CLIMATE VULNERABILITY ASSESSMENT IN PUNTLAND STATE, SOMALIA

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LIST OF ABBREVIATIONS

AfDB	African Development Bank
CCAFS	Climate Change Agriculture and Food Security
CGIAR	Consultative Group for International Agricultural Research
CORDEX	Coordinated Regional Climate Downscaling Experiment
CRHRP	Country Reports on Human Rights Practices
CSOs	Civil Society Organizations
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FGS	Federal Government of Somalia
GCF-NAP	Green Climate Fund National Adaptation Plan
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HDI	Human Development Index
IDPs	Internally Displaced Persons
IGAD	Intergovernmental Authority on Development
IMF	International Monetary Fund
INC	Initial National Communication
INDC	Initial Nationally Determined Contributions
INGOs	International Non-Governmental Organisations
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change
NAP	National Adaptation Plan
NASA	National Aeronautics and Space Administration
NGOs	Non-Governmental Organisations
NRC	Norwegian Refugee Council
NTFP	Non-Timber Forest Products
NUWACO	Nugal Water Company
OSS	Sahel and Sahara Observatory
PESS	Population Estimation Survey of Somalia
QGIS	Quantum Geographic Information System
SMHI	Swedish Meteorological and Hydrological Institute
SSP	Shared Socioeconomic Pathways
SWALIM	Somalia Water and Land Information Management
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
WASH	Water Sanitation and Sanitation
WCRP	World Climate Research Programme
WFP	World Food Program
WMO	World Meteorological Organization Sanitation

EXECUTIVE SUMMARY

Climate change is disproportionately impacting developing countries, particularly tropical and small island states. Geographical factors, high concentrations of impoverished populations, lack of resources and technical constraints have all contributed to their increased vulnerability. Somalia is recognized as one of the most sensitive countries, with more than 80% of the country made up of fragile arid and semi-arid ecosystems that make the country very vulnerable to the adverse effects of climate change. Among the different states in Somalia, Puntland is one of the most vulnerable, evidenced by the recurrence of devastating droughts in 2008, 2011, 2016 and 2017 underpinned by climate change, and causing the displacement of more than 20,000 households. Puntland's vulnerability is exacerbated by its heavy dependence on agriculture and pastoralism, coupled with extreme poverty. To develop an integrated strategy to combat climate vulnerabilities in a resource-constrained environment like Puntland, it is essential to identify and prioritize the most sensitive sectors and areas. In this respect, indicators based on climatic, geographic, demographic, agricultural and socio-economic sensitivity can be very useful in establishing priorities for creating and implementing appropriate adaptation measures. It is therefore essential that Somalia begins as soon as possible to measure, understand, and define the extent of its climate-induced vulnerability at the local level. Thus, the main goal of this assignment was to conduct a vulnerability assessment in priority sectors in Puntland State in Somalia. The Puntland climate vulnerability assessment also served to familiarize local communities and NGOs with the vulnerability assessment process, allowing for replicability in the 05 other states that make up Somalia.

The methodological approach of the study involved in-depth review of literature; holding of meetings with the Ministry of Environment, Range and Climate Change, Kaalo Aid and UNDP-NAP team; training of enumerators; consultation workshops with stakeholders of Puntland State; data collection and data analysis. Concerning literature review, relevant climate change related documents including but not limited to policies, plans, initiatives, rules, regulations, were reviewed. The document review focused on relevant climate-related sectors including land use, agriculture, water, food security, disaster risk reduction (DRR), marine and coastal resources, health, and biodiversity. Prior to the commencement of the data collection for the vulnerability assessment, a meeting was organised between Puntland's Ministry of Environment and Climate Change, Kaalo Aid and the UNDP-NAP team. During the meeting, the following sectors were shortlisted for the vulnerability assessment in the Puntland State: water, health, agriculture and food security, livestock, biodiversity, coastal zone, public works, education, disaster risk reduction, gender, and education. This was followed by the training of enumerators. Eight enumerators were identified and trained to ensure an effective data collection process. During the one-day training event, the international consultant trained the enumerators on the approaches to carry out key informant interviews (KIIs) and focus group discussions / community consultations using associated tools for each sector. The training enabled the enumerators to familiarize themselves while testing the tools, and to be sure that they were capable of independently collecting data for the study. Then, a 02-day consultation workshop with stakeholders in Puntland State was conducted. The key stakeholders were civil society organizations (CSOs) and government institutions relevant to the sectors selected for the vulnerability assessment. The consultation meeting focused on the following issues: realization of a stakeholder mapping for each sector; to reach agreement on the specific sites to be visited for data collection for the climate vulnerability assessment per sector; and to collect data from the sectoral actors for the climate vulnerability assessment per sector. A second one-day training of enumerators was organized in the Kaalo Aid office during which

the enumerators were trained on the use of the "Kobo collect", a telephone App employed in data collection. This was followed by data collection wherein, the enumerators embarked on the field mission and data collection. The data collection was done by a total of eight (08) enumerators. Data was collected through key informant interviews and focus group discussions. Data collected was directly keyed into Kobo application using smartphones. Relevant stakeholders consulted were: State-level line ministries linked to the sectors considered for the vulnerability assessment; Local institutions (non-governmental organizations, community-based organizations, educational institutions, etc.); Community leaders or gatekeepers; People in vulnerable situations (women, youth, the elderly, people with disabilities, indigenous peoples, etc.); Community or social mobilizers. Focus group discussions (FGDs) whose purpose was to discuss several topics on climate change vulnerability, guided by a facilitator was used to collect qualitative data. A semi-structured approach was used, asking predominantly open-ended questions that allowed the participants to express their views on different topics. Data analysis was done using descriptive and inferential approaches (for quantitative data) and theme-based approaches (for qualitative data). These involved an analysis of past climate and centred anomalies using different indices; analysis of climate scenarios; analysis of climate vulnerability impacts; analysis of future impact of climate change on natural ecosystem; analysis of climate vulnerability; and identification of adaptation options/strategies.

The findings revealed sectors adversely impacted by climate change induced hazards in the Puntland state of Somalia i.e. agriculture and food security; water; livestock; health; education; public works; biodiversity (forest and rangeland); and coastal and marine resources. Concerning Puntland's vulnerability to different climate change induced hazards, the assessment revealed that Puntland is very vulnerable to floods; wildfires (with the south-west and part of the north-east of Puntland being highly vulnerable); cyclones and storms.

Trend analysis of rainfall and temperature in the past 40 years revealed that overall, rainfall has dwindled and is generally rare. This drop in rainfall has a negative impact on plant growth, as changes in rainfall linked to climatic variability, accelerate the deterioration of plant cover and encourage erosion. Temperatures are on a rising trend. This rise is having a negative impact on people's livelihood activities, particularly the drying up of water reservoirs needed for agriculture and livestock farming. Climate change prediction models for the Puntland region for 2021 to 2100, indicate that rainfall will further decrease worsening the already precarious vulnerability situation of the region. Temperature meanwhile will continue to rise making it difficult for local communities to cultivate their crops and rear animals.

Vulnerability analysis for different sectors reveals a bleak picture. In the agriculture and food security sector, there are high levels of exposure and sensitivity with the vulnerability and risk level of agriculture and food security sector being high for climatic hazards such as drought, floods, crop diseases and pests, and locust. The agriculture sector is moderately vulnerable to hazards such as extreme temperatures and cyclones. Tsunami has a low hazard vulnerability and risk to the agriculture and food security sector. Certain factors, such as the degradation of the productive potential of plants and soils, land impoverishment, demographic pressure, pest pressure and the low level of technical support for producers, were identified like factors that can increase this vulnerability in Puntland. For the water sector, the vulnerability and risk were very high to droughts, and high to extreme temperature. However, this vulnerability and risk was moderate for climate hazards like floods and cyclones, and low for tsunami. For the livestock sector, the vulnerability and risk were very high to climate hazards such as drought. The vulnerability of the livestock sector to heat stress, flood, pest and disease and locust was high, moderate for cyclone and finally low for Tsunami. For the health sector, there was high

vulnerability and risk level for gastrointestinal diseases such as cholera, cryptosporidium, *E. coli* infection, giardia, shigella, typhoid, and viruses such as hepatitis A. Concerning the education sector, the vulnerability and risk level were very high for climatic hazards such as Tsunamis, and high for droughts, floods, and cyclone. It was moderate for extreme temperature and locusts. For the public works sector, there was a very high vulnerability and risk level to climatic hazards like cyclones and floods. However, it was high for extreme temperature and drought and finally moderate for tsunamis. Regarding the biodiversity sector, there was very high vulnerability to droughts / changing precipitation patterns and high vulnerability to extreme temperatures, floods, infestation of invasive species and locusts.

The impacts of climate change induced hazards are mainly adverse on the different sectors. Concerning the agriculture and food security sector, heat stress, drought, locust, cyclones, and flood related climatic hazards were the highest hazards that reduce agricultural yields, meanwhile crop pests and diseases, and tsunami caused farm destruction. On coastal and marine resources, the impacts include fish reduction, migration, extinction of some species leading to relocation of businesses around the coastal region, increased fish scarcity and hunger, and rural exodus. The impact was also felt on the mangroves by their reduction and destruction of coral reefs habitat. The impact of floods includes the reduction or destruction of livestock, fishing activities, fishing species, food availability, and businesses around the coast relocating to bigger cities, culminating in rural exodus (more people relocating from rural areas to major cities). The impact of climate hazards on the livestock sector were mostly on pasture as traditional grazing is decreasing. This has as consequence, the reduction of livestock numbers, reduction of livestock production (milk and meat) and incomes. The impact of climate hazards on the health sector were increasing disease prevalence and loss of life because during floods, diseases like cholera and malaria increase due to water pollution and water scarcity. The impact of climate change on the education sector was mainly adverse as droughts for example, caused drop-out and a decline in retention among students, low school enrolment, poor performance of students, reduced availability of learning material (books, pens, bags, etc.), low morale (loss of child petty cash), poor nutritional status, limited facilities, displacement and migration, and health problems. On school staff, the climate hazards like floods, drought and extreme temperatures cause decrease in livelihoods, loss of jobs, low morale, displacement, and many others. For school infrastructure, climate hazards were known to cause mainly damage to school infrastructures and water supply (especially for drought). For the public works sector, hazards cause displacement, affect internal transport during the day or at service times, making it difficult for rural communities to manage their livestock (heat stress) during the day and destroy the roofs of houses (in case of cyclones). For the biodiversity sector, climatic hazards lead to wildlife habitat destruction, biodiversity loss, increased mortality of perennial, woody and herbaceous plants, wildlife migration, rarity of Non-Timber Forest Products (NTFPs), and erosion. Concerning forest biodiversity (flora and fauna), biodiversity loss, increased mortality of perennial, woody and herbaceous plants, and wildlife habitat destruction were the main impacts of different climate hazards on this sector. In the water sector, the impacts of climate hazards were mostly related to water shortage, limited water availability, and destruction of water infrastructure (floods).

Regarding the future climate, the two IPCC scenarios, ssp245 (stabilisation) and ssp585 (pessimistic), show that average temperatures would continue to rise over a large part of Puntland, with peaks varying between 0.37°C and 0.51°C for the ssp245 scenario and between 2.2 and 3.3°C for the ssp585 scenario. The most affected areas could be the northern and central parts of the state. In terms of rainfall, in the stabilisation scenario, most parts of the state would be exposed to a drop in average annual rainfall, with peaks of significant variation in the northern areas. In the pessimistic scenario, significant variations will be observed throughout

the region. The projections thus show that the trends in climatic conditions recorded over the last few decades are likely to continue and even accelerate in the short and medium term.

With increasing vulnerability to climate change induced hazards in the Puntland State of Somalia, local communities are increasingly taking measures to enhance their adaptive capacity across different sectors:

- Agriculture and food security – adaptive measures include logistic and financial support, improved production techniques, improved seeds, micro-irrigation, climate-smart agricultural techniques, and agriculture-livestock integration.
- Water sector – adaptive measures include the use of traditional forecasts of droughts and floods as well as following information from phones and radios.
- Livestock sector – adaptive measures include access to veterinary services and water points, as well as good pasture.
- Regarding adaptive capacity to climate hazards in the health sector, the local communities indicated that, the population was adversely impacted by droughts and the response mechanism in terms of health was very limited. Some members of the population suffered from malnutrition due to famine and lack of sanitary support. They were assisted by some organizations that provide disaster relief.
- Regarding adaptive measures in the biodiversity sector (the forest and rangeland), it was found that 75% of local people implement actions towards conserving forest and rangelands, as well as improve their engagement in forest and rangeland restoration. In the forest sector, adaptive capacities were essentially related to tree planting. In rangeland sectors, adaptive capacity includes solving overgrazing problems, establishing more rangeland reserves and more boreholes, and firefighting brigades. Others were the collection of seeds from *Acacia* sp. for afforestation and reforestation; volunteering to sensitize people not to cut trees; controlling and conserving the few remaining vegetation in the area; distribution of animal dung; controlled grazing of animals in areas where grass and few trees are available; use of traditional/customary law that protects boreholes, and rangelands in the area.
- Coastal and marine resources sector, the main adaptive measures include awareness raising, community mobilization, women groups engaged in advocating for women in the fishing sector, early warning systems, communities supporting each other during hazards, information sharing, fishermen WhatsApp groups through which weather information is being shared, and reconstruction of destroyed infrastructures.

Adaptation measures, identified options include:

- Enhancement of the Federal disaster management department and the level of institutions of Puntland.
- Enhancement of the Early Warning Systems to build greater resilience to hydro and meteorological hazards in Puntland, and its platform that provides alert real time.
- Strengthening of the agriculture and food security, livestock sectors by developing Climate Smart Agriculture in Puntland.
- Development of safe buildings and infrastructure in the health, education, and public works sectors for climate resilience in Puntland.
- Development of sustainable financial mechanisms for smallholders in all priority sectors by creating green lines with concessional interest rates in Financial Institutions, and guarantees, risk coverage with insurance companies.
- Enhancement of the energy sector to provide readymade / renewable energy options to all the priority sectors.

- Promotion of forest landscape restoration programmes to restore existing ecosystems and create new opportunities for rangelands.
- Promote the construction of dykes, canals, dams, boreholes, and provision of climate smart fishing equipment to fishermen.
- Development of sustainable value chains for the common commodities, fish and animal products to enhance standards and markets for sale.

To sum up, Puntland and Somalia in general is highly vulnerable to climate change induced hazards, necessitating different adaptive measures to counter this high level of vulnerability. There are however different barriers hindering adaptation, most of which are governance related. It is thus recommended for early warning systems to be developed/strengthened to build greater resilience to hydro and meteorological hazards in Puntland.

1. INTRODUCTION

PURPOSE OF THE REPORT

The unavoidable and negative repercussions of global climate change are no longer regarded as a menace of the future. The Intergovernmental Panel on Climate Change (IPCC) has released evidence showing that the effects of climate change are already being felt throughout the world (IPCC, 2023[1]). The global response to climate change has now naturally shifted to the design and development of adaptation and resilience strategies. Developing policies and measures to deal with the effects of climate change has become more important, especially given that the manifestation of the effects of climate change can vary both temporally and spatially. This starts with a better understanding of the vulnerability to climate change, mainly its negative effects and the cross-cutting nature of these effects.

It is generally admitted that the level of vulnerability varies depending on regions and ecological zones, as well as on socio-economic sectors. In other words, a system's vulnerability is determined not only by the potential external consequences of climate variability, but also by socio-economic characteristics such as population growth, infrastructural development, human and social capital. These elements, known as adaptive capacity, describe the existing ability of the region or country to cope with the impacts. Determining vulnerability is therefore essential to developing adaptation measures and integrating climate policy.

Climate change is causing damage in developing countries, particularly the Least Developed Countries (LDCs) and small island states. Geographical factors, high concentrations of impoverished populations, lack of resources and technical constraints have all contributed to their vulnerability. While Somalia is recognized as one of the most sensitive countries, with more than 80% of the country made up of fragile arid and semi-arid ecosystems that make the country very vulnerable to the adverse effects of climate change (FGS, 2022[2]), Puntland state region has experienced devastating droughts in 2008, 2011, 2016 and 2017 underpinned by climate change, and causing the displacement of more than 20,000 households (Said, et al., 2019)[3]. It is therefore essential that Somalia begins as soon as possible to measure, understand, and define the extent of its climate-induced vulnerability at the local level.

Puntland's issues are exacerbated by its heavy dependence on agriculture, livestock, and fishery extreme poverty[4] (FGS, 2020), and the fact that people's livelihoods depend on climate-sensitive sectors, such as agriculture, grazing, water, wildlife, and pastoralism, which could be greatly threatened by the consequences of climate change. To develop an integrated strategy to combat climate vulnerabilities in a resource-constrained environment, it is essential to identify and prioritize the most sensitive sectors and areas. In this respect, indicators based on climatic, geographic, demographic, agricultural and socio-economic sensitivity can be very useful in establishing priorities for creating and implementing appropriate adaptation measures.

[1] IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, 184 pp., doi: 10.59327/IPCC/AR6-9789291691647

[2] Federal Government of Somalia. (2022). Somalia's First Adaptation Communication to the United Nations Framework Convention on Climate Change. Ministry of Environment and Climate Change. Mogadishu, Somalia.

[3] Said, A.A., Cetin, M., Yurtal,R., 2019, Drought assessment and monitoring using some drought indicators in the semi- arid Puntland State of Somalia. Fresenius environmental Bulletin, 28(11A)8765-8772. LINK

[4] Almost 69% of Somalia's population lives below the international poverty line.

BACKGROUND

The Horn of Africa (the region where Somalia is located) is among the most vulnerable regions to climate change in the world owing to a multitude of factors including porous land borders, vast drylands, unresolved trans-boundary water-rights issues, numerous pastoralist communities and multiple border disputes[5]. The region is notorious for conflicts, natural disasters, and famine. It was against the background of recurrent environmental hazards including droughts and desertification in the Horn of Africa that the Intergovernmental Authority on Development (IGAD) was created in 1986. The Horn of Africa is home to over 3 million refugees and over 12 million internally displaced persons, and presently one of the world's most food insecure regions[6].

Somalia is one of the most vulnerable countries to climate change in the Horn of Africa in particular and the world in general[7,8]. Much of the country's economy and people's livelihoods depend on climate-sensitive sectors, such as agriculture, grazing, water, energy, tourism, wildlife, and health, which are becoming more vulnerable to climate change[9]. Increases in the intensity and magnitude of weather-related disasters like droughts and floods, combined with rising temperatures and more unpredictable rainfall, continue to destroy livelihoods, aggravate conflicts, increase the country's internally displaced populations, and threaten the country's socio-economic development[10,11].

Roughly 70% of Somalia's population lives below the international poverty line[12]. Additionally, the country has experienced over two decades of conflict and fragility, limiting the capacity of the government to effectively respond to the growing impacts of climate change[13]. Climate impacts and conflicts double existing threats to Somali people's food and water security, productive livelihoods, health, and human development. Interactions between the two also create a vicious cycle: conflict increases climate vulnerability among the population, while climate impacts exacerbate tensions and conflicts over natural resources. This all presents significant challenges to the population, including those displaced by both violence and extreme weather events. All these challenges are underpinned by gender and social inequalities: women and youth, who make up more than half of Somalia's population, are extremely vulnerable to climate change and are more likely to experience poverty, making it difficult for them to recover from climate change impacts[14]. Adequately addressing these challenges will require an inclusive and gender-responsive approach to climate action.

Somalia is recovering from the aftermath of a 20-year civil war and the process of establishing government institutions is underway, following the formation of the Federal Government of Somalia (FGS) in 2012[15]. A new government, formed in 2017, has committed to prioritize

[5] Gavin, M. D. (2022). Climate Change and Regional Instability in the Horn of Africa. LINK
[6] Gavin, M. D. (2022). Climate Change and Regional Instability in the Horn of Africa. LINK
[7] Federal Government of Somalia – FGS (2022). Somalia's First Adaptation Communication to the United Nations Framework Convention on Climate Change. Ministry of Environment and Climate Change. Mogadishu, Somalia. LINK
[8] Notre Dame Global Adaptation Initiative, University of Notre Dame (2022). ND-GAIN Country Index. LINK
[9] FAO. (2022). Somalia Water and Land Information Management system (SWALIM). LINK
[10] Federal Government of Somalia (2022). Somalia's National Adaptation Plan (NAP) Framework. LINK
[11] Office of the Prime Minister, the Federal Republic of Somalia (2018). THE INITIAL NATIONAL COMMUNICATION FOR SOMALIA TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC). LINK
[12] Federal Government of Somalia – FGS (2020). NDP- 9 (2020-2024). LINK
[13] Government of Somalia. (2022). Somalia's First Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCC). Ministry of Environment and Climate Change (MoECC), Mogadishu, Somalia. LINK
[14] Federal Government of Somalia – FGS (2013). The National Adaptation Programme of Action Somalia – 2013 https://unfccc.int/resource/docs/napa/som01.pdf
[15] UNDP (2019). National Adaptation Plans in Focus. Lessons from Somalia. LINK

development and poverty alleviation[16]. Despite civil unrest, Somalia has maintained a healthy informal economy mainly comprised of remittance and money transfer companies, livestock, and telecommunications.

The economy of Somalia grew by an estimated 2.9% in 2019, up from 2.8% in 2018. The rebound was mainly due to recovery in agriculture and strong consumer demand. Inflation peaked at 5.1% in 2018 and declined to an estimated 4.4% in 2019 as food prices adjusted downward. The country's current account deficit improved from 9 % of GDP in 2018 to 8.3 % in 2019 because livestock exports recovered and import growth slowed. In Somalia's current account, humanitarian aid and remittances are reported to have countered the deficits, while foreign direct investment has remained subdued. Despite widespread dollarization, the Somali shilling has remained stable, depreciating by only 5.7 % since 2017 to 24,490.85 shillings per dollar in September 2019. The Somali High Frequency Survey, wave 2, of 2017 indicates that Somalis are among the poorest people in Africa, with a poverty incidence of 69.4% and per capita income of about $400[17].

With a population of 15.44 million in 2019, Somalia is a young and rapidly expanding nation with an annual population growth of three percent. Since the late 1980s, Somalia has experienced armed conflict, violence and a series of natural and man-made disasters which resulted in a long, drawn-out and comprehensive state collapse. In 2017, Somalia was ranked the lowest globally in all dimensions of the Human Development Index (HDI) at 0.251. It is not a surprise that the country currently has some of the lowest health and well-being indicators globally. Extended periods of conflict and insecurity exacerbated by recurrent extreme droughts and floods and subsequent food insecurity have devastated the livelihood status of the population and severely damaged its fragile health system[18].

Despite the immense challenges, approximately 70% of Somalis are dependent on climate-sensitive agriculture and pastoralism. As floods and droughts become more severe and frequent in Somalia, there is a need to find approaches that can reduce the sensitivity of farmers and pastoralists to increasing rainfall variability[19]. In the findings of Lwanga-Ntale & Owino (2020) there is an inextricable link between vulnerability, conflict, and disasters, with the major challenge facing the most vulnerable Somalis being uncertainty about the future. Somali households adopted different coping strategies depending on their resource endowments, including the social and organizational coping strategies, diversifying non-essential domestic assets, and diversification of income generation and food production strategies. Thus, different population groups survived the shocks through social connectedness, which aligned with the effective use of remittances to create robust mechanisms for sharing risk. That notwithstanding, groups that had the backing of more powerful clans seemed to have the edge over those who did not[20].

