ALIGNING CLIMATE RESILIENCE, SUSTAINABLE DEVELOPMENT AND POVERTY REDUCTION IN TANZANIA

CLIMATE SERVICES: Come in out of the rain

BASELINE STUDY OFTHE CONTRIBUTIONOF CLIMATE SERVICES TO THE ADAPTABILITY OF SMALLHOLDER END USERS IN four selected DISTRICTS of Tanzania;

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Executive Summary

Climate change impact the livelihood of smallholders in Tanzania. Climate Services (CS) increase the climate resilience of communities. The study „*Climate Services: Come in out of the rain* "aimed to provide a realistic picture of the status of Climate Services in Tanzania to inform projects and polices on Climate Services. The study covered 4 districts (Bagamoyo, Chalinze, Pangani, Lushoto) in Tanzania.

Key Findings:

The study found out that people engage in various number of socioeconomic and livelihood activities to earn their living. Due to their shared geography and climatology, all districts have almost similar socioeconomic activities and livelihoods with the only difference in dominant activities. Main activities identified include subsistence farming, fisheries, livestock keeping, petty business, transportation (including Bodaboda services), tourism& ecotourism, mining, small and medium enterprises (SMEs), forestry products and beekeeping. In terms of dominant livelihood activities, Bagamoyo is dominated by subsistence farming and fisheries; Chalinze is Livestock keeping and farming; Lushoto is centrally agricultural district; and Pangani is fisheries (Figure 1).

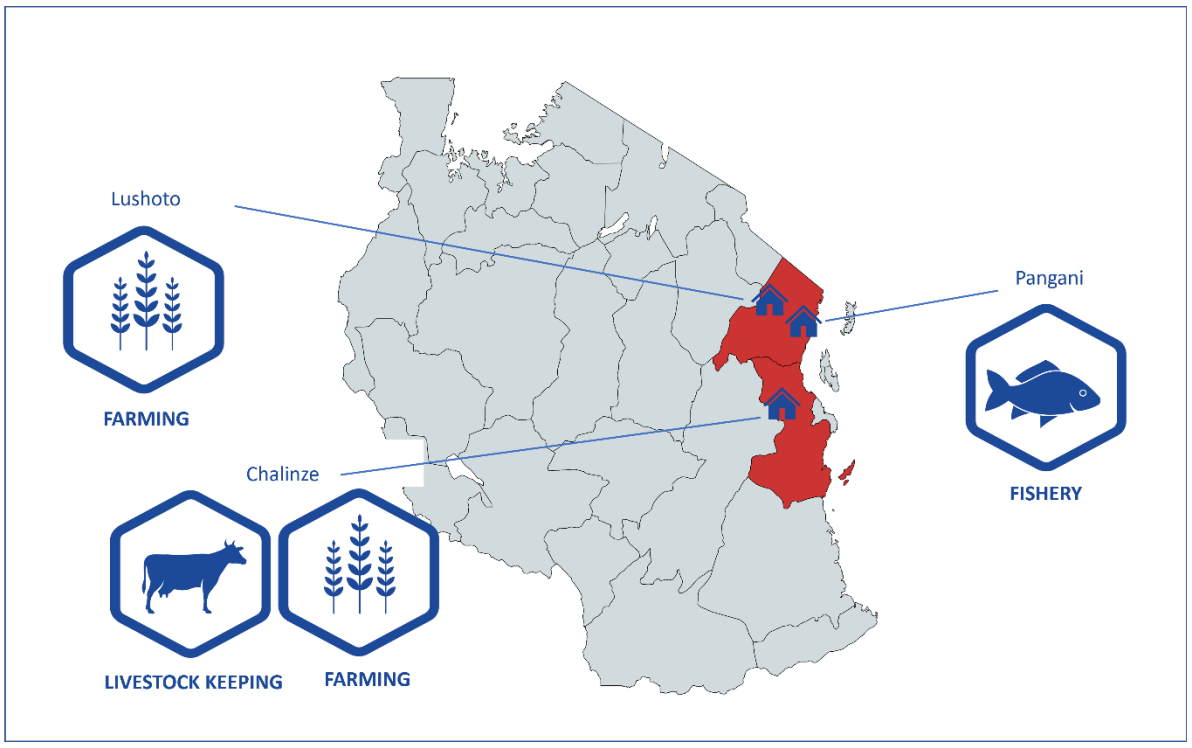

Figure 1:Main Livilihood Activities in Project Villiages: Pangani (Fishery), Chalinze (Livestock keeping, Farming), Lushoto (Farming).

That the impacts of climate change have continued to be great challenge to the livelihoods of the smallholders creating the circle of poverty environments while increasing vulnerable groups in the project districts. Unpredictability of rainy onset and cessation, prolonged drought conditions, coastal erosion from sea level raise, inundation and saltwater intrusion in freshwater aquifers, increasing temperatures, storms, and splash flooding were frequently reported by respondents to be the major climatic challenges affecting their livelihoods (farming, fisheries, and livestock keeping) productivity in all project districts. Community's awareness on these issues is rated to have been improving together with the local coping strategies.

In terms of the availability, access, and utilization of climate information and services including early warning systems for enhancing climate resilience and adaptability of the livelihoods, the study found out certain degree of improvement built up by the participatory integrated climate services (PICS) interventions emphasized in phase I of the project. However, major challenges in the chain of integrated climate services from production to the end utilization among smallholder communities persist.

Respondents in the study communities admitted to the availability of weather and information services generated and disseminated by TMA through Televisions (TV), Radio, Newspapers, and social media. However, due to the rural nature of the environment, they have limited access

to the services and majority do not know how to interpret and use the disseminated information in their livelihood undertakings. More than 60% of the respondents in all study villages also informed on the availability and higher contribution of the traditional (Indigenous Knowledge-IK) weather forecasting services that's usually applicable for their socioeconomic undertakings.

Recommendations:

Based on the study findings, the project phase II in these districts is of great relevance to continue addressing the challenges identified:

Firstly, it is important to **enhance access to the downscaled weather and climate services** produced by TMA linked with IK forecast services with strengthened capacity of district and ward extension officers to be able to help smallholders on interpretations of the weather and climatic information services. Since some of the smallholders (30%) in these rural communities have no access

to TVs and Radios and in many cases difficulty to follow weather forecasts in these channels, facilitating access using simple text messages through mobile SMS system and community radios should be emphasized.

Secondly, traditional weather forecasting knowledge in the communities should be promoted because it has been identified as useful, accurate and more reliable complimenting to conventional services. Indigenous people with such expertise need to be promoted and strategize on how to transfer this important knowledge from one generation to another. It should also go together with raising awareness of the community to discourage the negative attitude of associating IK with witchcraft practices.

Lastly, the study has recognized an existence of linking gap between TMA and Local Government Authorities as well as with traditional weather forecasters (IKs) on weather and climate forecast services generation, dissemination, and utilization. There should be a direct link between TMA and IKs as well as extension agents working directly with smallholders on the ground.

Project Context:

Climate change is one of the biggest global problems posing challenges to sustainable livelihoods and economic development, particularly in developing countries like Tanzania. The impacts of climate change are increasingly causing disturbing challenges on local and national development initiatives including attainment of the sustainable development goals by 2030. In poor countries such as Tanzania where large proportion of the population is made of smallholder farmers, fisheries, and pastoral communities, climate challenge impacts are accelerating poverty and increasing inequalities and vulnerable groups.

Climate Services can support and empower smallholders to make informed decisions on adaptation activities and enhance their climate resilience, The Climate Action Network Tanzania (CANTZ) – a non-profit and non-government organization (NGO) implements a programme, "Aligning climate resilience, sustainable development, and poverty reduction in Tanzania funded by BftW. On climate resilience, the programme seeks to enhance the adaptability of smallholder farmers, fisheries, and livestock keepers in Bagamoyo, Chalinze, Lushoto, and Pangani districts by promoting the production, dissemination, and utilization of available traditional and conventional weather and climate services to facilitate climate-smart practices among smallholder communities.

This baseline study was conducted to learn and assist the CANTZ project management and implementation teams to assess and understand the impact as well as mapping the existing community's conditions after the program phase I. It also intended to give insights and understanding of the current situations of community livelihoods, farmers' production systems, some community susceptibility to climate change impacts and challenges.

Methodology and Data Collection

Different data collection and analysis methodologies were applied to capture all required information fulfilling the requirements of the study objectives. Both primary and secondary information were collected. For the secondary data, in-depth documentary reviews for the districts on related topics were made to inform the understanding of the situation. For the primary data and information, Interviews were conducted to 329 households, Key Informant Interviews (KII) to 16 district technical officers, 8 Focus Group Discussions (FGDs), and observation.

Then, for the quantitative data, the Statistical Package for Social Sciences (IBM SPSS 24) and excel was used for analysis while for qualitative data analysis, conceptualization, reflections, reflexivity, examining relationships of issues and authentication of conclusions were made for an informed baseline report. Thereafter, the report was presented back to the audience for further inputs, buy-in and validations.

Abbreviations/Acronyms

ACRP	Agriculture Climate Resilience Plan
ASDP II	The Agriculture Sector Development Programme II
BftW	Bread for the World
CANTZ	Climate Action Network Tanzania
CC	Climate Change
CSOs	Civil Society Organizations
EMA	Environment Management Act
HH	Household
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
IWRMP	Integrated Water Resources Management Plans
KMD	Kenya Meteorological Department
NAPA	National Adaptation Plan of Action
NCCRS	National Climate Change Response Strategy
NDCs	Nationally Determined Contributions
NFCS	National Framework for Climate Services
NFYDP	National Five-Year Development Plan
NIBP	National Investment Blueprint
PICS	Participatory Integrated Climate Services
PICSAF	Participatory Integrated Climate Services for Agriculture and Fisheries
SMS	Short Message Services
SPSS	Statistical Package for Social Science
SRCCL	Special Report on Climate Change and Land
TMA	Tanzania Meteorological Authority
UNFCCC	United Nations Framework Convention on Climate Change

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CHAPTER 1

1.0 Introduction

1.1. Background

Climate change is one of the biggest global problems posing challenges to sustainable livelihoods and economic development, particularly in developing countries like Tanzania. The global climate is uncertain, and its trends leaves a lot of questions, calling for urgent serious actions for safeguarding the socio-economic development of the country. The future climate projections and impact models summarized in the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5°C, (SR15, 2018), and IPCC Special Report on Climate Change and Land(IPCC, 2019), show that climate change will continue to hamper community livelihoods, food security and access to essential services such as water and energy.

It is also projected to affect realization of Socio-economic transformation and poverty reduction efforts as well as Sustainable Development Goals (SDGs). Already climate change is leading to higher temperatures, irregular precipitation patterns, and more climate extreme events which are expected to affect disproportionately large majority (over 90%) of Tanzanian communities that depend on climate system to fulfil their livelihoods.

Following these concerns, the Government of Tanzania has adopted a number of national, regional and international frameworks to address climate challenge and related environmental issues (see 7.2. for Review of Climate Policy Landscape in Tanzania). In efforts to support government initiative on climate change, CANTZ initiate the project *„Aligning Climate Resilience, Sustainable Development and Poverty Reduction in Tanzania"* in four Districts of Pangani, Lushoto, Chalinze and Bagamoyo. The goal of this project is to contribute to the development of climate resilience and poverty reduction in Tanzania.

As part of the execution of this project, this comprehensive baseline study was conducted in the four project districts. This study had a broad objective of assessing and developing baseline information on climate services focusing on the impact of the previous phase of the project as well as collect addition information that are critical for enhancing achievement of the objectives of this phase of the project. Specifically, it sought to (see Figure 2).

a) Assess the community's awareness on the impacts of climate change affecting their livelihood productivity.

b) Assess the current knowledge, attitude, and practices of the community on livelihoods and climate services.

c) Explore the performance and challenges of the Participatory Integrated Climate Services for Agriculture and Fishery (PICSAF) approaches in the project areas.

d) Compare and contrast the community's preferences between modern scientific climate services and the traditional services.

e) Explore on the national versus local policy and institutional framework for climate services in Tanzania.

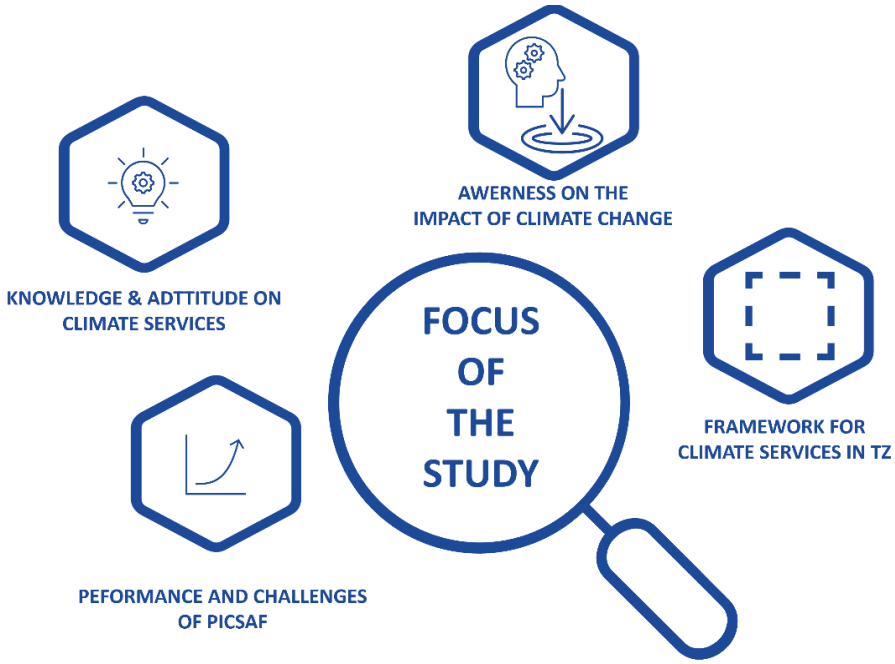

Figure 2: Overview of the focus areas of the study.

This report therefore presents the findings of the study which was conducted by the project team between November and December 2020. It summarizes the analysis of baseline information collected for the specific parameters. This report also provides crucial recommendations aimed at informing re-adjustment and target setting based on actual situation on the ground.

CHAPTER 2

2.0 Study Methodology

2.1. Sampling size

This baseline survey was conducted in four (4) project districts namely Bagamoyo, Chalinze, Lushoto, and Pangani. In each district, sample village was selected based on the alignment with the project thematic areas as well as having best practices demonstrated during the first phase of the project. Moreover, the villages were also selected based on recommendation from key stakeholders including CANTZ-Network Members, CSOs and respective LGAs. In this regard, a total of three hundred and thirty-nine (339) households were randomly selected for the survey in all villages.

It is worth noting that, in the Pangani district council, two villages were selected for this study based on the fact they are close to each other, and they inhabited by fishing communities which is one of important target community group under this project. districts below presents a list of the villages that were involved in the study from the four target districts.

Table 1. Descriptions of study sites in four districts

S/N	District	Village	Sample Size
1.	Bagamoyo	Kidomole	30
2.	Chalinze	Kihangaiko	101
3.	Lushoto	Mwangoi	99
4.	Pangani	Ushongo	92
		Bweni	17
	Total		**339**

2.2. Data Collection Methods and Tools

The baseline data collection involved multiple methods of data collection to capture the necessary information that was required to precisely inform the take off for this project. Both primary and secondary data and information were collected to inform this study/ baseline report. Table 2. Data source and collectionbelow shows the various methods used to collect data for this study.

Table 2. Data source and collection

Methods	Data/information collected	Data source
Household surveys	Socioeconomic features; livelihood activities and climate change, weather, constraints; perceptions and reactions	Mixed participants and groups
KII		
FGDs		
Literature review	Relevant information gathered	Mixed information
Observation	Physical observation undertaken during data collection	Various features observed

2.2.1. In-Depth Document Review and Analysis

For the secondary data, in-depth documentary reviews on the related topic were made to inform the understanding of the situation in the project sites. Data were collected from various sources including district's planning offices, academia, and other online sources for recent studies in all districts.

2.2.2. Interviews:

These are data that were generated from stakeholder consultations through interviews (16 district technical officers) and focus group discussions (8 focus groups). The team used an open data kit (ODK) an online tool to cover all the key questions that had been prior prepared based on the objectives of the study. The ODK tool helped to simplify the interview process by using smart phones and/or tablets that linked with server through organizing questions and responses which were automatically synchronized with the server in the office, Figure 3. CANTZ Staff conducting an interview with a fisherman in Pangani district on 12 November 2021.

Figure 3. CANTZ Staff conducting an interview with a fisherman in Pangani district on 12 November 2021

2.2.3. Focus Group Discussions

A total of 8 groups (2 groups per village) took part in the focus group discussion from all the five villages. These groups were women groups, youth group and government officials. FGDs were led by the electronic guide that had questions that were either to complex or sensitive to be addressed by an individual. These included issues such as those related to culture, beliefs, gender and how these interact with resource use and management, leading to climate vulnerability. Figure 4. The Focus Group Discussion during data collection exercise in Chalinze District, November 12, 2020.

Figure 4. The Focus Group Discussion during data collection exercise in Chalinze District, November 12, 2020

2.2.4. Physical Observations

In addition to, interviews and focus group discussion the study team also spent time in the field to undertake physical observation on key themes that were being investigated on. This undertaking helped the study team to have an in-depth understanding of the socio-cultural, practices, socio-economic and ecological dimension of the actual situation on the ground upon triangulation of the various data sets collected.

2.2.5. Data Analysis and Presentation

Due to the nature of data collected from the field, various tools of analysis were to be used accordingly. Both quantitative and qualitative data were collected in this baseline study. For the quantitative data, the Statistical Package for Social Sciences (IBM SPSS 24) was used to analyze these data as well as excel. In this software, several computations between variables were deployed through descriptive statistics and associations between variables which are likely to influence each other.

The output from key informant interviews, observations and discussions were thematically analyzed and interpreted with reference to the project baseline information required. For qualitative data analysis, conceptualization, reflections, reflexivity, examining relationships of issues and authentication of conclusions were made for an informed baseline report.

2.2.6. Stakeholders' Inputs and Validation Workshop

As part of quality check and quality assurance, a stakeholder validation workshop was held in Lushoto to present preliminary findings to stakeholders and receive feedback from them on various aspects relevant to study. The workshop also intended to reduce the possible biases, misinterpretation, and misunderstandings by the researcher (Mwanga, 2019). The validation workshops were attended by representatives from study villages in Bagamoyo, Chalinze, Pangani and Lushoto Districts. These included extension workers, local researchers, civil society organizations and media.

CHAPTER 3

3.0 Study Findings

3.1. Bagamoyo District

3.1.1. Socioeconomic Activities and Livelihoods

Understanding the socio-economic activities is a prerequisite to this baseline study as it gives a clear understanding of the households under study (Mwanga, 2019). Socio-economic activities have the power to determine and define how households and individuals will access and utilize livelihood capitals (Fakere, 2017). The access and utilization of natural resources and use of climate services are also influenced by socio-economic activities.

The study revealed that subsistence farming and petty businesses are the major socioeconomic and livelihood activities undertaken by households in the study area, Table 3. Major Livelihood Activities Undertaken by Households in Bagamoyo District. Fishing and livestock keeping at small scale are among the livelihood activities in Bagamoyo. The grown crops include cassava, rice (along Ruvu river), maize, beans, and pineapple. Focus group discussions discovered women in the studied area engage more in farming activities compared to men who concentrate on petty businesses and livestock keeping activities.

Other socioeconomic activities include *Bodaboda* (motorbike taxi) services among the male youths, dairy farming practiced by few households, wage labor, goat rearing and poultry. All respondents from the communities explained that these are the activities giving their household requirements such as food and incomes for education and health bills.

Table 3. Major Livelihood Activities Undertaken by Households in Bagamoyo District.

Activity	# Responses	Proportion (%)
1. Subsistence Farming	9	30.0
2. Subsistence Farming & Petty business	10	33.3
3. Cash Crop Farming	1	3.3
4. Subsistence farming & Wage Labour	1	3.3
5. Dairy farming & Poultry	2	6.7
6. Dairy farming & Petty Business	2	6.7
7. Subsistence Farming & Bodaboda	3	10.0

8. Subsistence Farming & Cash Crop Farming	1	3.3
9. Subsistence Farming & Goat rearing	1	3.3
TOTAL	**30**	**100.0**

3.1.2. Impacts of Climate Change in the Study Area

This study found out that Bagamoyo district has notable evidence of climate change impacts. According to **Fehler! Verweisquelle konnte nicht gefunden werden.**, 60% of the interviewed households (41% men and 19% women) under this study reported that they are quite aware of the climate change related challenges that impair their livelihood activities within their area.

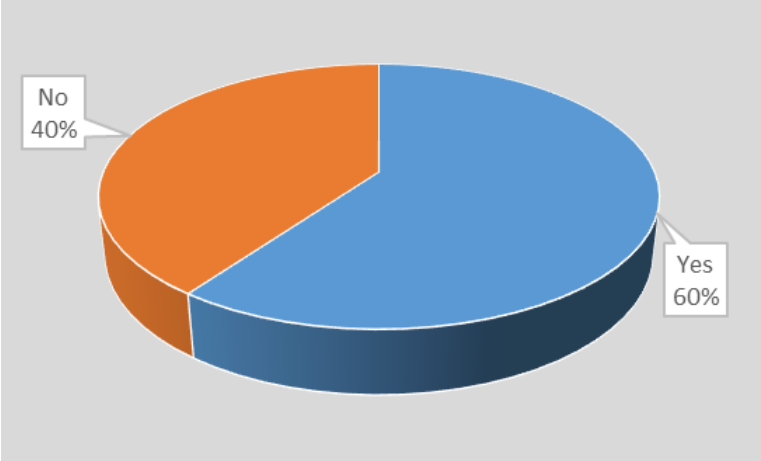

Figure 5. Community's awareness on the impacts of climate change in Bagamoyo District.

Further feedback from the study area revealed that the area is experiencing number of climate related challenges including uncertain rainfall patterns and seasons, prolonged droughts, sea level raise (linked to coastal erosion), saltwater intrusion into freshwater aquifers, severe floods (along Ruvu river), outbreak of pests and diseases. These climate challenges have severely affected livelihood options in the study area including reduction in cassava growth and harvests as their major drought resistant crop, irrigation farming specifically vegetables along Ruvu being affected by severely flooding recently and the invasion of pests due to increased temperature. (See Figure 6).

According to the District Socioeconomic profile (2017), apart from irrigation farming along Ruvu river, cassava is one of the famous drought resistant food crops cultivated in Bagamoyo. District officers working in the agriculture and irrigation departments informed researchers that, the reduced production of this crop is associated with crop diseases and water scarcity due to prolonged droughts and/or delayed rainfall.

