in some years of the last decade. On the other hand, the coast has been mapped as the most vulnerable to flash flooding (Figure 8). This is the reason why many participants in the study mentioned recurring flooding leading to various losses and damages in physical infrastructure.

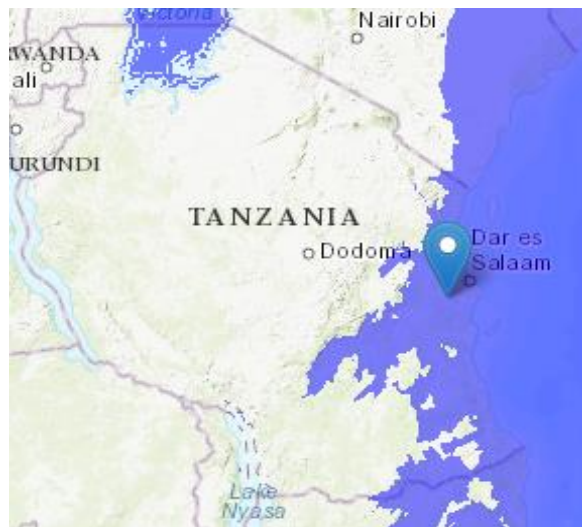


Figure 8: Global flood map (<https://www.floodmap.ne>) portraying vulnerability of coast areas including Tanzania

According to Chang’a et al (2017), there has been a significant increase in mean temperature anomalies since the last four decades in Tanzania (See Figure 9). As many participants in the study complained, Chang’a findings also uphold that the coastal areas have maintained higher temperatures in this period.

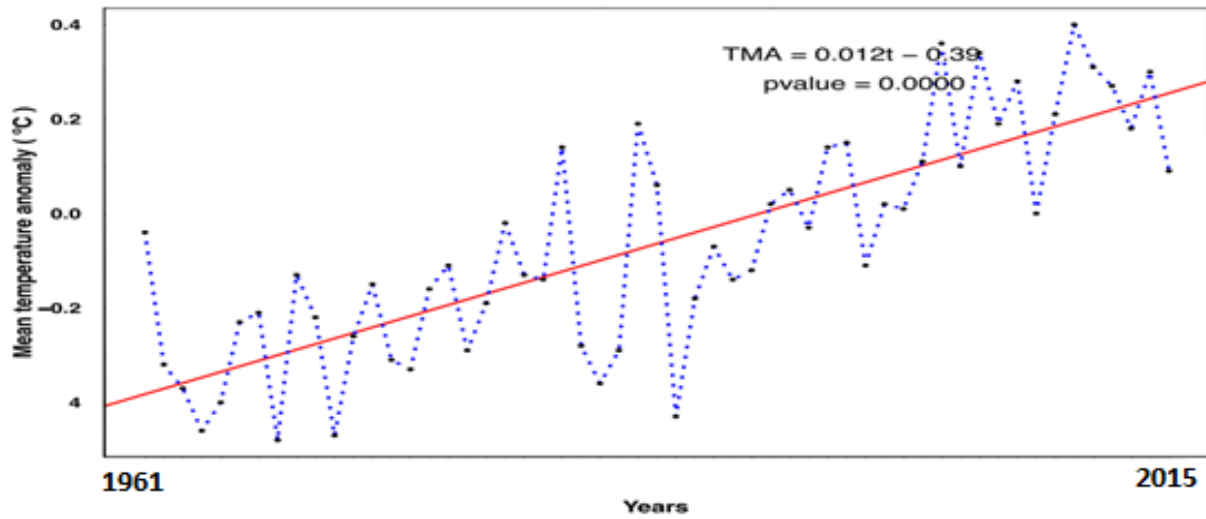


Figure 9: Mean Temperature anomaly trend in Tanzania (Chang'a et al, 2017)

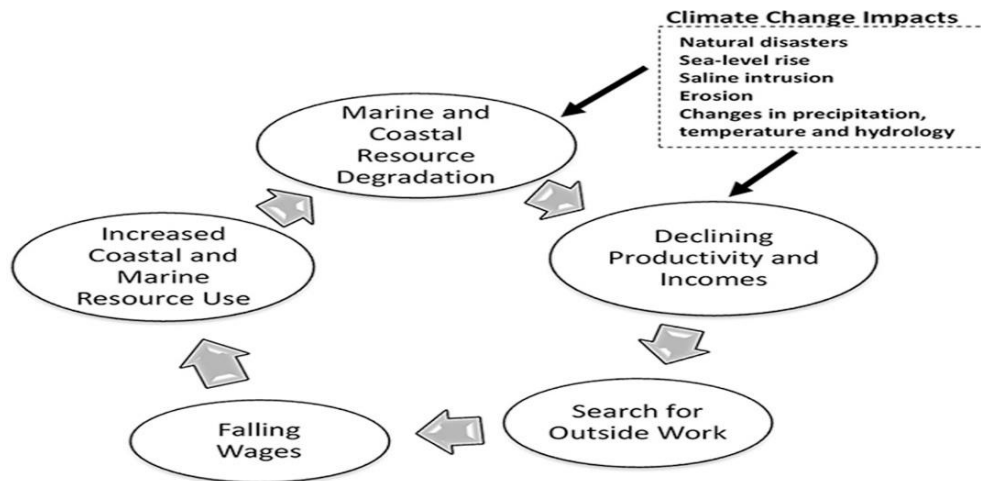


Figure 10: The vulnerability of poor rural households and their livelihoods in the low-elevation coastal zones to climate change impacts (Barbier, 2015).

3.2.2. Community Vulnerability

Community vulnerability to impacts of climate change can be attributed to their environmental setting, nature of socio-economic undertakings and technology used to harness the available livelihoods options. Geographically, large percentage of population in the study area settles within the shores of Indian Ocean which are prone to the climate-related coastal extremes like strong winds and sea level rise. Responses from household interviews, focus group discussions and key informant interviews have realized that these coastal communities with their livelihoods are highly vulnerable to decreasing and unpredictable rains and increasing temperature (See Figure 11). This was

confirmed by Shagega et al (2018) who projected future climate within the Ngerengere catchment that borders Bagamoyo and Pangani districts.