Since 2012, Somalia has taken several important initiatives to adopt policies, regulations, and institutional reforms that are essential in the state-building process. Those linked to climate change related actions include the preparation of the 2013 National Adaptation Programme of Action (NAPA), the 2015 Initial Nationally Determined Contributions (INDC) Report to the UN Framework Convention on Climate Change (UNFCCC), draft 2021 National Climate Change Policy, the 2021 National Environment Policy, draft 2021 Environment Act, and the

[16] Federal Republic of Somalia: Ministry of Natural Resources, Somalia National Adaptation Programme of Action to Climate Change, 2013.
[17] UNICEF, 2020. Vulnerability assessment in Somalia. LINK
[18].ibid 3
[19] UNDP (2014). Enhancing climate resilience of the vulnerable communities and ecosystems of Somalia. LINK
[20] Lwanga-Ntale, C. & Owino, B.O., 2020, 'Understanding vulnerability and resilience in Somalia', Jàmbá: Journal of Disaster Risk Studies 12(1), a856. LINK

2018 Initial National Communication (INC) to the UNFCCC. The Green Climate Fund National Adaptation Plan Project (GCF NAP) for Somalia consisted of the following outcomes:

- Strengthening institutional coordination and capacity for adaptation planning and implementation at the federal level;
- Enhancing the technical, institutional, and managerial capacity for adaptation planning at the state level;
- Developing the capacities at the Federal State level by active engagement and contribution to technical and strategic analyses with expert and stakeholder input through a learning-by-doing approach; and
- Mainstreaming of climate change adaptation considerations into the investment planning processes.

Thus, as part of the GCF-NAP project, a vulnerability assessment covering several sectors was conducted in Puntland State. According to Lind et al. (2020)[21] pastoralism remains the most productive use of most of East Africa's rangelands under immense pressure over the last few decades and the livelihood of many people mainly depends on pastoralism which is very sensitive to the changing climate. The frequency of drought occurrence in Puntland State has increased to one drought every two to three years from the initial one drought every eight years (Adanau and Daudi, 2012; Said et al., 2019). As a confirmation of the increasing frequency of droughts in the region, the years 2008, 2011, 2016, and 2017 experienced devastating droughts attributable to climatic changes (Said et al., 2019). According to the UNHCR (2017), the drought in 2017 led to the displacement of over 20,000 households in Puntland State. From the foregoing, it is evident that Puntland State is highly vulnerable to the adversities of climate change and thus warrants a vulnerability assessment covering different sectors.

[21] Lind, J., Sabates-Wheeler, R., Caravani, M., Kuol, L. B. D., & Nightingale, D. M. (2020). Newly evolving pastoral and post-pastoral rangelands of Eastern Africa. *Pastoralism*, *10*, 1-14.

2. PROFILE OF THE ASSESSMENT AREA

PHYSICAL ENVIRONMENT

2.1.1. Geographical position

Puntland is a region in northern east Somalia located between longitude 48 and 52°48 E and latitude 13°48 and 7°48 N. The name "Puntland" is derived from the Land of "Punt" mentioned in ancient Egyptian sources. Geographically, Puntland lays claim to the intra-46th meridian territories that were outside European colonial rule during parts of the Scramble for Africa period[22]. It is bordered by Somaliland to its west, the Gulf of Aden in the north, the Guardafui Channel in the northeast, the Indian Ocean in the southeast, the central Galmudug region in the south, and Ethiopia in the southwest. Puntland occupies a total land area of 212,510 km^2 or roughly one-third of Somalia's geographical area[23]. The location of the state of Puntland in Somalia is presented in **Figure *1***.

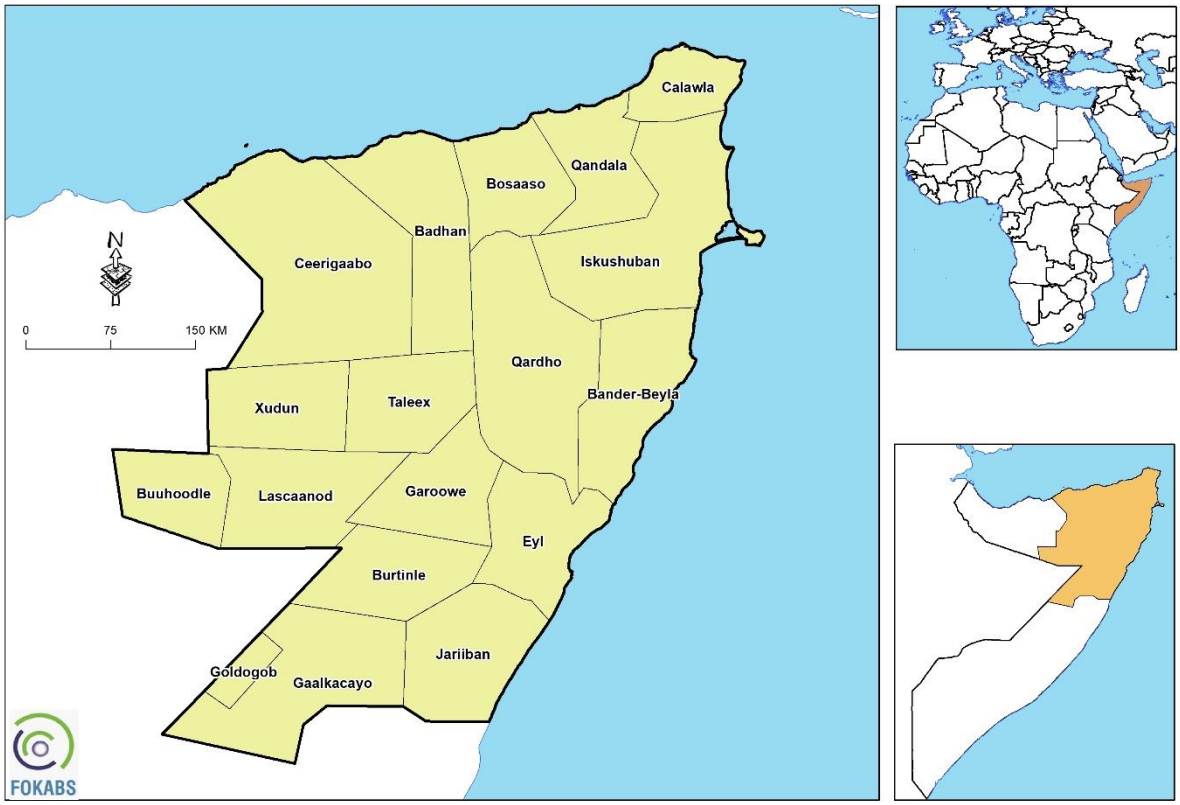

Figure 1: Location of state of Puntland

2.1.2. Climate

According to the Puntland Ministry of Planning, Economic Development and International Cooperation (2018), the climate of Puntland is a warm tropical climate, consisting of four main seasons:

- Jilal - January to March; the harshest dry season of the year.
- Gu - April to June; the main rainy season
- Xagaa - July to September; the second dry season
- Deyr - October to December; the shorter, less reliable rainy season.

[22] https://somalia.unfpa.org/sites/default/files/pub-pdf/puntland_shds_report_2020_0.pdf
[23] *"Where is Puntland?". WorldAtlas. 2 August 2019. Retrieved 30 June 2021.*

The rainy periods correspond to the passage of the sun at its zenith and the rainiest months are April-May and October-November. However, rainfall is rare and variable, with no area receiving more than 400 mm of rain per year. Average annual rainfall is around 250 mm.

Puntland is a semi-arid region, with a hot climate and average daily temperatures ranging from 27°C to 37°C. Average temperatures are around 27°C and the hottest months are generally May to September. However, it is important to note that temperatures can vary considerably depending on the region and altitude. In 2008-2009, extreme temperature drops were recorded in certain mountainous regions of Puntland[24]. Over the years, unpredictable climate change has led to recurrent floods and droughts across the country[25].

Analysis of the Umbro-thermic curve and the series of data calculated on the basis of monthly averages from 1981 to 2021 (**Figure *2***) shows that the main characteristics of the rainfall pattern in Puntland State are as follows:

- Rigorous and long dry season with a high level of sunshine during which temperatures are increasingly high, with an average monthly temperature of around 37°C. High temperatures are recorded in April, May, June and September, with a fall from October to December. During the dry season, temperature differences between night and day are more remarkable. Average monthly minimum and maximum temperatures are around 30°C and 36°C respectively. The term "dry" does not mean that there has been no rain, as these months have recorded average monthly rainfall below the temperature curve according to the Gaussen equation.
- Short rainy season lasting with the most extreme average monthly rainfall observed in October. This means that the rainfall pattern in this area is unimodal, with a long, very arid dry season and a short rainy period marked by heavy rains.

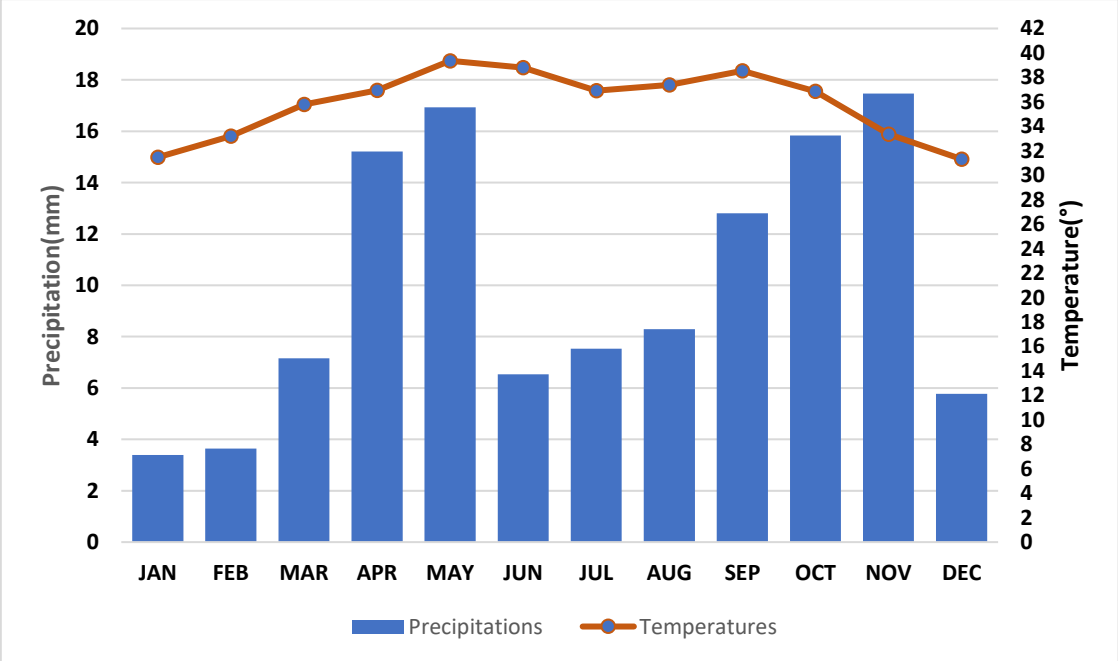

Figure 2: Ombro-thermal diagram of Puntland State

[24] Federal Republic of Somalia, 2013, National Adaptation programme of Action on climate change ministry of national resources-

[25] https://somalia.unfpa.org/sites/default/files/pub-pdf/puntland_shds_report_2020_0.pdf

2.1.3. Relief

Puntland's geomorphological profile is characterized by mountains, plateau and plains (**Figure 3)**. Puntland has several important geographical peaks, including Cape Guardafui, which forms the tip of the Horn of Africa, Ras Hafun, the most easterly point on the African continent, and the start of the Karkaar[26]. The Mountain range of Puntland includes the Golis, Galgala and Al Madow[27] mountains. The Al Madow mountains are the highest in the region with several peaks[28,29]. The Nugaal and Sool plateaus are located in the central and southern parts of the region, respectively. The coastal plains stretch for around 1,600 km along the Gulf of Aden. According to the Ministry of Fishery and Marine Resources, Puntland has 1800 km of coastline.

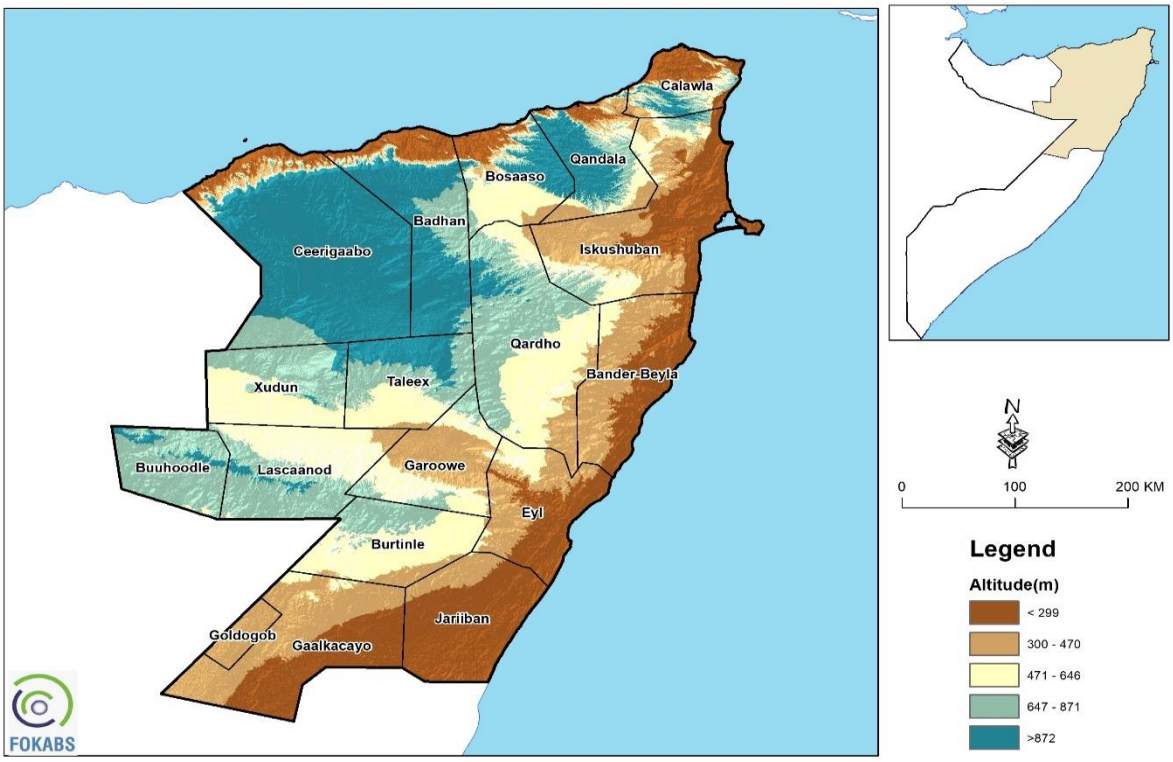

Figure 3: Relief of state of Puntland

2.1.4. Hydrography

The state of knowledge about hydrogeology of Puntland, quality and quantity of groundwater resources is very poor[30]. Three major river basins constitute the surface waters of Puntland and Somaliland: Gulf of Aden basin, Dharoor basin and Nugaal basin. The surface drainage closely follows the general geomorphology. Much of the area drains in a southeasterly direction towards the Indian Ocean; the extreme north discharges its runoff into the Gulf of Aden[31]. In the Puntland basins, run-off generally occurs in seasonal watercourses (toggas) and in addition to infiltration, feeds the riverbeds and floodplain aquifers.

[26] FEDERAL REPUBLIC OF SOMALIA, 2015, National Biodiversity Strategy and Action Plan (NBSAP)
[27] (*Hoehne, Markus Virgil (3 July 2014). "Resource conflict and militant Islamism in the Golis Mountains in northern Somalia (2006–2013)". Review of African Political Economy. **41** (141): 358–373. doi:10.1080/03056244.2014.901945. ISSN 0305-6244. S2CID 145703040*)
[28] https://fr-ca.topographic-map.com/map-dm4t6/Somalie/?center=-1.69897%2C42.91991&zoom=4
[29] https://history-hub.com/les-plus-hautes-montagnes-de-somalie
[30] Hydrological survey of Puntland, FAO SWALIM 2022,
[31] https://www.faoswalim.org/

2.1.5. Soils and pedology

Somalia has different types of soil, depending mainly on the climate and the parent rock[32]. The northern part of the country (northern Somaliland and Puntland) is characterized by a combination of shallow and/or stony soils and slightly deeper calcareous soils. The central part of the country is dominated by sandy soils along the coast and moderately deep silty soils with a high calcium carbonate and/or gypsum content further inland[33]. The soil types are mainly group 1 soils (calcisols and gypsisols) characterized by low water and nutrient availability; however, there are also group 3 soils (leposols, regosols and calcisols) which are stony, with limited rooting depth and low water availability) and group 6 soils (arenosols) characterized by low water availability, low nutrient retention capacity and wind erosion[34].

2.1.6. Vegetation and landscapes

According to FAO SWALIM (2022), Puntland's vegetation consists mainly of grassy savannah dotted with thorny shrubs and acacias. The wettest areas are occupied by tree savannah. The most common trees are baobab, tamarind, acacia and doum palm. In mountainous areas, there are coniferous and mixed forests[35]. Pastures include the Hawd region on the high plateau to the west of the Mudug and Sool regions, the green lands of Sanaag and Ethiopia, and the lower Nugaal valley. On the other hand, mild temperatures are only found along the high Bari mountains. There are vast grasslands in Puntland and sparse dunes in a strip of several kilometres along the coast. In the northern part of the Golis Mountain range, the vegetation consists of evergreen trees (*Junperus procera* and *Juniperus excelsa*) and open shrubs (*Buxus hilderbrandtii, Dodonea viscose* and *Terminalia brownii,* etc). The map of the region's vegetation cover is presented in **Figure *4***.

Mangrove communities are also located in the estuaries of seasonal rivers heading towards the Indian Ocean coast and the Gulf of Aden. Mangroves, such as the Golis Forest, are facing increased pressure from commercial logging. The mist forests of the Golis Mountains are important centres of biological diversity and endemism. Puntland also has 1,600 km of coastline, teeming with fish and other natural marine resources[36].

[32] https://www.faoswalim.org/land/soils-somalia
[33] Ibid 11
[34] https://www.faoswalim.org/resources/site_files/L-12%20Land%20Resources%20Report.pdf
[35] FAO SWALIM, 2022, Vegetation of Nothern Region of Somali Republic
[36] Ibid 14

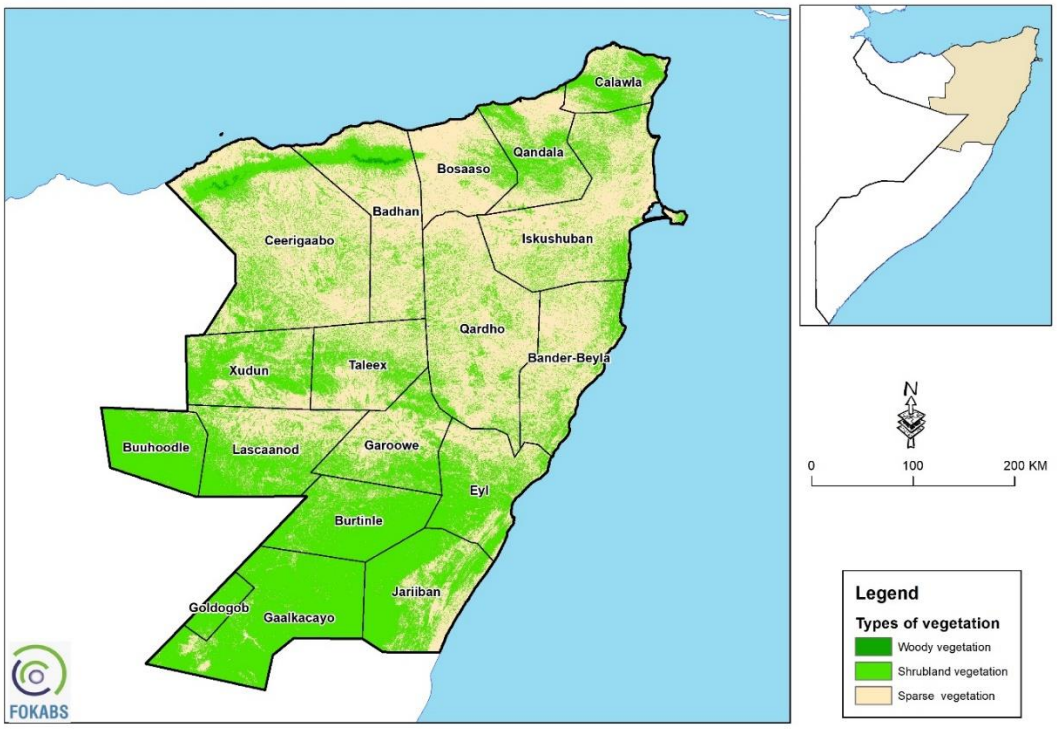

Figure 4 : Vegetation cover of Puntland

2.1.7. Main economic activities

In general, the economic activities of the people of Puntland include livestock rearing, frankincense, myrrh, gum Arabic, manufacturing and agriculture[37]. The economy of Puntland is based mainly on livestock rearing, salt mining and remittances from the diaspora (World Bank, 2023). The livestock sector dominates the economy of the Puntland region. Livestock products not only contribute to the subsistence of nomads, but also form an important part of the daily diet of the population living in rural and urban areas[38]. Livestock, mainly sheep, goats and camels, is the main source of income for most people in the country. Livestock is sold on local markets and exported to other countries in Africa and the Middle East. Puntland's climatic conditions favour pastoralism, which is the most efficient use of land in much of the region.

Agriculture is an important economic activity in the interior areas of Puntland (Puntland Ministry of Agriculture, 2023). The crops grown on a small scale include maize, sesame, fruit trees and vegetables, while crops such as bananas, guava, lemon, mango, and papaya are grown on a large-scale for domestic consumption[39]. Tomatoes, potatoes, maize, onions, cabbages, sorghum, and hot peppers are normally grown[40]. There are fruit trees as well. The main commercial centres in Puntland are in Bosaso and Galkayo. The nomads, who are the dominant ethnic group in Puntland, rely mainly on wells as a source of water rather than surface water.

Salt mining is another important economic activity in Puntland. Salt is extracted from the region's salt marshes and sold on local and international markets. Puntland salt is of high quality and is exported to a number of countries, including Saudi Arabia, the United Arab Emirates and India.[41]

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[37] *Puntland State of Somalia". Archived from the original on 5 October 2007.*
[38] https://somalia.unfpa.org/sites/default/files/pub-pdf/puntland_shds_report_2020_0.pdf
[39] Our work in Puntland (fao.org)
[40] WFP, 2007. Puntland Food Security and Vulnerability Assessment
[41] Puntland Ministry of Commerce and Industry, 2023,"Puntland Salt Industry".

In addition to livestock farming, agriculture and mining, the government of Puntland and the FAO describe the fishing sector as an important activity for the people of the coastal zone. Fishing represents an important source of income for the region. The main species of fish caught are tuna, mackerel, and shark, which are sold on local and international markets. Puntland's economy faces several challenges, including a number of natural and human resources that could be developed to stimulate economic growth (World Bank, 2023).