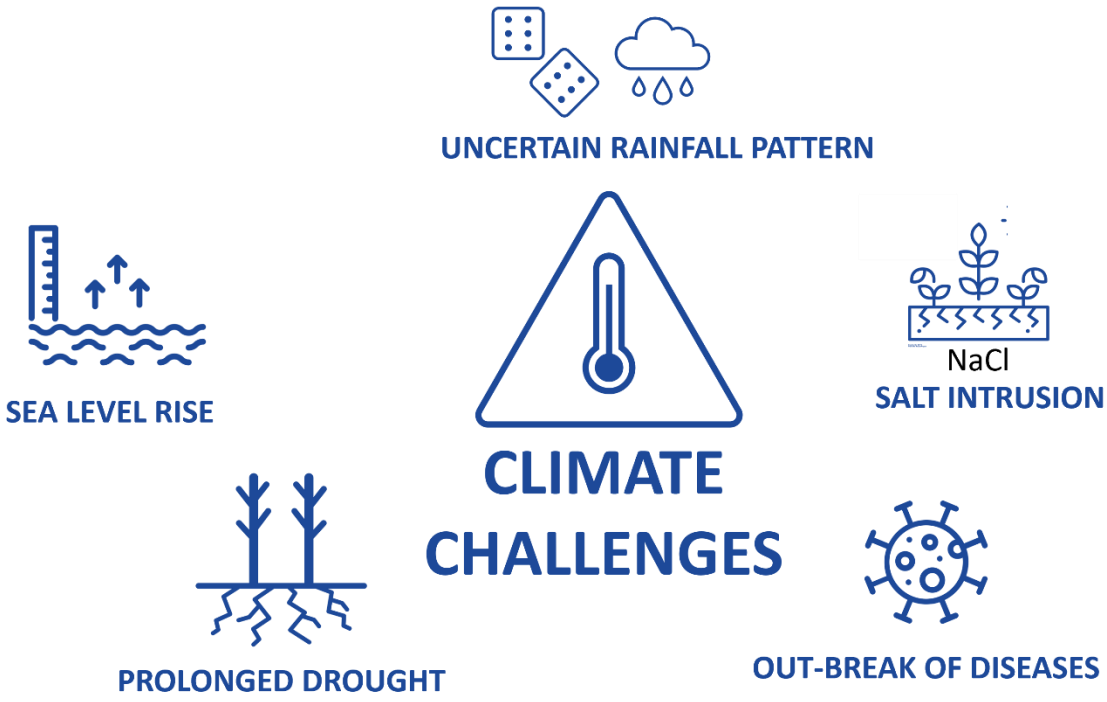

Figure 6: Climate Change Challenges reported by smallholders in Bagamoyo.

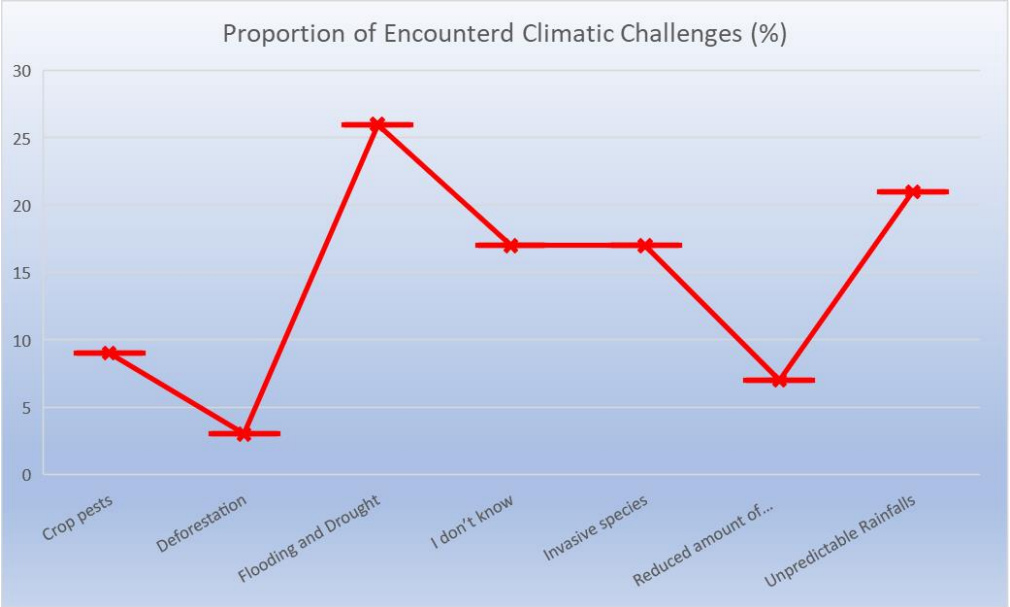

Figure 7. Climatic Challenges Affecting Communities in the Study Area, Bagamoyo District

Figure 7 presents the most pressing challenges of climate change and variability stated by 85% percent of all interviewed people in the study area. Uncertainty rains and seasons, variation of temperature, and prolonged drought conditions have been reported to negatively affecting productivity of socioeconomic and livelihood activities.

The most affected livelihood activities include farming and livestock keeping. It is also important to note that, in this community, 16.7% of the people are unaware of climate change challenges that cause impacts in their activities. Even the high percentage which is aware of climate change cannot mention the reasons behind the changes. This calls for the continued initiatives to raise climate change awareness which eventually contributes to successful integrated climate services into livelihood activities for resilience building.

3.1.3. Climate and Weather Information Services in the Study Area

This section of the study sought to assess the situation of climate and weather information services in the study area, Bagamoyo District in terms of availability, access, sources, usefulness, reliability and their association with household socioeconomic undertakings.

3.1.3.1. Access and Sources

Availability and use of downscaled weather and climate services is necessary to strengthen resilience to climate change and increasing incidences of extreme weather. Climate services allows end users (farmers, fisher folks and pastoralists), disaster risk managers to prepare more effectively for droughts and floods and help to improve the management of water resources.

The study revealed that most of the climate and weather information services in the area are accessed mainly through media including TV, Radios, and storytelling. Out of the 30 households interviewed, 83% affirmed to access this information through radio and TV while only 17% of the respondents reported to access this information through storytelling on media disseminated weather information from friends and neighbours (Figure 8). The information and services provided include start and end of the rainy season.

It was revealed that, in few cases the Met authority could follow up agroecological advises to smallholder end users. Respondents expressed that the climate and weather information provided is too general and it would be better if TMA could go beyond and provide downscaled season progress and updates. Some farmers, pastoralists and fisher folks still depend on friends and neighbours (use folkloric methods) in getting information about weather (Dayoub et al. 2018).

This is more supported by social connection and capitals in exchange of information and forecasting. This has existed for many years in rural areas of Tanzania and has become a fundamental component of decision making for smallholder farmers, fisheries, and livestock keepers. It was reported that, the use of traditional methods affects long-term and science informed forecasts.

Even those with access to TMA forecasts, reported that are generally using forecasts only at the time of start of the rains and or seasons but that use is not uniform – the poor and vulnerable smallholders are those that tend to trust traditional and/or folkloric methods, and are not using longer-term forecasts in their decision making.

This calls for policies and decision makers to enhance engagement between the potential end users and producers of forecasts to increase use of climate forecasts among the most vulnerable stakeholders (Parodi and Babcock,2020).

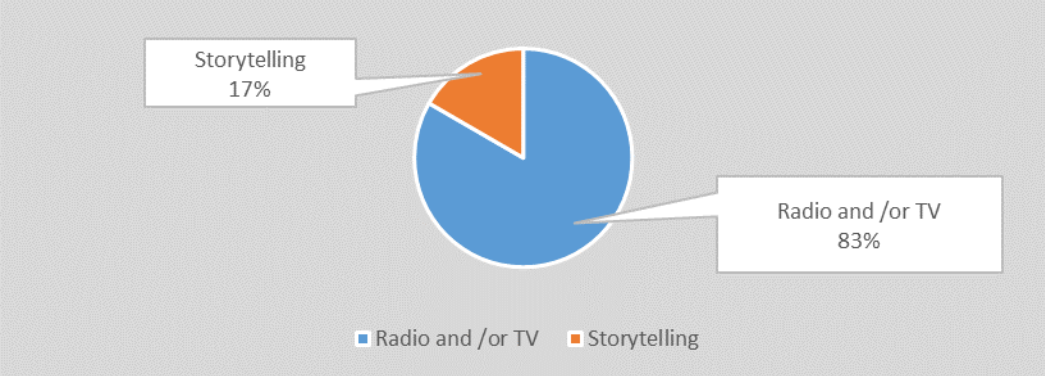

Figure 8. Major channels of accessing climate services in the study area

With regards to sources of this information, the study found out that TMA and (IK) are the two major sources of climate and weather information. Out of the 30 respondents interviewed (Table 4), 53.3% reportedto get this information from TMA while 13.3 % informed to get climate services from both TMA and IK. 36.7% of the population in the study have access to weather information services but do not understand where they come from and 23.4% out of 36.7%being women (Table 4. Proportion on sources of climate information with gender reflection in the study area, Bagamoyo District.. This indicates that women have limited access to climate services although are the ones who play a great role in farms and other livelihood activities that are climate sensitive.

Table 4. Proportion on sources of climate information with gender reflection in the study area, Bagamoyo District.

Sources	# Responses		Proportion (%)		Total %
	Males	Females	Males	Females	
1. TMA	10	6	33.3	20	53.3
2. TMA & IK	3	0	10.0	0.0	10.0
3. IK	1	0	3.3	0.0	3.3
4. Don't know	4	7	13.3	23.4	36.7

3.1.3.2. Usefulness and Reliability

Findings from KIIs and FGDs revealed that the climate and weather services from the TMA and elders (IK) are very useful to community members especially on their socioeconomic and livelihoods activities. However, 70%HH respondents revealed usefulness of the climate information from TMA

to farmers, fish folks and livestock keepers with 64% male and 75% female of the respectively respondent. However, 10% of the respondent still don't appreciate the services as its lack of its generality and not area specific.

On the other hand, traditional weather forecast related information was recommended reliable by only 10% of the respondents in the study area specifically for smallholders (farmers, fish folks and pastoralists) as of its timely and area explicit. Compared to information from TMA it seems traditional forecast is receiving low attention, and this could be linked to the fact that most the traditional forecast are the old people who have less interaction with youth groups.

Also, could be linked to the fact that, in recent years TMA and CANTZ trained extension and some village workers and leaders on the role of climate services in socio-economic development. 23% of the interviewed respondents said IK services especially on rainfall forecasting is useful, however, it lacks long term forecasts. Figure 9. Reliability and Usefulness of the climate services sources in the study area

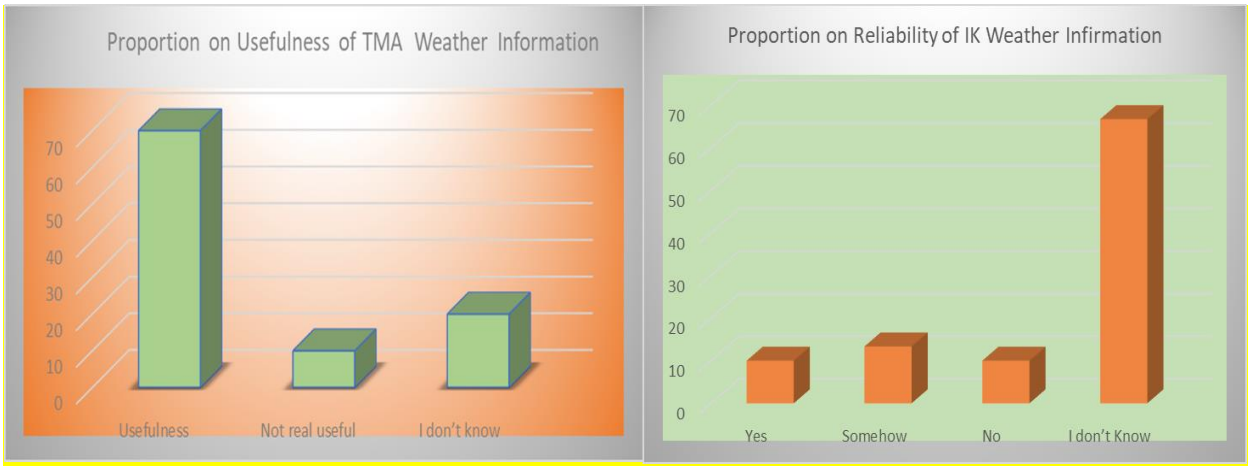

Figure 9. Reliability and Usefulness of the climate services sources in the study area

3.1.4. Indigenous Knowledge (IK) on Climate Services in Bagamoyo

This section aims at establishing the relationship between Indigenous knowledge and climate prediction as it contributes to community's awareness and in the socioeconomic undertakings. The section dwells on issues related to use of IK on climate prediction, sources, reliability, and key indicators of IK.

3.1.4.1. Awareness and use of IK on Climate Services

In this study area, the study reveals of 33% of the respondent being aware of traditional weather forecast (IK) knowledge with only 10% appreciating and relying on this kind of knowledge and service on climate and weather prediction. 67% of the respondent were not aware of the traditional forecast in the study area whereby with regards to its reliability 13% partially rely on these services where 10% and 67% of the same population never rely on these services and have no enough information about these services respectively, Figure 10. Community's awareness on the availability of IK weather and climate services in the study area. The response on the reliability of IK turned out to be subjective with youth qualifying as less useful while some adult appraising it as an important knowledge and services.

Also, some of the elderly, religious people downplayed IK on the grounds that its working related to superpowers. The fact that, community and national radios and TVs presents weather forecasts every day, could be the factor limiting the use of indigenous use. During the FGDs it was revealed that, the advancement and use of phones in many rural areas under study have given an opportunity to TMA to share weather forecast in terms of SMS and bulletin that are easily accessible on WhatsApp.

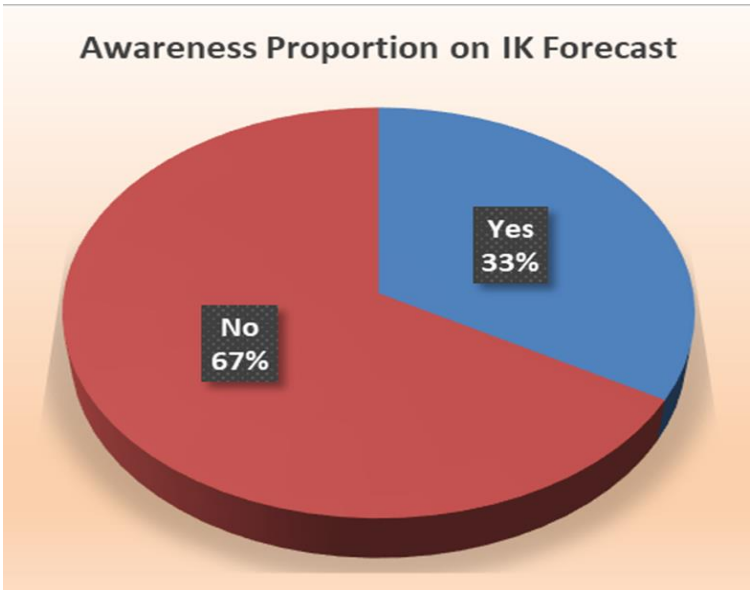

Figure 10. Community's awareness on the availability of IK weather and climate services in the study area

3.1.4.2. Sources of IK and Reliability

The study revealed that, elders are the main source of IK on weather and climate prediction. This is attributed to the fact that elders have witnessed different climate-related phenomena/cycles over time

as opposed to youth. It is worth noting that, the information provided through IK (animals, plants and features reactions) are seen to being less known and reliable for climate prediction in the study area suggesting of enhanced technology on conventional weather services through the use various media especially community radio and phone SMS.

It is also important to find the interface and means of communication and interaction between IK and conventional weather forecast. There should be dedicated efforts to disseminate long-term traditional weather predictions, and this should go hand in hand with documenting the IK so that it can be transformed across generations.

3.1.4.3. IK Indicators for weather/climate prediction in Bagamoyo District

For an informed understanding, the study sought to establish different indicators (signs) that qualifies IK for climate prediction in the study area. The study found out that apart from inadequate awareness and reliability of the IK services in the study area still some indicators for IK services are in use including birds when appear flying higher and in groups towards certain direction indicates approaching of rain seasons; insects emerging undergrounds indicates approaching rainy; animals' movements, reaction and appearance; wind direction and speed; plant flowering as well as clouds covers indicate rainy onset or cessation.

In the study area, birds and animals ranked high (23%) followed by insects and moon, Sun and wind (21% each) (area However, the proportion difference is insignificant for all identified IK indicators in the study area that suggest mutual use of all indicators for these services as the most common signs (indicators) used for climate prediction.

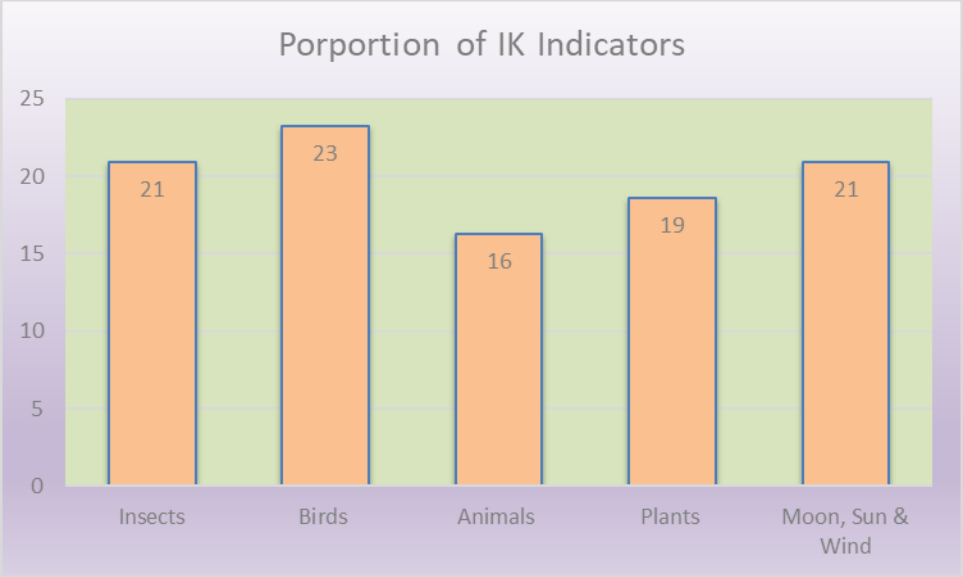

Figure 11. Proportion on the use of IK indicators in the study area

3.2. Chalinze District

In this district the undertaken study reached out to a total of 109 respondents who were interviewed in one village of Kihangaiko and its sub villages whereby 53 respondents (equal to 49%) were women and 56 men (equivalent to 51%).

3.2.1. Socioeconomic Activities and Livelihoods

The study revealed that small scale agriculture and livestock keeping are the substantial socioeconomic and livelihood activities undertaken in the study area. Other socioeconomic activities include petty business, mining (quarrying), charcoal making, gardening, riverine fisheries, and poultry. 76% of the respondents are engaged in farming activities followed by 10% engaged in animal husbandry. In most cases the livestock keepers are the Masai and Mang´ati tribes who practice both sedentary and nomadic livestock keeping.

The fieldwork reveals that, some communities are involved in charcoal making and quarry mining as their livelihood in the study area. The standard deviation for the households' size (people living in the household during this study) is 2.4 with 2.7 mean size while number of dependent per household; 1-

2 (19.27%), 4-6 (55.96%), 7 and above (23.85%) and 0.92% had no dependent of the interviewed households, the vulnerability assessment by Nyagawa (2020) in Chalinze district reported the average size to be 5 people per household Figure 12. Socioeconomic activities proportion distribution

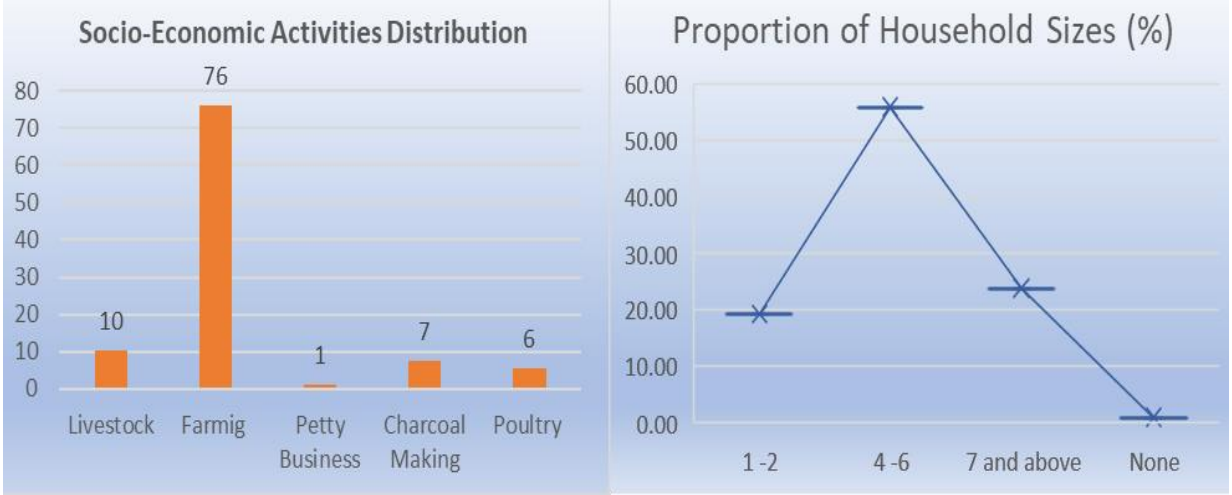

Figure 12. Socioeconomic activities proportion distribution

Moreover, this study found out that, the interviewees are mainly engaging socioeconomic activities as per area. For various reasons including income and food, cater for their household needs, lack of capital that limits them to engage in other available options (affordability) and others being inherited from their ancestors such livelihoods from their parents. *"animal rearing is my traditional livelihood and since then I have been engaged in animal rearing"* said one of the respondents from the study area.