Their study reported that there will be an increase in minimum and maximum temperature between 0.2-2.6°C and between 2.7-4.4°C in the 2050s. They also projected rainfall to decrease by 12-37% in April, May, June and July, while precipitation in the remaining months, was predicted to escalate by 3-58% (Shagega et al., 2018, p. 1)

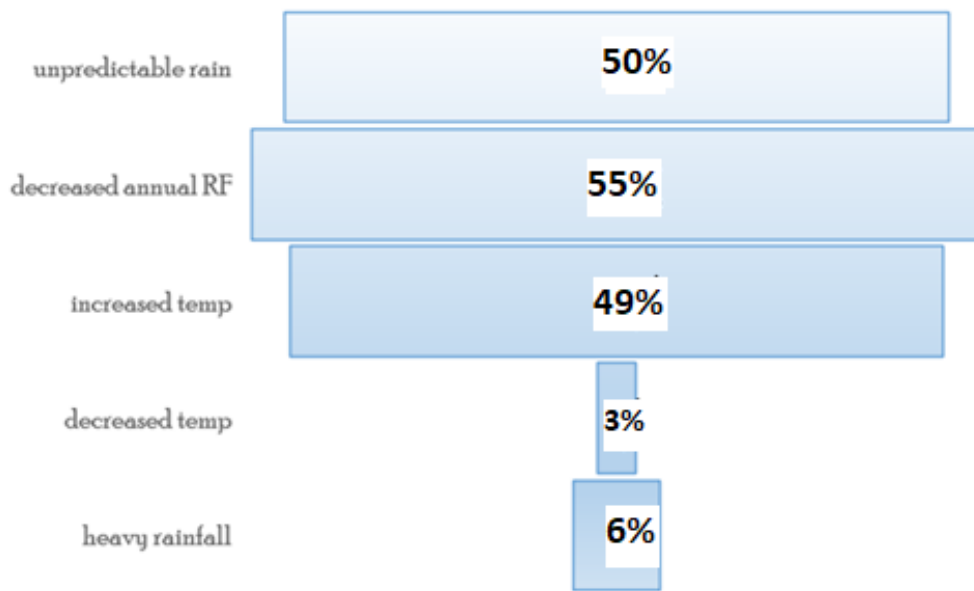


Figure 11: Mention any climatic changes you have seen over the past years.

When asked about their knowledge and experiences of the impact of climate-stressors on their livelihoods, almost all households responded that they are seriously threatened (see figure 12) and that their capacity to earn their living as has been lowered than never before.

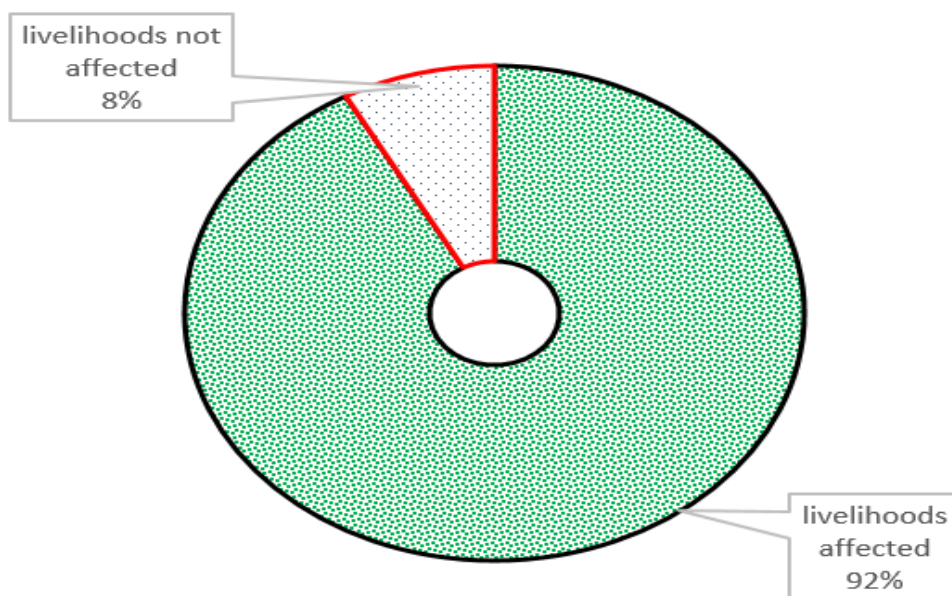


Figure 12: Has the change in weather conditions affected your livelihoods?

The research findings revealed that there are three main groups of people in these coastal communities who are principally mentioned to be more vulnerable to floods, drought, heavy winds, storms, and diseases (See Figure 13). These are Farmers and Fishermen, and livestock keeper. Farmers and fishermen are especially more vulnerable to drought and strong winds respectively. The reason behind vulnerability of farmers is due to the fact that they entirely practice rain-fed smallholder agriculture which is easily affected by drought. Subsistence fisheries are more vulnerable to increasing oceanic winds and increasing temperatures. On the other hand, expert interview results revealed that, with their poor fishing facilities like local canoes, fishers are sometimes dragged forcefully far away from their shores by winds and disappear. Narrative stories from elders have added that fishermen are more vulnerable from increasing temperatures in waters near to the shore imposing more difficult fishing and breeding environments.

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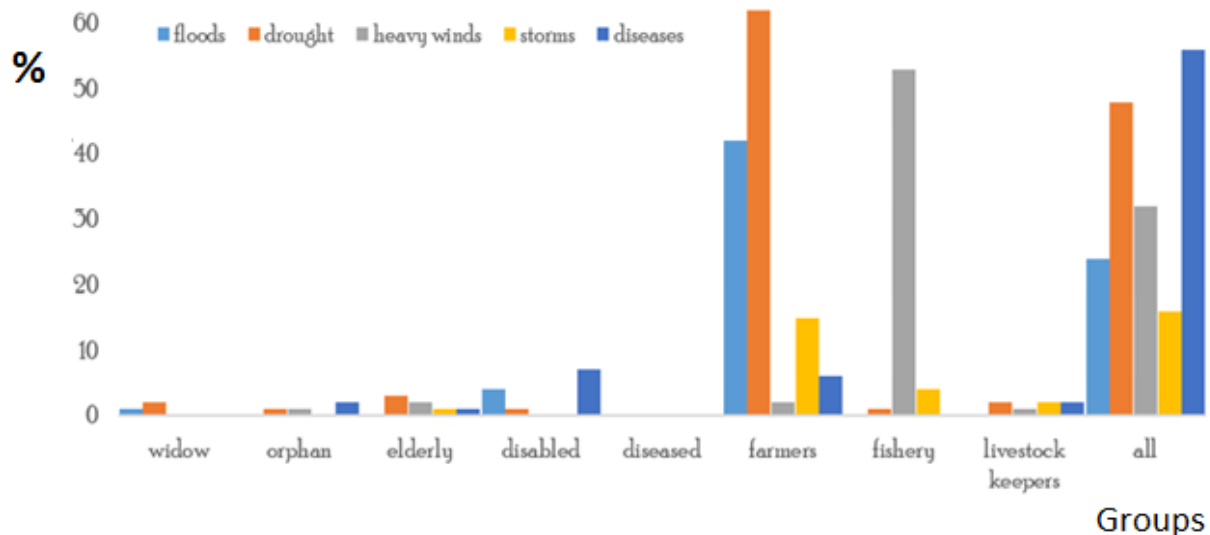


Figure 13: Which groups in your community are vulnerable to the hazards you mentioned?