2.1.8. Demographic overview

With a population density estimated at 20 inhabitants per square kilometre (52/sq mi) and population growth rate of 3.14 percent per year[42], the population of Puntland is estimated at 4.9 million inhabitants. Since 1991, Puntland has seen a massive growth in population attributed to the influx of internally displaced persons (IDPs) from southern Somalia, and in later years of refugees from Yemen, many of whom may also be labelled return migrants, as they are primarily of Somali descent. Puntland was estimated to have a population of 4,905,246 inhabitants in 2018, with a growth rate of 3.14 % / year, density of 23.08 inhabitants / km², life expectancy of 55.00 years; birth rate equal to 39.60 ‰ in 2017, fertility rate of 6.20 children / woman and death rate of 13.10 ‰[43](Puntland report, 2020). The household demographic landscape in Puntland is very different according to the Somali Integrated Household Budget Survey (SIHBS) report findings. Women make up 52.4 % of households. The working ages (15-64) account for 44 %, while the elderly (65 and over) account for only 3 %. At a significant 18.9%, the largest age group in the population is between 5 and 9 years[44].

Currently, 31 % of the region's residents live in the fast-growing towns of Bosaso, Gardo, Las Anod, Buuhoodle, Badhan, Galdogob, Garowe and Galkayo. The life expectancy is estimated at 53 years (men) 56 years (women). The official languages of Puntland are Somali and Arab[45]. Puntland has the lowest rate of poverty in Somalia, with 27%, compared to 50% in Somaliland and 57% in Mogadishu.

ADMINISTRATION AND GOVERNANCE

Puntland state was established in August 1998 with president, ministries, and its own flag, in part to avoid the clan warfare engulfing southern Somalia. Unlike its neighbour, breakaway Somaliland, Puntland does not seek recognition as an independent entity, wishing instead to be part of a federal Somalia. Puntland Government is the supreme governing authority of the semi-autonomous region of Puntland State of Somalia.

The legal structure of Puntland consists of the judiciary, legislative (House of Representatives) and the executive (the President and his nominated council of Ministries) branches of government. Its administrative and economic capital are respectively Garowe, and capital Bosaso. According to the constitution of Puntland state of Somalia (2012), the state consists of the House of Representatives, the Cabinet of Ministers and the judiciary. The House of Representatives has 66 members who are elected for a five-year term, and who are responsible for electing the president and vice-president.

This current report on climate vulnerability assessment in Puntland State, Somalia is a result of a participatory process involving diverse stakeholders across different activity sectors.

[42] Puntland Facts and Figures 2012-2017"
[43] Puntland • Country facts • PopulationData.net
[44] Puntland State Report 2022 Somali Integrated Household Budget Survey (SIHBS)
[45] https://www.bbc.com/news/world-africa-14114727

3. METHODOLOGY APPROACH

LITERATURE REVIEW

This entailed the review of relevant climate policy frameworks including but not limited to policies, plans, initiatives, rules, and regulations. The review focused on relevant climate-related sectors including land use, agriculture, water, food security, DRR, marine and coastal resources, health, and biodiversity. In addition, socio-economic literature, and publications from the Intergovernmental Panel on Climate Change (IPCC) constituted other sources of information.

MEETING WITH THE MINISTRY OF ENVIRONMENT

The vulnerability assessment process commenced with a courtesy visit to the Ministry of Environment, Range and Climate Change of Puntland made by the Kaalo and UNDP-NAP team. The visit and meeting with the Ministry of Environment was aimed at validating the different sectors for which climate vulnerability assessment will be carried out. During the meeting, the following sectors were selected for the assessment in Puntland State:

- Water
- Health
- Agriculture and food security
- Livestock
- Biodiversity
- Coastal zone
- Public works
- Education
- Disaster Risk Reduction
- Gender

TRAINING OF ENUMERATORS

Eight enumerators were identified and trained to ensure an effective data collection process. In fact, it was important for the enumerators or data collection team to have a mastery and understanding of the approach and the tools to be employed in the data collection. In this light, a one-day training of enumerators was organized. During the training, the international consultant trained the enumerators on the approaches to carry out key informant interviews and focus group discussions/community consultations using associated tools for each sector. The training enabled the enumerators to familiarize themselves while testing the tools, and be sure that they are able to independently collect data. Another one-day training was organized during which the enumerators were trained on the use of the "Kobo collect" tool, an application employed for data collection using mobile telephones or tablets.

TWO-DAYS CONSULTATION WORKSHOP WITH STAKEHOLDERS IN PUNTLAND STATE

A two-days consultation workshop was organised with Puntland stakeholders, including civil society organizations and government institutions relevant to the sectors selected for the vulnerability assessment. The consultation meeting focused on the following issues:

- realization of a stakeholder mapping for each sector;
- to reach agreement on the specific sites to be visited for data collection for the climate vulnerability assessment per sector; and

- to collect data from the sectoral actors for the climate vulnerability assessment per sector.

At the end of the workshop, the following were achieved:

- relevant stakeholders for each sector to be covered by the vulnerability assessment were identified.
- specific sites within Puntland to be visited for data collection were selected and surveyed (see Annex 1).
- stakeholders from the different targeted sectors were consulted as part of the data collection process.

DATA COLLECTION

Following the preceding steps, the enumerators embarked on the field mission and data collection. The data collection involved a total of eight (08) enumerators. Data was collected through key informant interviews and focus group discussions. Data collected was directly keyed in Kobo collect using smartphone. Data collection happened as per schedule provided in Annex 1. Relevant stakeholders consulted were:

- State line Ministries with focus sectors.
- Local institutions (non-governmental organizations, community-based organizations, educational institutions, etc.)
- Local government
- Community leaders
- People in vulnerable situations (women, youth, the elderly, people with disabilities, indigenous peoples, etc.)
- Community or social mobilizers
- UN and INGOs and NGOs, CSOs

Forty-one focus group discussions (FGDs) were held in different communities and vital sectors for which the purpose was to discuss several topics on climate change vulnerability, guided by facilitators to collect qualitative data. Thirty-one KIIs interviews were accorded to representatives of vital sectors under climate vulnerability. This aided in the identification of general issues and needs, understanding of the participants´ perceptions on climate change, current and potential future climate-related risks, and identification of capacities, local and indigenous knowledge and assets that can be enhanced to strengthen resilience. A semi-structured approach was used, asking predominantly open-ended questions that allowed the participants to express their views on different topics.

This method was particularly useful in cases where specific groups of people in vulnerable situations were identified (e.g., women only FGDs in contexts where women might not want to speak up or contradict the views of men in a whole group).

DATA ANALYSIS

Different approaches were used for data analysis, involving the use of several analytical tools. The various analyses carried out are presented below.

3.2.1. Analysis of the vulnerability of the physical environment to climate risks

The analysis of the vulnerability of the physical environment of Puntland to climate risk was based on methodological Guide for Mapping Vulnerability to Climate Risks proposed by the Sahel and Sahara Observatory (OSS, 2013). This method focuses on a combination of a series of vulnerability factors, with particular attention on topography and land use, which are then calibrated on a common measurement scale ranging from 1 to 4. This choice of approach is justified by its suitability or adaptation to the Sahelian zones but also to analyse the risks associated with climate change, as well as identify the most vulnerable zones with a view to inform decision-makers on issues related to sustainable land management and the risks associated with climate change.

3.2.2. Analysis of climate rationale

3.2.2.1.Analysis of past climate

One of the main problems in climate analysis in many sub-Saharan countries is the lack of high-quality observational data at an appropriate spatial and temporal resolution (Nikulin et al. 2012). In recent decades, satellite measurements have partly improved the situation. Given this situation, we opted for data from synoptic stations (temperature and precipitation) collected by NASA from geostationary satellites. This data offers enormous potential for studying changes in the distribution of precipitation and temperature.

To study past climate variability in the state of Puntland in Somalia, the behaviour of precipitation and temperature was examined. The statistical parameters on the inter-annual climate data series were then calculated using spreadsheet software.

To study climate variability in the state of Puntland, the behaviours of precipitation and temperature were examined by estimating centred precipitation and temperature anomalies. In fact, a climatic anomaly describes a climatic fluctuation whose amplitude (intensity and spatial extent) is outside the norm of observed fluctuations, i.e. is quite far from the climatic average (Janicot et al, 2015). In other words, the analysis of interannual anomalies in cumulative rainfall and temperature is of the utmost importance, as it makes it possible to identify years of extreme rainfall and temperature in relation to the series average, either positive years with high rainfall rates above the normal annual average, or negative years with very low rates below the average. To study the rainfall and temperature anomalies, the arithmetic means of the time series (40 years), the rainfall totals and averages for each year and the standard deviation of the series were calculated. The arithmetic mean was used to study the regimes (rainfall or T°). It is the fundamental parameter of central tendency represented here by the "normal", the average calculated over a thirty-year time series. By calculating the standard deviation, dispersion of values around the "normal" mean were assessed. It is the best indicator of climatic variability. Based on the standard deviation, the centred reduced anomalies of monthly and interannual rainfall and temperature were calculated. The following formula was used:

$$CV = (\boldsymbol{\delta} / \tilde{Y}) * 100$$

Where:

- Cv = coefficient of variation;
- $\tilde{Y}$= mean;
- δ = standard deviation.

3.2.2.2.Analysis of future climate

Projections of climate parameters such as precipitation and temperature have been based on the assessment presented in the IPCC's Sixth Assessment Report in Box TS.4 and section 9.6 of Working Group 1's contribution to the Intergovernmental Panel on Climate Change's Sixth Assessment Report[46]. These projections are provided for five shared socio-economic pathway (SSP) scenarios. For the purposes of this study, the SSP2-4.5 scenario which is approximately the upper end of the nationally determined global contribution emission levels by 2030 and the SSP5-8.5 scenario which is the highest baseline scenario with no additional climate policy were used.

The climate model used for the simulation is the CORDEX model, which relies on independent climate research centres as part of the coordinated regional downscaling of climate supported by the World Climate Research Program (WCRP) and assessed by the Intergovernmental Panel on Climate (IPCC). It has been justified by numerous African researchers (Worku et al., 2018; Dibaba et al., 2019) that the CORDEX model performs well in simulating rainfall and temperature.

The rainfall and temperatures simulated by the RCMs were taken from the forced CORDEX system of the Irish Centre for High-End Computing Ireland European Centre Earth climate model system (ICHEC-EC-EARTH). This is a CORDEX project in the African domain, with a spatial resolution of 0.44° ∗ 0.44°. The CORDEX Africa domain selected was mainly REMO2009. This model has been used in multiple studies in Africa and has proven successful in simulating rainfall and temperature (Worku et al., 2018; Dibaba et al., 2019). Rainfall and temperature data were downloaded from the public website and the required data for each station was extracted using station latitude and longitude in ArcGIS.

Once the data had been acquired from the REMO2009 model, it was extracted, followed by fitting operations using NASA's Panoply software, which enabled the date to be exported to Excel spreadsheets. In general, in CORDEX files, lat/lon variables are two-dimensional and rlat/rlon variables are one-dimensional. As a result, it's important to search for latitude and longitude in order to find the appropriate cell in the two-dimensional variables (lat/lon), then find the grid number in the two-dimensional variable. To do this, the CORDEX domain-based coordinate rotation platform was employed. This platform converts unrotated coordinates into rotated coordinates and vice versa. The rotation pivot is based on CORDEX domains. To extract data from CORDEX netcdf files, normal coordinates were converted to rotated coordinates using this platform, then extracted using rotated coordinates and rlat/rlon variables from the files.

The spatial pattern of precipitation and temperature was obtained by interpolating precipitation and temperature from different stations using inverse distance weighting (IDW). This is a suitable method for interpolating mean precipitation and temperature using latitude, longitude and the mean precipitation and temperature recorded at a station. IDW interpolation gives accurate results with reasonable calculation based on temporal and spatial structure (Maleika, 2020; Ryu et al., 2020; Yang et al., 2020). Spatial interpolation of extreme precipitation and temperature data using IDW algorithms has shown good results (Edalat et al., 2019; Tsangaratos et al., 2019).

3.2.3. Analysis of climate vulnerability

The analysis of climate vulnerability was done using information on exposure and sensitivity. Data was subjected to a scale ranging from 1 to 5 for exposure (1=Rare; 2=Unlikely;

[46] Sixth Assessment Report — IPCC

3=Possible; 4=Likely; and 5=Almost Certain) and sensitivity (Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme). The sum of the different average values (sensitivity and exposure) was used to assess the degree of vulnerability of ecosystems and communities according to the following classes: 1 to 2 very low vulnerabilities, 3 to 4 low vulnerabilities, 5 to 6 moderate vulnerabilities, 7 to 8 high vulnerabilities and 9 to 10 very high vulnerabilities.

3.2.4. Identification and assessment of adaptation options/strategies

Responses from focus group discussions, community consultations, administration and key informant interviews were used to identify and map out the adaptation options or strategies used by the population of Puntland across sectors to cope with different climate risks. The process entailed the identification of adaptation options/strategies that can reduce either the magnitude of the consequences, or the probability of occurrence, or both, of a climate change-related impact, based on the frequency and severity of climatic events.

4. AN OVERVIEW OF THE DIFFERENT SECTORS AT PUNTLAND

An overview of the eight sectors considered in this assessment and for which data was collected are presented in this section.

AGRICULTURE AND FOOD SECURITY

Agriculture/crop production is the second most important economic activity in Somalia after livestock in terms of contribution to national economic and food security. According to the strategic plan of 2018-2021 of the Ministry of Agriculture and Irrigation, before 1991, agriculture was one of the major activities with an estimated 1.8 million ha of cultivable land in Puntland. Of this total, close to 1.5 million ha produced crops under rainfed conditions whilst 250,000 ha was successfully irrigated. While agriculture constitutes one of the means of achieving equity and improving welfare of populations, it still makes a very low contribution to gross domestic product and employs a few people. Historically date palms were the main crop in Puntland oasis agriculture and continues to be grown nowadays although to a lesser degree. Common crops cultivated in Puntland includes lemon, date palm, cereals, pawpaw, maize, sorghum, onions, and vegetables. The diversification into vegetables and fruits to meet demand from urban areas, dates about two decades back and has resulted in increased total crop production and supported the stabilization and increase in the population's income.

The Food Security and Nutrition Analysis Unit (FSNAU) February 2020 report reported that an estimated 600,000 people were facing crisis and emergency food insecurity (IPC1 Phase 2, 3 and 4) in Puntland. Unfavourable international terms of trade, rising costs of inputs, climate change (climate disasters), global economic recession, pests and diseases, civil strife, and armed conflicts, conflicts between pastoral and agricultural populations were found to be the main constraints which have severely affected the food security of the whole country. In this sense, the Ministry of Agriculture and Irrigation of Puntland with the aim of promoting food security, reducing poverty and improving livelihood for the people, adopted measures to address the sector and bring it to production through an adaptative strategy. In connection to this, the Ministry of Agriculture had established a strategic plan 2018-2021 that aimed to principally recover and restore the full productive capacity of the sector, and to accelerate the transformation of agriculture into a competitive and commercially orientated enterprise.

According to the SIHBS, (2022),[47] the food security situation of households in Puntland gives rise to serious worries, as the food insecure experiences of these households in the month before the survey reveal that about 6 out of 10 households (60.4%) did not have access to healthy and nutritious food, about half of the households (56.0%) had to eat only a few types of food, 53.1% had to miss at least one meal, 52.4% had to eat less than expected, 51.6% feared not having enough food, 48.6% ran out of food, 46.0% suffered from hunger, and 42.9% of the population in Puntland went to bed without eating at least one time during the month prior to the survey date, at least once in the month preceding the survey.

Consultations with stakeholders in Puntland's agricultural sector revealed that many farmers grew crops mainly for semi commercial use while a few engaged in crop production solely for commercial purposes. Farmers reported that the main crops grown in Puntland included: lemon, date palm, cereals, pawpaw, maize, sorghum, onions, and vegetables. Of these, cash crops, lemon, date palm, and papaya were reported as the crops that generated high income to communities.

[47] Puntland State Report 2022 Somali Integrated Household Budget Survey (SIHBS)

WATER

Water shortages in Puntland and across Somalia have resulted in limited access to water, causing tension within communities. To obtain essential water for their families and livestock, people in the area are forced to use traditional water catchments known as berkades. In the wet season, 75.5% of the population have an improved water supply. This percentage drops by 5.4% during the dry season. In the worst conflict-affected areas in the south, this figure drops to 20%. Depending on the type of dwelling, there are significant differences in access to an improved water source. In urban areas, with little variation across seasons, about 84 % of households have access to an improved water source. However, from 75.9 % to 70.7 % and from 61.4 % to 48.9 %, respectively, the percentage of rural and nomadic households with access to improved water decreases[48]. Water scarcity reduces access to sanitation and hygiene, increasing the risk of waterborne diseases. Health problems caused by unsafe water also place an extra burden on poorer households, as they must spend a significant portion of their meagre incomes on medicine[49]. A dam is strategically located 75km from the village of Dhudo, between Bander Bayla and Dhudo. This central location allows nomads and communities from a wide area to access water for livestock and agriculture. With the help of El Niño rains, the dam has been able to store nearly 40,000 cubic metres of water, which can last for four to six months. The Puntland Water Resources Act of 2018 has been promulgated into law to manage Puntland water resources[50].

Water stakeholders argued that water was central to the performance of all living things in Puntland. The local communities obtained water for domestic use through dam water, water wells, water pumps, boreholes, and from the NUWACO water supply company. For those who used rainfed water, they obtain it seasonally. Climate change severely impacts both the availability of and access to water resources. Increased temperatures and dryness of the pasture (longer dry seasons) have led to increased demand for water. Poor households suffer most during droughts and end up exchanging water for livestock. Consultations with local communities revealed the lack of specific water harvesting techniques within communities.

LIVESTOCK

Livestock remains one of the main sources of economic activity, employment, and exports in Puntland. It is estimated that livestock exports contribute to around 80 % of foreign exchange earnings, 40 % of the gross domestic product, and 60 % of employment opportunities. Puntland is thus heavily dependent on the livestock sector and remittances from the diaspora which contribute significantly to household incomes and provide substantial funding for small businesses and basic service provision in and around towns.

Livestock production has been the backbone of the country's economy for centuries. Meat and milk that represent the main product of livestock production account for 55 % of the calorific intake of the entire population in the country. In Somalia, most recent projections estimate livestock numbers at about 5.2 million cattle, 12 million sheep, 12 million goats and 7.2 million camels, with cattle being concentrated mainly in the south and camels in the northern part of the country[51]. Today, livestock in Puntland is faced by several constraints, especially climate change. Puntland also experiences rare hailstorms which destroy livestock and crop plantations. In Libow, a village in Qardho District, the community has lost three communal berkades to cyclones and floods which happened in 1999 (Kafi and Mohamed, 2015). Also, the destruction

[48] Puntland State Report 2022 Somali Integrated Household Budget Survey (SIHBS)
[49] Water dams build resilience for communities in Puntland - Somalia | ReliefWeb
[50] Puntland Water Resources Act, 2018.
[51] Government of Somalia. (2022). Somalia's First Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCC). Ministry of Environment and Climate Change (MoECC), Mogadishu, Somalia

of the rangeland and forest landscapes affected the availability of forage and water storage for livestock leading to the reduced potential of livestock sector productivity, translating into a negative effect on the economy of Puntland. In addition to the government initiative taken to address these constraints, individuals engaged in livestock activities deployed some adaptative measures including but not limited to fodder production and water storage. However, for pastoralism to be sustainable, effective rangeland management and ecosystem protection programs must be initiated to increase the resilience of these communities and achieve continuous good livestock production (Kafi and Mohamed, 2015).

Interviews conducted with stakeholders in Puntland's livestock sector revealed that livestock production represents a key source of livelihood for the population. The main purposes for rearing livestock in Puntland include milk and meat production, and animal labour (pulling plows and wagons) that provide incomes for their subsistence and to support income generation. Livestock was also reared by some people for own use, clans' contributions (Mag iyo Qaan), domestication and business. The main animals concerned were goats, sheep, camel among others. The main sources of fodder for livestock were maize and grass (traditional grazing), and natural seasonal pasture.

HEALTH

Lack of proper waste collection, transportation, disposal, landfills, dumpsites, sanitation, and management is a key health issue in Puntland. It affects people and animal health, coastal and marine environments, and the socio-economic conditions of the people. Despite existing rules and regulations forbidding the dumping of hazardous waste materials, this act continued unchecked. Climate disasters also affect the health sector in Puntland. This is origin to some emerging Vector-borne diseases such as Malaria, Dengue, Rift Valley Fever-RVF and Gastrointestinal diseases such as cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A.

Moreover, recently, during the Covid-19 (emerging disease) pandemic crisis, access to primary healthcare was challenging because of the impact resulting from the disease itself, as well as the short- and medium-term consequences. These impacts affected the vulnerable groups (adolescent girls, women, children, elderly, disabled and Internally Displaced People) disproportionately on issues of sexual reproductive health, mental health, malnutrition among others. During the Covid-19 era, children vaccination programs against diseases including but not limited to polio and measles were commonly postponed or suspended, posing threats of serious health consequences in the future. However, the government engaged on measures such as health education, sensitization, and preventative practices on COVID-19[52].

SIHBS (2022) report shows that the prevalence of disability in Puntland is 8.4%, with a large variation from the younger age groups to the older age groups. According to the report, 5,4 % of Puntland's population suffer from chronic illnesses and the most frequent chronic illnesses reported were blood pressure with 24,1 %, diabetes with 12,5 % and renal illnesses with 11,3 %. Access to healthcare is a concern as 38.5% of people with non-chronic illnesses and injuries seek medical advice from pharmacies (38.5%), while the combined percentage going to hospitals either public or private is 27% and worryingly 37.5% of this population cannot afford basic healthcare, indicating the need for improved healthcare accessibility and affordability initiatives.

Consultations with stakeholders during the assessment revealed that the health sector is affected by climate hazards such as high temperatures and floods. Floods increase the

[52] Horn Population Research & Development, 2020. VULNERABILITY ASSESSMENT IN SOMALIA. Mogadishu Office, Somalia, 58p

vulnerability of the population to diseases like cholera, typhoid, dysentery and diarrhoea due to the consumption of water contaminated by overflooded toilets and other contaminants transported by the flood waters. Flooding occurs mostly in the rainy season.

EDUCATION

The educational system of Puntland comprises two years of early childhood development, eight years of primary education (four years of lower primary and four years of upper primary) and four years of secondary education. The educational system is under the jurisdiction of the Ministry of Education and Higher Education in Puntland. The Global Partnership for Education, Education Donor Group, the Education Cluster, and UNICEF are key players in the Puntland Education Sector. Displacement caused by conflict and climate change through climates hazards have further strained the precarious community-level social service capacity and the needs for education has increased significantly in Puntland. In fact, children continue to face serious protection threats with key issues of concerns being lack of access to safe and protective education opportunities as well as psychosocial support, child labour, threats of early marriage, and recruitment to armed groups. Moreover, education has been hardest hit by the COVID-19 pandemic worldwide including Puntland state of Somalia. Some students dropped out of school due to school closure across the country. Even before COVID-19, poverty, long distances to school, lack of school fees, safety concerns, social norms favouring boys' education, and inadequate/shortage of teachers, particularly female teachers, and the low availability of sanitation facilities were key barriers limiting school enrolment of children, particularly girls and mainly IDPs/refugees. The grim pandemic situation has only widened socio-economic inequalities between the poor and well-off households[53]. The Ministry of Education and Higher Education of Puntland State of Somalia presented the Accelerated Funding Global Partnership for Education (AF- GPE) Proposal to support the Education Sector Strategic Plan (ESSP).