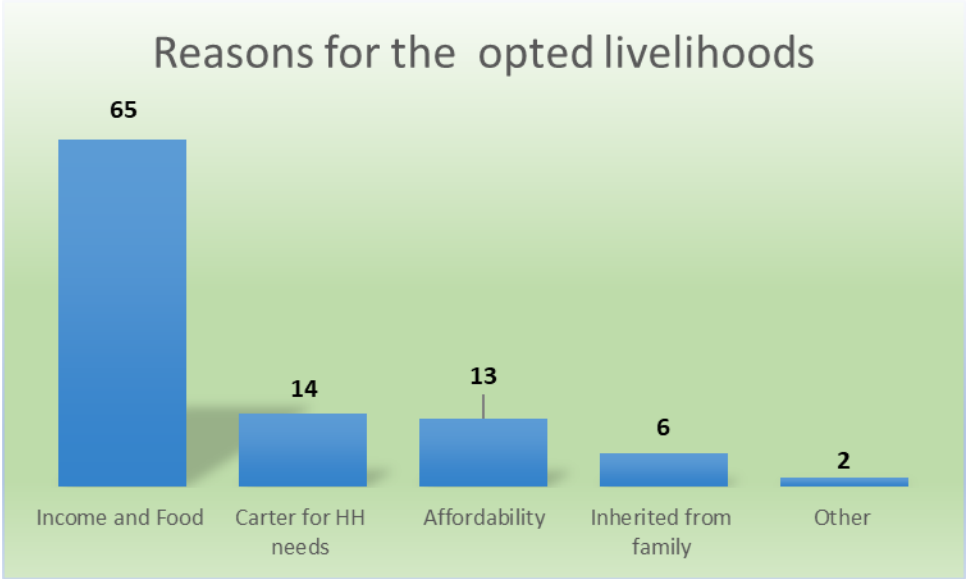

Figure 13. Proportion for the opted livelihoods by households in the study area.

This study also revealed variation and changes of undertaken livelihood (farming and livestock keeping) production with respects to annual production. Out of the interviewed households, 47.71% indicated the decrease of livelihoods (farming and livestock) production, 25.69% indicated for moderate form while 10.90% and 16.51% of the respondent show an increased and no difference for the production over the past 3 years respectively.

These outcomes were also complimented during focus groups discussion and key informant interview where participants were revealed declines of farming and livestock production in the study area which call for diversified livelihood as an immediately adaptive option. Out of the respondent 58.72% shows severely level of effects while 30.28% shows moderate level of effects with 3.67% and 7.34% shows low level of effects and no effects respectively of climate change impacts in farming and livestock production, Figure 14. Proportional livelihoods trends and effects levels for the livelihoods in 3 years

Uncertain climate condition coupled with lack of financial capital for investment revealed as a reason behind these changes which expose these communities into high level of vulnerability and setback for inclusive socioeconomic transformations.

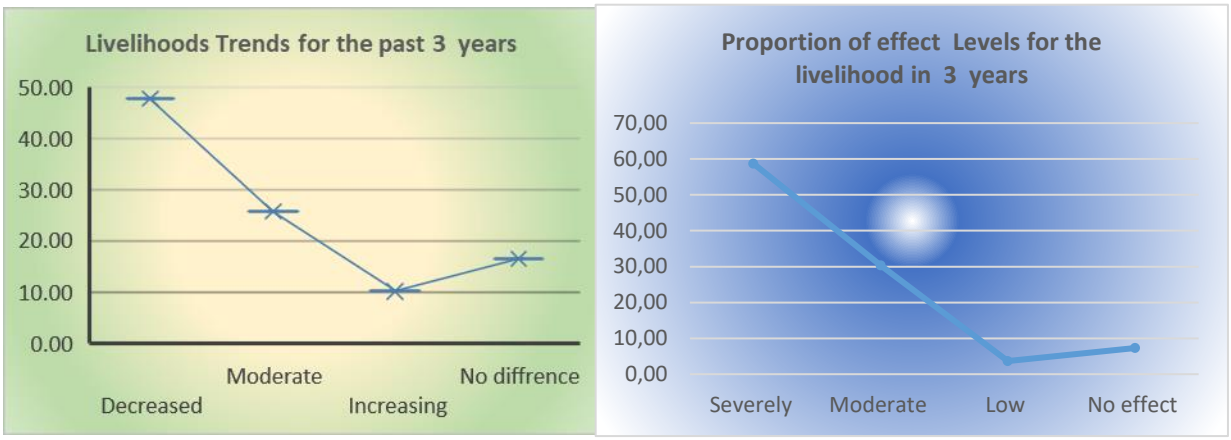

Figure 14. Proportional livelihoods trends and effects levels for the livelihoods in 3 years

3.2.2. Impacts of CC in the Study area

Like other parts of the country, Chalinze district is also experiencing climate change impacts. A USAID funded undertaken study by the E-link consult and SERVIR East Africa revealed that the impacts of climate change are already being felt in all key sectors of the economy including agriculture, forestry, water, livestock and land management. According to this study, smallholder farmers and pastoralist are already facing serious challenges due to decreased rainfall and increased and prolonged dry spells.

They are already experiencing crop and animal diseases and pests which are leading to low productivity and risks of food insecurity. These findings were fully supported by response of respondents during this baseline survey which pointed out the same challenges, noting increased frequencies and severity of the threats from climate change to livelihood options particular on agriculture, livestock, water and food security.

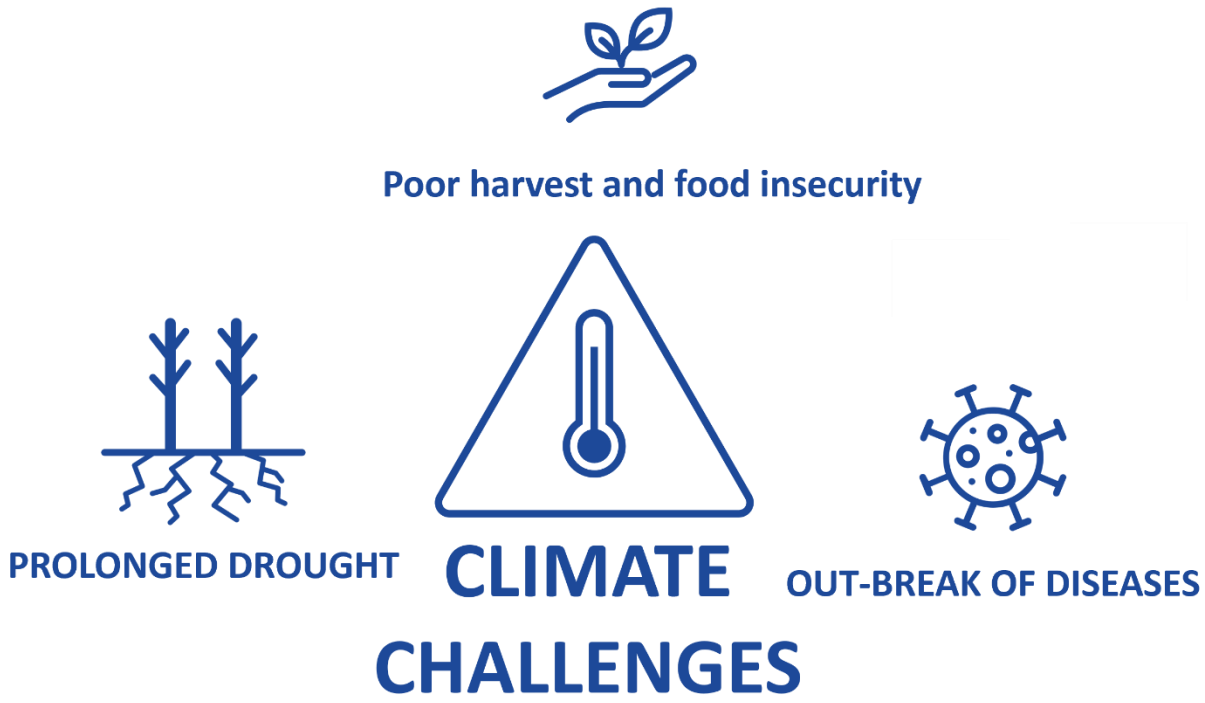

Figure 15: Climate Change impacts reported by smallholder in Chalinze.

area. Presents the scores of responses on climate change impacts and risks as perceived by respondents in the study area whereby poor harvests, food insecurity (64.1%), prolonged and recurrent droughts (11.7%), reduced income (6.8%) and emergence of crop pests and diseases were reported to be the most pressing challenges among smallholder farmers and pastoralists. Other challenges reported include poor rains, flooding and lack of pasture as shown in Figure 13. Proportion for the opted livelihoods by households in the study area.

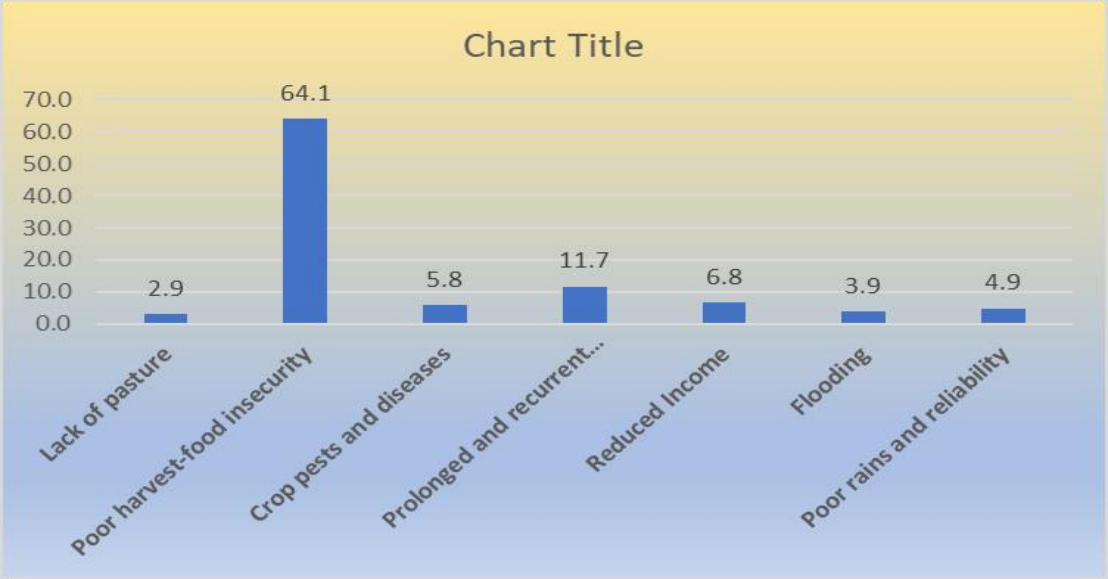

Figure 16. Perceptions of Respondents on Climate Change Risks in the Study area

3.2.2.1. Coping and adaptation strategies with Climate Change Impacts

In view of the climate change impacts, the study sought to understand measures used by smallholder farmers to cope with those impacts and whether or not those measures are adequate. Results from the smallholder farmers (48%% women and 52%men) revealed that 37.6% of the smallholder farmers are doing nothing to respond to the impacts of climate change due to limited knowledge and financial resources for implementing some strategies.

Those (22.8%) with some knowledge on climate change key strategies used to cope with the impact of climate change with climate smart technologies including early planting and use drought resistant crops. 7.9% have been engaged in petty business including restaurants, kiosk, vegetables, and fruits vending while 19.8% have been engaged in casual labor (19.8).

Other strategies included purchase of extra food, seeking support from friends and relatives, and migrating to other areas particularly for pastoralists. A small number (between 1% to 5%) of respondents reported that they are simply not taking any initiatives to respond to the situation (district illustrating different coping strategies are used by different smallholder farmers in the study area.

Nevertheless, when asked to comment on the effectiveness of their coping strategies, majority of the respondents revealed that their strategies were not good enough since the impacts were increasingly being felt both temporal and spatial across the years.

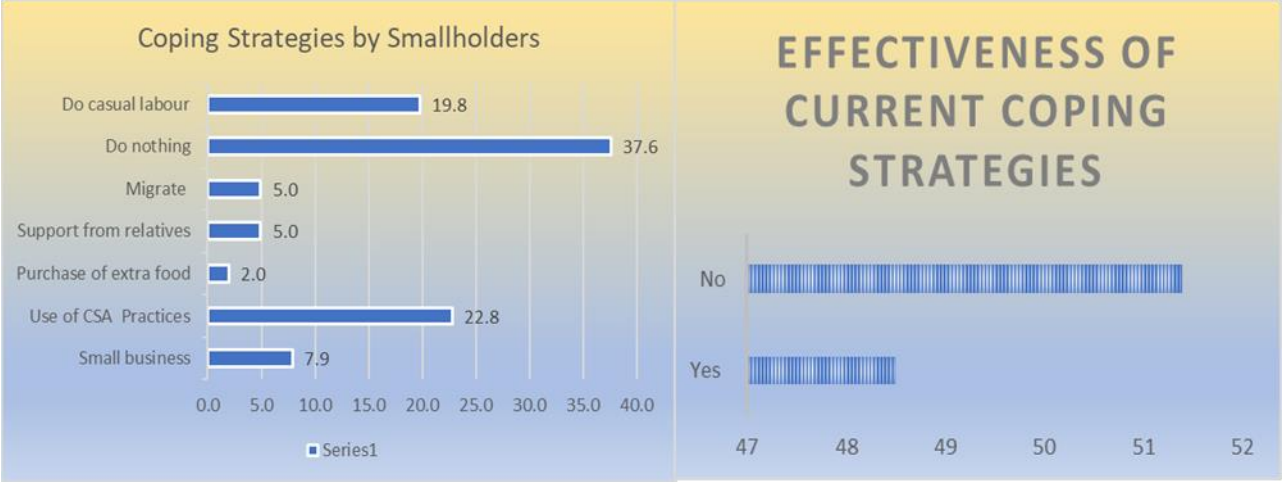

Figure 17. Community's coping strategies to climate change impacts in Chalinze district

3.2.3. Climate and Weather Services

This section of the study sought to assess the situation of climate and weather services in the study area in term of access, sources, usefulness, and reliability. The findings based on response from respondents are presented in the subsections below.

3.2.3.1. Access and Sources

Out of all respondents (109), 61.5% confirmed to have been accessing climate and weather services, while 21.1% had never had access to the same. The shared climate and weather information was more on short term forecasts (1-3 months) and was on start and end of the season. The information given was considered too general but without mentioning to when to start planting crops without mentioning specific crops.17.4% of the respondents responded 'somehow' meaning that their access to climate and weather services was uncertain and general.

However, there was a great variation on the frequencies with which respondents received the climate and weather services. Respondents (42.7%) received information seasonally followed by 23.5% and 21.8% who received climate and weather information on a frequent and daily basis respectively. About 12% of all respondents are not receiving climate and weather services at all forecasting stipulates proportional response on accessibility and timing of the weather forecasting.

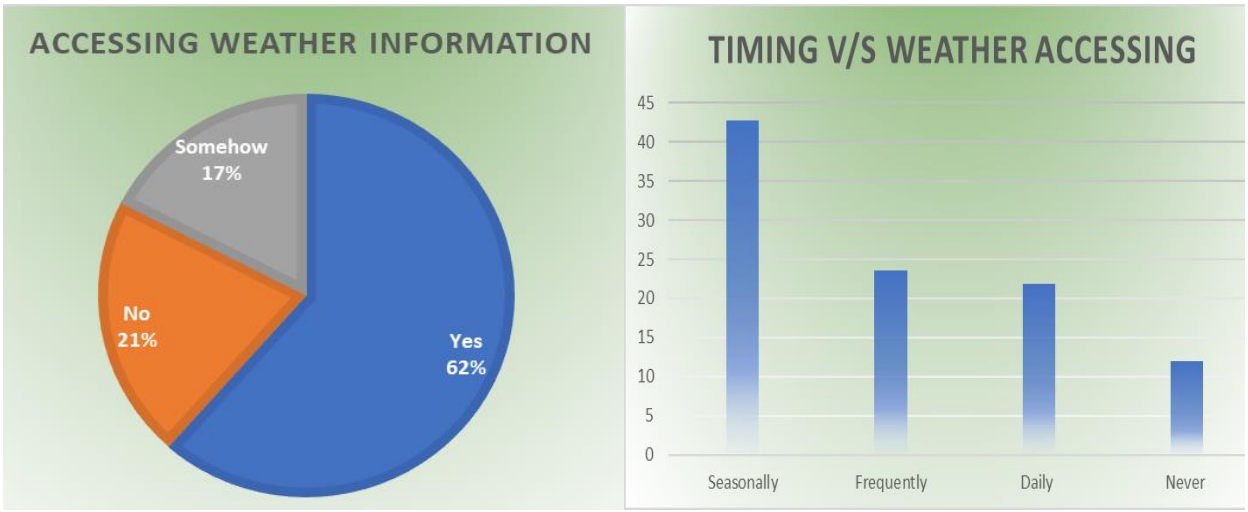

Figure 18. Proportional accessibility and timing of weather forecasting

Both interview and focus group discussions revealed that from those receiving climate and weather services, 57.8% of respondents reported TMA to be the primary source of the information and was channeled through radio or TV. Some farmers reported to received season forecasts through SMS from both TMA and CANTZ: Other sources reported include friends who have radio and indigenous knowledge (IK) experts at 6.4% and 1.8% respectively.

Nevertheless, a significant number of respondents who received climate and weather services (i.e., 33.9%) revealed that they didn't know the source of such information. See Figure 19. Proportional of received weather information. presenting source proportions of received weather information. These results were also complimented by the information gathered during focus group discussions where community members revealed to receive daily weather forecasting through media including radios and television as well as through their mobile phones.

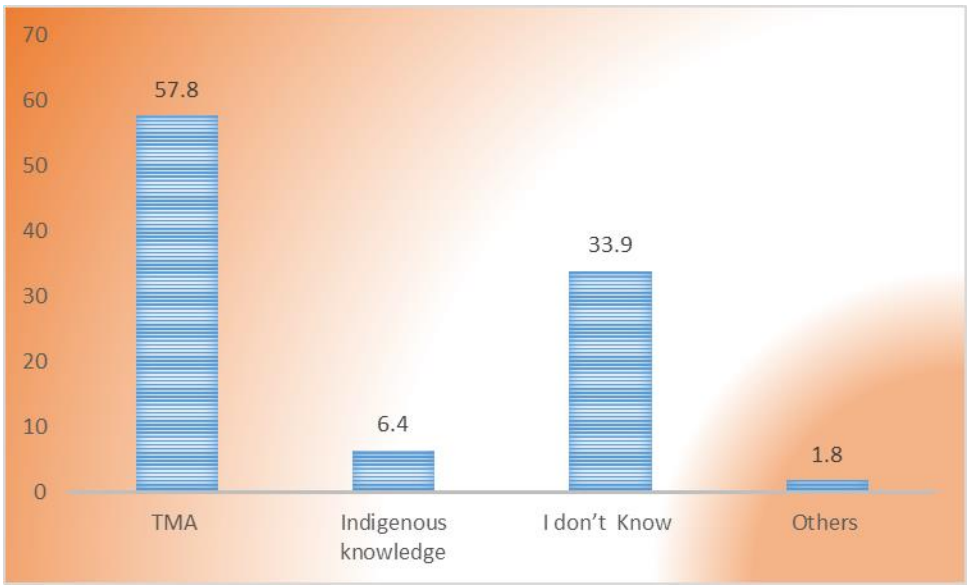

Figure 19. Proportional of received weather information.

Regarding the type of climate and weather services received from TMA and used by smallholders in the study area revealed the following: majority of smallholder farmers (77.2%) used rainfall and floods weather information while 13% of respondents used temperature and drought information to inform their livelihoods practices. On the contrary, 10% of the respondent did not use TMA provided climate and weather services as they believe to contribute nothing to their livelihoods practices while other not trusting TMA shared weather forecasts. This was also revealed during the focus group discussion where member argued of TMA disseminated weather forecasting not being realistic and location specific.

The study further explored the mechanism through which community members are receiving climate and weather services information. Resources and efforts need to be invested for timely and reliable availability of weather forecasting specifically to smallholder farmers and pastoralist from the study area and beyond. The findings are presented in Figure 20. Proportion of media used to receive weather information

According to these results, most smallholder farmers and pastorals (62.9%) are receiving weather and climate services information through TV & Radio while 22.3% and 10.8% of smallholder farmers and pastorals access climate and weather services information from Farm SMS (Phone) and their neighbors through story telling respectively. The 22.3% access weather forecasts direct from TMA

after being registered to TMA data base [this was supported by the first phase of this project) where information is shared through a form called FarmSMS.

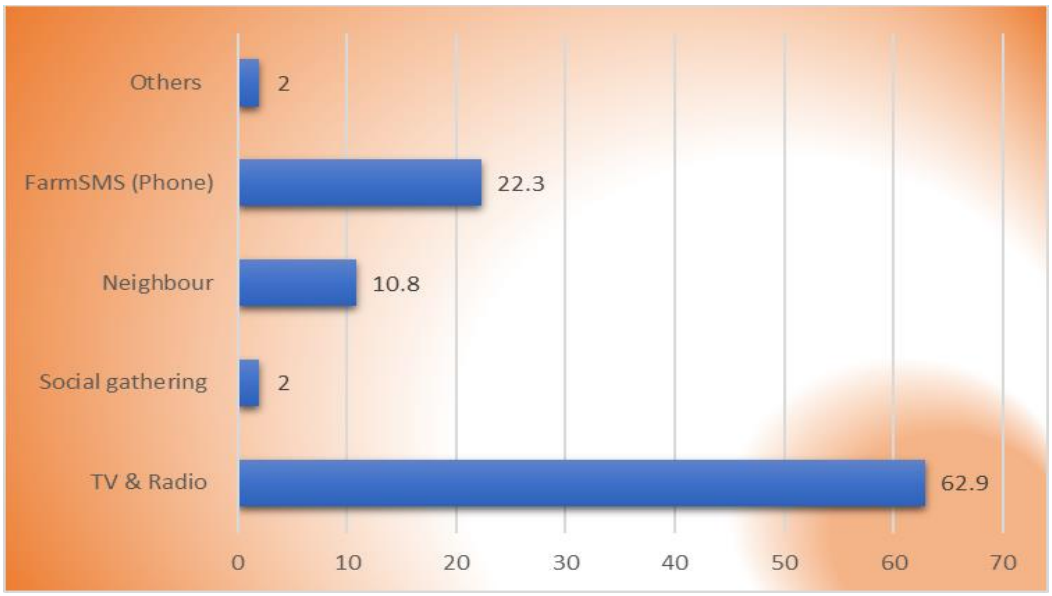

Figure 20. Proportion of media used to receive weather information

The study was also interested in finding out whether the climate and weather services received from TMA is useful. 34% of the respondents revealed that the information received was useful while 65% of the respondents revealed that information was not useful as it was general. However, some respondents reported lack of alternative sources of climate and weather services information (Figure 21. Proportional on the usefulness of the received weather information from TMA. Moreover, out of the shared weather information, temperature and drought are mostly used factors by smallholder farmers and pastorals in the study area to inform their livelihoods.