Although community groups are affected differently by climate change hazards, respondents admitted that the sufferings of one group usually affect the entire community (See Figure 13) as a system. To them, climate stressors are never specialized to a certain group of people as they are all negatively affected by the reduced agricultural production, reduced household incomes, business failure due to diminishing purchasing power, and fisheries difficulties (See Figure 14).

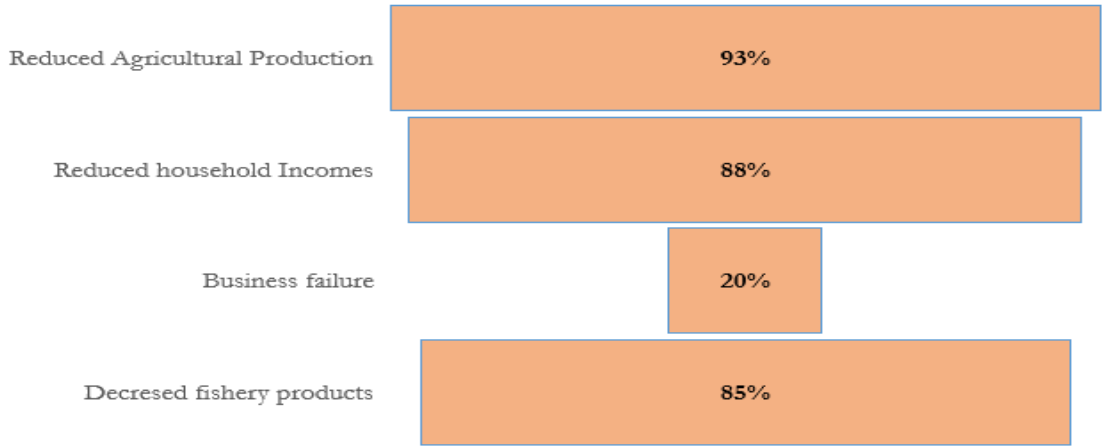


Figure 14: What changed in the production of livelihoods in the past decade?

Nevertheless, majority of respondents (See Figure 15) ranked farming, fisheries, and livestock livelihoods being more vulnerable to climate change. Most of people were worried about their future survival if such condition persists as they depend on small on-farm production and fisheries which are currently providing poor yields.

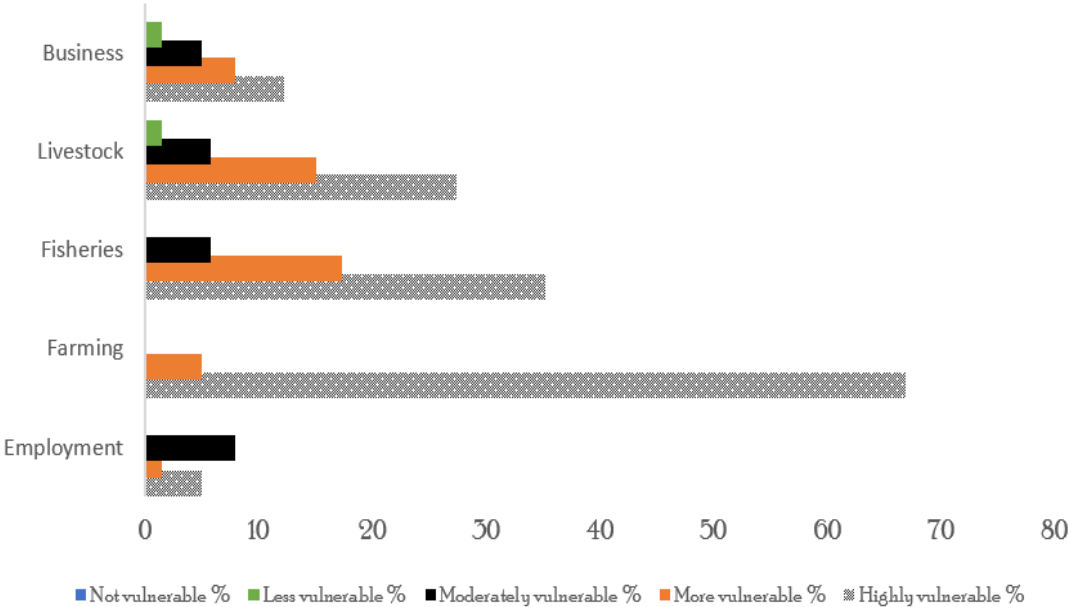


Figure 15: How do you rank the vulnerability of various livelihoods in your community?

3.3. Local adaptation measures to climate-related stressors

Climate related stressors in the study area have influenced the community to adapt new techniques for harnessing available livelihoods and life styles. These adaptations include but not limited to adoption of use of pests resistant and hybrid crops in agriculture, engaging irrigation system in farming, livelihoods diversification, ensuring food storage systems and money saving options.

A large number of respondents (45.67%) identified livelihood diversification as the major adaptive style in the area as depicted in figure 16 (b) and figure 17. Most of respondents described the livelihood diversification adaptive measure as the best option as it ensures family and community income in the presence of any climate stressor. While conducting FGD, one respondent gave his own example of his livelihood activity that he has engaged over varied period of his life time in relation to climate stressors in the area. He used to be the fisherman and farmer at the same time in 1990s. Due to the unpredictable rainfall seasons and prolonged drought in the area he is now engaging as a mason and carpentry to ensure living and support to his family. This is supported by (Msuya, Mposo, & Chausiku, 2013), who reported a tremendous drop in cash and food crop production through the year 2006 to 2009 in Bagamoyo district as the result of changing climate and shifting of seasons.



Figure 16: Adopted drought resistant cassava crop and livelihood diversification (Welding activities).

From figure 16 above, two important adaptive activities are observed:

- (a) Drought resistant cassava (***Manihot esculanta***) farm at Mlingotini village in Bagamoyo District,
- (b) Youth at Pangani Mashariki village in Pangani district engaging in welding activities (diversified livelihood activities).