According to the findings of SIHBS, (2022) the population is 49.6% literate, with the highest rate of literacy among the 15-19 age group at 68.5%. Nevertheless, a significant 58.3% of the population has no formal education. In terms of school enrolment, there is a relatively low net enrolment rate of 16.6 % for secondary education, in comparison to 32.4 % for primary education.

During discussions with the communities and education stakeholders, this sector was found to be a pillar of development. The vulnerability assessment for this sector was done on four sub-sectors: students, staff, parents and school's infrastructures.

PUBLIC WORKS

In Puntland, the management of this sector is under the responsibility of the Ministry of Public Works, Transportation and Housing. Its principal mission is to plan, design, construct and maintain Puntland public assets such as government buildings, hospitals, schools, police stations, prisons, courts, theatres, public sewage schemes and other infrastructures such as roads, ports, dams, runways, and bridges in collaboration with line-Ministries and local government authorities, with the aim to increase the capacity of the workers of the public works and provide a safe working environment. The vision of this ministry is to deliver world class public infrastructure, public transportation and housing conforming with international standards and environmental protection protocols.

The development of public works in Puntland is challenged by several factors including climate hazards. For instance, frequent floods cause erosion, damage roads, dams and bridges, leading

[53] Ibit 53

to increased cost of maintenance or security threats in some regions. In 2013, flood damaged the Midigar Bridge along the main tarmac highway that connects the port city of Bosaso to Galkaio. However, historically flooding in Puntland has remained large and widespread (Kafi and Mohamed, 2015). Other factors that affected public works includes political conflicts, and most recently Covid-19 pandemic. In general, The Ministry of Public Works have insufficient financial resources to rebuild or retrofit infrastructures. However, peace and security enjoyed by most regions of Puntland, coupled with the existence of district councils has encouraged international agencies to implement infrastructural projects in the districts. The good governance and reform-oriented government in Puntland represent opportunities explored by the Government to improve the public works sector in Puntland.[54]

In assessing the climate vulnerability of the public work sector, three main institutions were consulted: Mansuur Cooperative, District municipality and the Ministry of Public works, housing and transport.

BIODIVERSITY

Biodiversity plays an important role in the ecosystem and contribute to the ecosystem's provisioning services (production of foods, fuels, fibres, water, genetic resources), cultural services (recreation, spiritual and aesthetic satisfaction, scientific information), and regulating services (controlling variability in production, pests and pathogens, environmental hazards, and other key environmental processes) which are important for livelihoods of communities.

The vegetation class "Grassland" is the most dominant class, representing approximately 60% of the state's vegetation. This natural ecosystem of Puntland was historically subject to a high pressure that has affected its diverse functions in providing ecological, economic and social services. Puntland rangeland ecosystem has depleted over the past 20 years. Gully erosion, tree cutting, sand dunes and invasive plants have taken over the rangelands. According to the findings of Kafi and Mohamed (2015), extreme climate conditions have threatened the biodiversity (e.g. wildlife) and contributed to land degradation i.e. formation of gullies (locally known as kaankaro dhuleed 'Land Cancer'), and dunes, water diversion disrupting the ecosystem functions (provisioning, supporting, and regulating) which the pastoral communities benefited from the rangelands. Other contributors to ecosystem disruption are increased pressures from increasing population, increasing number of livestock, clan conflicts and access to guns, invasive plant species, and lack of effective environmental governance and mismanagement of natural resources.

Puntland's forest and rangeland sector is under the control of the Ministry of Environment, Range and Climate Change. This ministry has elaborated a strategic plan 2022-2024 setting out six strategic key priorities that include Rangelands and Biodiversity Sustainable Development. The vision of this strategic plan is "Ensuring Puntland Achieves Sustainable Environmental Management and Climate Change Resilience". Puntland aims to achieve targets set by the State's development plans; the Federal Government aspirations on economic prosperity; the Africa Union's Agenda 2063; and the United Nations Sustainable Development Goals (SDGs).

COASTAL AND MARINE AREAS / RESOURCES

Despite the rich marine biodiversity and an extensive coastline, exports of fishery products only account for around 3% of total exports and contribute about 2% to GDP in the State of Puntland, Somalia. Fishing fluctuates by season and contributes to household income. Income from fishing varies with fishermen earning $1.5 USD per day during the monsoon season and

[54] Ministry of Public Works, Transportation and Housing, 2020. Strategic Plan 2022 – 2024 Puntland State of Somalia. 60p.

an estimated $40 USD per day during the fishing season[55]. The income disparity between the monsoon and fishing seasons is quite substantial, with fishermen earning approximately 27 times more during the fishing season ($40 USD/day) compared to the monsoon season ($1.5 USD/day). This fluctuation could be due to various factors such as fish availability, weather conditions, and market demand. It's crucial for these communities to have strategies in place to manage this income variability and ensure sustainable livelihoods throughout the year. However, law enforcement and policy development in the fish sector are practically insufficient. In the same line, climate change affects the marine resources, fishing activities and the subsistence of households. Despite the variety of fish resources, poor processing facilities, poverty, old fishing gear and the isolation of fishing communities constitute the weaknesses prevalent in the sector. Nevertheless, opportunities such as the development of local marketplaces, the provision of micro-finance, improved processing facilities and the standardization of inboard and outboard engines, all highlight the prospects existing in the sector[56].

Interviews and focus group discussions with stakeholders and coastal communities revealed that several techniques / equipment are employed in the fish harvesting in Puntland, including traps, cast net, lift net (walking and static netting), Angling, local technique called Tasbiyad (literally translated as shark fishing in English) and hooking. Fishers also use small boats, pots, mini trawls Gargoor, jillaab, Milgo as the harvesting equipment. The dominant fish species harvested include Grunts (Shoox, cadaasho), Demersal fish, Pelagic fish Tuna Groupers (suumaan, kaluun qareed, caalo), Suubaan, and Gaxash.

[55] Somalia final draft 22-11-2010.docx (iwlearn.net)
[56] ibid55

5. VULNERABILITY ANALYSIS AND RISK (VAR) PROFILE

ANALYSIS OF THE VULNERABILITY OF THE PHYSICAL ENVIRONMENT TO CLIMATIC RISKS IN PUNTLAND SOMALIA (PAST AND CURRENT)

Vulnerability assessment is a fundamental step in planning appropriate adaptation strategies. This assessment helps to determine how the physical environment will be affected by climatic hazards.

5.1.1. Vulnerability of Puntland to flooding

Flooding is one of the most frequent natural hazards affecting the state of Puntland in Somalia. It rarely rains, but when it does, the impact is devastating. These floods are mainly caused by heavy rainfall, which raises the water level causing them to overflow their banks and resulting in catastrophic flooding. These floods are responsible for the destruction of essential grazing land for animals, the leaching of land and the destruction of crops, leading to food insecurity and forced migration. To gain a better understanding of this phenomenon and examine potential vulnerable areas, the mapping of flood-prone areas has been highlighted to delimit the zones in which flooding is likely to occur following heavy rainfall, considering the topographical parameters of the environment.

The analysis of flood risks in the various districts of the state of Puntland revealed that the state has several levels of flood risk, ranging from very low to very high (**Figure 5**). Approximately 50% of the territory is vulnerable to the risk of flooding. Areas with very high and high risk to flooding respectively represent 20% and 31.96% of the state's surface area. These very high- and high-risk classes correspond to areas with low and medium slopes, low drainage density and high population density. Coastal areas are particularly vulnerable to flooding due to the morphological conditions of the environment (generally flat with practically no slopes), which predisposes it to this risk. These zones cover most of the south-eastern and north-eastern part of the coastal edge of the state of Puntland. However, moderate risk sites represent 27.27% of the territory. In practice, these are predominantly vegetated areas characterised by a medium drainage system and medium slopes. The very low (5.65%) and low (15.03%) risks correspond to areas with steep slopes, which facilitate the drainage of run-off water. This clearly shows that the low slope areas bordering the watercourses are more susceptible to the risk of flooding.

Table 1 : Statistic of flood vulnerability in Puntland State

Level of Vulnerability to Flood	Area (Ha)	Area (%)
Very high	10236457.81	52.05
High	5361739.36	27.26
Moderate	2955590.174	15.03
Low	1110440.476	5.64
Total	19664227.82	100

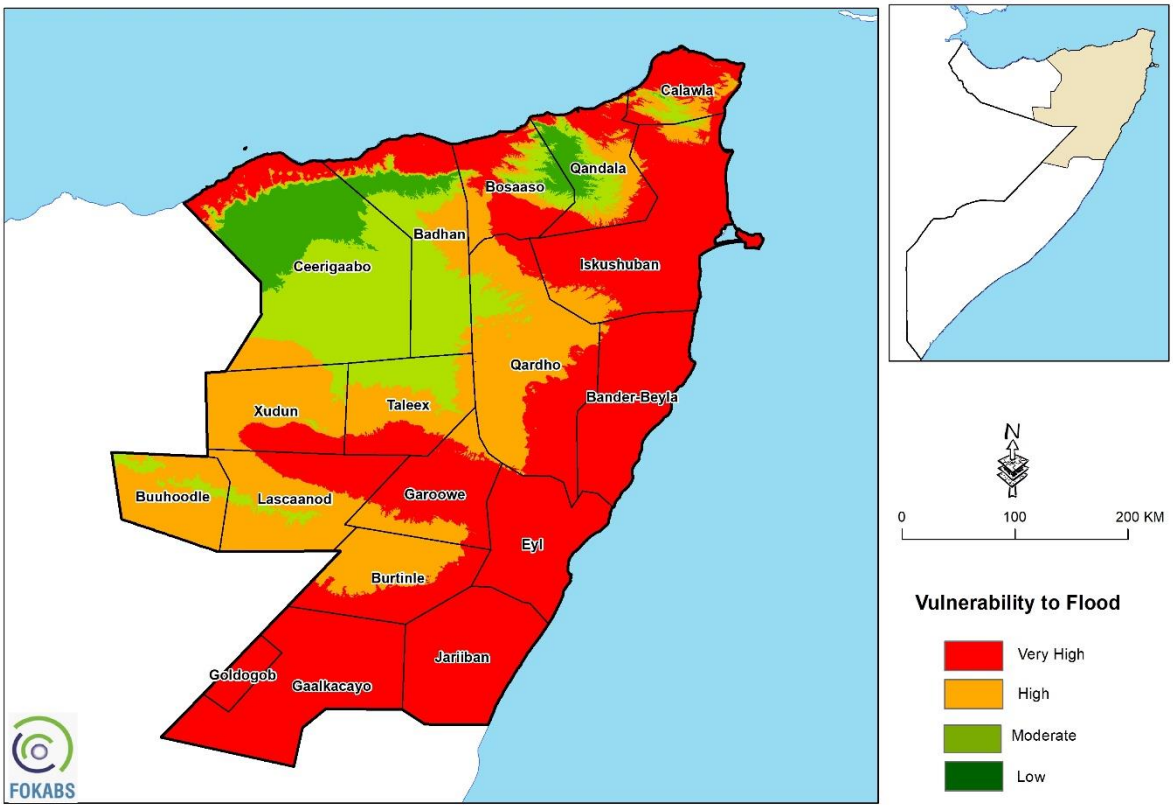

Figure 5 : Flood vulnerability map for the state of Puntland

5.1.2. Vulnerability of Puntland to drought

Drought is one of the most serious problems threatening most of the countries in the Sahel, and in Somalia, particularly in the state of Puntland, the onset of drought sequences in recent years has had a damaging effect on natural resources, in particular the drying up of water sources, the drying up of plant cover and the drying up of crops during their growth, with repercussions on agricultural productivity and food security. To gain a better understanding of this phenomenon and identify potential areas exposed to it, drought-vulnerable areas have been mapped in the state of Puntland in Somalia, considering the degree of exposure and sensitivity of the different land-use class.

According to the results in **Figure 6***, four levels of drought risk have been identified in the state of Puntland in Somalia, ranging from low to very high. Bare soils devoid of vegetation present a level of risk (very high) to the drought phenomenon and occupy 51.73% (*

Table *2*) of the total area of the territory, and this includes cultivated areas among others. Herbaceous and shrubby savannah formations present a high level of vulnerability to drought. The areas with a high vulnerability occupy 48.10% of the total area of the territory. Areas of low and moderate vulnerability account for less than 1% of the total land area and correspond to Shrubland and developed areas.

The analysis sufficiently demonstrates that the areas devoid of vegetation constitute the most sensitive areas and the most exposed to climatic and pedological drought. The drought vulnerability map for the state of Puntland is presented in **Figure *6***.

Table 2 : Statistic of drought vulnerability in the state of Puntland

Level of Vulnerability to Draugh	Area (Ha)	Area (%)
Very High	9864330	51.73
High	9172161.91	48.10
Moderate	27251.4	0.14
Low	3834.92	0.02
Total	19067578.2	100.00

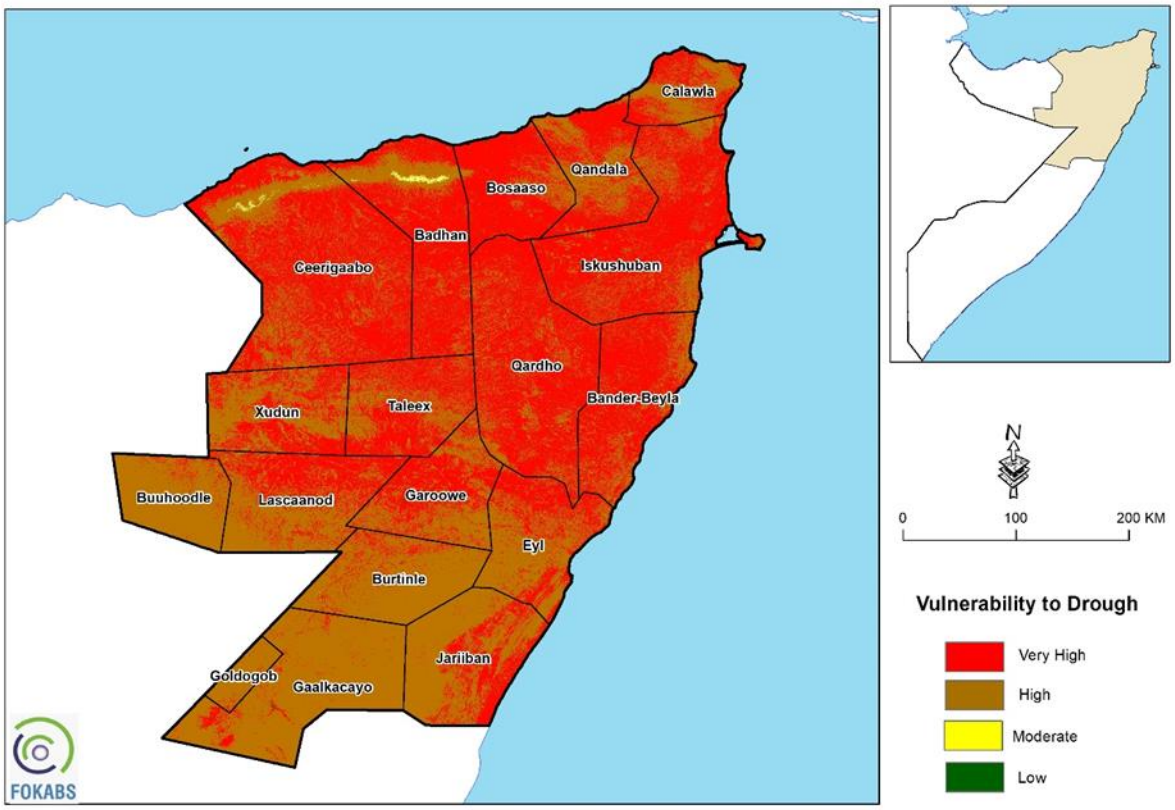

Figure 6 : Drought vulnerability map for the state of Puntland

5.1.3. Vulnerability of Puntland to cyclones and storms

Tropical cyclones are one of the most frequent climatic hazards to affect the north-eastern coast of the state of Puntland. This phenomenon occurs once a year. The cyclone season depends on the summer monsoon, with the most violent storms occurring before the months of May and June. These cyclones cause a great deal of damage in the areas where they occur, including the loss of livestock, contamination of local drinking water points and the loss of crops for many local farmers.

A map of the potential areas in Puntland sensitive to cyclones has been established (**Erreur ! Source du renvoi introuvable.**). The resulting vulnerability map clearly shows the areas vulnerable to cyclones and storms according to wind strength, but also considering the altimetry variations in the terrain.

According to **Erreur ! Source du renvoi introuvable.**, an estimated 44% of the Puntland's territory is vulnerable to cyclones and storms. Areas with high and very high risks respectively

represent 33.79% and 11.09% of the state's territory (**Erreur ! Source du renvoi introuvable.3**), corresponding to the low-lying coastal areas around the Indian Ocean. Areas with moderate risk accounts for 31.48% of the territory of the state. These are the contact zones between the coast and the mainland, with average slopes. The low-risk and no-risk zones (very low risk) respectively represent 17.50% and 6.13% of the total surface area of the territory. In practice, these are the inter-land zones where storms do not propagate due to the decrease in wind speed as one moves away from the coast. Moreover, the low-lying areas bordering the sea are more sensitive and exposed to cyclones and storms than the inter-land areas, as wind speeds decrease as one moves away from the coast.

Table 3: Statistics of vulnerability to cyclone and storms in the state of Puntland

Level of vulnerability of Cyclone and storm	Area (Ha)	Area (%)
Very High	2181628	11.09
High	6644732	33.79
Moderate	6190850	31.48
Low	3442005	17.50
Very low	1205014	6.13
Total	19664229	100.00

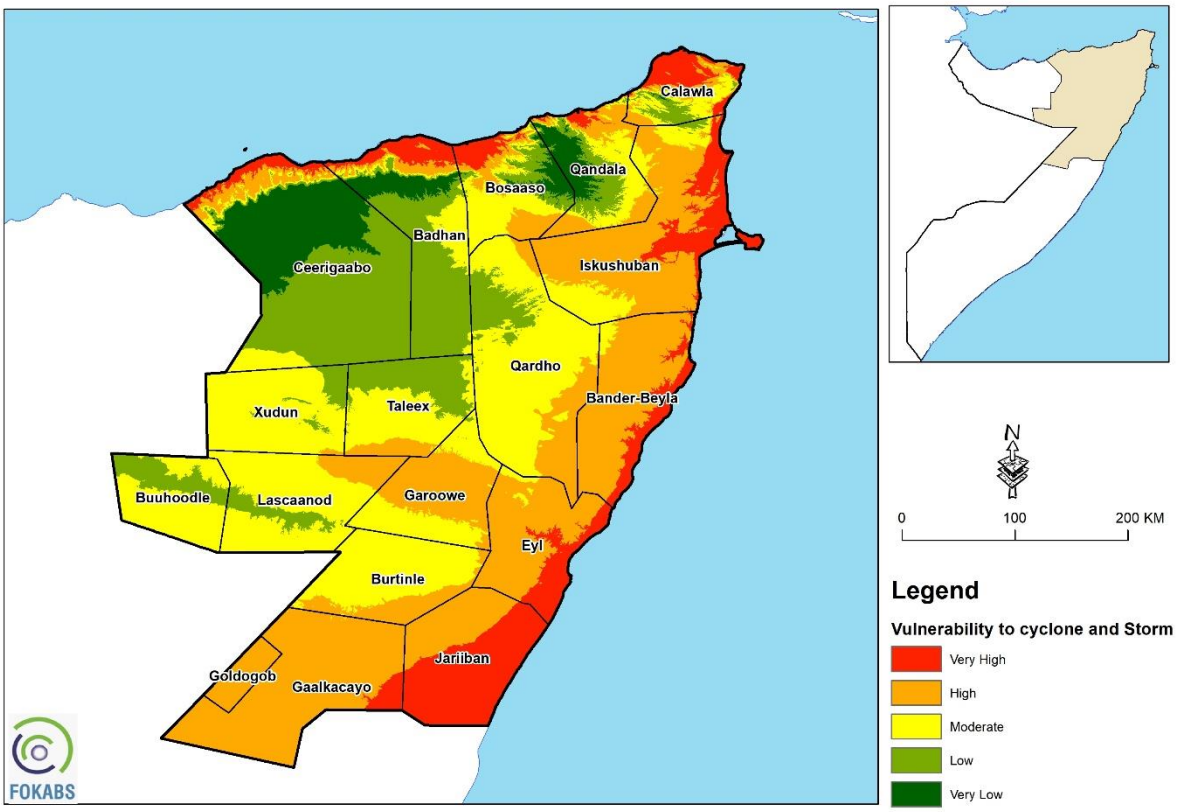

Figure 7: Level of vulnerability to cyclones and storms in the state of Puntland

Flooding, cyclone storms, and drought are all threats that disrupt people's livelihoods in Puntland. However, the spatialisation of these climatic hazards has made it possible to identify the areas likely to be affected if these phenomena occur. This provides a solid basis for local

authorities to take steps towards mitigating potential damages. **Erreur ! Source du renvoi introuvable.** summarises the districts vulnerable to the various climatic hazards in the state of Puntland.

Table 4: Summary of the vulnerability of Puntland's districts to climatic hazards

Climate risk	**Districts affected and level of vulnerability**	
	Less vulnerable	Hight vulnerable
Flood	Ceerigaabo	Jariiban
	Badhan	Bander-beyla
		Gaalkacayo
	//	Caluula
	//	Eyl
	//	Iskushuban
	//	Laasqorey
	//	Qardho
	//	Gandala
	//	Calawla
	//	Goldogob
	//	Garoowe
	//	Bosaaso
	//	Burtinle
Drought	//	Bander-beyla
	//	Iskushuban
	//	Badhan
	//	Qandala
	//	Calawla
	//	Gardho
	//	Bosaaso
	//	Jariiban
		Eyl
		Garoowe
		Taleex
		Caluula
		Ceerigaabo
		Xudun
		Lascaanod
Cyclone and strom	Ceerigaabo	Jariiban
	Gandala	Bander-beyla
	Badhan	Iskushuban
	//	Eyl
	//	Caluula
	//	Laasqorey
	//	Gandala

CLIMATE CHANGE AND CLIMATE PROJECTIONS

5.2.1. Climate Change between 1981 and 2022

5.2.1.1.Precipitation

In Puntland State, rainfall is generally scarce, typical of a desert or semi-desert climate. The rains occur in two periods, corresponding to the passage of the sun at its zenith, from March to the end of May (the Gu), and from October to the beginning of December (the Dayr). The rainiest months are April-May and October-November. The evolution of inter-annual rainfall anomalies is presented in **Erreur ! Source du renvoi introuvable.**.

Based on the analysis presented in **Erreur ! Source du renvoi introuvable.**, between 1981 and 2021, the inter-annual change in rainfall anomalies shows a general downward trend (decreasing) in annual rainfall, represented by the trend line. The inter-annual trend in rainfall anomalies is characterised by a wet period (surplus) marked by positive values with peaks of up to 2.5mm. These anomalies are in the 2mm to 2.5mm range, with 1995 and 2003 recording the highest positive anomaly values, representing the wettest years in the series. Periods of reduced rainfall (deficit periods) were also observed, with negative index values ranging from -0.50mm to -1mm. The years 1983, 1991, 1999, 2009, 2013, 2017, 2019 and 2021 were all drier than average, representing the driest years (with less rainfall), and the peaks in the graph are rather heterogeneous. The year 1985, with the highest negative anomaly value, undoubtedly corresponds to periods of drought in Africa.