Since the facts that majority of the communities' livelihoods solely depends on weather conditions specifically farming and animal rearing, the change in weather conditions trends cause severe socio-economic as well as ecological impacts (Irish Aid, 2018). Households who solely depend on keeping livestock were more depending on IK or had limited access to conventional climate and weather forecasts. This could be linked to the fact that, most of pastoralists in Chalinze district are nomadic with limited access to phones and radio due to limited places for changing their phones and radios.

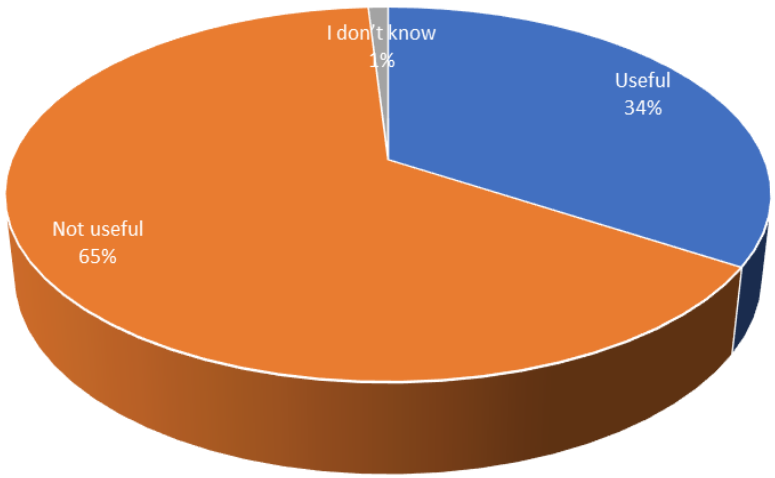

Figure 21. Proportional on the usefulness of the received weather information from TMA

3.2.3.2. Usefulness and Reliability

The study showed that the climate and weather services from the TMA and elders (IK) are useful to community members 63% and 34% respectively especially onto inform planning and execution of their socioeconomic and livelihoods activities. The most supported livelihood activities include farming and animal rearing. However, in terms of reliability out of all the respondents, 64% of the respondent claimed indigenous knowledge (IK) to be more reliable compared to 36% claimed that claimed information provided by TMA are reliable.

The high score of IK as compared to TMA information could associated with the fact that, in Chalinze most of the interviewed households are pastoralists who have limited access to radio, phones and TV which are mostly used by TMA. TMA information was found to be sometimes untimely and not area specific, while elder (IK) related weather prediction was found to be realistic and location specific. This suggests the demands for the downscaled weather forecasts because of its location specific. However, the country systems (TMA) face challenges, including technology investments which hinder timely, accuracy and reliability of shared forecasts which is likely to affect livelihoods planning, specifically to smallholders, the size of the country, with highly remote areas affect access and utilization of the weather forecasts (Irish Aid, 2018).Figure 22. Proportional of the usefulness and reliability of weather prediction from TMA and those of IK below shows the percentage distributions according to the reliability and usefulness of these information

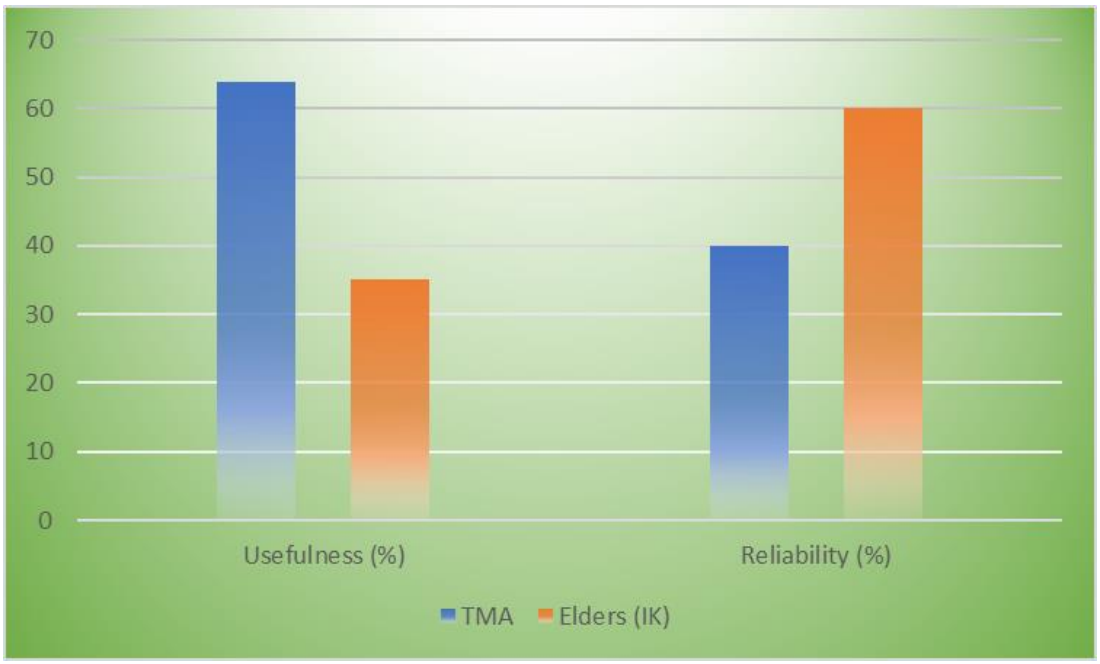

Figure 22. Proportional of the usefulness and reliability of weather prediction from TMA and those of IK

3.2.4. Indigenous Knowledge and Climate

This section aimed at establishing the relationship between Indigenous knowledge and climate prediction as it contributes to community's awareness and in the socioeconomic undertakings. The section dwelled on issues related to use of IK on climate prediction, sources, reliability, and key indicators of IK.

3.2.4.1. Awareness and use of IK on Climate

In Chalinze district, the study found out that 52% (48% women and 52 % men) of the respondents were aware and found IK to be useful on climate prediction. 48% of the respondents were neither aware nor unsure of the importance and use of IK on climate prediction. Another 20.18% of the respondents said that IK was not useful at all on climate prediction in the study area and this might be with respect to nature of livelihoods from respective respondent but also beliefs. Livelihoods. Shows the distribution of respondents as interviewed on the aspect under consideration.

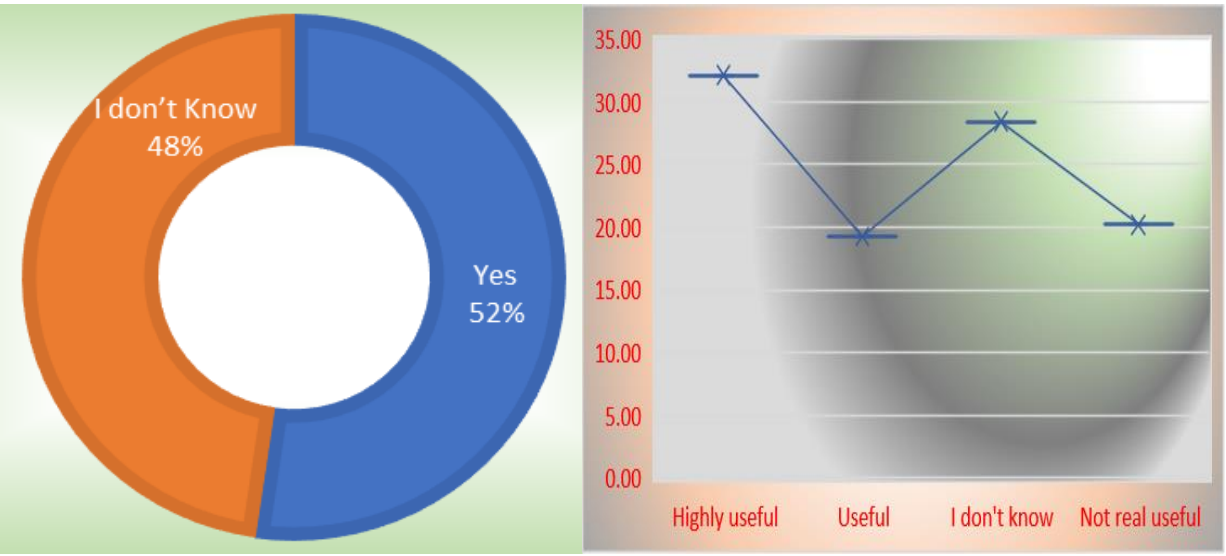

Figure 23. Awareness on Traditional Weather Forecasters and Its Contribution to Local Livelihoods.

3.2.4.2. Sources of IK and Reliability

The study revealed that, elders found in a certain society are the main source of IK on weather predictions in the study area. This is attributed to the fact that elders who have been living in the area for more than three decades have observed and perceived different weather and climate-related phenomena over time as opposed to youth and migrants. It is worth noting that, the information provided through IK are seen to be reliable on climate prediction in the area especially among nomadic pastoralists. This is since, IK related weather forecasting responded as mostly reliable, timely and area specific. The most shared information is on amount of rainfall in the area and or coming of temperature that shall lead into droughts.

3.2.4.3. IK Indicators

There have been numbers of indicators implies for most of the traditional forecasting and prediction of weather and likely climatic events. Traditional forecasting normally uses specific indicators for specific weather and climatic events. For an informed understanding, the study sought to establish different indicators (signs) that qualify IK on climate prediction.

The study found out that insects, animal and birds' reaction and appearance; clouds cover, wind direction and plant flowering that are suggesting certain weather conditions being the most common signs (indicators) used by traditional weather forecasters. In the study area, birds and animals'

migration that indicates rainy onset and cessation ranked high (34.86%) as the most common signs (indicators) used for climate prediction and 22.94% clouds cover being used as indicator for raining events, Figure 24. Proportional distribution of IK indicators

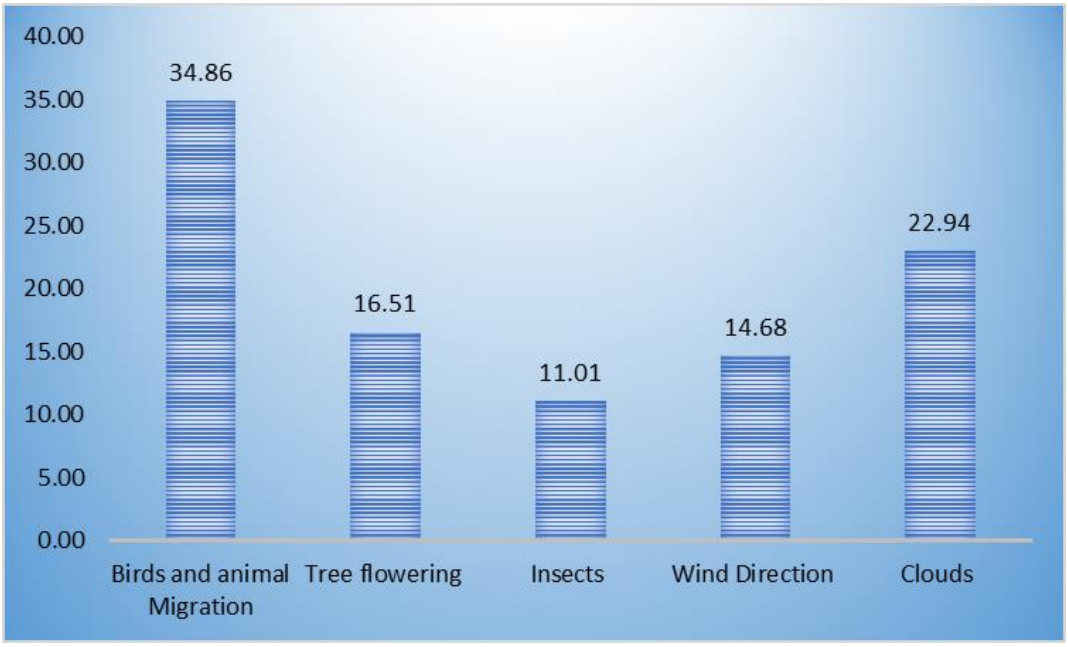

Figure 24. Proportional distribution of IK indicators

3.3. Lushoto District

3.3.1. Socioeconomic Activities and Livelihoods

The study revealed that subsistence farming is the major livelihood activity undertaken by majority of households in the study area. Other supporting activities include dairy farming, livestock rearing, and petty business. Out of the interviewed households, the area below indicates relative distribution of socioeconomic activities in the study area.

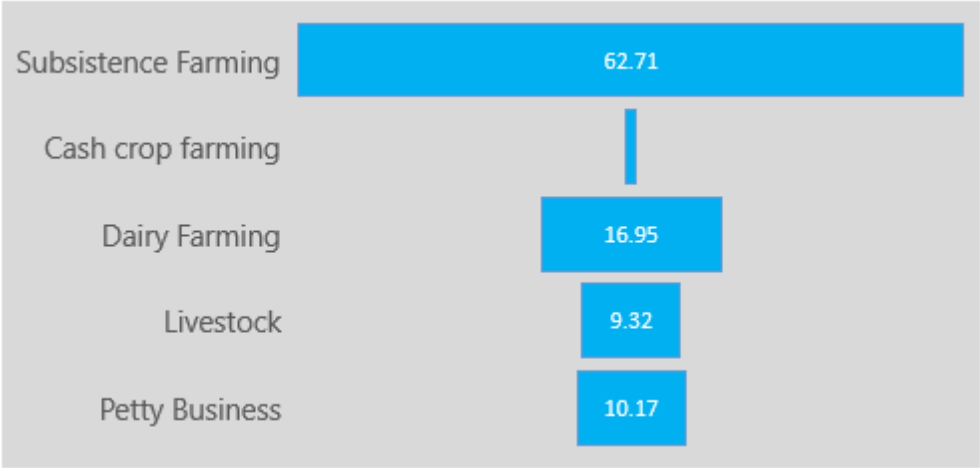

Figure 25. Major socioeconomic activities undertaken in the study area

Majority of the interviewed households (70.4%) informed that they mainly engage in the mentioned activities to obtain food and some income to cover household costs such as shopping, medical bills, and education fees Figure 26. Combination of household requirements obtained from livelihood activities in the study area

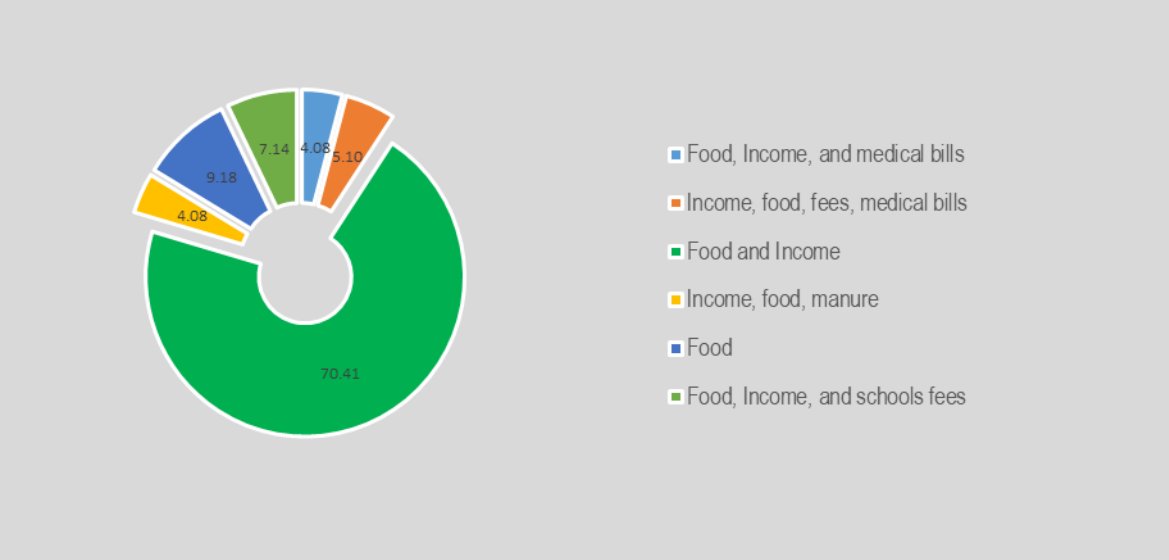

Figure 26. Combination of household requirements obtained from livelihood activities in the study area

3.3.2. Impacts of Climate Change in the Study Area

Like in many parts of Tanzania, in Lushoto district smallholder farmers face numerous climatic and non-climatic challenges. Some of these include poor soil fertility and decline of crop yields, poor market access, declining land sizes and constrained access to land (Mahoo et al. 2015). Families are experiencing food insecurity and increasing poverty level. Climate change worsen the situation due to the limited adaptive capacity and low levels of development.

Lushoto district is also experiencing climate change impacts as reported by majority of the surveyed households under this study area Feedback from the study area revealed that the area is experiencing the number of climate related challenges including uncertain rainfall patterns, prolonged droughts, floods, outbreak of pests and diseases. These climate challenges have severely affected livelihood options especially agriculture in the study area leading to general economic underdevelopment of the community. area indicates most pressing climate related impacts in the study are.

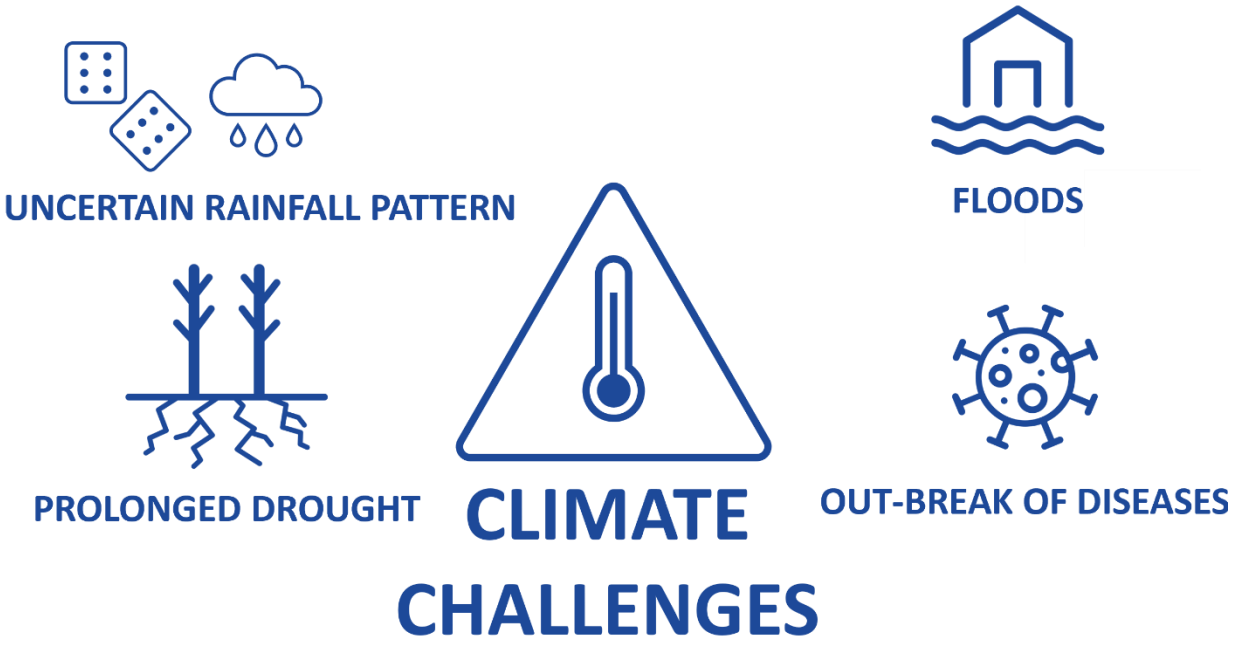

Figure 27: Climate Change challenges reported by smallholders in Lushoto.

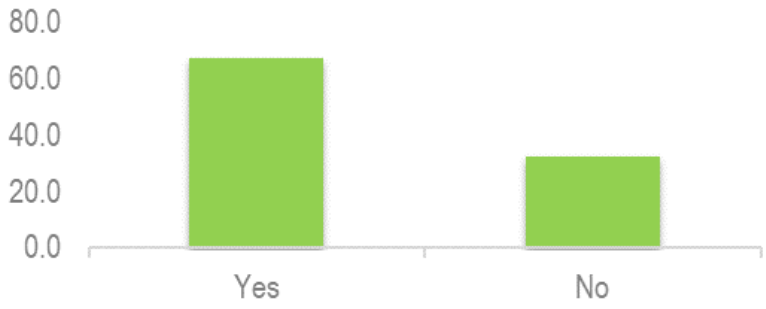

Figure 28. Awareness on Climate change challenges in the study area

Respondents were able to justify the dangerous effects of the climate change challenges on their livelihood activities making them worried about their future. Continued decrease in their produce/yields and the spread of crop diseases were mentioned as major challenge affecting food security and household income. Emphasizing this concern, the agriculture extension officers informed the study team that there has been an eruption of Fall worm (*ViwaviJeshi*) locally known as *Kanitangaze* which is affecting crops such as maize and beans based on increased weather variability (temperature and wind direction) and thus provide favorable condition for their survival and migration during farming seasons.

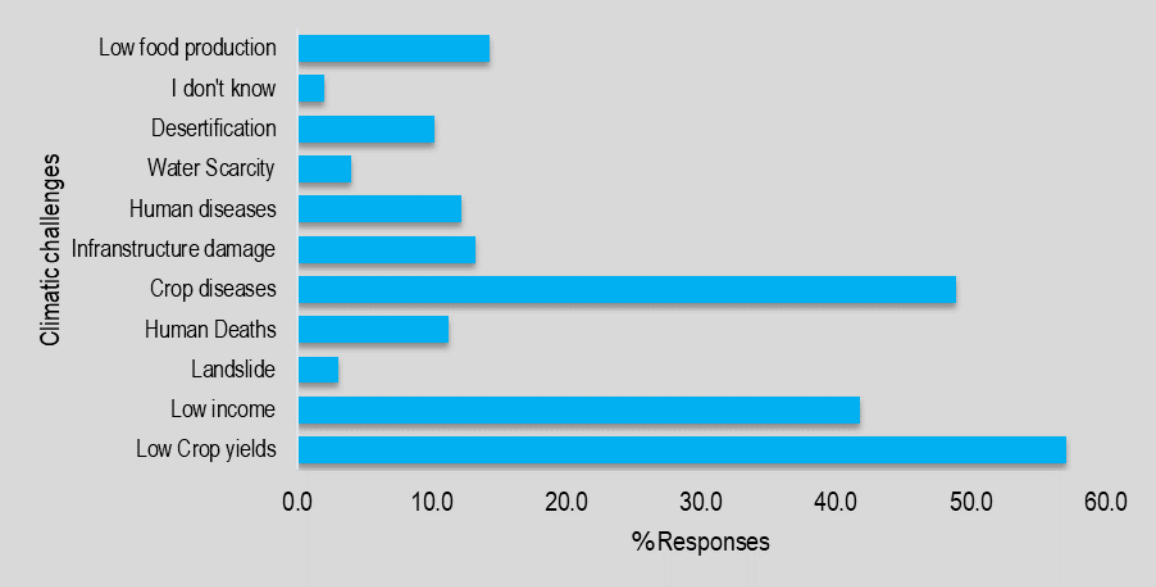

Figure 29. Climate change challenges in the study area

3.3.3. Climate and Weather Services

This section of the study sought to assess the situation of climate and weather services in the study area in term of access, sources, usefulness, and reliability.