The other adaptation measure was meant to ensure enough food for future use in the unpredictable weather and climate conditions. More than 24.41% of respondents revealed that food storing practices was the best solution towards food security in the area. The remaining respondents had different opinions on adopted adaptation measures such as the use of pests' resistant crops, farming irrigation scheme, money saving systems and integration of hybrid crops in farming as depicted in figure 16. Also Mwiturubani (2019) substantiated that the drought hybrid resistant crops such as cassava and cashew nuts that started to be grown in 1990s was the best adaptive measure to deal with climate-related stressors and food security in the country.

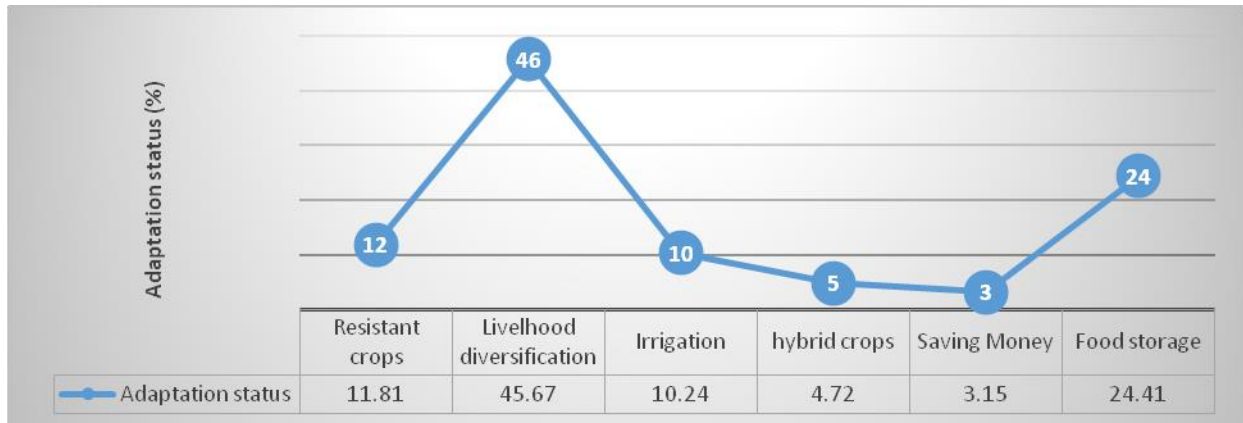


Figure 17: What climate adaptation measure you have taken against climate stressors?

On the other hand, figure 18 shows that out of all 139 respondents 80 were unaware of any adaptation measure in practice while 59 were already practicing adaptation techniques in the area. Fifty-one (51) respondents reported to be positive on the use and helpfulness of the adapted practices in addressing the impacts resulted from climate change. On the other hand, 8 respondents who adapted different techniques had negative feelings on the use of adaptive practices and that they were not helpful in addressing the impacts resulted from climate change.

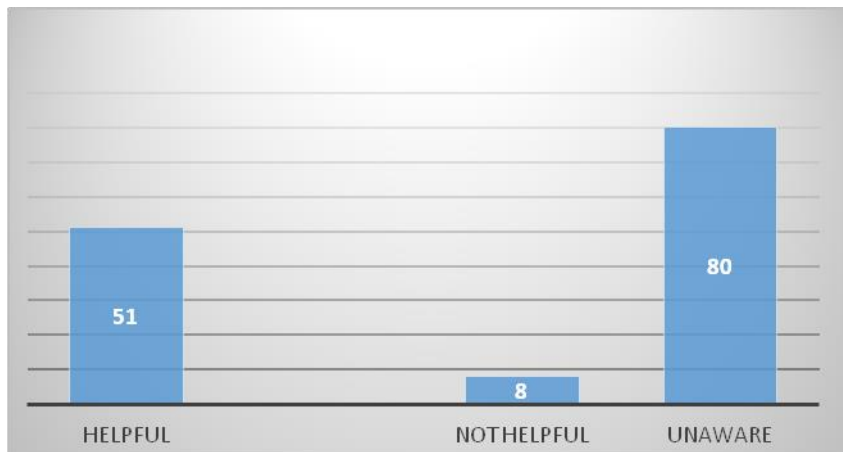


Figure 18: Was the adapted measures against climate related stressors helpful?

Referring to figure 17 and figure 19, results revealed that most of the communities are struggling to adapt to climate stressors in their environment. *Figure 19* shows the percentages of respondents that confirm to find solutions to the adopted measures. Taking an example of livelihood diversification being a widely adopted measure but only 48.28% of respondents confirmed for its helpfulness and that was able to give positive results than other adaptation measures. This shows that, the Bagamoyo and Pangani communities are in constant struggle to find a convenient adaptation means despite their limited ability to suite the means. These communities find it hard to adapt to climate related stressors in place due to limited financial resources, lack of awareness, lack of proper education, and presence of extreme poverty.

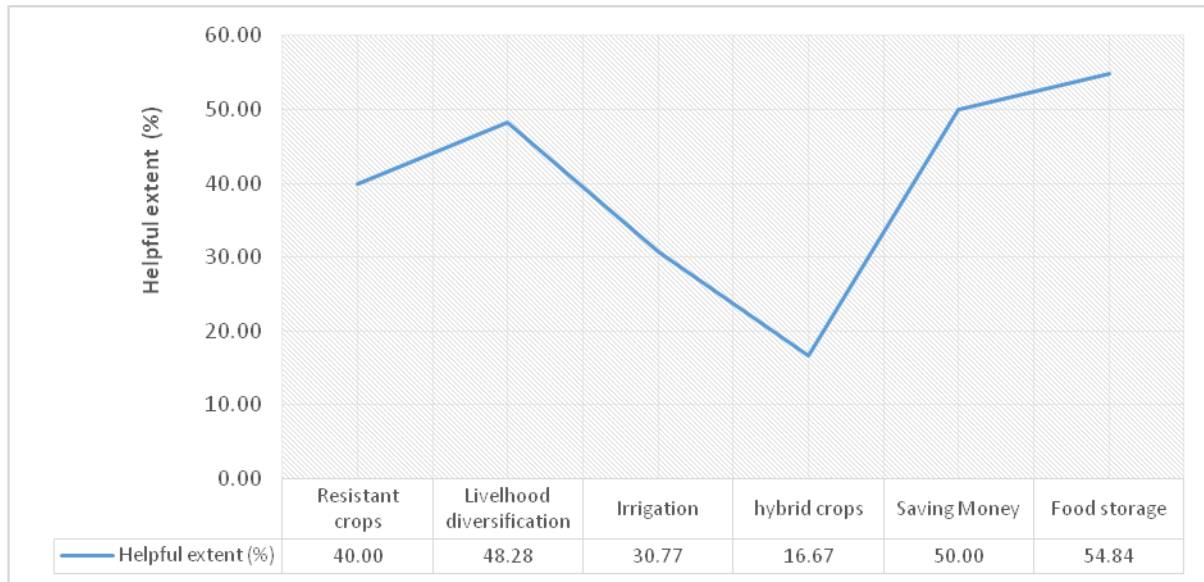


Figure 19: To what extent were the adapted measures helpful?