Overall, rainfall is low and generally rare. This drop in rainfall has a negative impact on plant growth, as changes in rainfall linked to climatic variability accelerate the deterioration of plant cover and encourage erosion.

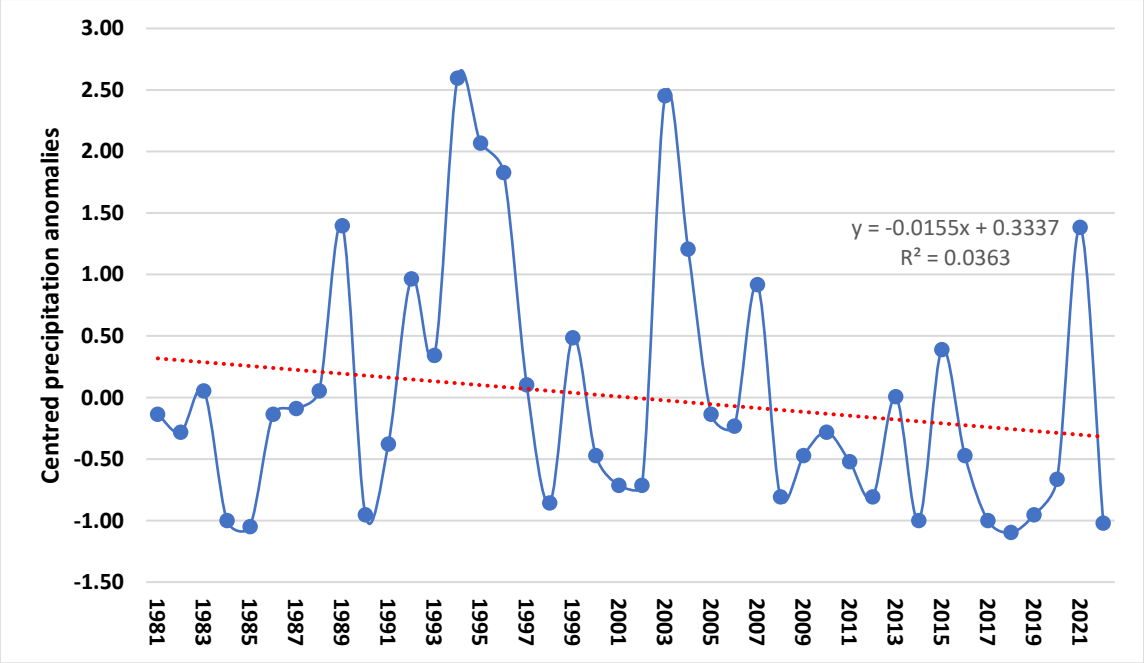

Figure 8: Centred precipitation anomalies in Puntland

5.2.1.2.Temperature

Between 1981 and 2021, the inter-annual trend in temperature in Puntland State shows a general increasing trend in temperatures, represented by the trend curve (**Erreur ! Source du renvoi introuvable.**). The inter-annual trend in temperature is characterised by thermal periods (surplus) marked by positive values with peaks of up to 2.5°. The year 2000 recorded the

highest positive anomaly value, making it the warmest year in the series. Deficient periods compared with the thermal normal were also observed, with negative index values fluctuating between -1 and -2.50°. This was the case for the years 1987, 1997, 2003 and 2011, which were deficient compared to the normal, representing the warmest years in the series.

On the whole, temperatures are on the rising trend. This rise is having a negative impact on people's activities, particularly the drying up of water reservoirs needed for agriculture and livestock farming.

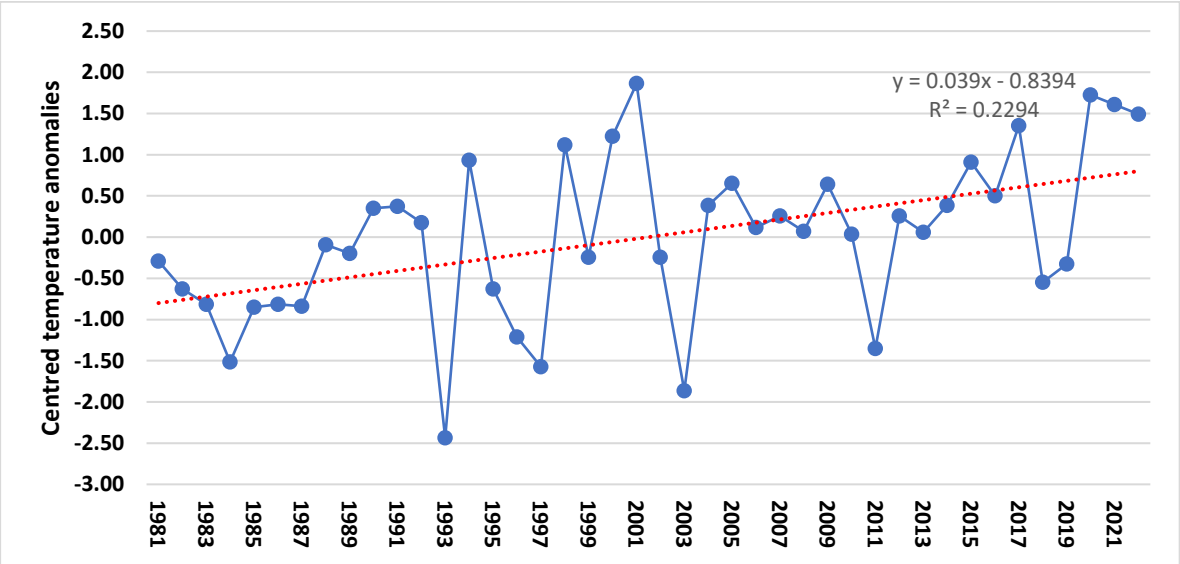

Figure 9: Centred temperature anomalies in Puntland

5.2.2. Climate projections expected for the Puntland State

5.2.2.1. Expected precipitation in Puntland

- ***Precipitation prediction for 2021 to 2040***

Based on the SSP2_45 scenario, expected precipitation in Puntland between 2021 and 2040 will range from 17 mm to 426 mm. With scenario SSP5_85, precipitation will range from 19 mm to 431 mm. Districts in the northern part of Puntland will have less rainfall. On the other hand, southern Puntland districts will have more rainfall, while central districts will have average rainfall (**Figure *10***).

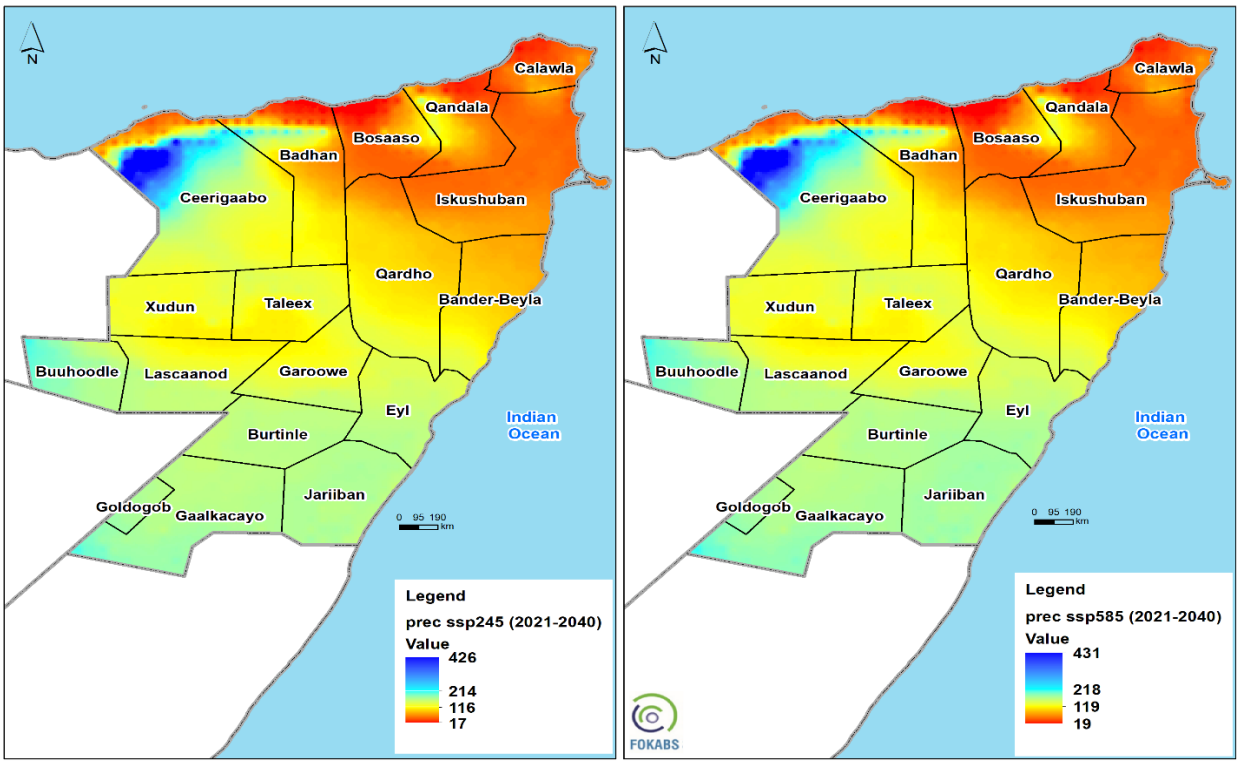

Figure 10 : Distributions of precipitation expected in Puntland between 2021 to 2040 under SSP2 4.5 and SSP5 8.5 scenarios.

- ***Precipitation prediction from 2041 to 2060***

Expected precipitation in Puntland between 2041 and 2060 will range from 18 mm to 431 mm based on SSP2_45 scenario. With scenario SSP5_85, precipitation will range from 19 mm to 440 mm. Districts in northern Puntland will have less rainfall. On the other hand, southern Puntland districts will have more rainfall, while central districts will have average rainfall (**Figure *11***).

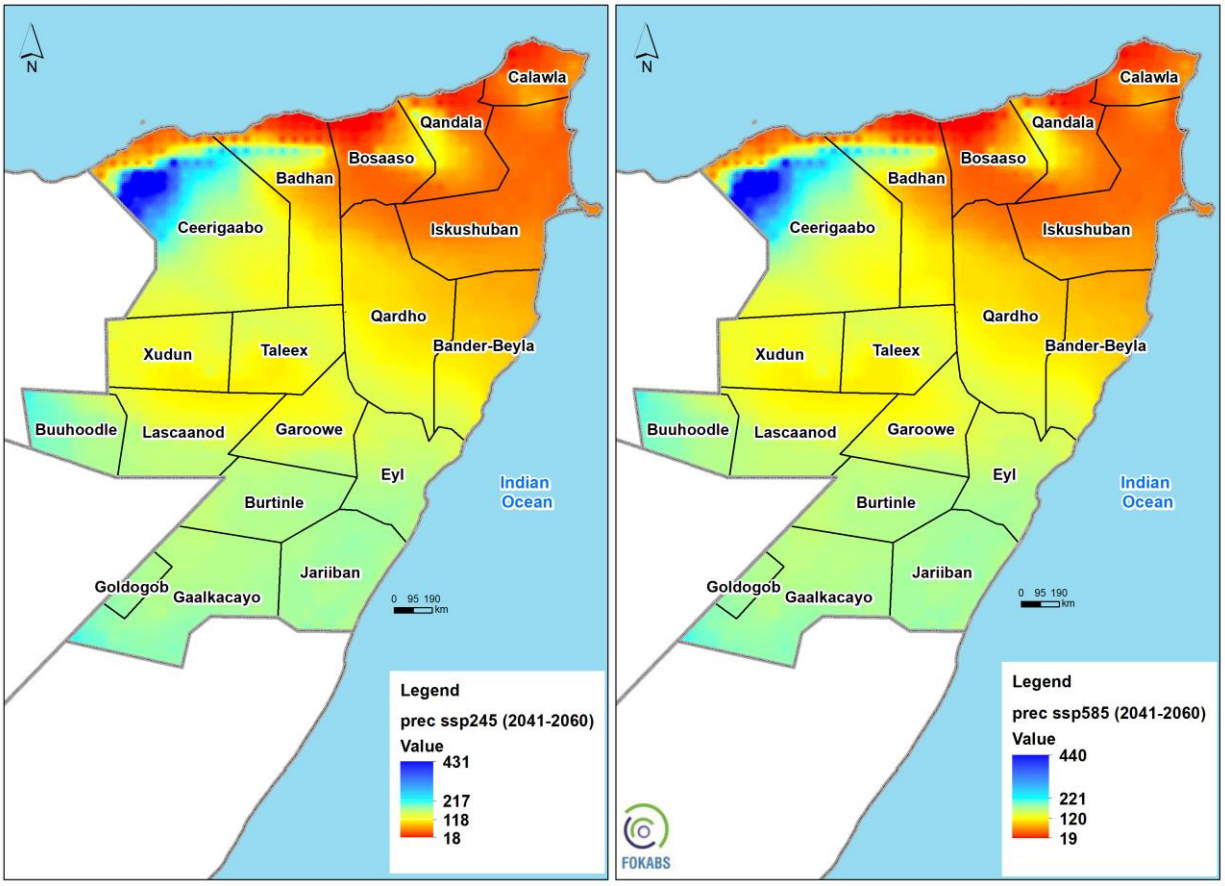

Figure 11 : Distributions of precipitation expected in Puntland between 2041 to 2060 under SSP2 4.5 and SSP5 8.5 scenarios

- ***Precipitation prediction from 2061 to 2080***

Expected precipitation in Puntland between 2061 and 2080 will range from 18 mm to 432 mm based on SSP2_45 scenario. With scenario SSP5_85, precipitation will range from 19 mm to 465 mm. Districts in northern Puntland will have less rainfall. Southern Puntland districts will have more rainfall, while central districts will have average rainfall **(Figure 12**).

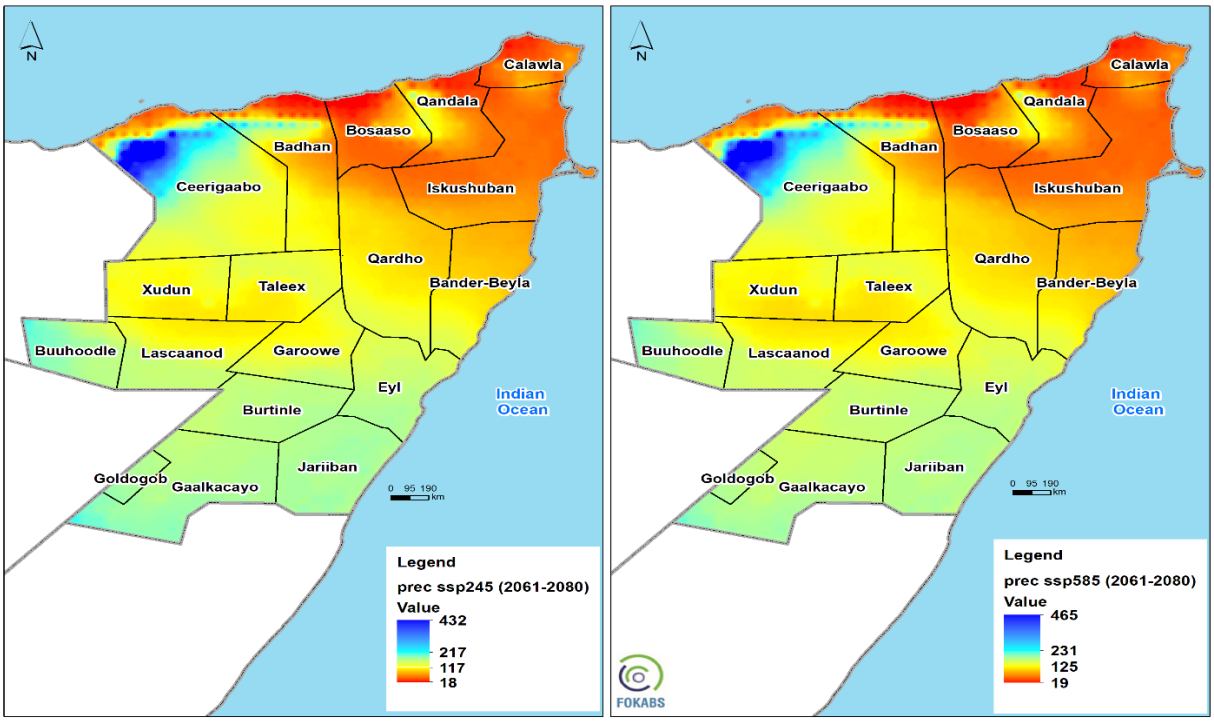

Figure 12 : Distributions of precipitation expected in Puntland between 2061 to 2080 under SSP2 4.5 and SSP5 8.5 scenarios

- ***Precipitation prediction from 2081 to 2100***

The future expected precipitation in Puntland between 2081 and 2100 will range from 18 mm to 444 mm based on SSP245 scenario. With scenario SSP585, precipitation will range from 26 mm to 538 mm. Districts in northern Puntland will have less rainfall. Southern Puntland districts will have more rainfall, while central districts will have average rainfall (**Figure *13***).

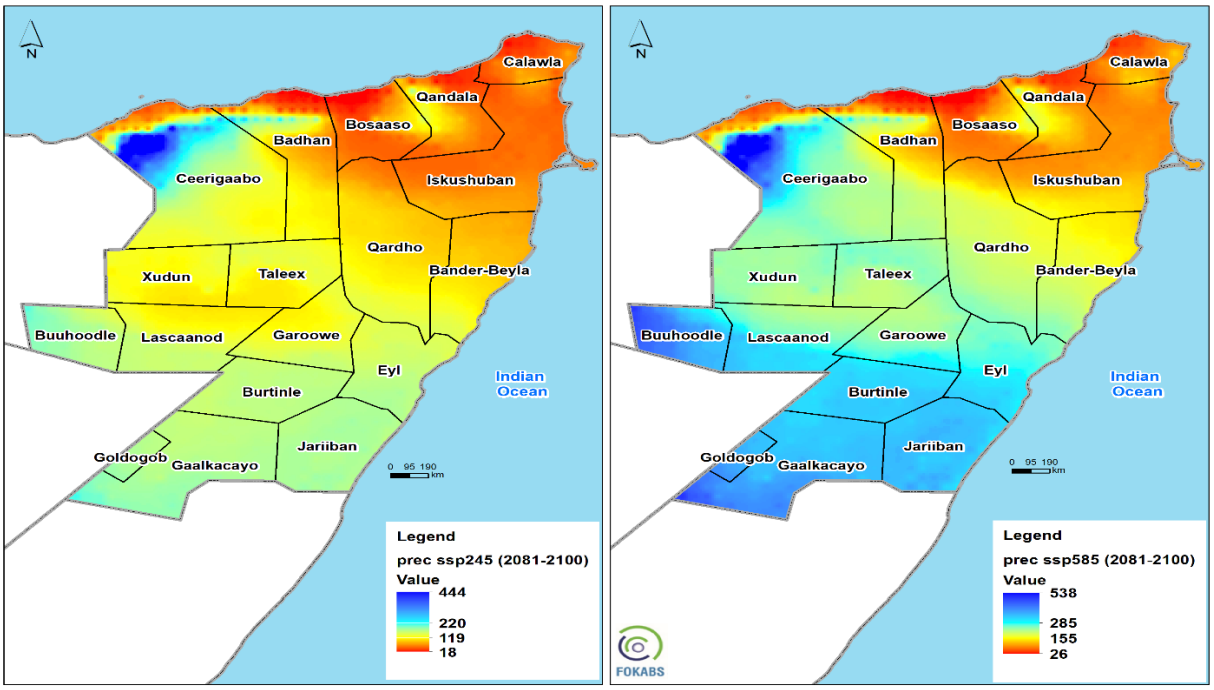

Figure 13 : Distributions of precipitation expected in Puntland between 2081 to 2100 under SSP245 and SSP585 scenarios

5.2.2.2.Expected temperatures in Puntland

- Temperature prediction from 2021 to 2040

According to the SPPE_45 scenario for the period 2021 to 2040, expected temperatures range from 21°C (lowest) to 36°C (highest). In the SSP5_85 scenario, Puntland's temperature is projected to range from 21°C to 35°C. The lowest temperatures will be observed in some northern districts, while the highest values will be seen in the southern Puntland districts and some northern districts as well. Districts in central Puntland will see average temperatures (**Figure 14**).

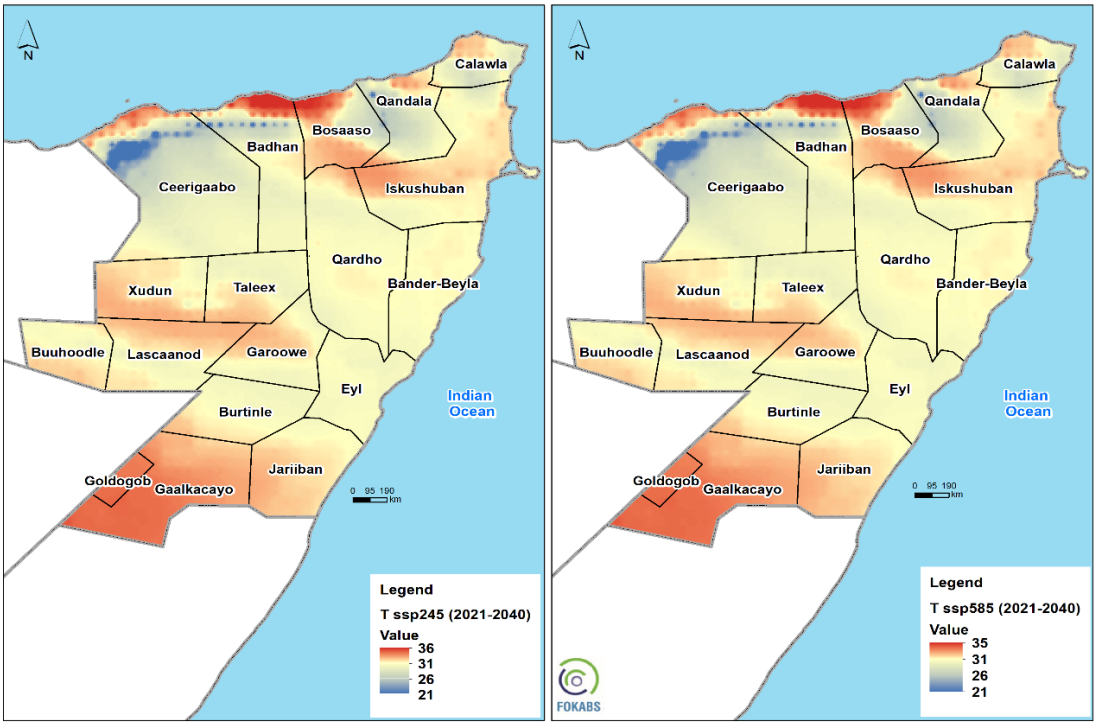

Figure 14 : Distributions of temperatures expected in Puntland between 2021 to 2040 under SSP2 4.5 and SSP5 8.5 scenarios.

- Temperature prediction from 2041 to 2060

The future expected temperatures using SPPE_45 scenario and SSP5_85 scenario for the period 2041 to 2060 ranges from 22°C to 36°C. In some areas of the districts, the lowest temperatures will be observed, while the highest values will be seen in the southern Puntland districts. Districts in central Puntland will see average temperatures (**Figure *15***).