3.3.3.1. Access and Sources

The study revealed that, despite being remotely located, large proportion of the people in the study area have access to weather and climate information services provided from various sources. services portrays that 79.6 percent of the interviewed households confirmed to have full access while only 13.3 and 7.1 percent informed to have no and limited access respectively.

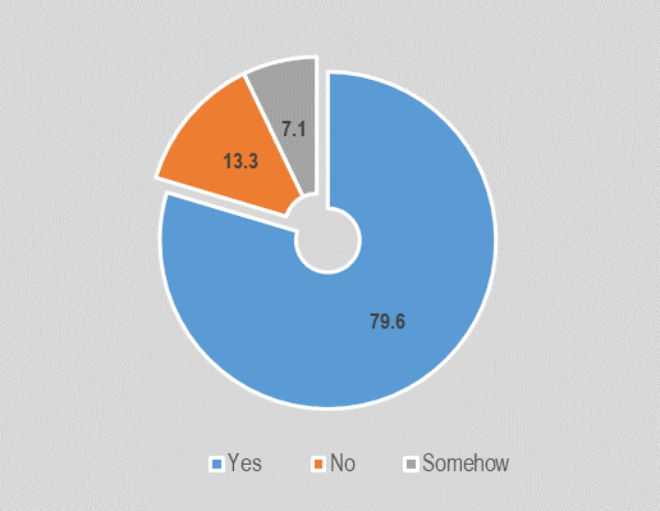

Figure 30. Community's access to climate and weather information services

Learning from the climate services dissemination channels in the study area, it was found out that majority have access to the services through Radios (60.6%) followed by TVs (21.3%) and social gathering (12.8%), and lastly internet (1.1%) where 4.3% access this information from other form including word of mouth from relatives, friends, researchers and NGO networks such as CANTZ (Figure 31. Climate services access channels in the study area

These findings are consistent with those of Mahoo et al. (2015), who reported that almost 61% of respondents owned a radio in Lushoto, thus making it a useful media for accessing climate and weather information and forecasts. Due to the nature of the environment, awareness level and education capacity of the community, very few interviewed individuals have ability to access the information through modern ways such as internet and social media.

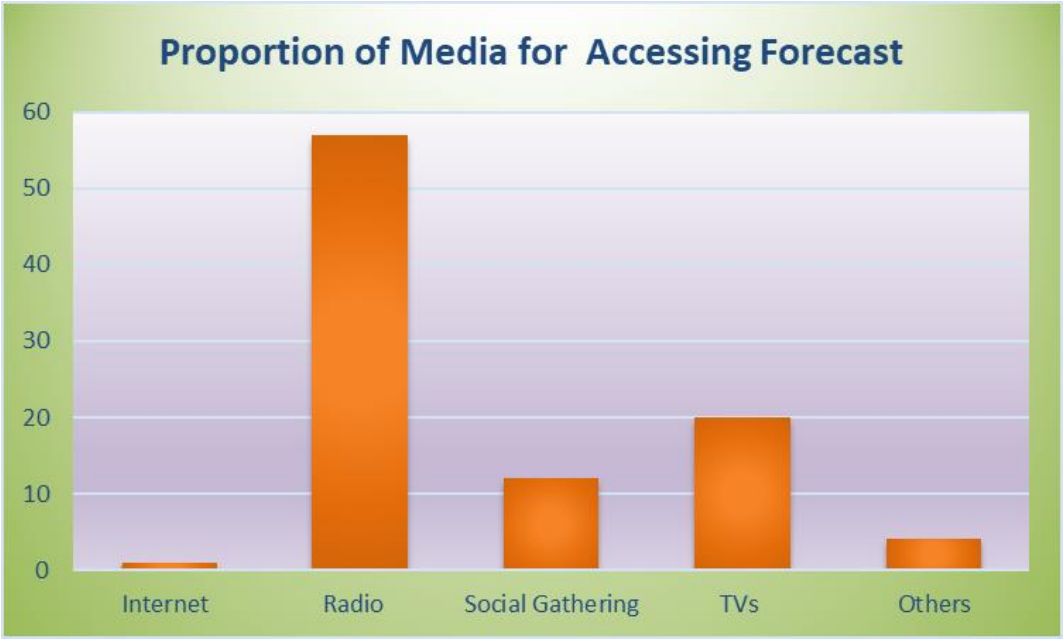

Figure 31. Climate services access channels in the study area

In terms of sources of this information, the study found out that TMA and elders (IK) are the two major sources of climate and weather services depicts that out of the 98 respondents, 82% acknowledged to get this information mainly from TMA and 5% from elders (IK) while the remaining get this information from other sources including the Kenya Meteorological Department (KMD). Lushoto district especially the study area borders Kenya to the north, hence residents have access to Kenyan radio and TV broadcasts. It is worth noting that 10 percent of the interviewed households do not recognize the source of the climate and weather and information they receive.

Table 5. Sources of Weather & Climate Services in the study area

S/N	Sources	# Responses	Proportion (%)
1.	TMA	80	82
2.	TMA & IK	5	5
3.	Traditional (IK)	2	2
4.	Don't know	10	10
5.	Others (e.g. KMD)	1	1

3.3.3.2. Usefulness and Reliability of Climate Services

The study showed that climate and weather services provided by TMA especially rainfall and temperature forecast are somehow reliable and useful for farming activities in Lushoto district. Figure 32. Kinds of climate services available in the study area. Few respondents with no communication facilities such as radios, TVs, and mobile phones were neither able to rate the reliability of the services nor comment on the usefulness.

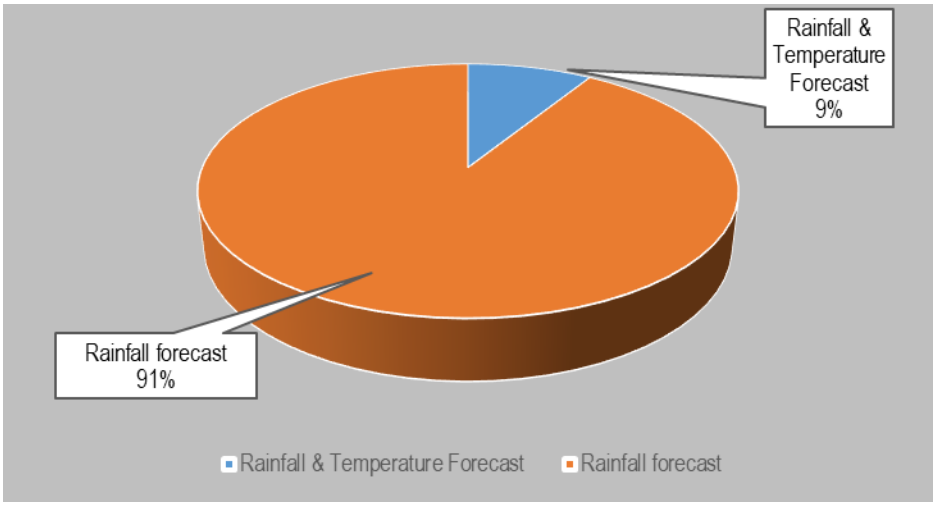

Figure 32. Kinds of climate services available in the study area

However, in terms of usefulness, out of all the respondents, 38.8% and 32.7% respectively claimed that the information provided by both TMA and IK are useful and highly useful, Figure 33. Usefulness of the weather & Climate information services both from TMA and IK in farming activities.

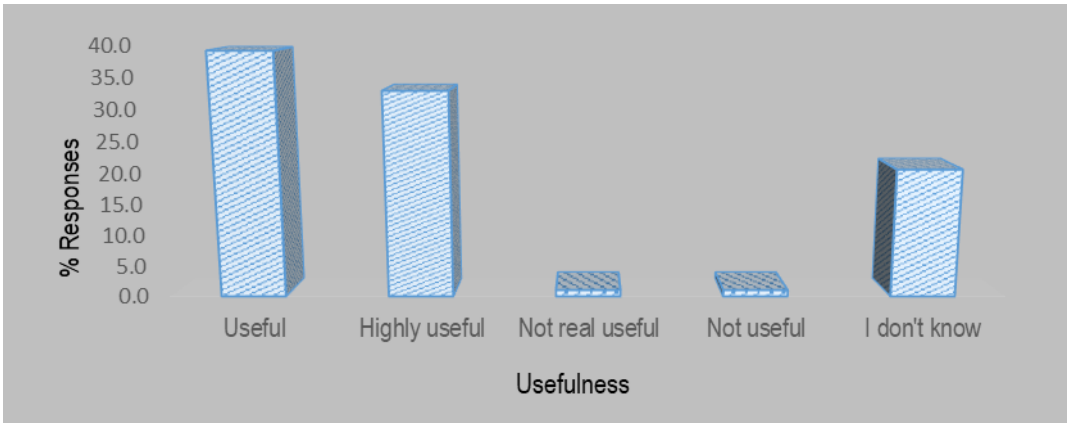

Figure 33. Usefulness of the weather & Climate information services both from TMA and IK in farming activities

According to farming majority of the respondents in the study area were able to testify that climate and weather information services on seasonal basis from TMA have been instrumental in facilitating their cropping selection, farm preparations, and, sowing decisions.

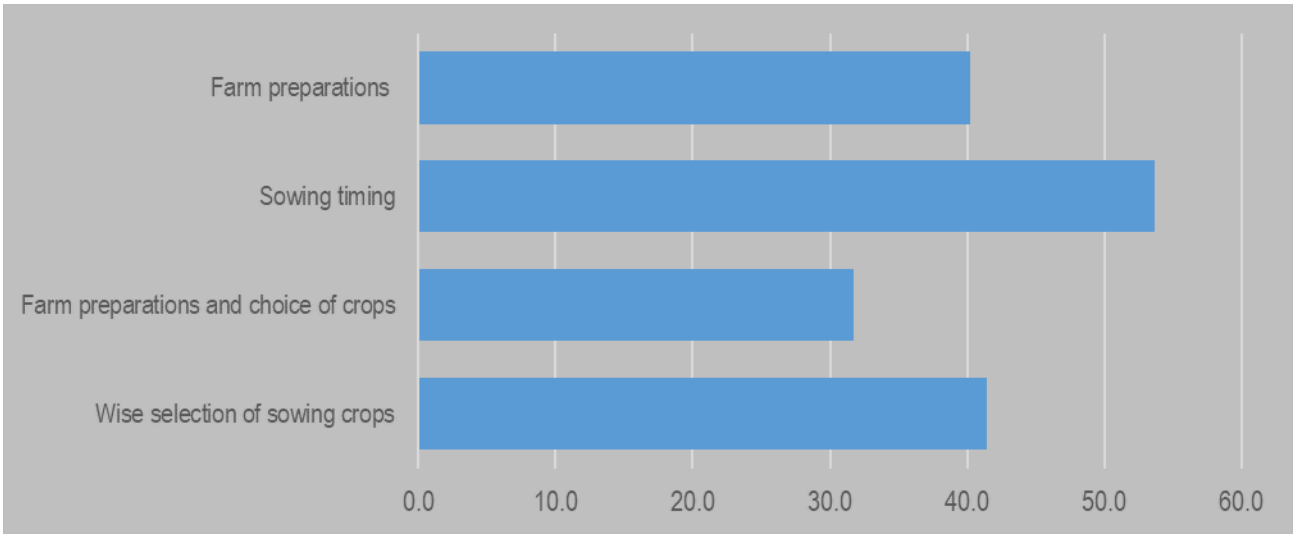

Figure 34. Role of weather & climate information services in farming

3.3.3.3. Downscaling Level of Weather & Climate Services in The Study Area

Despite of the usefulness of the climate and weather information services provided by TMA stated by majority of respondents, they also commented that in most cases the rain forecasts do not come true. In probing more about this, the study realized that this might be caused by the TMA forecast scale which is still generalized. According to level more than 50% of the 98 respondents have experience with forecasts covering the whole coastal zone, more than 30% said sometimes forecast at regional level (Tanga) is given while very few have experience with weather services covering the district level (Lushoto)

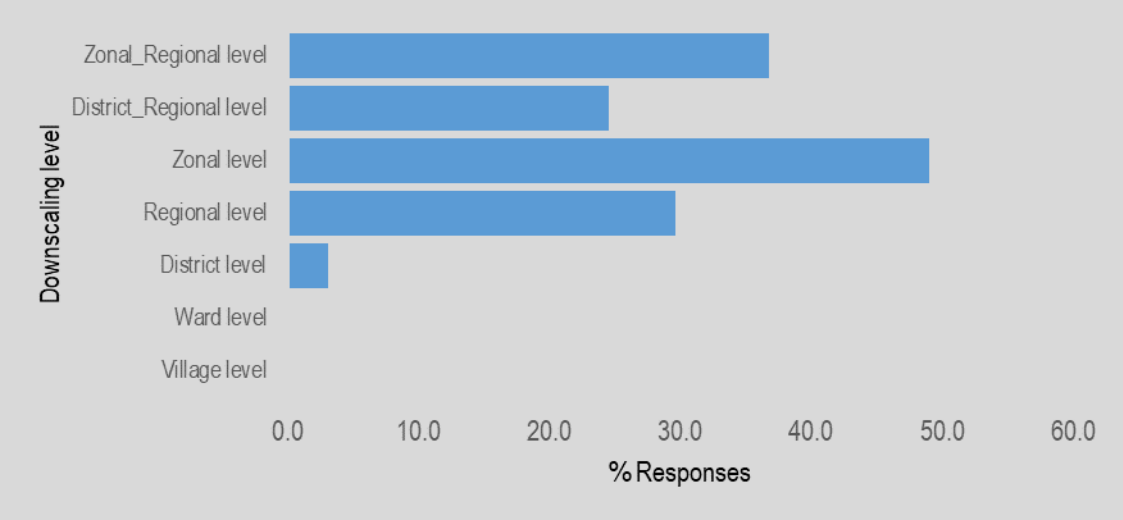

Figure 35. Respondents' comments on TMA weather forecasting downscaling level

3.3.4. Indigenous Knowledge (IK) and Climate change

This section aimed at establishing the relationship between Indigenous knowledge and climate prediction as it contributes to community's awareness and in the socioeconomic undertakings in Lushoto district. The section dwelled on issues related to use of IK on climate prediction, sources, reliability, and key indicators of IK.

3.3.4.1. Awareness, Reliability, and Use of IK on Climate Services

The study found out that 43.9% of the 98 respondents confirmed to have awareness on the availability of IK climate services especially on weather prediction. 34.7% of these respondents were uncertain of the existence of IK climate services while only 21.4% stated that the knowledge does not exist in the village, area This group also associates the traditional weather forecasts with witchcraft practices among elders.

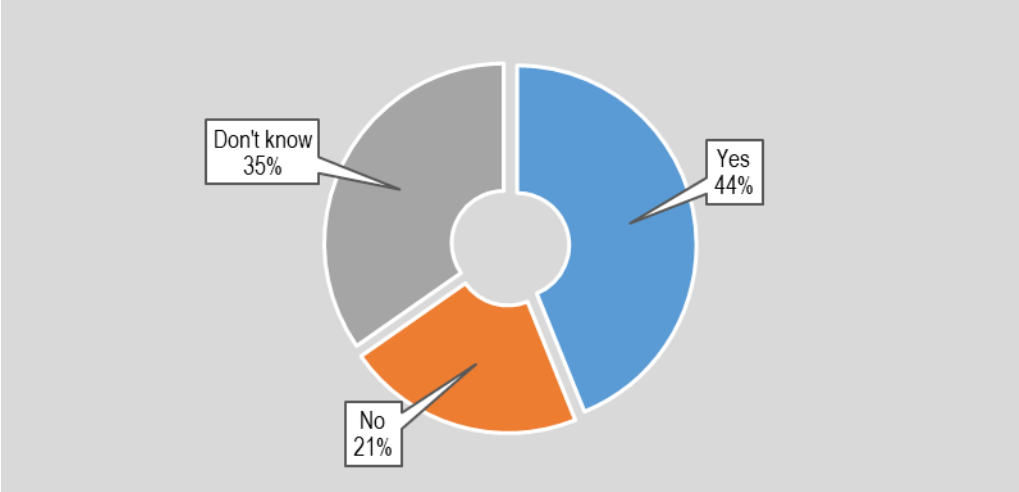

Figure 36. Proportion of responses on IK climate services awareness in the study area

In terms of reliability of the traditional climate services (Table 6.Reliability of IK climate services in the study area) 43.9% reported to know nothing about the reliability of the traditional weather forecast in the study while 31.6% said the services are not reliable. Only 14.3% of the respondents reported that the traditional services on weather forecast are reliable and play considerable role in livelihoods decisions and 10.2% said that somehow the services work especially prediction for rainy onsets and cessation as well as expected prolonged drought.

Table 6.Reliability of IK climate services in the study area

Answer	# Responses	Percent %
Yes	14	14.3
No	31	31.6
I don't know	43	43.9
Somehow	10	10.2
Total	**98**	**100**

On the other hand, 44.9% (Figure 37. Usefulness of traditional climate services in livelihood activities) of the respondents who confirmed the existence of traditional climate and weather services reported that they are useful and 21.4% believe that traditional weather forecasting is not useful in livelihood activities as of their belief linked with witchcrafts practices.

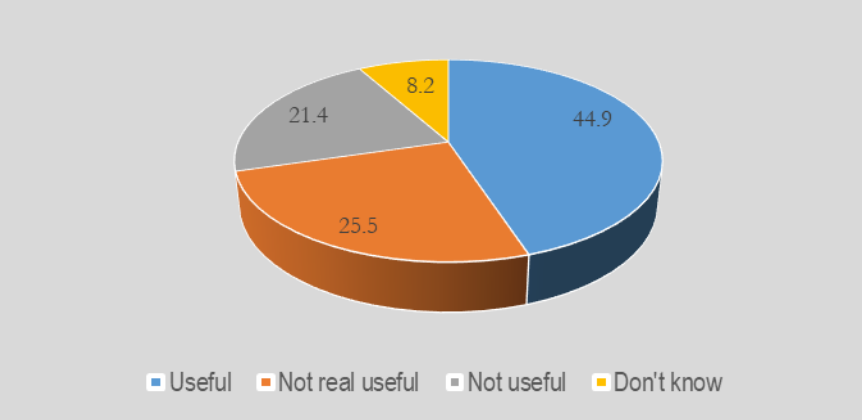

Figure 37. Usefulness of traditional climate services in livelihood activities

3.3.4.2. Sources of IK on Climate services

The study revealed that, elders (more than 50s) are the main source of IK expertise on climate and weather prediction in Lushoto district. This is attributed to the fact that elders have witnessed different climate-related phenomena over time as opposed to the youth. To confirm this situation, few elders with intensive knowledge and expertise in the study area on traditional climate services especially rain forecasting were frequently mentioned Figure 38. Renowned traditional rain forecasters in the study area.

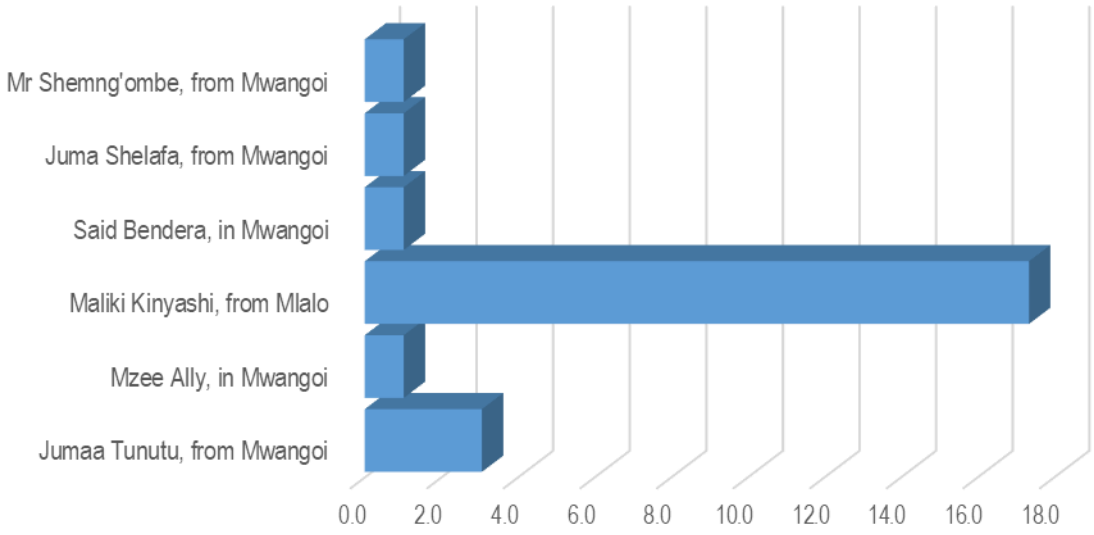

Figure 38. Renowned traditional rain forecasters in the study area.

3.3.4.3. IK Indicators on Weather forecasting in the Study Area

For an informed understanding, the study sought to establish different indicators (signs) that qualifies IK on weather and climate prediction. The study found out that birds, insects, animals, wind direction, and early flowering of trees are the most common signs (indicators) of IK on climate prediction. In the study area, birds and animals ranked high (60%) as the most common signs (indicators) used for climate prediction.

Table *7.* Traditional Weather prediction signs and Indicators in Lushoto district list of indicators and signs used by indigenous people to predict weather in the study area. The monitoring of the behaviour of the birds and animals is done informally and by people with time and experience, the community is informed on the weather prediction as per birds and animal behaviour.