3.4. Climate-related losses and damages in the study area

Most of the communities in Pangani and Bagamoyo districts were found to be highly impacted by the climate changes to unrecoverable state in the area. For example, most of the livelihood activities that were relied on for the past years were no longer reliable and useful for their existence. The observed impacts were of great loss and damage to such an extent that the affected communities could not easily adapt further and at some point they were failing to adapt due to the resulted state (Hirsch et al., 2017).

3.4.1. Economic Loss and Damage

Several studies across the globe have been conducted and explored on the tremendous irreversible economic effects of climate change particularly in developing countries (Hirsch et al., 2017). These impacts have caused noticeable loss and damage that influenced deliberate initiatives to address the problem. Majority of the poor communities from the least and developing countries are now experiencing difficulties in recovering from the effects of climate change and building their means to economic production destructed from climate stressors. A number of initiatives at a local and international level such as national climate policies, UNFCCC and Paris agreement, Agenda 2030 have been put forward for community resilience and mitigation actions towards these noticeable impacts on human race.

During the focus group discussion and storytelling, most of respondents reported that there is a loss of large portion of land for agriculture (Paddy farms, mangrove forests and fish breeding habitats) as seen in figure 20 and figure 21(a). One respondent from Mlingotini village of Bagamoyo district noted that more than 120 acres of paddy farms and mangrove forests have been covered by water as a result of sea level rise. These were coupled with destructed local ports and fish markets where fisherfolks used to mobilize their canoes and conducting small businesses after fishing activities.



Figure 20: Massive land loss and damages at Mlingotini village in Bagamoyo District

From figure 20 we see a number of phenomena that substantiates damage and loss as a result of climate changes which is described as:

(a) Photograph showing the eroded portion of the mangrove forest which formerly joined the mangrove forest seen at the photo background; (b) Coconut tree stump remaining after being eroded by water as a result of sea level rise at Mlingotini Village; (c) A Mlingotini village resident pointing a hand in water explaining on where coconut tree farms ere formerly extended to prior sea level rise. (Source: Field photo on July 11th, 2019)

Also during household questionnaire, 34.2 % of the respondents reported that most of the local livelihood activities were highly impacted while 18.95% pointed out that infrastructures were seriously damaged and 12.89% stressed on the destructed goods and services in the community for instance the ongoing erosion of Bagamoyo port as depicted in *Figure 21* (b). The reported loss and damage however remain neither unquantified nor mapped in the entire coastal areas of Tanzania. A little attention to the caused impacts and limited resources are attributed to few studies that have been conducted to explore on the loss and damage in big part of the country.



Figure 21: Evidences of goods and services loss and damages in Bagamoyo district

- (a) Destroyed fish breeding site along Kaole-Bondeni beach in Kaole village; (b) Destroyed Bagamoyo port due to sea level rise. (Source: Field survey data on July 12th, 2019)

Furthermore, during the FGD and actual field observation as depicted in figure 20(c), four water wells at Kaole-Bondeni, Kaole-Shaurimoyo and Mlingotini in Bagamoyo district were found to be no longer in use. The focus group discussion pointed out three reasons for non-use of these wells: prolonged drought, gradual increase of surface temperature as well as being covered by water as a result of sea level rise and thus filled by swept beach sands. This corresponds to WSDP-Phase II, 2019 that identifies a number of wells and boreholes which were destroyed by the impacts of sea level rise and thus being incorporated in the water sector climate change adaptation strategy for rehabilitation. Another study by Mwiturubani (2019) as seen in figure 22 (b) revealed an abandoned boreholes in Msaraza village of Pangani district as a result of inland sea water intrusion which accelerated the increase of fresh water salinity. Mwiturubani (2019) further unfolded that the increased level of salinity to about 6-7 km from the mouth of Pangani River is an indicator for sea level rise leading to sea water intrusion to the mainland.



Figure 22: Loss and damage evidences experienced in the study area

Figure 22 shows:

(a) A respondent at Mlingotini village describing the abandoned water springs which were formerly used as source of water in the village, Source: Field data on July 11th, 2019; (b) Abandoned borehole due to increased salinity level in Msaraza village of Pangani district (Source: (Mwiturubani, 2019)); (c) A remnant water well at Kaole-Shaurimoyo Village in Bagamoyo District (Source: Field data survey, July 9th, 2019).

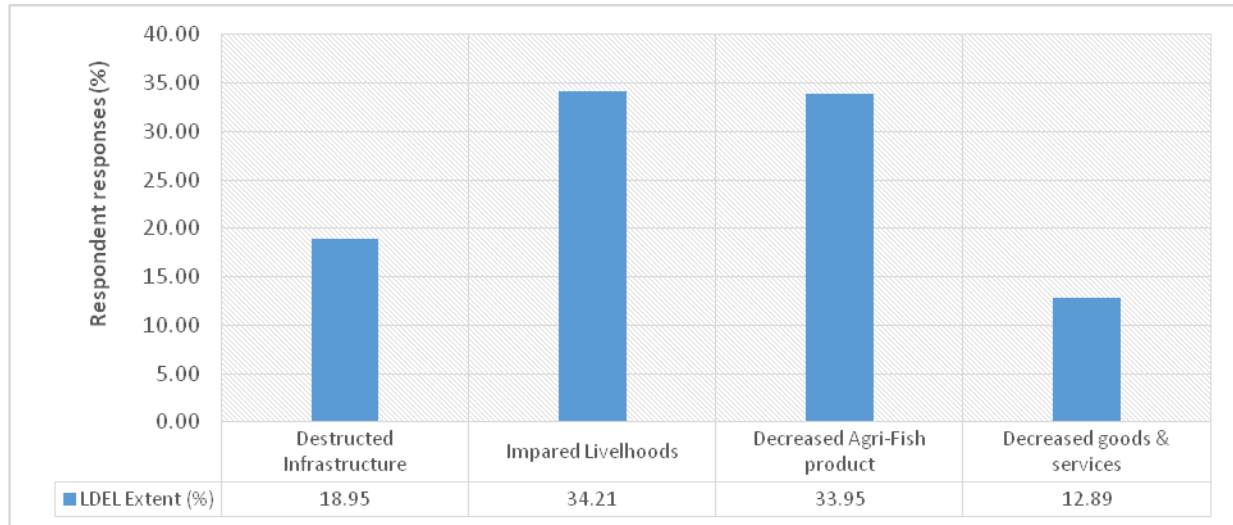


Figure 23: To what extent climate stressors have resulted into economic losses and damages in your area?