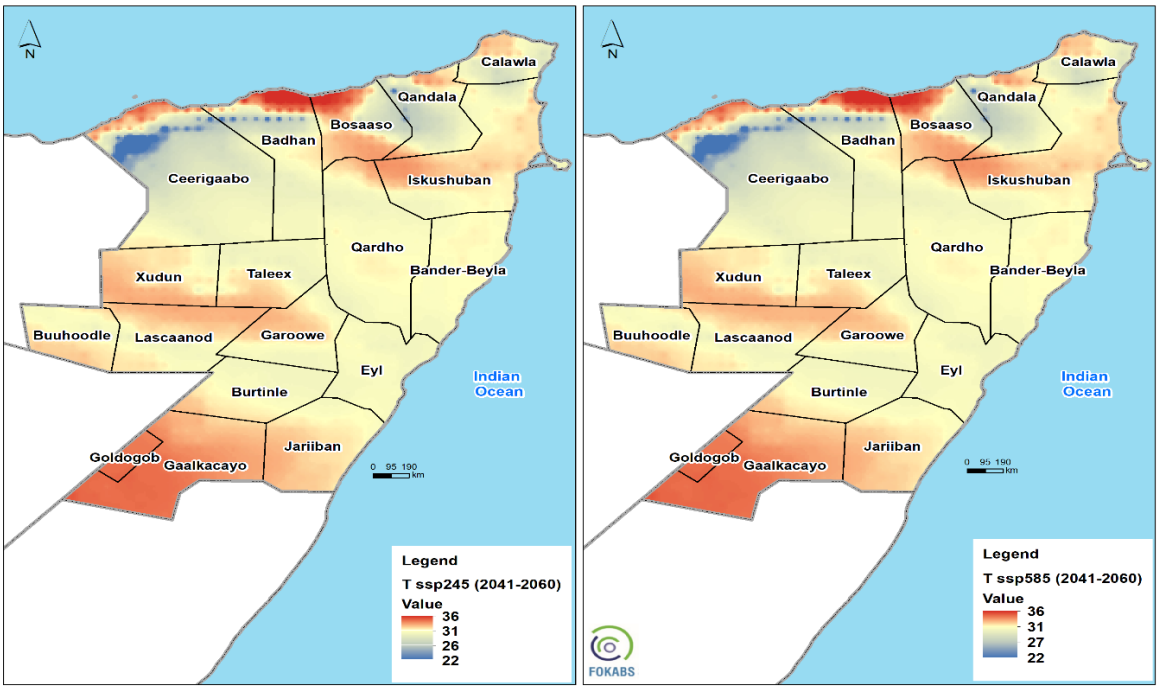

Figure 15 : Distributions of temperature expected between 2041 to 2060 under SSP2 4.5 and SSP5 8.5 scenarios

- Temperature prediction from 2061 to 2080

The future expected temperatures using SPPE_45 scenario for the period of 2061 to 2080, range from 22°C to 36°C. In the SSP5_85 scenario, on the other hand, these temperatures range from 23°C to 37°C. In some areas of the districts, the lowest temperatures will be observed, while the highest values will be seen in the southern Puntland districts. Districts in central Puntland will see average temperatures (**Figure *16***).

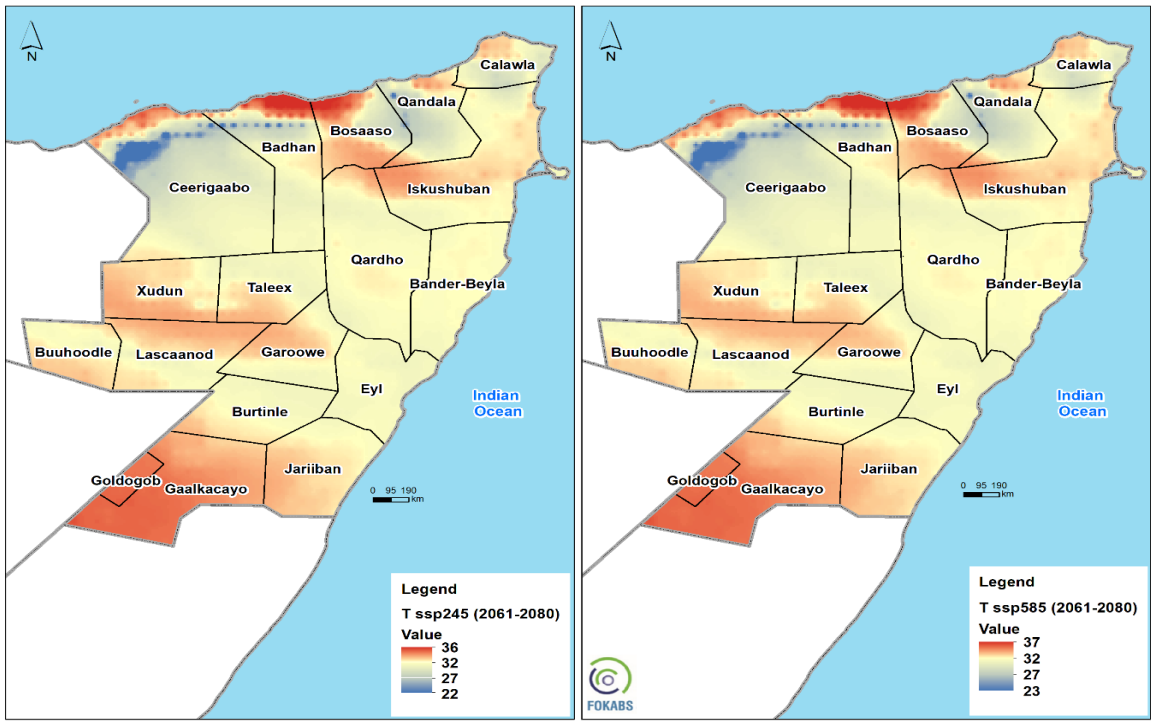

Figure 16 : Distributions of temperatures expected between 2061 to 2080 under SSP2_45 and SSP5_85 scenarios

- Temperature prediction from 2081 to 2100

The future expected temperature using SPPE_45 scenario for the period of 2081 to 2100 ranges from 22°C to 37°C for the highest. Under the SSP5_85 scenario, temperatures are projected to range from 26°C to 40°C. In some areas of the districts, the lowest temperatures will be observed, while the highest values will be seen in the southern Puntland districts. Districts in central Puntland will see average temperatures (**Figure 17**).

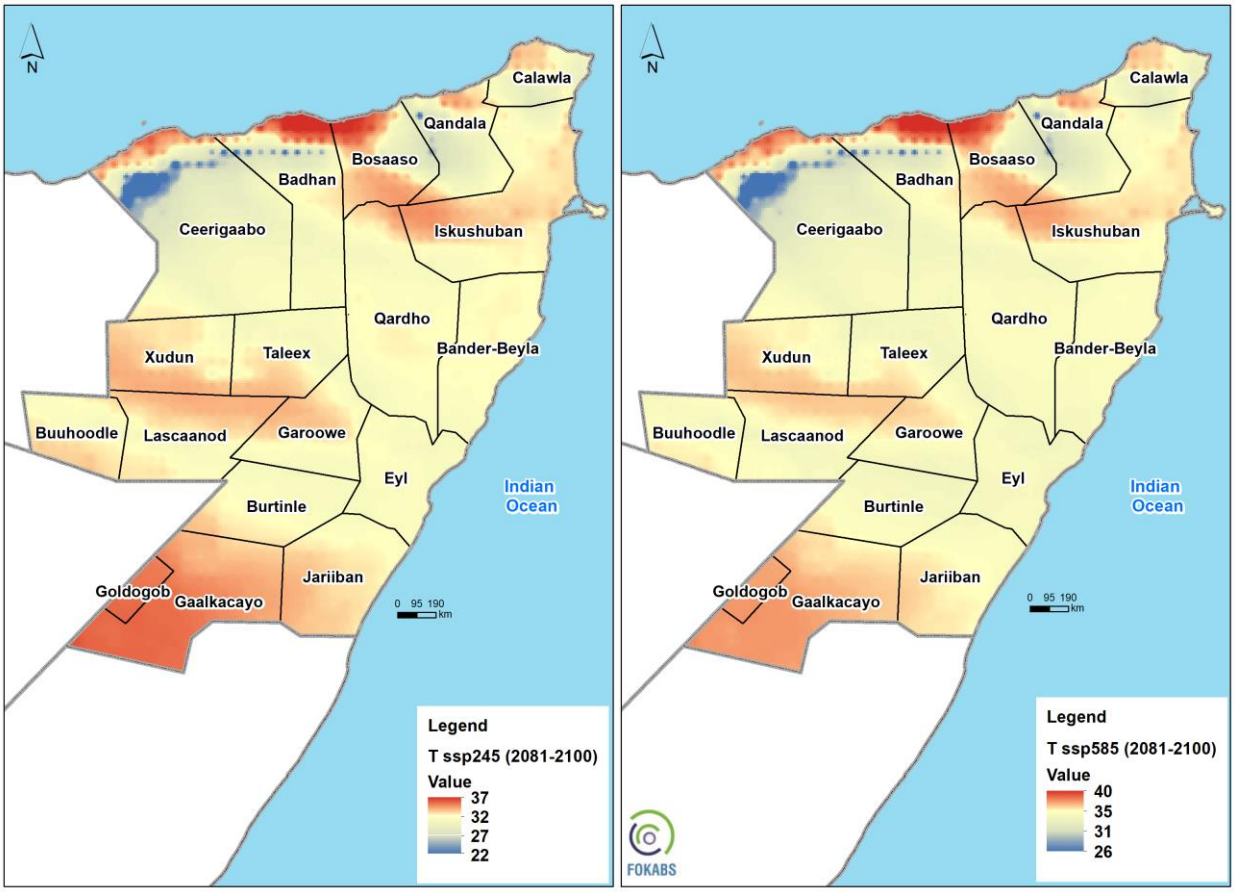

Figure 17 *:* Distributions of temperatures expected in Puntland between 2081 to 2100 under SSP2_45 and SSP5_85 scenarios

5.2.2.3.Variability and future trends in precipitation

Future Precipitation Variability

SSP245 Scenario

According to the SSP2_45 scenario, rainfall is set to increase by between 1.91 and 9 mm over the period 2040-2060. The south-eastern part of Puntland will receive the most rainfall, while the northern and north-western parts will receive less. Between 2080 and 2100, there will be considerable variability in rainfall. Some areas will experience a drop in rainfall (-3 mm), while others will record 12 mm. For both scenarios, the regions that will experience the most water stress will be Calawla and Iskushuan (**Figure *18***).

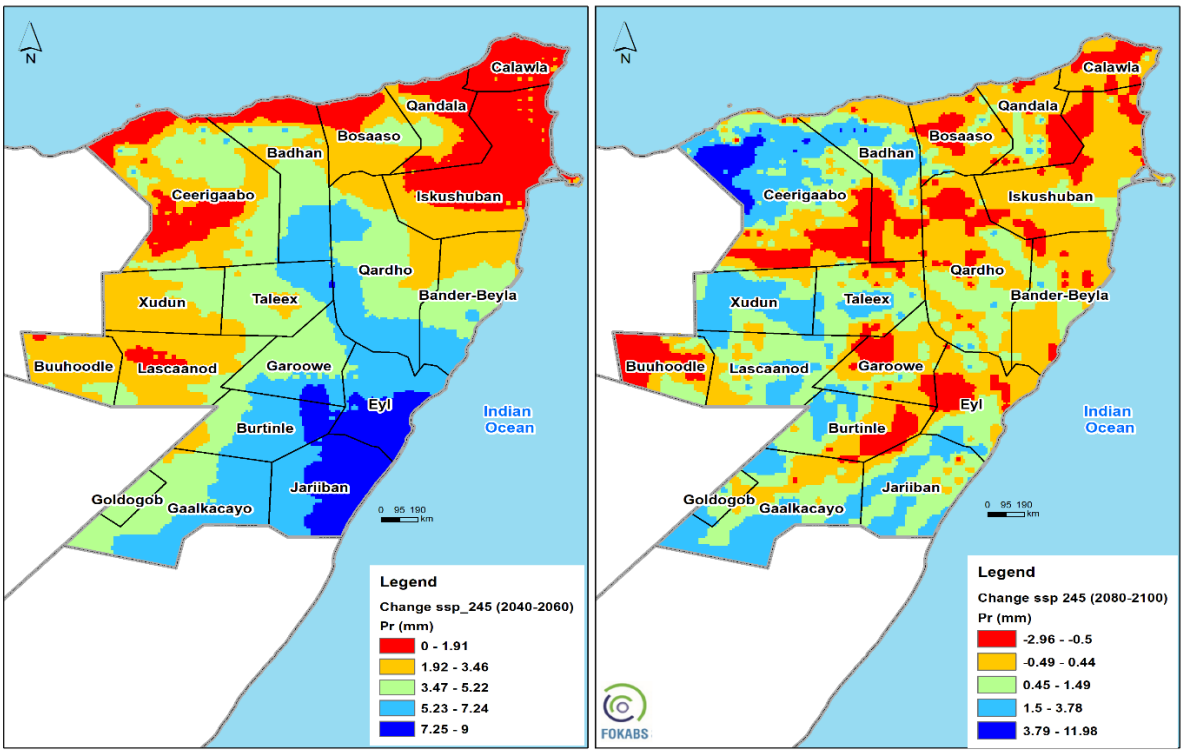

Figure 18 : Variation in precipitation between 2021 and 2100 under the SSP245

SSP585 Scenario

In contrast to the SSP2_45 scenario, rainfall will decrease in the SSP5_85 scenario for the period 2040-2060. This drop will range from -5 to -0.53 mm in most of the regions located in the centre of Puntland. The northern regions may see a slight increase in rainfall. For the period 2060-2100 for the same scenario, high rainfall is likely to be observed in the west, south and east parts of the state. The areas which may experience a rainfall deficit will be the whole of the northern strip of Puntland (**Erreur ! Source du renvoi introuvable.**).

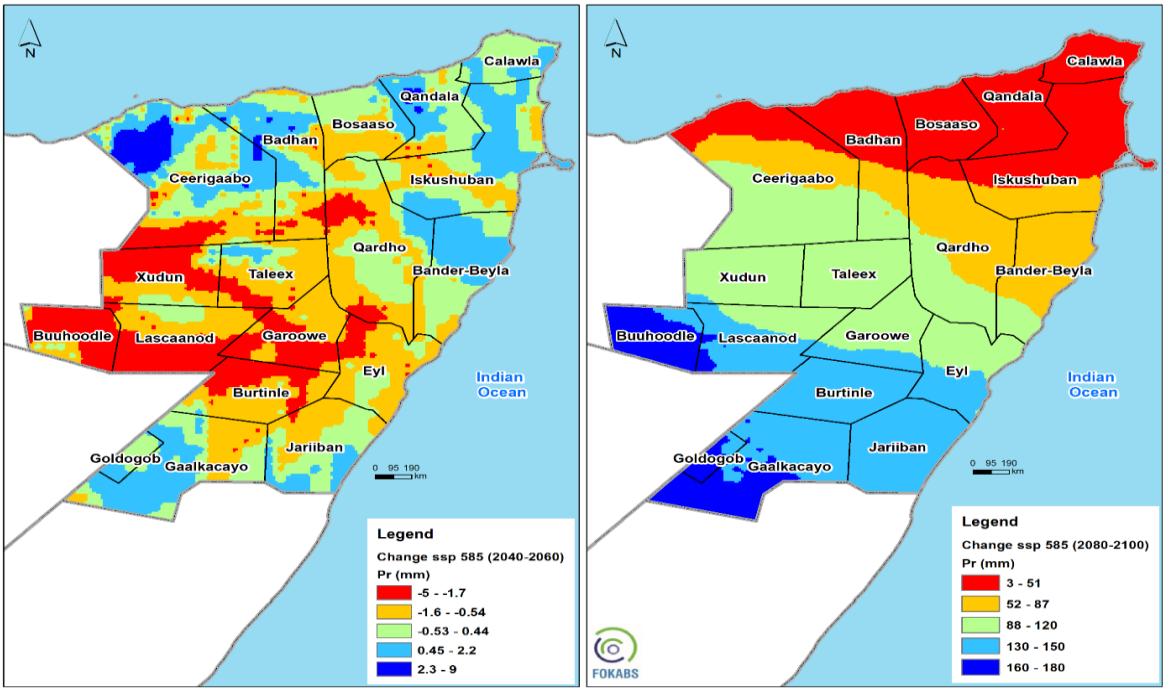

Figure 19: Variation in precipitation between 2021 and 2100 under the SSP585 Scenario

Future Temperature Variability

SSP245 Scenario

For the period 2040-2060, the SSP2_45 scenario shows an increase in temperature of between 0.37 and 0.51 mm. This increase could be less pronounced to the east and south-east of Puntland. On the other hand, between 2080 and 2100, a moderate increase in temperature of between 0.059 and 0.31°C is projected. The warmest regions for this period will be those with the highest temperatures – the whole north-east-south band. The less warm areas will be those in the west of Puntland (**Figure *20***).

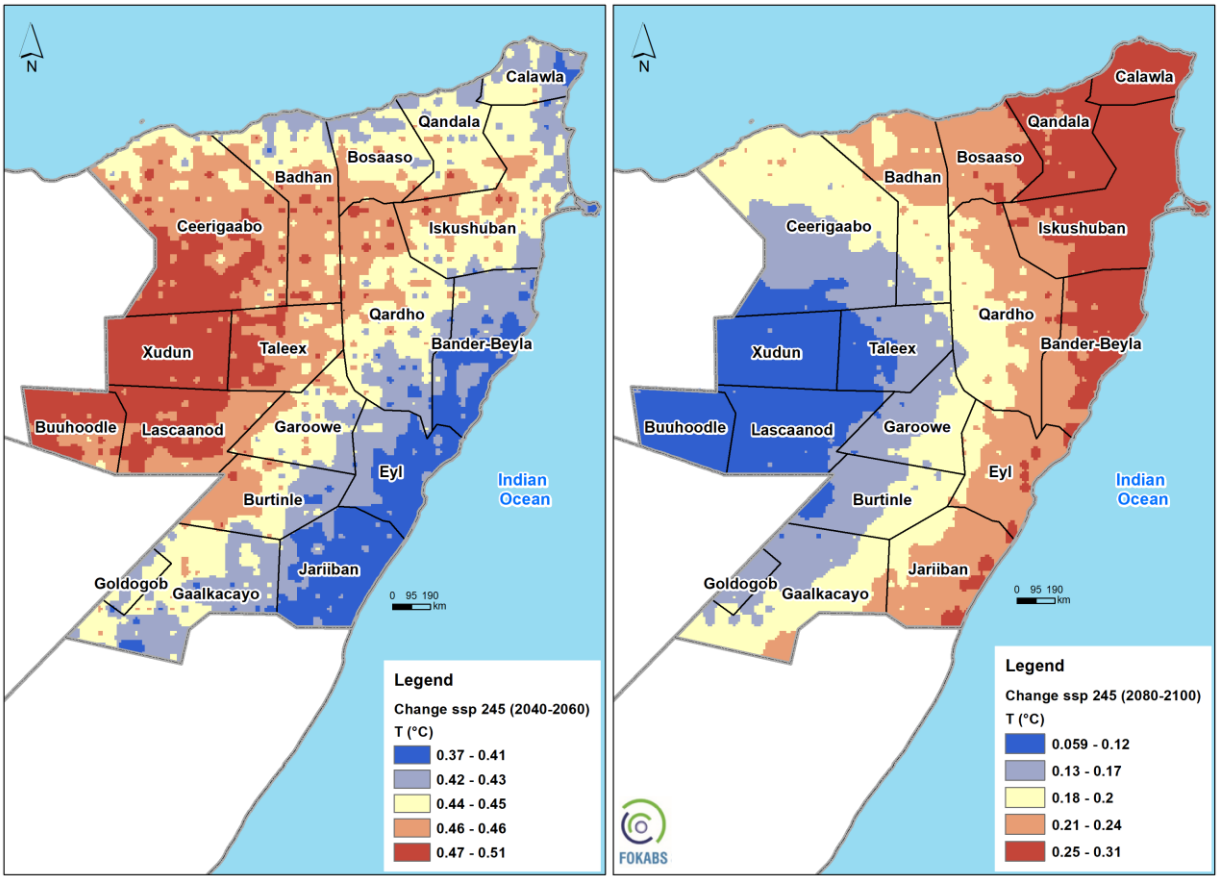

Figure 20 : Temperature change between 2021 and 2100 according to the scenario SSP2_45

SSP585 Scenario

For the period 2040-2060, a sharp rise in Puntland's temperatures is projected. This temperature variability could be between 0.65 and 0.87°C with hotspots located in the central and western parts of the state. The East-North-South band is the zone which could see a moderate increase in temperatures. The SSP5_85 scenario for 2080-2100 shows the greatest variations, ranging from 2.2 to 3.3°C. The greatest amplitude will be observed in the northern part of the country. Moderate variations are likely to be seen in the centre of Puntland (**Figure *21***).

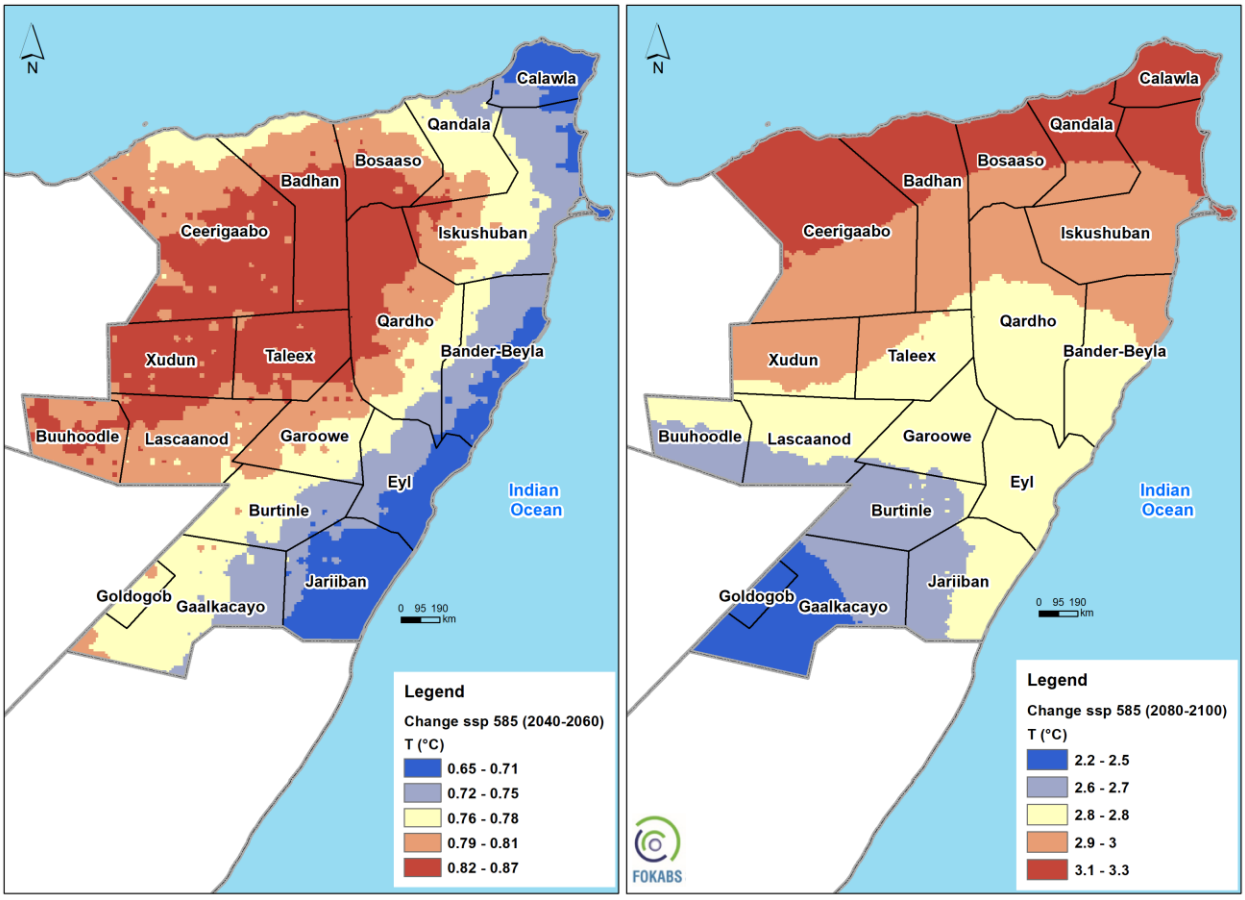

Figure 21 : Temperature change between 2021 and 2100 under the SSP5_85 scenario

6. PERCEPTION BASED VULNERABILITY ASSESSMENT ANALYSIS

ACTUAL VULNERABILITIES ANALYSIS

6.2.1. Vulnerability and risk in agriculture and food security

Based on exposure and sensitivity data, the vulnerability and risk level of the agriculture and food security sector was **high** for the climatic hazards like drought, floods, crop diseases and pests, and locust (**Erreur ! Source du renvoi introuvable.5**). The sector was **Moderately** vulnerable to extreme temperatures and cyclones. Tsunami has a **low** hazard vulnerability and risk to agriculture and food security sector (**Table 6**). Certain factors, such as the degradation of the productive potential of plants and soils, land impoverishment, demographic pressure and the low level of technical support for producers, were identified as factors that can increase the vulnerability of Puntland's agriculture and food security sector.