Table *7.* Traditional Weather prediction signs and Indicators in Lushoto district

S/N	Indicator	Sign(s)	Weather prediction indication
1.	Driver ants	appearance in big numbers	indicates it will rain soon
2.	Ants	establishing in houses	it will rain the soonest
3.	Grasshoppers	increasing in fields	predicts moderate rains to start
4.	Pigeon and coucal birds	producing certain type noises	indicates the approaching rain season
5.	Wild bird (Shemkoko)	nocking at trees	good sign for the start of rains
6.	Salai birds	nosing	heavy rains coming
7.	Monkeys	appearance in fields	the coming of rains
8.	Rats	inversion of rats in houses and fields	indicates the coming of drought conditions
9.	Gorilla	appearance in fields	predicts upcoming heavy rains and good harvest
10.	Elephants	appearance	predicts the coming of rains
11.	Frogs	noises	predicts it will rain the soonest

3.4. Pangani District

Pangani is among the few districts along the coastline of Indian ocean in Tanzania, with major socioeconomics activities being fisheries, farming (commercial and food crops), animal husbandry (indoor and migration practice) and other petty businesses.

Coastal communities including those of Pangani are experiencing climate change impacts with expected escalation of the impacts soon which will lead into significant alteration of socioecological aspects of the coastal ecosystems. Coastal environment and communities are highly vulnerable to climate change related impacts including sea level raise, coastal erosions, increase of sea surface temperature, severe sea storms, coral bleaching, saltwater intrusion into fresh water aquifers and other socioecological system as amongst of the severe problem in coastal Tanzania (Uchida, 2019).

These challenges are likely to impair local efforts for sustainable development and poverty reduction. On the other hand, its poor population depend mostly on natural resources for their livelihoods including fisheries which makes them most vulnerable to climate change impacts, given their limited options and adaptive capacity.

3.4.1. Socioeconomic Activities and Livelihoods

Apart from other relevant findings, the study aims to explore on major socioeconomic and livelihood activities with respect to climate services. The undertaken study discovered that fisheries (51.38%) is the major livelihoods followed by subsistence farming (22.02%). Other livelihoods include petty business, dairy farming, casual labour, and cash crop farming. The standard deviation for the households' size (people living in the household during this study) is 2.3 with 5.2 mean size while number of dependent per household; 1-2 (31.19%), 4-6 (49.54%), 7 and above (15.6&) and 3.67% had no dependent of the interviewed households. Out of the interviewed the Activities indicates relative distribution of livelihoods activities in the study area.

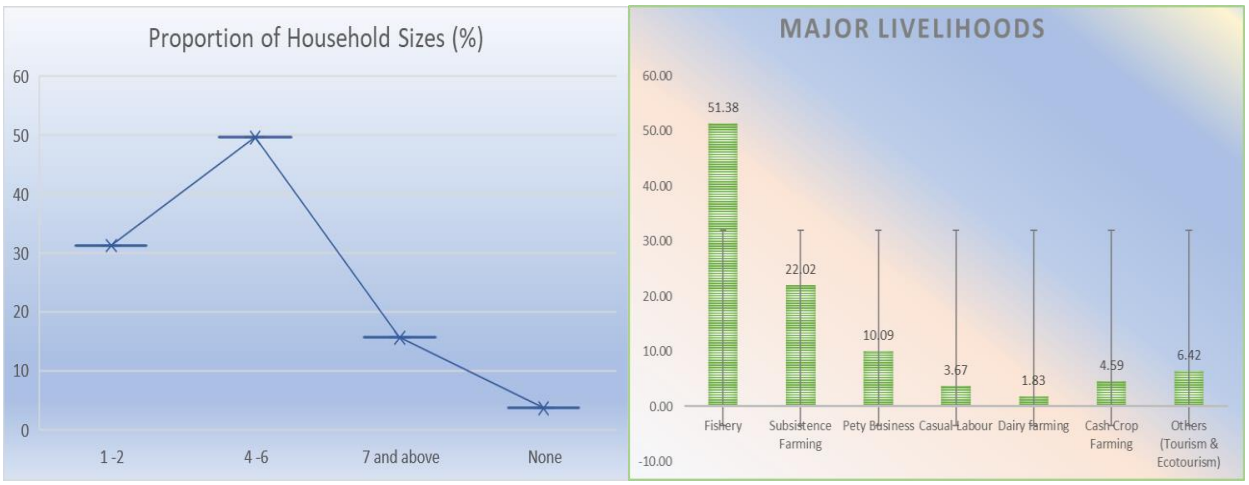

Figure 39. Proportion Household Size Socioeconomic Activities

On roles played by the households for the explored socioeconomics; open sea fishing is mainly undertaken by men (>60%) with female mostly working on inshore and species-specific fishing, processing, and selling of fisheries products, animal rearing discovered to be gender neutral, Figure 40. Proportion of Roles Played by Household Member to Respective Socioeconomic

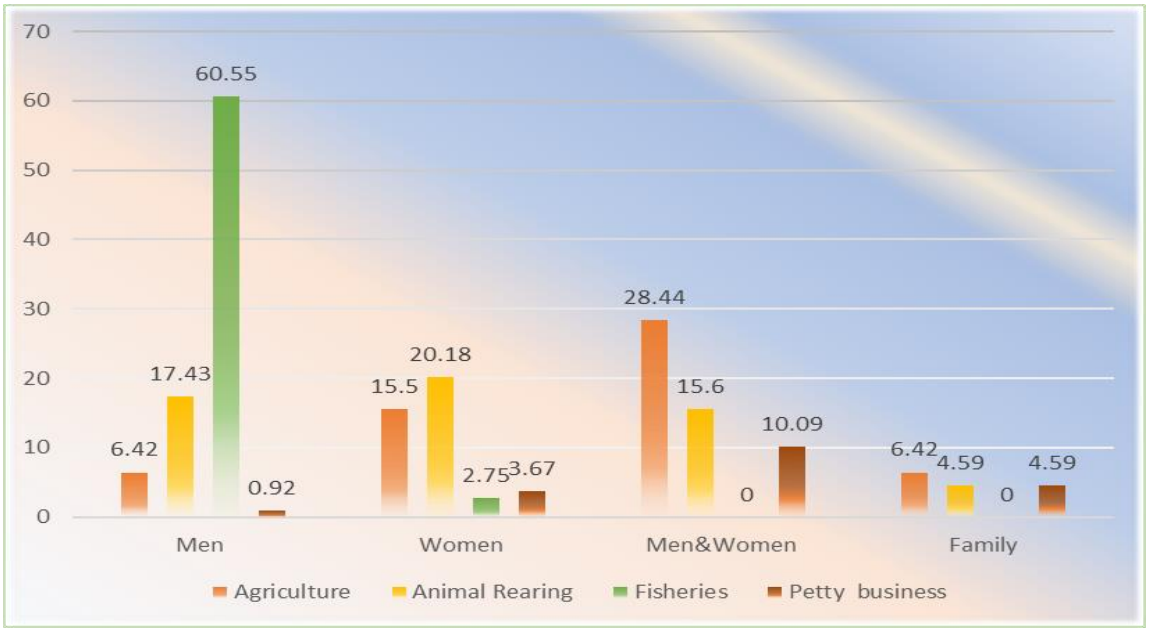

Figure 40. Proportion of Roles Played by Household Member to Respective Socioeconomic

Moreover, this study revealed that, the interviewees are mainly engaging into socioeconomic activities (climate for various reasons including; income and food, cater for their household needs, lack of capital that limit them to available options (affordability) and others being inherited from their ancestors

(fisheries, artists etc.). This study also revealed variation and changes in fisheries, animal rearing and agricultures production with respects to final produce. Out of the interviewed households, 57.80% indicated the decrease of products, 35.78% indicated moderate form while 5.5% and 0.9% of the respondent show an increased and no difference for the produces over the past 3 years respectively.

These findings were also complimented during focus groups discussion and key informant interview where participants reported decline of livelihoods produces specifically fish catches in the study area. Out of the respondents 59.63% show severely level of climate change effects while 33.94% show moderate level of effects. 4.59% and 1.83% shows low level of effects and no effects respectively. Uncertain climate conditions including sea level raise, coral bleaching from increased sea surface temperature and storms recurrence and turbidity coupled with lack of capital for investment were revealed as a reason behind communities' vulnerability thus setback for inclusive socioeconomic transformations in the study area.

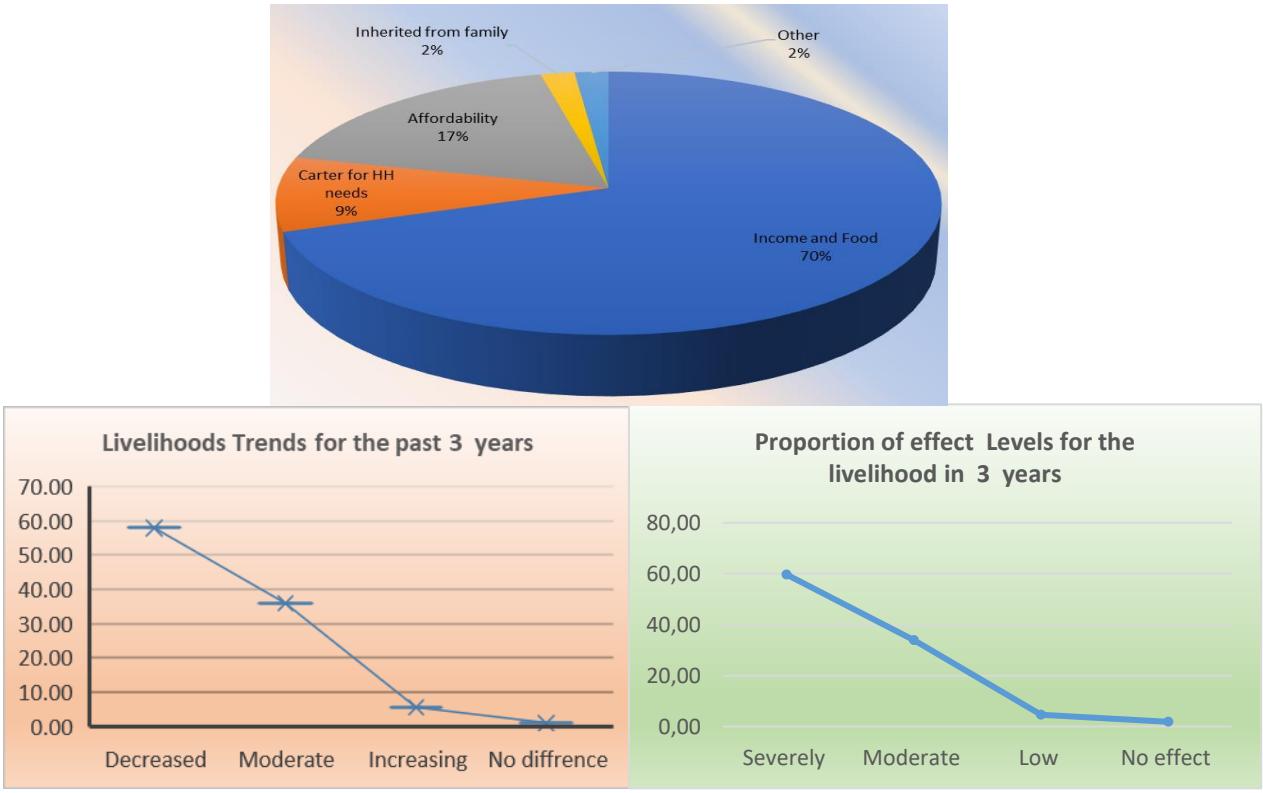

Figure 41. Proportion for engagement, trends, and level of effect to livelihood from changing climate

3.4.2. Challenges of Climate Change in the Study area

Like other parts of the country, Pangani District is also experiencing climate change challenges. Feedback from the study area revealed that the area is experiencing the number of climate related challenges including uncertain rainfall patterns, prolonged droughts, floods, sea level raise, coastal erosion, saltwater intrusion into fresh water resources, wind speed variability, unpredictable sea storms, coral bleaching from increased sea surface temperature, outbreak of pests and diseases. Awareness on climate change revealed that 88.99% of the respondents were aware of the changing climate that linked to frequently climate change related challenges, Figure 42. Proportion Understanding of Climate Change and Major Related Challenges.

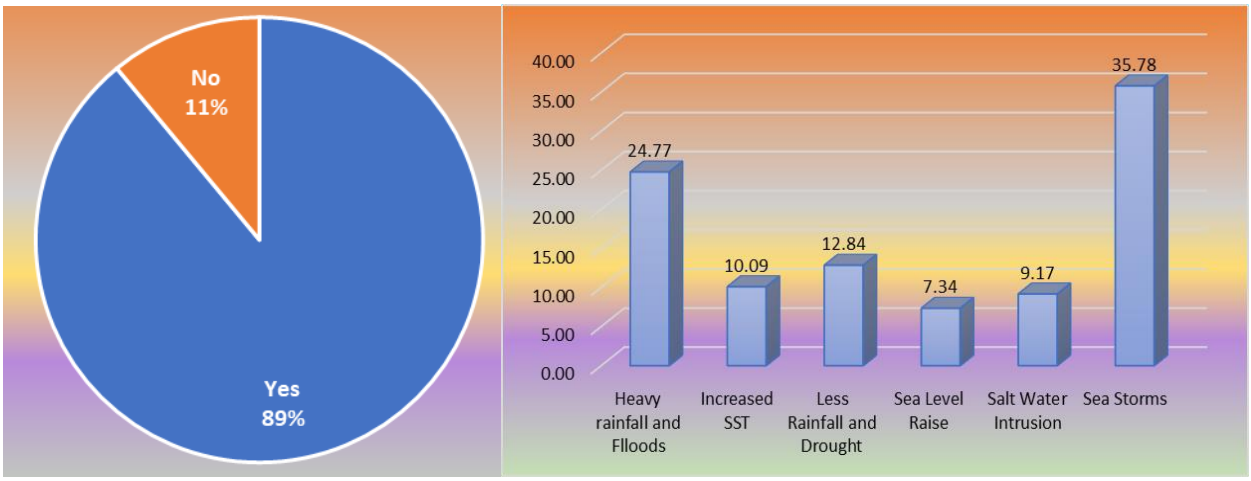

Figure 42. Proportion Understanding of Climate Change and Major Related Challenges.

These climate challenges have affected livelihood options in the study area leading to general economic underdevelopment of the community. Farming activities are also affected by both drought and floods. climate signpost proportion of the livelihood's trends and effect levels with respect to climate change related challenges in the study area.

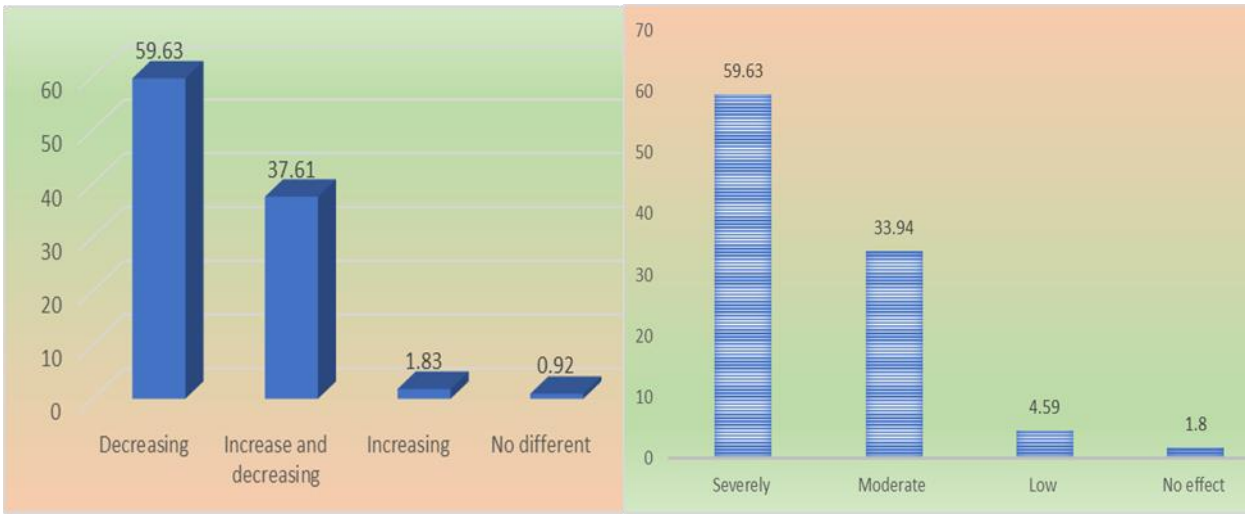

Figure 43. Proportion of livelihood's trends and effects level with respect to changing climate

Capacity to cope and adapt to climate change challenges remain a major challenge in the study area Women and old people are the most vulnerable group due to their social constructed roles and responsibilities but also their limited mobility that limit their exposure to potential and available adaptive options including technology and capital. In the study area common coping strategies include switching to alternative livelihoods (petty business such as small shops/kiosks and *bodaboda*) for youth and food vending for women and girls.

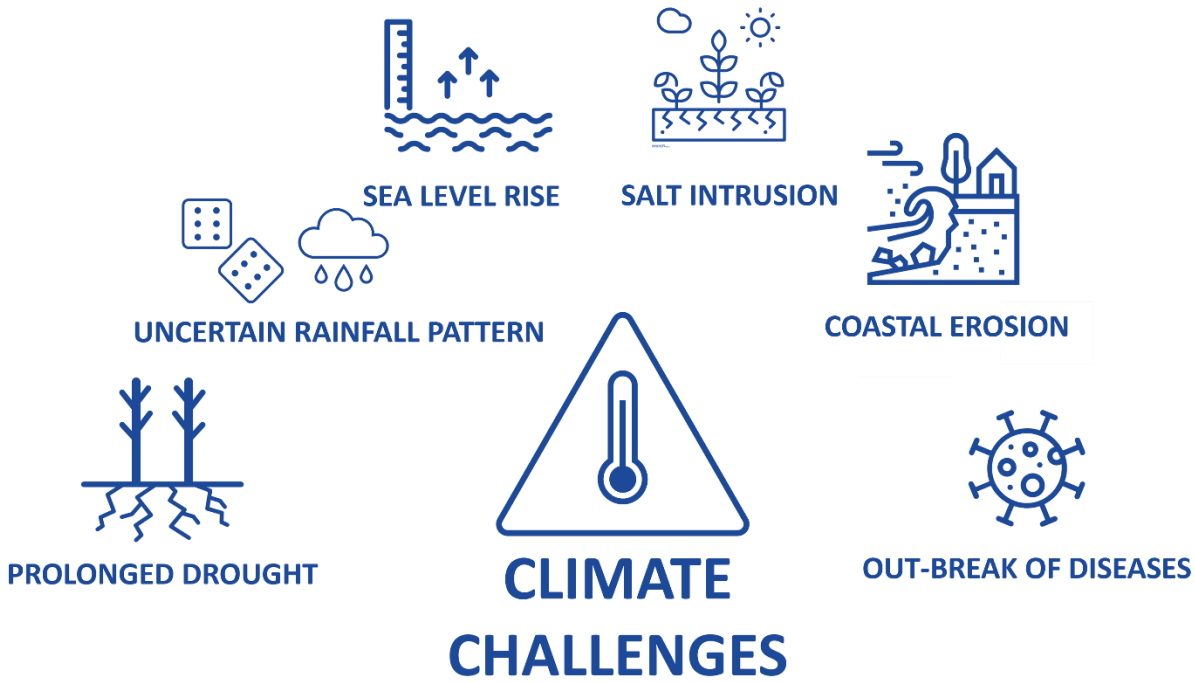

Figure 44: Climate Change challenges reported by smallholders in Pangani.

During the FGDs, men reported being migrating to potential areas where they can access other options for livelihoods. In some cases, this led to abandoning their families. Other coping strategies important to document include cut-off some spending, diversify livelihoods (opting for petty business, poultry, casual labor etc) while others were doing nothing but to tolerate the situation hoping for recovery.

3.4.3. Climate and Weather Services

This section of the study pursued to assess the situation of climate and weather services in the study area with respect to access, sources, usefulness, and reliability.

3.4.3.1. Access and Sources

The study revealed that 63.3% of the respondents in the study area often (35.78% daily) acquire climate and weather services from both TMA and IK, 8.26% rarely access this information and notably 29.36% have no access to this information at all. This information is mostly accessed through various media including TV, Radios, newspaper, storytelling (word of mouth) and FarmSMS (mobile) (Figure 45. Proportion for acquiring weather and climate services).

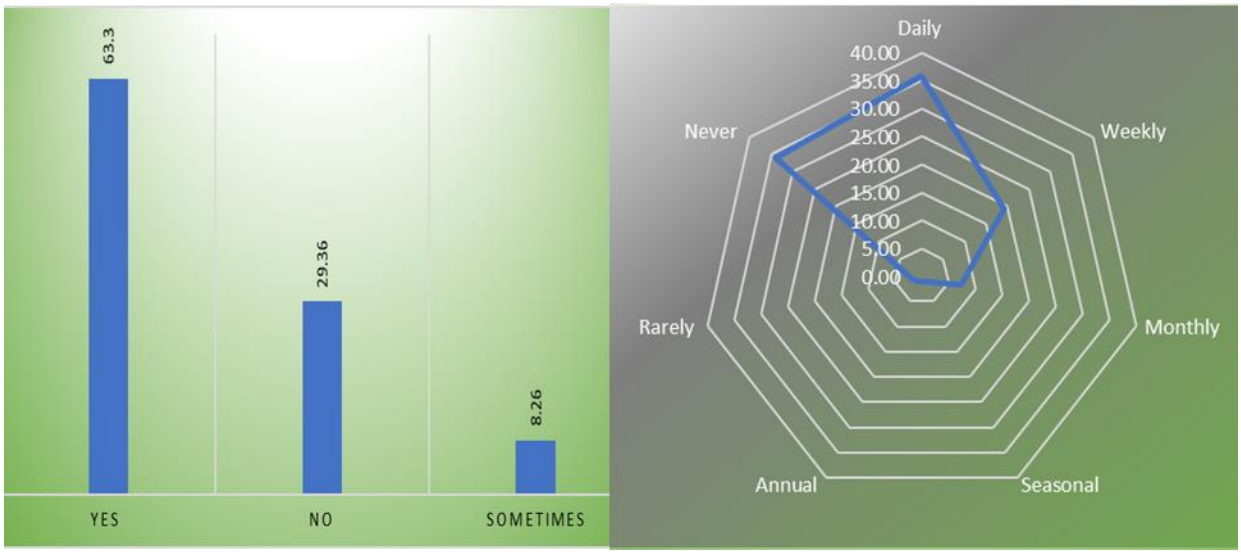

Figure 45. Proportion for acquiring weather and climate services

In terms of sources and means of accessing weather and climate information, the study found out that TMA and elders (IK) are the two major sources of climate and weather services. Out of the

respondent 61% claimed to get climate and weather forecast information from TMA while 32% receive from elder (IK) and the remaining 7% have no clue at all with regards to these services. Moreover, out of the interviewed households, 81.65% affirmed to access this information through radios and/or TV, 11.93% mobile phone SMS. 2.75% of the respondents reported to access this information through storytelling. Information shows the distribution of respondents in terms of access to weather and climate information.