The study further explored on the repetitively road and water plumbing systems destructions connected to extreme weather events. The villages of Kaole-Bondeni and Kaole-Mlingotini repetitively were getting disconnected due to strong water actions flowing through undefined drainages in the village areas. On the other hand, the sea level rise opposite to Bagamoyo secondary school necessitated road diversion to ensure safe passage on the named road section. The named diversion was locally and quickly constructed; thus it was not in a good condition resulting into unfriendly vehicles passage. These observations were supported by respondents' findings as depicted in figure 23 whereby 18.95% of respondents reported on the number of different destroyed infrastructures in the area.

3.4.2. Non-Economic Loss and damages

Despite the economic loss and damage caused by climate stressors and which results to life standard deterioration, extended impacts have tremendously caused damage and loss that are not linked to economic standard and values of Bagamoyo and Pangani district residents. These communities are living under social tension that is linked to psychological effects as revealed by the current study. The non-economic losses and damages explored include the following:

- (i) Increased morbidity, loss of biodiversity, destroyed ecosystem, and loss of life: 23.87%, 20.32% and 12.90% of respondents confirmed the felt consequences due to an increased morbidity, loss on biodiversity and ecosystem, and loss of life respectively as depicted in figure 24. In line with the respondents' responses, field researchers observed the lost fish habitat and breeding sites at Mlingotini and Kaole-Bondeni villages, bare beach portion which were formerly covered by mangrove forest, reported number of incurable cattle and human diseases as depicted in figure 8. Further studies by Yanda et al., 2018 has reported on the tremendous

loss of mangrove species such as *avicena* and *sonneratta alba* along the coastal areas of Rufiji districts in Tanzania. The loss of these mangrove species has accelerated the low fish catch; hence unreliable food supply in these coastal communities which in turn affects their health and economic productions.

- (i) (ii) Loss of cultural heritage: 9.68% of respondents during household questionnaire showed a number of graves at Mlingotini village that were demolished by the rise of sea level. Most of the old people in the village felt sympathy for the destructed graves of their forefathers in the area. Also during actual field observation, the team noticed that most of the historical buildings such as the Bagamoyo port, the historical Old Bagamoyo Boma building were seriously impacted by sea level rise. This in turn had presented disturbances to the port operations and tourism activities in the area. As a result of climate change impacts especially season shifts, prolonged droughts and unprecedented rainfall in the area, most of the communities have started to engage in tourism activities as source of income. It will be a great horror if the dependable historical buildings will be lost in the near future due to lack of long term plans to protect these buildings from tremendous disaster and risk resulted from sea level rise.
- (iii) Loss of indigenous knowledge: 9.03% respondents from household questionnaire pointed out that the loss of biodiversity such as some of the fish species, mangrove trees and decreased life expectancy at birth has caused the loss of local knowledge and technologies. The large population has now started depending on the modern technologies while neglecting or finding difficulties on where to harness indigenous knowledge. It was found that the current population could no longer exploit some of the mangrove species for medical treatment which was the case in previous years.
- (iv) Human mobility: 7.10% of respondents from household questionnaire confirmed that Bagamoyo and Pangani district villages are greatly facing a significant emigration of youth to nearby cities and town such as Dar es Salaam, Tanga and Korogwe. This young age population has been forced to migrate for the search of employment opportunities in urban areas. Small scale farmers have been forced to abandon some pieces of land and move to the southern part of Tanzania for the search of fertile land. On the other hand, pastoralists are migrating from time to time as a result of unpredictable rainfall and prolonged droughts not to ensure pastures for their livestock. As the result, there is a shrinking zone for agricultural land and less economic activities that can support the rural communities –a situation leading to youth migration to urban areas as depicted by (Roy et al., 2018)
- (v) Socio-cultural identity and social cohesion both with 6.77% of severity in the community. The impact of climate change has led to increased human mobility that influence the destruction of villages' culture such as dressing style and spread of diseases such as HIV AIDS as reported from Kaole-Bondeni FGD. Most of the Mang'ati and Maasai Pastoralist communities migrate with their cattle into these villages thus accelerating cultural erosion, intermarriages and lessen village's children morals and values.
- (vi) As the result of low food production, peace and tranquility, and social cohesion have been minimized in the community as depicted in figure 24. During the focus group discussion at Mlingotini, most of the respondents pointed out the problem of no more family gatherings. In the past, most of the family members used to gather at grandparents and spend significant long time which increased love and cooperation within the family and society at large.