Table 5: Level of vulnerability and risk of climate hazards on agriculture and food security in the communities of Puntland

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Risk Scoring
Extreme temperature (heat stress)	2.5	2.8	5	Moderate
Droughts	3.7	4.2	8	High
Floods	3.8	4.1	8	High
Crop pest and diseases	3.0	3.9	7	High
Locust	3.4	4.4	8	High
Cyclone	2.3	2.5	5	Moderate
Tsunami	2.0	2.3	4	Low

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.2. Vulnerability and risk in the Water Sector

The climate vulnerability and risk assessment for the water sector was carried out based on exposure and sensitivity information obtained from stakeholders through interviews and group discussions. Based on the analysis, the vulnerability of Puntland's water sector is **very high** for droughts, and **high** for extreme temperatures. The sector's vulnerability is **moderate** for climate hazards like floods and cyclones; and low for tsunami (**Erreur ! Source du renvoi introuvable.**).

Table 6: Vulnerability and risk level of climate hazards on the water sector

Climate hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Risk scoring
Extreme temperature (heat stress)	3,2	3,9	7	High
Droughts	4,0	4,8	9	Very high
Floods	2,9	2,9	6	Moderate
Cyclone	3,1	3,0	6	Moderate
Tsunami	2,0	2,0	4	Low

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.3. Vulnerability in the Livestock sector

The sector is mainly exposed to climatic hazards such as extreme temperatures, drought, floods, diseases and pests (desert locusts), tsunamis and cyclones (**Erreur ! Source du renvoi introuvable.**). The vulnerability and risk of the livestock sector to drought is **very high**, signifying that drought is a real threat to the development of livestock farming. The sector's vulnerability to heat stress, flood, pest and disease and locust is **high**, **moderate** for cyclone and finally, **low** for tsunami.

Table 7: climate vulnerability and risk level on climate hazard on Livestock sector

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Risk scoring
Extreme temperature (heat stress)	3.3	3.6	7	High
Droughts	4.0	4.8	9	Very high
Floods	3.4	3.8	7	High
Livestock pest and diseases	3.5	4.0	8	High
Locust	3.4	3.3	7	High
Tsunami	2.0	2.0	4	Low
Cyclone	2.3	3.0	5	Moderate

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.4. Vulnerability and risk level in the health sector

The results of the climate vulnerability assessment for the health sector are presented in **Erreur ! Source du renvoi introuvable.**. Information on sensitivity of hazards was obtained solely for gastrointestinal diseases – the sector's vulnerability to hazard is scored as **high**, resulting from the deterioration of water quality caused by flooding, promoting the occurrence of some diseases such as cholera, diarrhoea, cryptosporidium, *E. coli* infection, giardia, shigella, typhoid, and viruses such as hepatitis A. etc. For other climate hazards like extreme temperature (heat stress), drought, floods, vector-borne diseases, stakeholders consulted provided only information concerning exposure. However, the link between climate change and non-communicable diseases (NCDs) is a growing concern because climate change has the potential to exacerbate the burden of NCDs such as hypertension and Type 2 diabetes[57].

Table 8: Vulnerability and risk level of climate hazards on the health sector

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Risk scoring
Extreme temperature (heat stress)	3.0	-	-	-
Droughts	4.0	-	-	-
Floods	3.5	-	-	-
Vector-borne diseases (Malaria, Dengue, Rift Valley Fever-RVF)	3.0	-	-	-

[57] The Vulnerability of Health Infrastructure to the Impacts of Climate Change and Sea Level Rise in Small Island Countries in the South Pacific (sagepub.com)

Gastrointestinal diseases (e.g., cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A)	3.5	3.5	7	High

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.5. Vulnerability and risk level in the Education sector

Vulnerability of the education sector to tsunami is **very high**, and **high** for the following hazards: droughts, floods, and cyclone. The sector is moderately vulnerable to extreme temperature and locusts (**Erreur ! Source du renvoi introuvable.**).

Table 9: Vulnerability and risk level in the Education sector

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Risk scoring
Extreme temperature	2.5	3.5	6	Moderate
Droughts	3.5	4.4	8	High
Floods	4	4.3	8	High
Cyclone	3	3.9	7	High
Tsunami	4.8	3.8	9	Very High
Locust	3	3	6	Moderate

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.6. Vulnerability in the Public Works sector

The public works sector (road infrastructures, public buildings, etc.) has a **very high** vulnerability (9, 10) to climatic hazards like cyclone and floods (**Table *10***). The sector's vulnerability to extreme temperature and drought is **high**. Subjected to drought and more intense and longer-lasting extreme temperatures, public works such as roads, buildings, bridges for example, undergo deterioration linked to the phenomenon of shrinkage and swelling of clay soils. In addition, this reduces water availability, thus disrupting certain public works requiring large quantities of water. Finally, the sector is **moderately** vulnerable to tsunami.

Table 10 : Vulnerability and risk level of climate hazards on public work sector

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Ranking
Extreme temperature (heat stress)	3.7	3.3	7	High
Droughts	4.0	4.0	8	High
Floods	4.7	4.3	9	Very high
Cyclone	4.5	5.0	10	Very high
Tsunami	2.3	3.0	5	Moderate

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.7. Climate Vulnerability and risk level of the biodiversity sector

Vulnerability assessment of forests and rangeland to climate hazards respectively revealed a high and very high vulnerability to droughts/changing precipitation patterns. Forests and rangeland were revealed to be moderately vulnerable to cyclone and tsunami while they are highly vulnerable to extreme temperatures, floods and locust (**Table *11***).

Table 11 : Vulnerability of Puntland's forest and rangeland to climate hazards

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)		Vulnerability and Risk scoring			
		Forest	Rangelands	Forest		Rangeland	
Extreme temperature	3,7	4,0	4,3	8	High	8	High
Droughts / changing precipitation pattern	4,0	4,4	4,6	8	High	9	Very high
Floods	3,2	3,9	4,0	7	High	7	High
Cyclone	2,9	3,0	2,7	6	Moderate	6	Moderate
Tsunami	2,3	2,3	2,6	5	Moderate	5	Moderate
Locust	4,0	4,4	4,3	8	High	8	High

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

6.2.8. Vulnerability in the coastal and marine areas/resources sector

The analysis in (**Table 12**) shows that the coastal and marine sector is exposed to a number of climatic hazards, which cause considerable damage to the livelihoods of local populations. The vulnerability of the sector to all identified climate hazards (sea-level rise, coastal flood and extreme temperatures) is **Moderate** (**Table *12***).

Table 12 : vulnerability and risk level of climatic hazards on the Coastal and marine areas/resources sector

Climatic hazards	Exposure (1-5)	Sensitivity (1-5)	Vulnerability (1-10)	Ranking
Extreme temperature (Rising water temperature)	1.3	4.1	5	Moderate
Coastal flood	1.3	4.3	6	Moderate
Sea level rise	1.3	4.1	5	Moderate

Legend (Vulnerability degree): 1-2 = Very low; 3-4= Low; 5-6= Moderate; 7-8= High; 9-10 = Very High

7. IMPACT OF CLIMATE CHANGE IN PUNTLAND

IMPACT OF CLIMATIC HAZARDS ON AGRICULTURE AND FOOD SECURITY

Climatic hazards that have occurred within the state of Puntland in the past 5 to 10 years are presented in (**Table *13***). Some respondents have not witnessed heat stress (33.4%), cyclone (41.6%) and Tsunami (50%) in the past 5-10 years. Heat stress, drought, locust, cyclones, and floods constitute the highest hazards that reduce agricultural yields, meanwhile crop pests and diseases, and Tsunami caused farm destruction. A summary of the impacts of each climatic hazards on agriculture and food security is presented in **Table *13***.

Table 13 : Impact of climatic hazards on agriculture and food security

Climate Hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	Impact on agriculture and food security
Extreme temperature (heat stress)	Yes (66.6%)/ No (33.4%)	• Lower agricultural yields • Food insufficiency • Crop losses • Water shortage • Low income • Disruption of agricultural calendar • Risk of extinction of less resilient species • Soil leaching • Reduction in soil fertility • Farm destruction
Droughts	Yes (100%)	• Lower agricultural yields • Food insufficiency • Crop losses • Low income • Disruption of agricultural calendar • Risk of extinction of less resilient species • Reduction in soil fertility • Soil leaching •
Floods	Yes (100%)	• Lower agricultural yields • Food insufficiency • Crop losses • Low income • Soil leaching • Farm destruction • Risk of extinction of less resilient species • Reduction in soil fertility • Water shortage (infrastructure damage)
Crop pest and diseases	Yes (100%)	• Farm destruction • Reduction in soil fertility

		• Lower agricultural yields • Crop losses • Low income • Disruption of agricultural calendar • Risk of extinction of less resilient species • Food insufficiency
Locust	Yes (100%)	• Lower agricultural yields • Crop losses • Food insufficiency • Low income • Farm destruction • Reduction in soil fertility • Risk of extinction of less resilient species • Disruption of agricultural calendar
Cyclone	Yes (58.4%)/No (41.6%)	• Lower agricultural yields • Food insufficiency • Crop losses • Farm destruction • Water shortage (infrastructure damage) • Low income • Risk of extinction of less resilient species • Disruption of agricultural calendar • Reduction in soil fertility
Tsunami	Yes (50%)/No (50%)	• Farm destruction • Reduction in soil fertility • Lower agricultural yields • Low income • Disruption of agricultural calendar • Crop losses • Food insufficiency • Water shortage (infrastructure damage) • Risk of extinction of less resilient species • Soil leaching

IMPACT OF CLIMATE CHANGE ON COASTAL AND MARINE RESOURCES

The local people of the coastal communities of Puntland perceived the occurrence of rising temperatures (88.8%), coastal floods (100 %) and sea level rise (80%). They perceived different adverse impacts of climate change on coastal and marine resources including fish reduction, migration, extinction of some species leading to relocation of businesses around the coastal region, increased fish scarcity and hunger, and rural exodus. The impact was also felt on the mangroves by their reduction and destruction of coral reefs habitat, etc. (**Table 14**) The impact of floods on the coastal communities were also visible, including reduction or destruction of livestock, fishing activities, fishing species, food availability, and businesses

around the coast relocated to big cities leading to rural exodus (more people relocating from rural areas to major cities).

Table 14 : Impact of climatic hazards on fish resources and mangroves in the study area

Climatic hazards	Occurrence of climate hazards in the past 5 to 10 years (Yes)	Impact on fish resources	Impact on mangroves
Extreme temperature (Rising water temperature)	Yes (88.8 %)/ No (11.2%)	• Fish reduction, and extinction • Fish species migration • Scarcity of fish in the market, • Loss of fish quality, • Prevalence of Malaria, • Fish business is reduced, • Fish house damaged • Reduction in fishing hours, • Rural exodus for fishermen	• Mangroves declining
Coastal flood	Yes 100 %	• Fish species lost, • Fish related business relocated, • Some fish species migrate while others submerge and die, • Destruction of coral reefs, • Fishes move in polluted water which adversely affects the fish. • Fish migrates; fishermen move to other cities, poverty, weak capacity, and facilities. • Fishing nets are destroyed	• It destroyed the effective first line of defense against coastal hazards
Sea level rise	Yes (80 %)/ No (20%)	• Fish resources reduction, • Destruction of corals and loss of fish habitats • Fishes move in polluted water which affects them, • Small boats unable to do fishing, • Fish species reduction, • Fish business opportunities reduced, • Poverty levels increased	• • Enable coastal flood, • Reduce coastal protection from from flooding during large storm events

IMPACT OF CLIMATE HAZARDS ON THE LIVESTOCK SECTOR

Concerning livestock, the impacts of climate hazards in general are mostly focused on pasture as traditional grazing is decreasing. This has as consequence, the reduction of livestock density, livestock production (milk and meat) and incomes. The impacts associated with different climate hazards are summarized in **Table *15***.

Table 15 : Impact of climatic hazards on livestock

Climate Hazards	Occurrence of climate hazards in the past 5 to 10 years? (Yes/No)	Impact on the **livestock sector**
Extreme temperature (heat stress)	Yes (80%)/ No (20%)	• Mortality and morbidity of livestock • Pasture quality reduced • Limited pasture • Quality of milk and meat reduce; • Increase water intake of livestock • Lack of edible grass for livestock
Droughts	Yes (100%)	• Shortage of milk production; • Water scarcity, • Losses of livestock, • Loss of grass, • Incomes reduced
Floods	Yes (100%)	• Pasture availability reduced, • grazing and feedings to livestock become rare; • Destruction of animal habitats • Loss of animals, • wealth and loss of rangeland resources, • pasture and grazing degradation
Locust	Yes (80%)/no (20%)	• Loss and reduction of pasture and grazing; • Quality of meat and milk reduce;
Cyclone	Yes (50%)/No (50%)	• Animals loss • Livestock weight and density decrease, • Poor feeding, • Limited pasture, • Quantity of milk produced decreases;
Tsunami	Yes (40%)/No (60%)	• Plenty of dead livestock; • Traditional grazing and pasture reduced

IMPACT OF CLIMATE HAZARDS ON THE HEALTH SECTOR

Puntland community recognized the occurrence of climate hazards and its impact on the health sector. The impacts of these climate hazards on health sectors are diverse (**16**). They are mostly at the origin of increasing disease prevalence and loss of life because during floods, the incidences of diseases like cholera and malaria increase due to water pollution, potable water scarcity and stagnant waters serving as breeding grounds for mosquitoes. Floods also culminates in toilets being filled up and washed away, contaminating water sources and increasing the spread of vector-borne diseases and gastro-intestinal diseases (**16**).

Table 16 : Impact of climatic hazards on the health sector in Puntland

Climate hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	Impacts on Hospitals	Impact of health posts and centers	Impact on general health sector
Extreme temperature	Yes (100%)	Shortage of water, inadequate electricity supply, shortage of medicines, increase in demand for hospital services.	Affects functionality and operation of health facilities, disrupts transport in the centers, disrupts water infrastructure, and increase the demand for health services	The impact of the hazard is huge and it happen periodically like droughts and floods
Droughts	Yes (100%)	• It leads to increased pressure on the health workforce and hospital infrastructure, which might have been overstrained and with limited resources. • Can lead to reduced supply of essential medicines - limited supply of equipment, following disrupted transport and or logistics, or increased price	• led to limited availability and quality of drinking water, hygiene, and sanitation, increasing the risk of infections and diseases. • increased demand for health centers due to increase drought-related illnesses - it might reduce access to health centers and posts for remote and displaced communities following difficulties in reaching centers or affording transport costs	Increase diseases and famine as children and women experience malnutrition
Floods	Yes (100%)	• It will decrease access to hospital services for remote and displaced communities • Increased pressure on the health workforce and infrastructure with limited resources - reduced supply of essential medicines and equipment due to increase logistics and transportation	• Reduced portable water, hygiene, and sanitation, increasing risk of infections and diseases. • Increased demand hospital services due to flood-related illnesses • Disruption of transportation and communication, making it difficult to	• Health disease • increase e.g., cholera • Destruction of toilets and which brings out wastes and pollutes water • Increasing water scarcity,

			deliver humanitarian aid and relief supplies to centers Negative effects on mental health	
Vectors born disease	Yes (50%)/ No (50%)	• High burden of malaria with • increase morbidity and mortality among children, pregnant women, and internally displaced persons. • -weakens health system in under-resourced area with limited access to diagnostic tests, drugs, bed nets, and vector control interventions - disrupted of the delivery of essential services for malaria and other vector-borne diseases	• Increased demand for health services, overwhelm the existing capacity and resources of the centers. • Increased risk of infection for health workers and patients, due to exposure to vectors and contaminated environments. Increased demand for surveillance, monitoring, and reporting of vector-borne diseases. This requires adequate training, equipment, and communication systems	• Impacts all community once the rainfall and water waste increase • Expose people to some disease like malaria and RFV that cause fever and reduces white blood cells Loss life
Gastrointestinal diseases	Yes (100%)	• Increased demand for health services, which can exceed the available capacity and resources of hospitals. • Increased morbidity and mortality among patients, especially the elderly, children, and those with comorbidities. • Increased burden on health workers, who may face challenges such as lack of training, equipment, drugs, and guidelines. Increased need for prevention and control measures, such as sanitation, hygiene, vaccination, screening, and surveillance	• leads to high burden of morbidity and mortality, especially children under five years of age. - increase the demand for health services, which are often inadequate, inaccessible, or unaffordable. - pose a challenge for infection prevention and control, water, sanitation, and hygiene (WASH) interventions, in an area with a fragile health system and a protracted humanitarian crisis	It impacts hugely in terms of health systems and productive sectors

IMPACT OF CLIMATE CHANGE ON THE EDUCATION SECTOR

Climate hazards impact the education sector in different ways (**Table *17***). The assessment revealed that climate hazards have mainly negative impacts on the education sector. The impacts of droughts on students for instance includes drop out of students, low enrolment, low achievement, less learning materials (books, pens, bags, etc.), low morale (loss of child petty cash), nutrition status, limited facilities, displacement and migration, and health problems. On school staff, the climate hazard like floods, drought and extreme temperature cause decrease of livelihoods, loss of jobs, low morale, displacement, and many others. For school infrastructure, climate hazards cause damage to school infrastructure and water supply (especially drought). Regarding impact on parents, these individuals become unable to pay school fees due to loss of livelihood and decrease in the income of families.

Table 17 : Impact of climatic hazards on the education sector in Puntland

Climate Hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	Impact on students	Impact on school staff	Impact on school infrastructure	Impact on students' parents
Extreme temperature (heat stress)	Yes (100%)	• Increased drop out for the sake of high temperature, • Health problem • Low attendance and satisfaction of students	• Decrease of salaries • Teaching time is reduced because they may not be able to stay longer in the classes	• Damages water channels • Wear and tear of school infrastructure	• Less, motivation to send children to school. • Less incomes • Loss of economic welfare
Droughts	Yes (100%)	• Increased drop out rate of students • Reduced performance of students • Less learning material (books, pens, bags) • Low morale (loss of child petty cash) • Food availability decrease	• Loss of jobs • Decrease of income • Low morale • Less teaching materials • Limited facilities • Displacement of staff • Livelihood challenges of staff families	• Destruction of school materials, • Water supply become dry •	• Unabaility of parents to pay school fees due to loss of livelihood and reduced income

		• Limited facilities • Displacement of students • Health problems.	• Health problems		
Floods	Yes (100%)	• Students become drop outs • Destruction of learning materials; • Loss of life, • Migration and displacements • Pollution and health problems; • -Less enrolment	• Loss of jobs; • Impact on their settlement • Pollution and health problem; • Displacement and migration • Loss of livelihood and nutrition	• Destruction of school infrastructures (school, road, water supply); • School bankruptcy	• Loss of incomes • Loss of homes • Migration and displacements • Decrease in livelihood capacity
Locust	Yes (100%)	• Causes malnutrition	• Loss of livelihoods and loss of incomes	• Destruction of trees in schools, • Destruction of hygiene and sanitation equipment	• Loss of livelihoods and incomes
Cyclone	Yes (50%)/ No (50%)	• School cancellation, loss of life, dropouts	• Loss of jobs, loss of incomes	• Destruction of school infrastructure	• Loss of livelihoods and incomes
Tsunami	Yes (50%)/No (50%)	• Loss of life, loss of education	• Loss of life, loss of livelihoods	• Destruction and demolition of homes	• Loss of life and loss of livelihoods

IMPACT OF CLIMATE CHANGE ON THE PUBLIC WORKS SECTOR

Climatic hazards such as extreme temperatures or heat stress, droughts, floods, cyclone, and tsunamis have significant impacts on the public works sector (**Table *18***). The most significant of these impacts relates to the disruption of internal transport during the day or at service times.