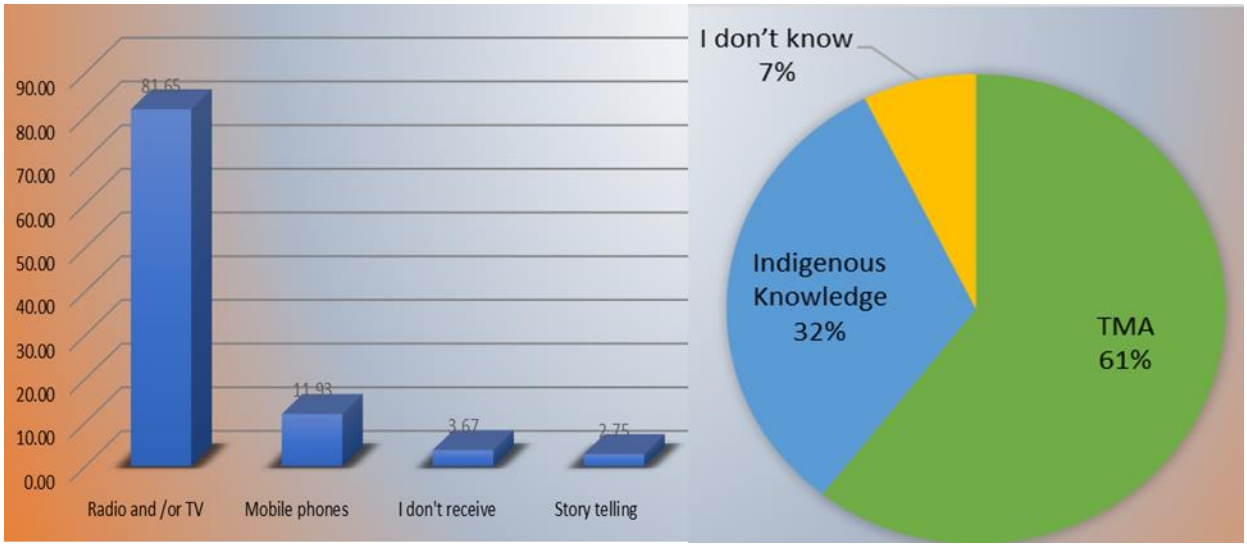

Figure 46. Proportion Source and Means of Acquiring Weather and Climate Information

3.4.3.2. Usefulness and Reliability

The study showed that the conventional climate and weather services from the TMA and that from elders (IK) are very useful specifically on informing communities´ socioeconomic and livelihoods activities. However, in terms of reliability, out of all the respondents, 76.33% claimed that the information provided by elders (IK) are more reliable compared to 23.67% who claimed conventional climate weather forecasting (TMA) being reliable (Figure 47. Reliability and Usefulness of Weather and Climate Information from TMA and Elders (IK)).

This confirms Mahoo et al. (2015) findings that over 90% of respondents were aware of the indigenous weather and climate forecasts and were useful in planning their agricultural activities. In the same study end users (56%) believed that the IK forecasts were reliable compared to scientific forecasting. Respondents mentioned the reliability IK information based on its realistic, timely and area specific

compared to that of TMA which covers wider areas (mostly zone-based) and not area specific (not downscaled).

A study by Chang'a (2010) undertaken in the south-west highland reported about community being relying on forecast information from IK than that from the conventional weather forecasting here in Tanzania referred to TMA. These findings, disclose the demand for the downscaled weather forecasts by smallholders specifically fisheries as of its location specific. However, the country systems (TMA) face challenges, including technology investments which hinder timely, accuracy and reliability of share forecast which is likely to affect livelihoods planning specifically to smallholders, the size of the country, with highly remote areas affect access and utilization of the weather forecasts (Irish Aid, 2018)

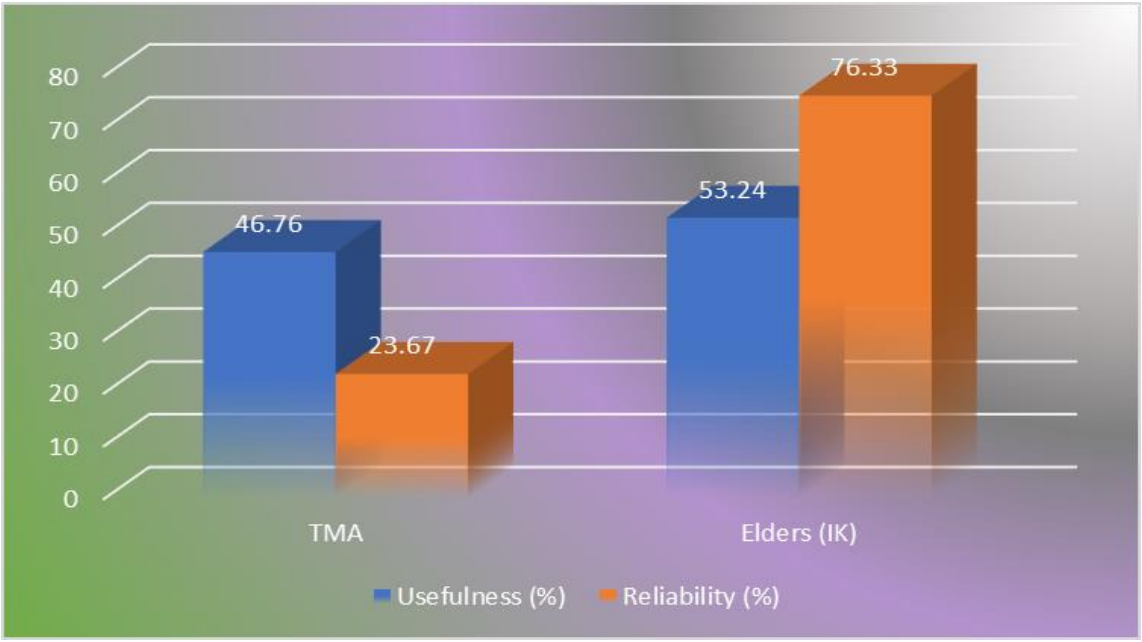

Figure 47. Reliability and Usefulness of Weather and Climate Information from TMA and Elders (IK)

3.4.4. Indigenous Knowledge and Climate

The local weather and climate are measured and projected by locally observed variables and experiences using combinations of indicators including wind direction, plant phenotypes, animals, insects, and astronomical indicators. This section aimed at establishing the relationship between IK and climate prediction as it contributes to community's awareness and in the socioeconomic undertakings. Indigenous knowledge on weather and climate forecasting used mostly by natives

especially fisheries communities mean of informing and making vital decisions for their livelihoods against climate change related weather variability.

In the study area of fisheries communities, IK weather and climate forecasting remains the greatest accessible and affordable source of weather and climate information. Elders not only keep records of the weather and climate scenarios experienced but also get feedbacks from a continuously changing relationship for the noticeable variables/indicators and unnoticeable changes in weather and climate so as to unceasingly updating and enhance their knowledge. The section resided on issues related to use of IK on climate prediction, sources, reliability, and key indicators of IK.

3.4.4.1. Awareness and use of IK on Weather and Climate Predictions

The study found out that 77% of the respondents were aware and found IK to be useful on climate prediction. 23% of the respondents were neither aware nor sure of the importance and use of IK on weather and climate prediction. 66.06% of the respondent reported the usefulness of IK while 11.01% of the respondents said that IK was not useful at all on weather and climate prediction in the study area. This might be attributed to the nature of the households interviewed being young family. Livelihoods. Shows the distribution of respondents as interviewed on the aspect under consideration.

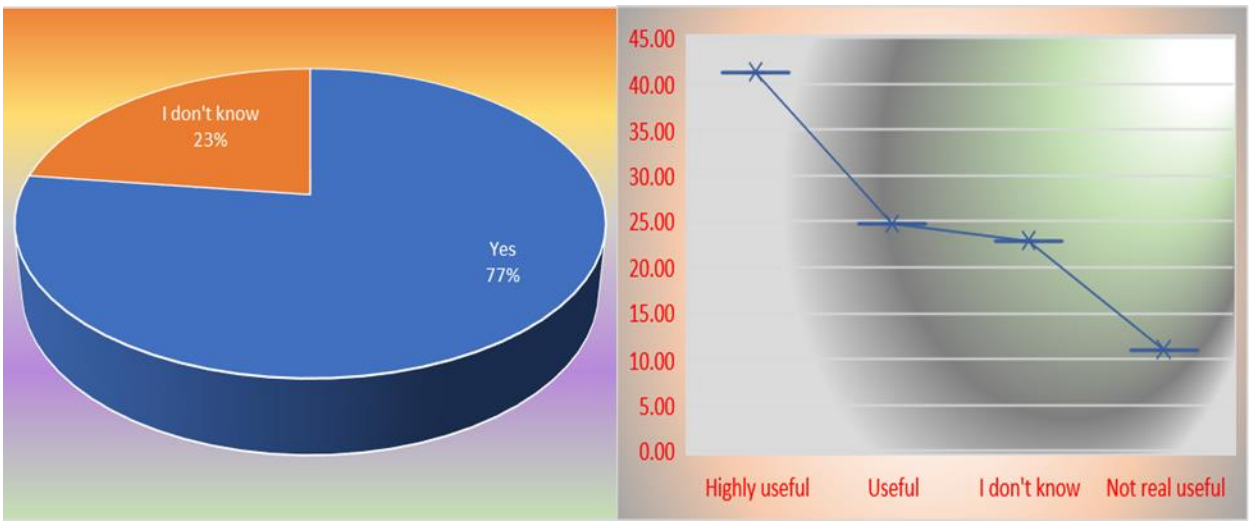

Figure 48. Awareness on Traditional Weather Forecasters and Its Contribution to Local Livelihoods.

3.4.4.2. Sources of IK and Reliability

Indigenous knowledge centred on observed changes in weather phenomena, physical variations on trees (flowering, shedding of leaves, etc.) and behaviours of certain animal species (birds, amphibians, insects, and arthropods). The study revealed that, elders being the main source of IK on weather and climate prediction in the study area specifically for coastal communities on fisheries practices. This is attributed to the fact that elders have witnessed different climate-related phenomena over time that linked to major socioeconomic activities as opposed to youth.

It is worth noting that, the information provided through IK report on start and intensity of rains within a given season and are seen to be reliable and trustworthy by the community for weather and climate prediction in the area. It is since, elders (IK) provide timely, realistic and area specific

3.4.4.3. Indigenous Knowledge Indicators

For an informed understanding, the study sought to establish different indicators (signs) that qualifies IK on weather and climate prediction. The study found out that birds, insects, animals, wind direction (south and north monsoons), clouds cover, fish coloration, and early flowering of trees are the most common signs (indicators) of IK on climate prediction in the study area. In the study area, wind direction and clouds cover ranked high 44.95% and 29.36% respectively as the most common signs (indicators) used for climate prediction for fisheries community (Figure 49. Common Indicators Use for Indigenous Weather and Climate Forecasting).

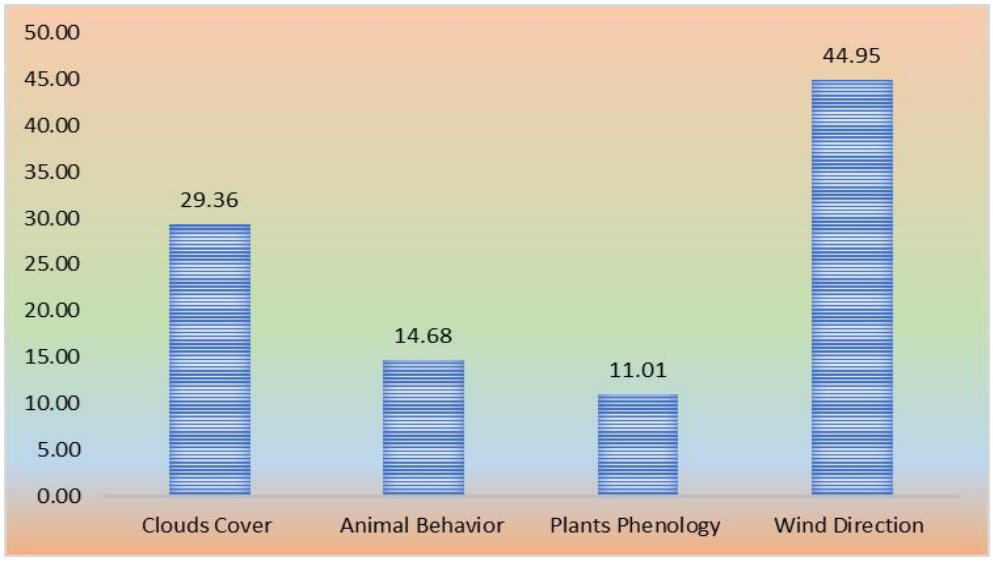

Figure 49. Common Indicators Use for Indigenous Weather and Climate Forecasting

3.4.4.3.1. Variation of Tree Phenology

The study revealed that, some of the plants are used as weather and climate prediction indicators (signs) as of the changes as a result of approaching weather and climate condition. These includes tree flowering with respect to approaching raining seasons, leaves shedding as an indication of drought or less rain is approaching. IK prediction in respect to tree varies from species to species and place to place as plants affected by weather and climate varies topography and other environmental features.

3.4.4.3.2. Animal Behaviors

The study explores that, IK uses animal behaviors to foresee the approaching weather and climate conditions. The observation is linked to changes in feathers of birds, reproductive and browsing behaviors also movement and appearance of ants and insects including butterflies. Animals have instinctive capabilities of sensing and detecting understated changes in environmental variables and anticipate different natural events including climatic and geological events, whereby changing their behaviors including reproduction, migration and feeding to cope with weather and climate variation. Some of the animals showing signs of distraught and uneasiness indicate impending approaching of stressful weather and climate conditions including flooding or droughts.

For coastal and fisheries community, appearance of certain birds flying and aggregated over certain fishing ground, indicates a sign of large schools of fish or the upcoming migration of school of fish

to certain area like estuaries as of approaching certain weather condition (onset and cessation of rainfall), water pools or upwelling of benthic dweller fish species.

Estuaries receives massive upstream flow of nutrient and food stuff for marine and coastal creatures during rainy season, so migration of marine creature towards and/or from estuaries indicates rain onsets and/or cessation. *'When I spot a groups of heron birds diving in a certain reef that's the sign of reef fish migration, so I go for them and set my fishing gear at that ground'* said a respondent at Ushongo village. IK uses these signs (indicators) to predict upcoming weather and climate conditions including.

3.4.4.3.3. Wind Direction and Speed

Traditional forecasters from coastal and fisheries communities uses wind direction and speed as a sign of approaching certain weather and climatic condition and/or seasons. Coastal traditional forecasters observe and use the direction, strength, force, and duration of winds that blow at different seasons to quantify incoming weather and climate conditions. Elders characterize or use wind based on timing, directions, strength, humidity, and speed. Each of the coastal winds (southeast and northeast monsoons) has unique characteristic and describe different weather and climate condition that informs fisheries and other livelihoods practices of the community in the study area.

Table 8. Traditional Weather prediction signs and Indicators for fisheries communities in Pangani district

S/N	Indicator	Sign(s)	Weather prediction indication
1.	Driver bird in the ocean	birds diving for fish	indicates sensation of rain season
2.	Ants	carrying food stuff	sign of hunger in next season
3.	Grasshoppers	increasing in fields	predicts moderate rains to start
4.	bird flying groups	producing certain type noises	indicates the approaching rain season
5.	Cloudy cover (dark)	nocking at trees	good sign for the start of rains
6.	Cloudy cover (white and transparent)	nosing	heavy rains coming
7.	wind direction (southeast and northeast monsoon)	direction and strength of each wind	wave strength and types of fish to be fished, timing for fishing too
8.	Wind	Strong wind	Indicate less rainfall in the next season
9.	Rats and cockroach	inversion of rats and cockroach in houses	indicates the coming of drought conditions
10.	High temperature	too hot during day and nighttime	signify near rainfall onset and prospect of good rain seasons

11.	Frogs	When frogs start to make a lot of noise,	it indicates near rainfall onset
12.	Tree phenotypes	Shedding leaves	Approaching hot season
13.	Tree phenotypes	Nourishing its leaves	Approach rain season

CHAPTER 4

Discussion

As presented in the previous chapter, findings from this study point out different important directions regarding the role of climate services on enhancing adaptation among end users (small scale agriculture, fisheries, pastoralism) in the project areas as well as needs for institutional capacity to influence climate services and renewable energy policy processes in Tanzania. Summary of key findings across the districts is presented thematically below:

4.1 Socio-economics activities

As noted earlier, socio-economic and livelihood activities varied significantly based on the social cultural, socio-economic, and geographical location underpinnings. On this basis, subsistence farming and petty businesses are the major socioeconomic and livelihood activities in Bagamoyo, Chalinze and Lushoto. In Pangani, fishing and preparation of mats were observed to be the key socio-economic activities. Beside these two separate categories of economic activities, there are several other socioeconomic activities implemented by communities in all study districts including dairy farming practiced by few households, wage labour, goat rearing and poultry. Still, both socio-economic and livelihood options are highly climate sensitive.

During discussions in the focus group participants pointed out the evolving transformation among youth whereby interests have shifted towards *BodaBoda* as opposed to all other socio-economic opportunities such as farming and fishing. With regards to allocation of tasks and distribution of labour the interviewee revealed that women are more engaged in agriculture compared to their male counterparts who concentrate on petty businesses and livestock keeping activities

4.2 Climate Change Related Challenges in The Study Area:

Ever increasing frequencies of droughts, floods and sea level rises, reveal significant vulnerability and exposure of smallholder farmers, pastoralists and fisher folks. Challenges related to climate change such as droughts and floods alter food production, water supply and access. Since, most of community livelihoods are climate sensitive any change in rains and temperature is quickly sensed. Some of the challenges are linked to increased food prices, food insecurity and water challenges.

As revealed in chapter three, all study areas are experiencing climate change challenges. Majority of respondents from all project areas confirmed presence of climate related phenomenon ranging from uncertain rainfall patterns and seasons, reduced rainy intensity, floods to increased disease and pest outbreak for crops.

In addition to the above impacts, Pangani, being as a coastal district faced additional climate change threats including sea level raise, severe coastal erosion, wind speed variability, unpredictable sea storms, coral bleaching from increased sea surface temperature and saltwater intrusion into freshwater aquifers. Evidence from this study show that all study districts are already experiencing resource use conflicts resulting from decreasing resources against increasing resource demands and partly population increase. This experience was particularly evident in Chalinze district between farmers and pastoralists.

Out of the interviewed respondent in all four districts, majority of them revealed and qualified the above information: 60% of the interviewed households in Bagamoyo; 58.72% households in Chalinze; 60% in Lushoto and 88.99 in Pangani district. According to these responses, the vulnerability of these communities to climate change challenges is exacerbated by over dependence of climate sensitive sectors including farming, livestock keeping and fishing.

Moreover, despite of the knowledge of climate change threats, communities in these districts have limited knowledge on how to address the growing climate change challenges due to perceived complexity of the matter but also limited access to frequent and adequate information on adaptation options. These show the need for urgent and deliberate and continued interventions to educate these communities on alternative ways of coping with the changing climate and securing livelihoods through practical and affordable climate response solutions at the community level.

4.3 Climate and Weather Information Services in the Study Areas

As revealed in chapter 3, a vast majority of interviewed participants received climate and weather information services albeit with different contexts, for instance, in Lushoto and Chalinze districts, 79.6% and 61.5% of interviewed participants confirmed to receive climate and weather information respectively. On the other hand, in Pangani and Bagamoyo the proportion of interviewees who accessed such information was reported to be 63,3% and 83% respectively.

Despite variation in information access rates, communities in study districts were found to access information from common sources which are predominantly Radio followed by TV and social gathering and/or storytelling from neighbours and friends. There was also a very small number of respondents (i.e.<10%%) who receives climate and weather information through their phones (Farm SMS notable in Lushoto). This indicates that the use of phones (sms) to access climate services is still limited even though many people in rural areas have phones. The few respondents who mentioned to use of SMS is those who took part in the first phase of CAN Tanzania project.

For communities receiving information from radio, TV and mobile phone sources, TMA was found to be the dominant source of such information while Indigenous knowledge (IK) was reported to be the main source of information to old people. Most of information communicated, climate services information communicated include start of the season, the possible amount of rainfall in the season and end of the season. For IK, the use of animals and insects could also determine start of the rains, intensity, and possible droughts. Despite variation geographical and climatological conditions, study districts were found to have almost common IK indicators such plants, ants, birds, and winds. Sources for IK forecasts were from friends and family members who had relevant knowledge.

Moreover, regardless of the source and rates, the frequency of accessing climate and weather information also varied considerable among communities in the study districts. Some communities received it either seasonally and or monthly while others received it daily. The later was typically the case to those with access to electricity (to charge radios) and TV services.

Concerning relevancy, preference and usefulness of the climate and weather information received varied with locations in relation to the main source of livelihood in the area. For instance, in agricultural and livestock keeping dominated districts (e.g., Chalinze, Lushoto and Bagamoyo), rainfall and droughts were the most important sets of information used by smallholder farmers and pastoralists. Conversely, wind, temperature and rainfall were the most important data sets for fishing communities in Pangani district.

In the case of reliability, there was mixed opinions on the reliability of climate information provided by the sources typically TMA. Some respondents in all districts registered some reservations without scientific justification, arguing that TMA information was less relevant partly due to lack of localized

(i.e. ward/district level) weather forecast as well as limited provision of practical advice to farmers in light of climate forecast.

As a solution, interviewed participants reported use of combined scientific and IK in planning their responses. IK was considered more reliable and useful (by older people) as it is timely and local specific compared to conventional forecast from TMA which is still too general and sometimes comes a bit late. The challenges which were reported to be facing both IK and conventional information from TMA were lack of long-term forecasts which could beyond seasonally forecasts.

4.4 Lesson Learnt

Important lessons from the analysis of climate and weather information in study areas are that there is limited interaction and engagement between TMA and traditional forecasters. There is also limited interactions and engagements between climate services/products providers and end users especially during and after forecast. This trend limits both access and having accurate interpretation of climate services shared and hence limits farmers to take informed decisions on livelihood options a situation that further limits production choices.