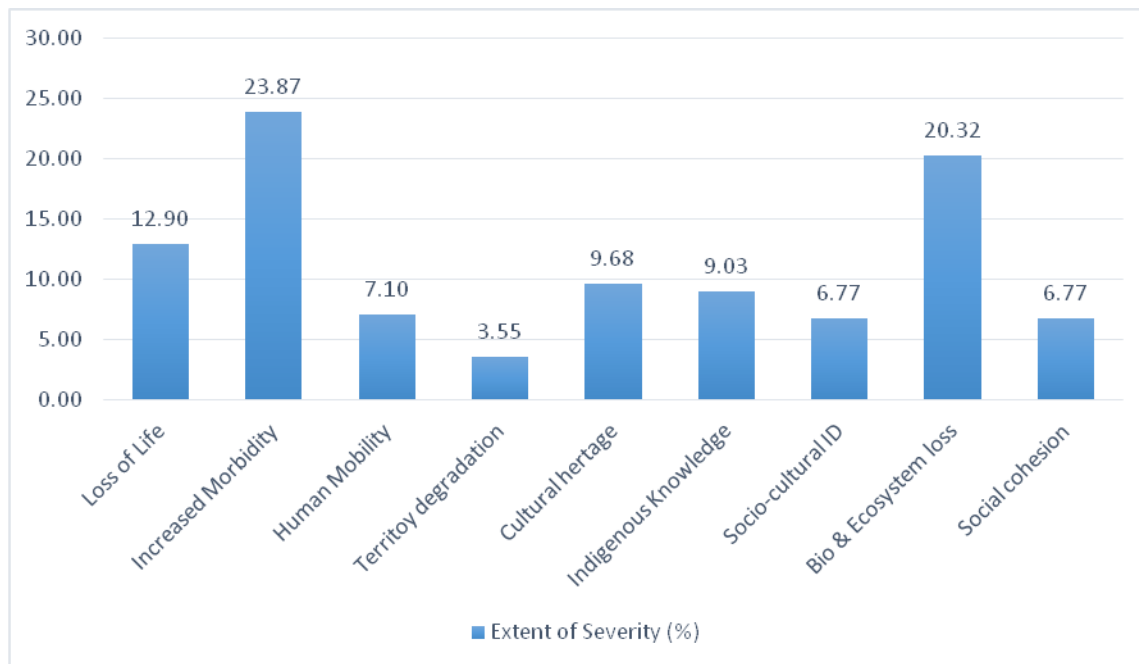


Figure 24: What is the severity extent of the following non-economic losses and damages in your area?

3.5. Climate-related loss and damage financing mechanisms

Despite of unstable and small economic base in these communities, the existing climate – stressors have worsened the situation by hindering predictable and sufficient production from their livelihood activities. This situation has resulted into financial aid dependence for accelerating successful livelihood activities. Based on the findings from this study as depicted from Figure 25 (a), micro savings such as SACCOSS covering 42% and micro credits covering 25% are the dominant financing options in these communities. Other financing options include micro grants, contingent credits, disaster relief, insurance and climate themed bonds.

Figure 25 (b) depicts the highly prioritized financing instruments of all existing options in the study area. The highest priority was on micro savings (31%) and micro grants (30%) followed by disaster relief (20 %). The micro credits option was not greatly prioritized due to large interest rates although is the most readily available option in these communities.

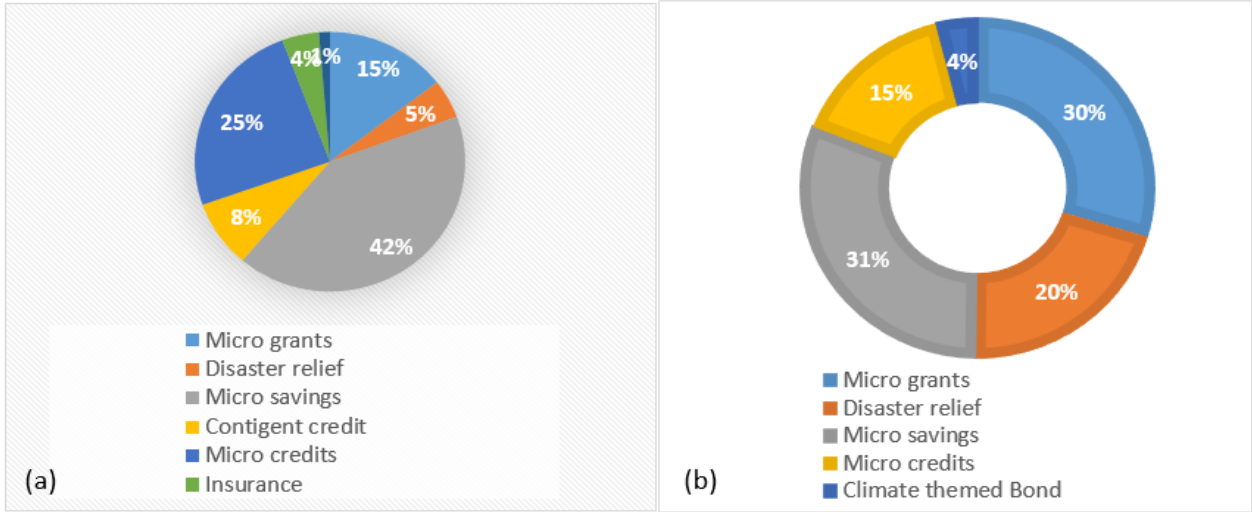


Figure 25: What are the available financing options and (b) highly prioritized financing option in your area?

However, all of the prioritized financing instruments are not the organs available for financial aid during climate related stressors. The highly practiced option is the community contributions where by community members call for available amount of money which is provided to the victims for temporal relief from the resulted climate-related stressors. The findings showed that 8.13% and 5.42% of the respondents confirm the availability of the government and community contribution as the source of financial assistance respectively during the climate-related stressors in the community. However, very few respondents (0.6% and 0.3%) confirmed availability of support from Local and International Non-Governmental Organizations as the source of the assistance. Furthermore, the findings showed that there is no any international organization available to provide financial aid during any climate- related stressor in the area.

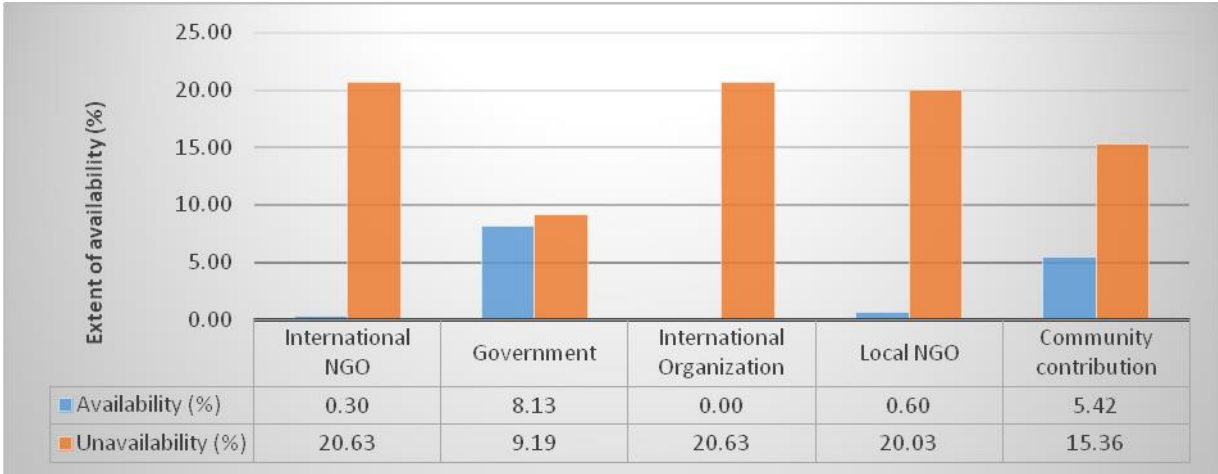


Figure 26: What is the available financial aid during climate related stressors in the community?