The results showed that a participatory approach could achieve integration in designing and using a mobile application in agriculture to achieve sustainable development.

There is an urgent need for ensuring inclusivity, integration and provision of localized, regular and long-term climate services that are relevant to the key livelihood occupations. Another lesson is the fact that, although undocumented, IK still play an important role in informing communities' planning and response to changes in weather and climate variability. This suggests the needed for blending scientific and traditional weather forecast to provide optimal climate information that is suitable to communities in different settings.

Further, lesson is the fact growing rates of environmental change due to degradation of habitats and climate change pose significant challenges to indigenous adaptation options and thus raise their vulnerability levels with increase climate change challenges. It is therefore important to integrate both scientific and indigenous knowledge approaches for reducing vulnerabilities and getting better results which is important for guiding smallholder end users in making critical farming and fishing decisions.

CHAPTER 5

5. Conclusion and Recommendations

5.1 Conclusion

Challenges linked to climate change impacts are more evident among the smallholder farmers, fisheries, and livestock keepers due to their low adaptability capacity and the exposure of their livelihoods. Unpredictability of rains and seasons, increasing minimum and maximum temperatures, short-lived and above normal storms in the recent years in Bagamoyo, Chalinze, Lushoto, and Pangani districts is highly reduce the productivity of the livelihoods and hence impeding the efforts against poverty and sustainable development.

Globally, weather and climate information services have been recommended as one of the working mechanisms to minimize the risks associated to impacts of climate change as well as enhancing resilience and adaptability of communities and their livelihoods. According to this baseline assessment, weather and climate information services in the districts is still a challenge in all aspects including generation, quality of the services, dissemination, and end utilization among communities' particular smallholders (farmers, fish folks and pastorals). Although, the TMA has improved greatly in the generation and dissemination of the modern weather and climate forecast services, rural communities and extension workers have reported weaknesses in the reliability, downscaling, translation and livelihood advisories.

On the other hand, traditional knowledge and expertise in weather forecasting has been identified as an important mechanism which has been helpful in livelihoods decision making since the immemorial. Large proportion of the people in the study area admit having been relying on certain traditional indicators and signs in their surrounding natural environment to predict the future weather/climate which is likely to affect their socioeconomic undertakings. Although difficult to prove scientifically on the reliability and truth of the prediction, communities believe that it has been helpful. However, there is a worry that the availability and utilization of this IK will soon perish because the young people are not interested in knowledge and associate it with the witchcraft practices.

Even though, climate services seek to support and allow decision makers and users to take informed decisions on their livelihood options for short and long term, there are still challenges that, there is no

inclusivity and engagement between the communities of climate service providers and users. This limits accurate interpretation and use of the information shared.

Generally, weather and climate services in Tanzania and the study area is still a new discipline and has not yet significantly contributed to the fight against poverty nor facilitated the resilience to climate change impacts. There is a challenge in the general community awareness on the services and national framework for climate services. TMA being the leading national figure in the aspect, has not yet received required support from both the public and private stakeholders to accelerate the agenda.

5.2 Recommendations

5.2.1 To the TMA

The climate resilience of communities can be enhanced by strengthening Climate Services (CS) disseminated by TMA. To strengthen CS downscaled CS (more area specific) and increased interaction with end users (co-production & feedback).to ensure that useable and actionable climate information are disseminated. Useable and actionable information can inform and initiate adaptation activities.

Improved access to CS by establishing new dissemination channels for CS (SMS & Community Radio) can increase use and uptake as well as unlock the potential for fast real-time user feedback and interaction.

The integration of indigenous knowledge (IK) into CS is key to get downscaled and useable forecasts.

Additionally mainstreaming CS into national planning and budgeting is elementary to locate the necessary resources for improving CS disseminated by TMA

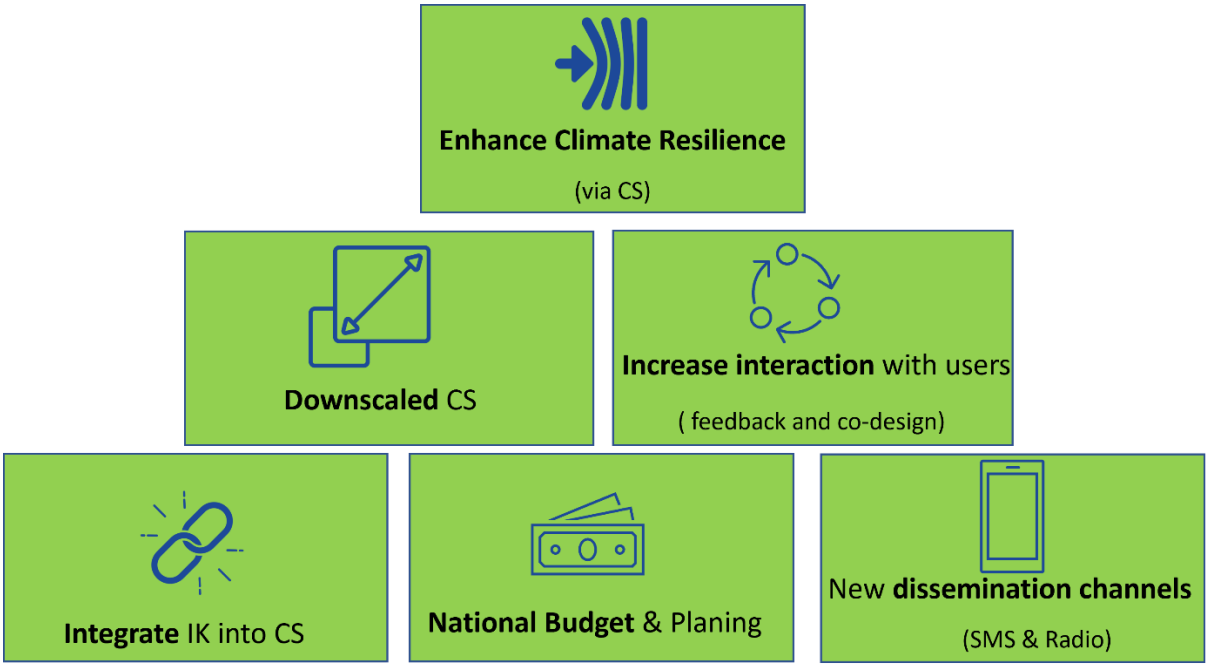

Figure 50: Building up climate resilience communities by strengthening Climate Services (CS): Key recommendation to TMA to strengthen CS.

Increase interaction with users (co-production & feedback)

It is also important to make sure that, the target end users are taking part and engaged in the process of designing and producing climate services to increase the trust, co-production, and dissemination of climate services. The engagement should also include on opportunity for end users to give feedback on how useful the forecast was given.

Downscaled Climate Services (useable & area-specific)

End users (especially farmers, pastoralists, and fish folks) need weather and climate information that show onset of the rain seasons, intensity of the rains in the season, temperature and wind speed and directions. The provided weather and climate services remain important for end users to decide on when and type of crops to grow (farmers), where to go/do in case of droughts (pastoralists and farmers) and when and which directions we should go for fishing in case there is wind and or high temperature. TMA and stakeholders should make sure that, this service should remain areas and end users specific possible to allow accurate interpretation and use.

Integrate Indigenous Knowledge (IK) into Climate Services (CS)

It is recommended that, there should be deliberate efforts for TMA to interact and work with IK right from the design, establishing interpretation and forecasting of weather and climate information to ensure ownership, timely accurate and access of the products by end users.

Establish new dissemination channels (SMS & Community radios)

Since some of the smallholders (30%) in these rural communities have no access to TVs and Radios and in many cases difficulty to follow weather forecasts in these channels, facilitating access by the use of simple text messages through mobile SMS system and community radios should be emphasized.

Include CS in national planning and budgeting

The national policy and planning system should consider climate services as an important information and services for end users that help them to make informed decisions on their livelihood options, plans and hence increase climate resilience. TMA should be capacitated and supported to have state-of-the-art technologies for enhancing the downscaled and or local specific weather and climate information services in the country.

5.2.2 To the Local Government Authorities

District governments are directly responsible for ensuring the development and the wellbeing of communities in rural areas. They are supposed to increase the capacity and service of extension workers on CS to support smallholder communities with appropriate weather and climate advisories to reduce the risks. It is important for these institutions to cooperate with private sector such as NGOs and CSOs, Ministries and Agencies, development partners and private sectors (cooperates) as well as media to effectively addressing climate change challenges in farming, fisheries, and livestock keeping.

5.2.3 To the Civil Societies

Civil societies play important role in development initiatives in Tanzania especially in rural areas. However, their work has not put priorities on climate and weather services for increasing resilience and adaptability of communities. It is recommended for NGOs, CSOs, FBOs, and CBOs to adopt climate action initiatives like working with TMA in facilitating participatory integrated climate services which is important for guiding livelihoods decision making to end users.

5.2.4 Communities

Enhance and maintain transition of IK to young generation

Indigenous knowledge is important for socioeconomic development. Traditional weather and climate forecast has been an instrument for local climate change adaptation and resilience. To avoid the disappearance of this important knowledge in the current climate change era, it should be enhanced and maintained by ensuring IK transition to young generation.

Raise awareness for importance of IK

This should go hand in hand with bridging existing gap with TMA in production, interpretation and dissemination of products. The youth should be educated on the importance of traditional knowledge and use their phones to enhance climate change adaptation and adoption of both conventional and IK services for effective climate services informed livelihood planning and execution.

Establish and support new dissemination channels (SMS & radio)

Majority communities seem to use radio (majority), television and phones to access climate services from TMA. However, complains exist that the information shared come late and sometimes in few radio stations. It is recommended that, efforts to use both local radio stations and phones to be given priority and enhanced so that many end users can have access.

Enhance understanding of CS and climate change challenges

Like in many parts of Tanzania, in the study areas, end users (farmers, pastoralists and fisherfolks) still have limited skills and motivation on the use of climate services to make informed decisions important for building climate resilience. This calls for this project to enhance the understanding of smallholders in the study on the use of climate services to increase productivity. This will also be possible if end users are part and parcel in the interpretation and dissemination of climate services.

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7.APPENDIX

7.1 Project Details of the Aligning project

This study was designed, conducted, and funded to inform the implementation of the program "*Aligning Climate Resilience, Sustainable Development and Poverty Reduction in Tanzania"*.

In efforts to support government initiative on climate change, CANTZ secured financial resources from Bread for the World Protestant Development Service to execute a three years' programme titled *"Aligning Climate Resilience, Sustainable Development and Poverty Reduction in Tanzania"* in four Districts of Pangani, Lushoto, Chalinze and Bagamoyo. The goal of this project is to contribute to the development of climate resilience and poverty reduction in Tanzania achieved through three interrelated objectives:

a) National planning and budgeting frameworks on energy integration and expansion of renewable energies (RE) by 2023.

b) Climate services contribute to the adaptability of end users (small scale agriculture, fisheries, and pastoralism) in the project areas by 2023; where this study have its focus to determine and assess the roles of climate services to the adaptability the project targeted smallholders in Bagamoyo, Chalinze, Pangani and Lushoto districts.

c) CAN TZ's institutional capacity to influence climate services and renewable energy policy processes in Tanzania has increased by 2023.

This project follows intends to build capacity of local populations and local government to enhance climate resilience and poverty reduction initiatives. It also aims at enhancing innovative climate information service solutions. The programme seeks to enhance the adaptability of smallholder farmers, fisheries, and livestock keepers in Bagamoyo, Chalinze, Lushoto, and Pangani districts by promoting the production, dissemination, and utilization of available traditional and conventional weather and climate services to facilitate climate-smart practices among smallholder communities.

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In 2020, the project entered the second 3-year phase to continue strengthening the numerous project activities initiated since 2017 in the aforementioned districts and RE policy advocacy at the national level. This baseline study was conducted to learn and assist the CANTZ project management and implementation teams to assess and understand the impact as well as mapping the existing community's conditions after the program phase I. It also intended to give insights and understanding of the current situations of community livelihoods, farmers' production systems, some community susceptibility to climate change impacts and challenges

More details and insight can be found on the website of CAN TZ: https://cantz.or.tz/programmes

7.2 Climate Policy Landscape in Tanzania

The Government of Tanzania has adopted several national, regional and international frameworks to address climate challenge and related environmental issues. At the national level, the government has developed various legal frameworks, National Strategies, programs and action plans including , the Environmental Management Act (2004), a NAPA document(URT, 2007), a National Climate Change Strategy (URT, 2012), revised National Climate Change Response Strategy (2021), the Agriculture Climate Resilience Plan(URT, 2014-2019), the Integrated Water Resources Management Development Plans (IWRMDPs, 2018), Water resources Management and Climate Change Action Plan (2017), the National Framework for Climate Services (URT, 2018) and the Nationally Determined Contributions (NDC, 2021 (a draft)) have been developed.

Others are the National Five Years Development Plan (URT, 2021), the National Investment Blue print (2019), and The Agriculture Sector Development Programme (ASDP II of 2019). These frameworks provide specific directives and recommendations on a range of climate change response that should be implemented in various sectors (e.g. energy, water, health, agriculture, transport, human settlement, coastal and marine) in order to address climate change.

Further, the government in collaboration with development partners, CSOs and to a limited extent, private sector, has implemented climate responses projects in different parts of the country with a view of reducing communities' vulnerability and enhancing government capacity to coordinate various climate initiatives.

7.3 Geographical Descriptions of the Target Districts

The baseline survey was conducted in four project districts namely Bagamoyo, Chalinze, Lushoto, and Pangani, **Fehler! Verweisquelle konnte nicht gefunden werden.**These districts are geographically different in-terms of climatic characteristics, soil conditions, drainage, vegetation cover, socio-economic activities, demography and levels of development. A snapshot explanation of each and every district is described below: -

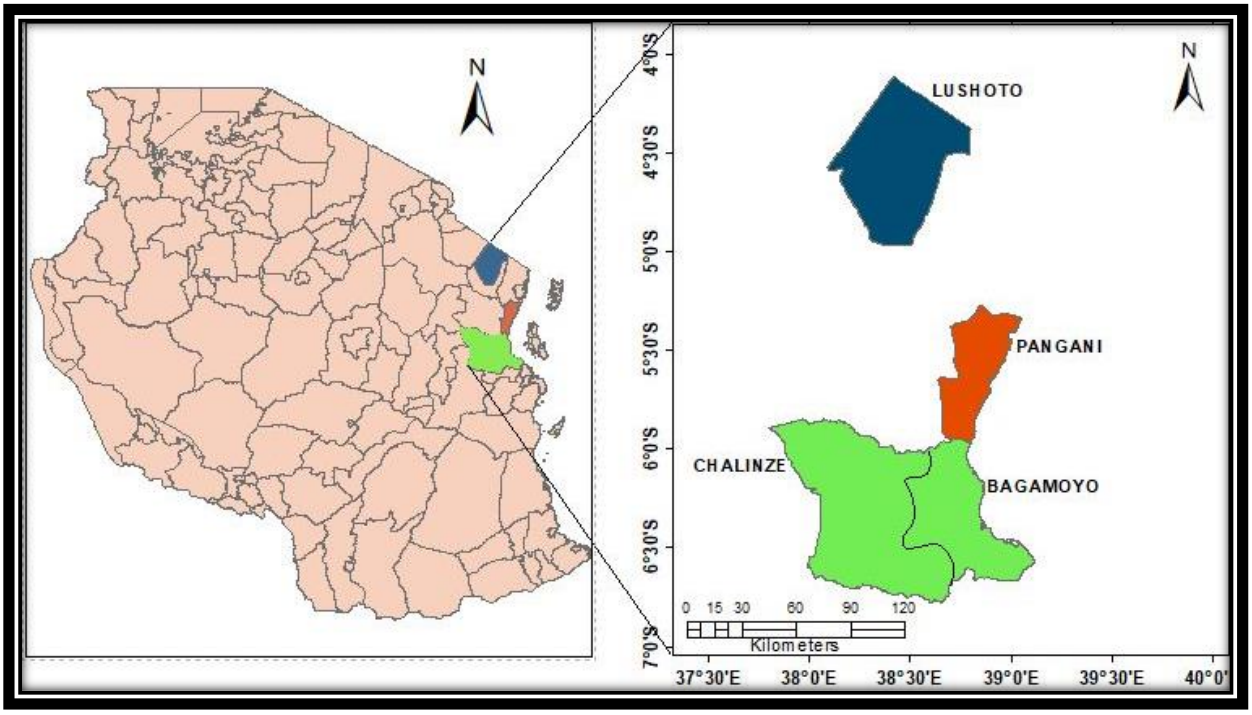

Figure 51. A map showing the location of the districts into which the baseline study was conducted

7.3.1 Bagamoyo District

Bagamoyo District is one of the six districts of the Pwani Region of Tanzania. It is located between 370 and 390 East; and between 60 and 70 South of the Equator (Bagamoyo DC, 2010, 2016). The district borders Pangani District on the northeast; Indian Ocean on the east; Kinondoni District on the south east and Kibaha District on the south. Based on the National Census results in 2012, Bagamoyo District Council has had a population of 97,660 of which 48,603 are males and 49,057 are female people.

The district has a humid tropical climate with seasonal average temperature ranging from 130C - 300C. There are two ecological zones namely the coastal strip which is characterized by Savannah, and

bushes while the up country which is mainly covered with dense forest. The coastal strip receives relatively more precipitation than the up-country. Rainfall ranges between 800 – 1200mm per annum (Kabanda, 2018; Mahongo & Francis, 2012). The short rain season is between October to December while the long rainy season normally starts from March to June.

The district council has two major rivers namely, the Wami and Ruvu rivers. These two rivers are the source of water for human consumption, livestock and irrigation in the district and nearby towns such as Dar es Salaam. These rivers discharge water into the Indian Ocean. The topography of Bagamoyo District council is characterized by gently undulating plains, which is covered with low sparse vegetation. The East North and Western part of the district are covered by the natural forest. The coastal belt is covered by mangrove swamps as well as mangroves. The main socio-economic activities conducted in the district includes, farming, livestock, tourism, beekeeping, fisheries and petty businesses. The district is relatively connected with infrastructure and social services including roads, water, health services, electricity and financial institutions such as banks(Bagamoyo DC, 2010).

7.3.2 Chalinze District

Chalinze District is one of the eight (8) Districts of the Pwani Region of Tanzania. It is located between 37^0 and 39^0 East: and between 6^0 and 7^0 South of the Equator. Chalinze district borders Morogoro District on the west; Mvomero, Kilindi and Handeni districts on the north; Pangani District on the northeast; Bagamoyo District on the east; Kibaha District the southeast and the south. According to 2012 National population census the District had 214,080 people of which 105,595 are males and 108,485 are female people(Chalinze DC, 2017).

The district has a humid tropical climate with seasonal average temperature ranging from 13^0C - 30^0C. The district has two ecological zones namely the coastal Strip, which is characterized by Savannah, and bushes while the up-country which is mainly covered with dense forest. The coastal strip receives relatively more precipitation than the up-country. Rainfall ranges between 800 – 1200mm per annum. The short rain season is between July and October while the long rainy season normally starts from the last week February to the first week of June.

The district has two major rivers, namely the Wami and Ruvu rivers. These two rivers are the source of water for human consumption, livestock, and irrigation in the district. Still the district experiences water challenges and related conflicts especially between farmers and pastoral communities. These

rivers discharge water into the Indian Ocean. Topographically, Chalinze District is characterized by gently undulating plains, which is covered with low sparse vegetation.

The East North and Western part of the district are covered by the natural forest. The coastal belt is covered by mangrove swamps as well as mangrove. The main socio-economic activities conducted in the district includes farming, livestock, tourism, beekeeping, fisheries, mining and petty businesses. The district is relatively connected with infrastructure and social services including roads, water, health services and electricity.

7.3.3 Lushoto District

Lushoto District is situated in the northern part of Tanga Region within 4°25' – 4°55' latitude south of Equator and 30°10' – 38°35' Longitude East of Greenwich. It borders with The Republic of Kenya in the northeast, Same District of Kilimanjaro Region in the northwest, Korogwe District in the south, Bumbuli District in the southeast and Mkinga District together with Muheza District bordered at further east. The District has an area of 2,300 km2 (Ha.227, 371.43) and accounts for about 8.41 percent of Tanga Region(Lushoto DC, 2014). According to the population census of 2012, the District Council has the population of 332,436 People (153,847 Male and 178,589 female).

Lushoto District within its area of the Western Usambara Mountains dominates the landscape which lies between 300 – 2,100 meters above sea level. The main physical features are highlands covering about 75% (1,725 km2) of the total district area, with altitude of 1,000 – 2,100m above sea level. The main drainage of the Lushoto district is Umba river that flow east into the Indian Ocean. There are several small springs and streams that form local micro-drainage systems, and which are important sources of water for domestic and agricultural use. Lushoto District can be zoned into five agro-ecological zones that are humid warm, dry hot, humid cold, dry warm and dry cold.

The categorization is based on the altitude, rainfall, temperature, and humidity. Based on such characteristics, such zones offer different cropping patterns/possibilities. The main socio-economic activities conducted in the district includes, farming, livestock, tourism, bee-keeping and petty businesses. Due to step slopes and undulating terrain most of villages experience limited land for socio economic livelihoods especially farming. The district is relatively connected with infrastructure and social services including roads, water, health services, electricity, and financial institutions such as banks.

7.3.4 Pangani District

Pangani is one of the eleven districts in Tanga Region located in north-eastern Tanzania. The district is bordered by Muheza district in the north, Indian ocean to the east, Bagamoyo district to the south and Handeni District to the west. The district lies between $5^0$15' to 6^0South of the equator and 38^0 35' to 39^0East of the Greenwich Meridian. Its altitude ranges from 0 to 95 meters above sea level. The district covers an area of 1830.8 sq. km which is almost 6.5% of Tanga Region total land area of 28,055 sq. kilometres.

Pangani climate is classified as tropical with average temperatures ranging from 24°C -33° C(Pangani DC, 2018; Robertson et al., 2018). May to July is the coolest season while December to February is the hottest season (Msuya et al., 2013). The district has three major rain seasons termed as the long rains (March to June) used for intensive cultivation, the short rains (October to December) used for cultivation of crops that resist dryness like cassava and Occasional showers (June to September) that is used for cultivation of vegetables and legume crops.

Generally, the district receives an average rainfall between 600mm to 1400mm per year with more rain in the interior areas. Pangani District practices commercial farming, fisheries, food crops and forestry as the main sources of income and livelihoods in the district. Hunting, livestock keeping, trade and commerce, mining and quarrying are some of the additional socio-economic activities in the district. Infrastructure development and social services provision is pertinent to the socio-economic development of the district.