Following the financial aid availability and accessibility in Table2, 77.05% of the respondents were unaware of any existing financial aids while 22.95% of the respondents were aware and recommended for the following:

- (i) There is a need for follow up on the available financial aids in the community for the sake of regulating them so as to ensure that the provided opportunities make an impact to the community.
- (ii) There is a need for a wide coverage of the provided assistance as most of the provided aid helps only a small portion of the impacted area. The focus should be put more on the following aspects:
 - a. Agricultural inputs
 - b. Support for mangrove rehabilitation
 - c. Infrastructure (roads, water boreholes) renovation
 - d. Increased awareness or climate related education
- (iii) There is a need of providing more education and awareness in relation to climate change impacts, adaptation and mitigations.
- (iv) The available micro credits and savings should provide loans with no interest rate or if any should be very small not to impact developmental progresses.
- (v) The government and other international organizations should provide grants to support the damage and loss resulted from the climate change impacts.

Table2: Recommendation on the financing mechanisms in place

Responses	Need for follow-up	Large coverage	Awareness	Non interest loan	Grants	Sub total	% expression
Recommending	21	60	30	24	19	154	22.95
Unawareness	116	77	108	98	118	517	77.05
Total						671	100.00

4.0 CONCLUSION AND RECOMMENDATIONS

4.1. Conclusion

This study was conducted to assess the extent of Loss and Damage in the coastal communities arising from climatic stressors and whether there are any compensation given to Pangani and Bagamoyo districts which occupy about 12% of the total coastal land along the Indian Ocean in Tanzania. It has been realized that coastal areas are the most vulnerable environments to impacts of climate change and variability.

The impacts of climate change and variability are noticeable in the communities composing mainly the poor: smallholder fisherfolks, livestock keepers, and farmers. People have been able to distinguish the current climatic situation from past decades whereby economic and non-economic losses and damages have been increasing from time to time affecting productivity of livelihoods. As a result, the wellbeing of people in the study area is in jeopardy due to disruption of coastal systems resulting from sea-level rise and changes in fish breeding sites.

Economic and non-economic loss and damage due to climate-induced stressors in these vulnerable coastal districts have been gradual but destructive and restraining the resilience and sustainability of people and ecosystems. It might be difficult for these poor and innocent communities to graduate from poverty conditions despite of numerous national and regional plans, programmes and strategies towards achievement of sustainable development goals.

Notwithstanding of the climate sufferings in these innocent communities who contribute almost nothing to atmospheric pollutants, they are not compensated to recover from these loss and damage. The international climate financing mechanisms have not yet penetrated enough to cause significant impact among smallholder farmers and fisherfolks in rural areas. Unfortunately, these communities have little to none reliable financial options within their areas that can help to build capacities for resilience. Since majority of people are poor, the existing cooperative groupings and communal contributions as initiatives to tackle social problems are unable to raise enough funds that may be required to cover the costs of loss and damage.

4.2. Recommendations

The study has learned the seriousness of climatic loss and damages in the coastal areas in the two districts. The situation calls for integrated and multidisciplinary short-term, medium and long-term actions needed from development actors within and beyond the country's borders to help in capacitating the vulnerable communities for their resilience and sustainability. This study therefore recommends the following to the responsible bodies:

4.2.1. The Government of Tanzania

The situation of climate induced loss and damages are complex and affiliated to other socio-economic factors. The government therefore should prioritize these coastal communities when planning for development projects and public services delivery. Since these areas are expected to be hit by natural disasters, it is important for the government to plan for strong economic infrastructures which can accommodate weather extremes.

Overall, since Tanzania has the coastline stretching 1424 km that covers five regions of Tanga, Coast, Dar es Salaam, Lindi and Mtwara (URT, 2012) which is equivalent to 15% of the country's total land area, it is high time for the government and policy makers to develop a standalone coast management policy that will accommodate all issues of environment and climate change scenarios for sustainable development of the country.

4.2.2. Local Government Authorities

The local government authorities of Pangani and Bagamoyo districts are directly responsible for the sustainability of these coastal communities. Their undertakings towards improving lives of the poor people should always take precautions and mainstreaming the impacts of climate change. During interview with key informants, the district officers admitted to have awareness over the climate-induced loss and damages although little measures to address them have been established. Specifically, district departments responsible for fisheries, agriculture and livestock should strive to transform the communities from doing their economic activities in business as usual approaches to climate smart actions.

4.2.3. Non-Governmental Organizations

Non-governmental organizations such as CSOs, FBOs, CBOs, and international organizations play a considerable role in backing the efforts of central and local governments towards improving the wellbeing of people and their livelihoods. Organizations inside and beyond coastal districts must take concern to implement capacity building and environmental restoration projects. It is also important to concentrate on alternative and climate adaptive activities which will build their resilience through innovative adaptation approaches. Financial institutions like insurance companies should think to establish climate insurance that will compensate people during climate disastrous situation.

4.2.4. Research community

This study has just assessed the general overview of the extent of climate-induced loss and damages in coastal districts of Pangani and Bagamoyo. There are still a lot to learn from this field of climate change in the coastal regions and help policy makers to decide. The immediate study gaps uncovered and therefore recommended herewith include full scientific quantification of the economic and non-economic losses and damages caused by impacts of climate change and variability in these areas.

Fisherfolks have also complained of the decreasing quantity and type of certain fish species and are suspecting the increase of temperature at the shore water being the major reason behind this. Climate and environmental scientists should study and establish such kind of relationship which the current study has failed to clarify.

Climate induced losses and damages have not emerged recently but rather from time immemorial. There is therefore a need to study on how these vulnerable communities have been adapting and surviving with these incidences. Such best indigenous adaptive technologies will then be promoted into other communities across the country. GIS and remote sensing community should also help to map geophysical damage dynamics that will raise knowledge among policy makers and climate financing organizations.

4.2.5. Climate financing organizations

This study has found out that these poor communities are neither compensated for loss and damage caused by climatic hazards nor capacitated for appropriate adaptation. International and local climate financing organizations should increase funds for projects designed to recover loss and damage as well as innovative adaptation especially in vulnerable coastal communities like Pangani and Bagamoyo in Tanzania.

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