Table 18 : Impact of climatic hazards on the public works sector in Puntland

Climate hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	Impacts on roads	Impacts on Ports	Impact on bridges	Impact on runways	Impact on dams	Police stations	Impact on the public sewage	Impacts on the general Public
Extreme temperature (heat stress)	Yes (100%)	Pavement buckling; deformation, cracking and reduced lifespan of asphalted roads	Softening of pavements in ports; damage to port equipment such as straddle carriers	Accelerated material damage and degradation; increased stress on concrete bridge girders; weakening of bridge joints; swelling of bridges	Reduce air density which forces planes to travel faster down the runway to produce enough lift to take off; runways buckling	Reduction in water; reduction in dams' water resources such as fish; increased concentration of pollutants	More incidents requiring police intervention; More emergency situations	Decreased performance in the public sewage system; damage to sewage infrastructure	Hinders transportation movements during the day especially good and service. Rural communities find it difficult to keep their animals during the day
Droughts	Yes (100%)	Warping, buckling, cracking and shifting of roads	Reduction in cargo-carrying capacity; alteration of the hydro-sedimentary dynamics of ports making docking difficult or	Warping, buckling, cracking of bridges	Reduce air density which forces planes to travel faster down the runway to produce enough lift to take off;	Reduction in water; reduction in dams' water resources such as fish; Increased concentration of pollutants	More incidents requiring police intervention; More emergency situations	Decreased performance in the public sewage system; damage to sewage infrastructure	Reduce the progress of work;

			impossible; increasing pollution due to greater concentration of pollutants		runways buckling; Sand and dust storms which increase risk of take-off on the runways.				
Floods	Yes (100%)	Erosion of unpaved roads; reduce the load bearing capacity of paved roads; wash out sections of roads; damage bituminous layers of roads; blockage of the drainage systems of roads	Disrupt operations; cause damage to goods, operations equipment and port infrastructure	Scouring, hydrodynamic loads and pressures on the deck and piers, overtopping, and debris accumulation	Impedes landing and take-off; degrades and damages runways	Collapse of dams; damage of dam infrastructure	More incidents requiring police intervention; More emergency situations	Flooding spills and odour; water quality deterioration due to increased uncontrolled; discharges and damage to infrastructure	Floods limit the traffic and destroys some public infrastructures
Cyclone	Yes (100%)/	Erosion of unpaved roads; reduction of the load bearing capacity of paved roads; wash out sections of roads; damage bituminous layers of roads; blockage of the drainage systems of roads	Anchor breakage and collision with other ships and infrastructure; destruction of storage facilities; leakage of chemicals or fuels from destroyed storage facilities; failure of sewage systems leading to pollution of water around ports; complete halting of port operations.	Scouring, hydrodynamic loads and pressures on the deck and piers, overtopping, and debris accumulation	Impedes landing and take-off; degrades and damages runways	Collapse of dams; damage of dam infrastructure	More incidents requiring police intervention; More emergency situations	Flooding spills and odour ; water quality deterioration due to increased uncontrolled discharges and damage to infrastructure	Destroys roads and public infrastructure like markets
Tsunami	Yes (100%)	Erosion of unpaved roads; reduce the load bearing capacity of paved roads;	Anchor breakage and collision with other ships and infrastructure; destruction of	Scouring, hydrodynamic loads and pressures on the deck and	Impedes landing and take-off; degrades and	Collapse of dams; damage of dam infrastructure	More incidents requiring police intervention; More	Flooding spills and odour ; water quality deterioration due to increased	Destruction of infrastructures

		wash out sections of roads; damage bituminous layers of roads; blockage of the drainage systems of roads	storage activities; leakage of chemicals or fuels from destroyed storage facilities; failure of sewage systems leading to pollution of water around ports; complete halting of port operations.	piers, overtopping, and debris accumulation	damages runways		emergency situations	uncontrolled; discharges and damage to infrastructure	

IMPACT OF CLIMATE CHANGE ON THE BIODIVERSITY SECTOR

The perception of local people concerning the impacts of climatic hazards that have occurred in Puntland in the past 5 to 10 years in the biodiversity sector, most especially rangelands (natural grasslands, wetlands, etc.) and forest biodiversity resources (flora and fauna) is summarized in **Erreur ! Source du renvoi introuvable.**. On rangelands (natural grasslands, wetlands, etc.) the impact of climatic hazards were wildlife habitat destruction, biodiversity loss, increased mortality of perennials, woody and herbaceous plants, wildlife migration, rarity of non-timber forest products (NTFPs), and erosion. However, the highest impact varied in function of the climate hazard. Concerning forest biodiversity (flora and fauna), impacts from climatic hazards included biodiversity loss, increased mortality of perennial, woody and herbaceous plants, and wildlife habitat destruction.

Table 19: Impact of climatic hazards on biodiversity

Climate Hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	Impact on rangelands (natural grasslands, wetlands, etc.)	Impact on forest biodiversity resources (flora and fauna)
Extreme temperature (heat stress)	Yes (100%)	• Wildlife migration • Increased mortality of perennial, woody and herbaceous plants; • Biodiversity loss; • Wildlife habitat destruction • Fish driven out of rivers, • Scarcity of NTFPs	• Increased mortality of perennial, woody and herbaceous plants, • Biodiversity loss, • Wildlife migration, • Wildlife habitat destruction, • Rarity of NTFPs, • Erosion, • Fish driven out of rivers,
Droughts	Yes (100%)	• Increased mortality of perennial, woody, and herbaceous plants, • Wildlife habitat destruction, • Erosion, • Biodiversity loss, • Wildlife migration, • Fish driven out of rivers, • Scarcity of NTFPs,	• Biodiversity loss, • Wildlife habitat destruction, • Increased mortality of perennial, woody, and herbaceous plants, • Erosion, • Wildlife migration, • Rarity of NTFPs,
Floods	Yes (100%)	• Erosion, • Wildlife habitat destruction, • Biodiversity loss, • Increased mortality of perennial, woody, and herbaceous plants, • Scarcity of NTFPs,	• Biodiversity loss, • Wildlife habitat destruction, • Erosion, • Increased mortality of perennial, woody, and herbaceous plants, • Wildlife migration,

		• Wildlife migration, • Scarcity of NTFPs • Erosion	• Rarity of NTFPs
Crop pest and diseases	Yes (100%)	• Biodiversity loss • Increased mortality of perennial, woody, and herbaceous plants • Wildlife habitat destruction • Wildlife migration • Scarcity of NTFPs • Erosion	• Biodiversity loss, • Wildlife habitat destruction • Increased mortality of perennial, woody, and herbaceous plants • Erosion, • Wildlife migration • Rarity of NTFPs
Locust	Yes (100%)	• Biodiversity loss • Increased mortality of perennial, woody, and herbaceous plants • Wildlife habitat destruction • Scarcity of NTFPs • Wildlife migration • Erosion	• Biodiversity loss • Wildlife habitat destruction • Increased mortality of perennial, woody, and herbaceous plants • Wildlife migration
Cyclone	Yes (100%)	• Biodiversity loss • Wildlife habitat destruction • Wildlife migration • Erosion • Increased mortality of perennial, woody, and herbaceous plants (13.0%) • Scarcity of NTFPs	• Wildlife habitat destruction • biodiversity loss • Erosion • Wildlife migration • Increased mortality of perennial, woody, and herbaceous plants • Rarity of NTFPs • Others
Tsunami	Yes (80%)/No (20%)	• Biodiversity loss • Wildlife habitat destruction • Rarity of NTFPs • Increased mortality of perennial, woody, and herbaceous plants • Erosion • Wildlife migration	• Biodiversity loss • Increased mortality of perennial, woody, and herbaceous plants • Erosion • Wildlife habitat destruction • Wildlife migration • Rarity of NTFPs

IMPACT OF CLIMATE HAZARDS ON THE WATER SECTOR

The perception of local people concerning the impact of climatic hazards that has occurred in Puntland in the past 5 to 10 years on the water sector is summarized in **Table *20***. The impacts of climate hazards are mostly related to water shortage, limited water availability, and destruction of water infrastructure.

Table 20 : Impact of climatic hazards on the water sector in Puntland

Climate Hazards	Occurrence of climate hazard in	Impact on the water sector

	the past 5 to 10 years? (Yes/No)	
Extreme temperature (heat stress)	Yes (100%)	• Water becomes over heated and polluted due to high temperatures, and caused health disease like cholera • Water wells become dry leading to loss of livelihood, lack of potable water and general water scarcity, • Water shortage • Limited water availability
Droughts	Yes (100%)	• Water wells become dry leading to loss of livelihood, lack of potable water and general water scarcity • Water shortage • Limited water availability
Floods	Yes (100%)	• Destruction of water infrastructure • shortage of water
Cyclone	Yes (67%) / No (33%)	• Water scarcity and shortage of water
Tsunami	100 (100%)	• Destruction of water infrastructure, • shortage of water

8. ADAPTIVE CAPACITY AND STRATEGIES TO CLIMATE VULNERABILITY IN PUNTLAND, SOMALIA

ADAPTIVE CAPACITY AND STRATEGIES IN THE DOMAIN OF AGRICULTURE AND FOOD SECURITY

Many respondents did not attend school (55.5%) and a few attended primary schools (44.4%). Regarding support from institutions to farmers to enhance their access to improved production techniques, 50% respondents acknowledged receiving some sort of support while the other half attested to receiving no support. The extension services engage financial institutions to support and provide farmers with access to financial resources such as loans and grants (Premier Bank, AMAL Bank, Salaam Bank). Only 33.3% of respondents (farmers) attested to having access to improved production techniques including improved seeds, micro-irrigation, climate-smart agricultural techniques and agriculture-livestock integration.

With regards to funding for farmers, only 22.2% of respondents affirmed to receiving funding. Regarding saving groups that can provide loans for livelihoods, especially specific savings groups for women, all respondents (100%) responded in the negative. Concerning farmers having access to climate information, the response was Yes (66.7%) and No (33.7%). The type of climate information referred to by farmers included warning systems (29.4.), farming calendar (35.5%) and weather information (35.5%). Regarding farmers receiving material support, many of the respondents (66.7%) accepted and 33.3% refused receiving material support. The type of material support included improved seeds (45.5%) and equipment (54.5%). The extension service/institution provided certified seeds (whole vegetables, watermelon, onions, tomatoes, cereal crops like, maize, sorghum, beans, leguminous crops) and workshop/training, build seed bank, demonstration farms, tractors, fencing, fertilizers, pesticides.

Regarding extension services, many respondents (66.7%) have access, and a few (33.3%) do not have. The type of services provided by the extension services include soil and water management services, farm planning, crop production and planning, management, and irrigation systems; providing information on new technologies for agriculture, linking farmers to their production sites, and providing training on good agricultural practices. Many farmers (77.8%) used irrigation in crop production while only 22.2% did not. The extension services supported farmers' drip irrigation systems, and also supported awareness related to the canals infrastructure and layouts.

In the event of climate-induced food shortages, the early warning system used to disseminate information to the farmers comes into play. The extension service provides social safety nets for the community and farmers, and the international organizations are alerted for drought intervention to support the drought-affected people with food distribution, shelter, water and health kits. Promote climate-smart agriculture and water harvesting during the rainy season for use during the drought for irrigation and drinking. Early warning information to predict droughts will also be provided. Food intervention, inputs to farmers such as fertilizers, certified seeds, drilling of boreholes construction, shallow wells are provided.

Many farmers proposed the use of different practices as adaptive measures against climate vulnerability to agriculture and food security in the study area (**Table 21**). The main constraints or barriers to these actions were insufficient financial resources and lack of mastery of technology and unavailability of technology.

Table 21 : Adaptive practices against climate hazards and constraints frequently encountered.

Climatic hazards	Adaptation practices	Constraints to their implementation
Extreme temperature (heat stress)	• Advocate and sensitize the population to plant trees on the lands and farmyards, • Train and support the local farmers and herders practice agroforestry systems. • Conserve existing vegetation and plantation from further destruction. • Adapt seedlings from built greenhouses for the crop and agriculture sectors so it could withstand the temperature and drought, • Train and support beneficiary on how to conserve enough water for irrigation during water stressed season. • Acquire forecast apparatus/ system, thermometer and install to assist the local people to have early warnings alerts	Unavailability of technology (40%), Insufficient financial resources (80%)
Droughts	• Support the beneficiary tobuild dams and harvest water in reservoirs for irrigation and other vital uses • Elaborate drought preparedness plan, water banks, reconstruct shallow wells, water conservation reservoirs, and water boreholes. • Capture enough water for irrigation, construct barrages, harvest water, and promote drip irrigation.	Insufficient financial resources (88.9%), and lack of mastery of technology (11.1%)
Floods	• Support the planting of trees that will serve as buffers during this hazard • Build dikes, flood control systems, boreholes, water channels and dykes •	Insufficient financial resources (100%)
Crop pest and diseases	• Train personnel in extension services.	Insufficient financial resources (75%),

	• Control Pest and use pest killer and build mobile centre for pest control, • Use pesticides, fungicides, create awareness, construct greenhouses, and promote climate smart agriculture.	Lack of mastery of technology (25%)
Locust	• Train farmer on methods to fight against locust, • equip and support farmer with materials • Support with airplane for spraying locust, • Diversify and rehabilitate, livelihood • Promote collective actions like locust sprayer • Provide pesticides, greenhouses, climate smart agricultural practices	Unavailability of technology (12.5%) and Insufficient financial resources (87.5%)
Cyclone	• Develop early warning systems, • Conserve vegetation and plantation • Promote sustainable livelihood, • Develop an evacuation plan, DRR • Support shelter and food supplies	Unavailability of technology (20%), Insufficient financial resources (80%)
Tsunami	• Provide the early warning systems. • Promote vegetation systems, plantation and evacuation plan, • Provide coastal protection measures, build shelters, DRR. • Support input supplies after farm destructions, • Support financially for the recovery, and precaution approach	Insufficient financial resources (100%)

ADAPTIVE CAPACITY AND STRATEGIES IN THE WATER SECTOR

Local communities have inadequate knowledge and adaptive capacity in the water sector. Traditional knowledge-based practices used by the community to cope with climate-induced disasters are rare and limited. They use some traditional forecasting to predict climate-related disasters such as floods and droughts. These communities do not have a formal external organization to help the community prepare for and respond to disasters. The tools used by the communities to access information on climate change are mobile phones and radio. At the same time, there are no formal disaster management plans in the settlement, and no formal early warning systems for impending extreme weather events (**Table 22**).

Table 22 : Adaptive practices against climate hazards and constraints frequently encountered in the water sector

Climatic hazards	Adaptation practices	Constraints to their implementation
Extreme temperature (heat stress)	• Plant trees • Promote silvipastoral systems, • Conserve vegetations • Promote early warning system, • Build dams • Harvest and conserve water • Protect water catchments and sheds.	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Droughts	• Put in place early warning system, • Plant trees, • Promote silvipastoral systems, • Conserve vegetations and plantations • Build dams and canals. • Harvest and conserve water, • Practice irrigation agriculture	• Insufficient financial resources; • Lack of mastery of technology
Floods	• Provide early warning system, • Build dikes, • Protect water reservoirs, wells,	• Insufficient financial resources; • Lack of mastery of technology
Locust	• Promote early warning system to alert local communities on locusts invasion • Promote and support local knowledge of locust prevention	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Cyclone	• Protect water conservation areas, • Plant more trees to act as wind breaks	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Tsunami	• Put in place early warning system	• Unavailability of technology; • Insufficient financial resources; • -Lack of mastery of technology.

ADAPTIVE CAPACITY AND STRATEGIES IN THE LIVESTOCK SECTOR

Primary education is the main level of education for all livestock keepers. About 80% respondents do not have access to improved breeds of livestock. Very few livestock breeders have access to financial resources. At the same time, about 80% of them have limited access to climate information such as early warning systems and weather information. Only 20% have received livestock support in the form of water, food and mosquito nets. They also have limited access to veterinary services and water points.

However, disputes can sometimes arise over where to fetch water. They have limited year-round access to pasture for their livestock because of the seasonal nature of pasture. These farmers have limited social networks that support them during shocks such as floods, etc. Only

20% of respondents of the communities believe that the farmers in their community will be better able to cope with impacts of climate change in the future **Table 23**.

Table 24 presents adaptive practices adopted by livestock keepers. Early warning system was identified as the best adaptive practice that was underutilised by livestock keepers to adapt to climate hazards. Insufficient financial resources, and lack of technological mastery were identified as the main constraints to livestock keepers' adaptive practices.

Table 23 : Adaptive practices against climate hazards and constraints frequently encountered in the livestock sector

Climatic hazards	Adaptation practices	Constraints to their implementation
Extreme temperature (heat stress)	• Plant shade trees • Promote silvipastoral systems	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery
Droughts	• Put in place early warning system	• Insufficient financial resources; • Lack of technological mastery
Floods	• Provide early warning system	• Insufficient financial resources; • Lack of technological mastery
Pest and diseases	• Promote local knowledge for disease treatment • Government should continue to provide drugs to helps in controlling pest and diseases	• Insufficient financial resources; • Limited government support in terms of drugs providing for controlling pest and diseases; • Shilin pests
Locust	• Promote early warning system to alert local communities on locusts invasion	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery.
Cyclone	• conserve water and promote fodder production	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery.
Tsunami	• Put in place early warning system	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery.

ADAPTIVE CAPACITY AND STRATEGIES IN THE HEALTH SECTOR

The local communities' adaptive strategies to climate hazards in the health sector indicated that the people were adversely affected by droughts and the response mechanism was very limited and weak. Some of these people suffered from malnutrition due to famine and lack of sanitary support. They were assisted by some organizations that provided disaster relief. **Table 24** summarizes the climate hazards' adaptive strategies identified in the health sector.

Table 24 : Adaptive strategies against climatic hazards in the health sector

Climate hazards	Adaptive practices	Constraints to their implementation
Extreme temperatures	• Construct heat moderating houses to avoid heat stress • Provide cold storages, health facilities and distribute vans	• Unavailability of technology; • Insufficient financial resources;

Drought	• Promote facemask, • Create health awareness and education	• Insufficient financial resources;
Floods	• Add Chlorine in potable water, • Provide blankets and shelters •	• Insufficient financial resources; •
Vectors borne diseases	• Mosquito nets	• Insufficient financial resources;
Gastrointestinal diseases	• Provide clean water • Enhance cleaning campaign to minimize the diseases • Awareness and education raising, • Increase health clinics and health visits	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery

ADAPTIVE CAPACITY AND STRATEGIES IN THE BIODIVERSITY SECTOR

Approximately 75% respondents acknowledged that the local people implement actions towards conserving forest and rangelands as well as improve their engagement in forest and rangeland restoration. For example, the adaptation strategies adopted by local communities in Puntland were not specific to climate hazards. However, in forest sectors, adaptation strategies are mainly related to tree planting. In the rangeland sectors, adaptation strategies include addressing overgrazing problems, establishing more rangeland reserves and more boreholes, and fire-fighting brigades. Information gathered from civil societies and ministries on concrete actions (adaptation strategies) that do not focus on specific climatic hazards implemented in Puntland, indicate that these strategies are:

- Collection of *Acacia* sp seeds for afforestation and reforestation;
- Elders gather members of the community to work as volunteers to sensitize people not to cut down trees;
- Controlling and preserving the few remaining vegetation in the area;

In terms of restoration activities carried out by local communities, the adaptation strategies identified include:

- The distribution of animal dung;
- Community elders controlled animal grazing in areas where grass and few trees are available;
- The use of traditional/customary law to protect boreholes, and rangelands in the area

Potential adaptation options in the forest and rangeland sectors as identified by local stakeholders are presented in **Table 25**.

Table 25 : Adaptive strategies against climatic hazards in the Biodiversity sector

Climate hazards	Adaptive practices	Constraints to their implementation
Extreme temperatures	• Create healthy vegetation on slope • Provide terrestrial and inland water systems	• Unavailability of technology; • Insufficient financial resources;

Drought	• Promote landscape restoration efforts • Create health awareness and education and protect climate refuges • Conserve wildlife by creating more protected areas	• Insufficient financial resources; • Unavailability of technology;
Floods	• Provide structural flood protection measures, • put in place an early warning systems, • develop a risk-informed land planning, • promote nature-based solutions, • support social protection and risk financing instruments • Construct dykes	• Insufficient financial resources; • Unavailability of technology; Lack of technological mastery.
Cyclone	• Plant wind breaks • put in place an early warning systems, • promote nature-based solutions, • support social protection and risk financing instruments • support awareness raising	• Unavailability of technology; • • Insufficient financial resources; • Lack of technological mastery
Tsunami	• promote nature-based solutions, • support social protection and risk financing instruments • support awareness raising • put in place an early warning systems,	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery

ADAPTIVE CAPACITY AND STRATEGIES IN THE COASTAL AND MARINE RESOURCES SECTOR

With regards to the coastal and marine resources, there were no specific adaptation strategies for the different climate hazards adopted by coastal and marine resources. However, some of the adaptation strategies used include awareness raising, community mobilization, women groups which advocate for women in the fishing sector, early warning systems, communities supporting each other during hazards, information sharing is very high, fishermen have WhatsApp groups where they share weather information, communities reconstruct destroyed infrastructures, and community organizations advocate for relief. Constraints include limited marine resources and government support, limited sensitization, and limited provision of fishing equipment (**Table 26**).

Table 26 : Adaptive strategies against climatic hazards in the Coastal and Marine sector

Climatic hazards	Adaptive practices	Constraints to their implementation
Extreme temperature (Rising water temperature)	• Forecasting/monitoring using weather forecasts and heat and health indicators to warn and prepare for extreme heat events. • Educate and raise awareness • Respond to heat wave through early warning systems, urban cooling centres, emergency services, and social support networks • Improve infrastructure to lower urban temperatures and protect infrastructure from heat damage. • Implement flexible and adaptive management to reduce risk and increase resilience	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery.
Coastal flood	• Forecast and monitor with the aid of reliable weather forecasts and flood indicators to warn and prepare for extreme flood events. • Educate and raise awareness about the risk factors, impacts, and prevention of flood-related damages and losses, and providing guidance on how to stay safe and resilient[2]. • Implement measures flood risk management to reduce the probability or consequences of flooding. • Implement practices of flexible and adaptive management that reduce vulnerability and increase resilience	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery..
Sea level rise	• Forecast and monitor using reliable weather forecasts and flood indicators. • Educate and raise awareness about the risk factors, impacts, and prevention of flood-related damages • Implement flood risk management practices to reduce the probability or consequences of flooding. • Implement flexible and adaptive management practices that reduce vulnerability and increase resilience	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery..

ADAPTIVE CAPACITY AND STRATEGIES IN THE EDUCATION SECTOR

The education sector of Puntland have always faced a lot of negative impact from climate hazards. With regards to the prominent climate hazards affecting the sector, a number of adaptive practices have been provided in **Table 27**

Table 27: Adaptive capacity and strategies in the education sector of Puntland

Climate Hazards	Adaptive practices for students	Adaptive practices for school staff	Adaptive practices for school infrastructure	Constraints to their implementation
Extreme temperature (heat stress)	• Build climate proof classrooms that will optimise classroom temperature appropriate for learning. • Construct school infirmaries that will take care of first aid treatment for ill or sick students. • Advocate and sensitize on importance of school to citizens of a nation	• Advocate and improved on teachers' salaries • Build climate proof classrooms to provide appropriate classroom conditions for teachers and students	• Train and support schools to plant trees on their campuses. • Support and maintain school infrastructure to withstand adversity over time. • Build water conservation system to provide safe and drinking water to students	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Droughts	• Build climate proof classrooms that will optimise classroom temperature appropriate for learning. • Construct school infirmaries that will take care of first aid treatment for ill or sick students.	• Improved on teachers' salaries • Build climate proof classrooms to provide appropriate classroom conditions for teachers and students. • Promote activities that will create jobs for working age class	• Train and support schools to plant trees on their campuses. • Support and maintain school infrastructure to withstand adversity over time. • Build water conservation system to provide safe and drinking water to students	• Unavailability of technology; • Insufficient financial resources. • Lack of mastery of technology.

	• Advocate and sensitize on importance of school to citizens of a nation. • Support parents and students for learning material (books, pens, bags) • Promote the culture of motivation through scholarships to stimulate learning competition. • Advocate for more food from development partners and stimulate both the agriculture and livestock for food production			
Floods	• Support the building of climate proof buildings in the community. • Relocate and support displaced flood victims. • Provide health assistance to affected groups and communities	• Support the building of climate proof buildings in the community. • Relocate and support displaced flood victims. • Provide health assistance to affected groups and community. • Train and support them on alternative livelihood	• Construct climate proof infrastructures (school, road, water supply); • Provide technical and financial support to School as minimum packages by local councils, State, and development partners	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.

		sources and nutrition		
Locust	• Causes malnutrition	• Loss of livelihoods and loss of incomes	• Destruction of trees in schools, • Destruction of hygiene and sanitation equipment	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Cyclone	• Provide early warning systems and rapid evacuation system. • Build Climate proof infrastructure	• Provide early warning systems and rapid evacuation system. • Build Climate proof infrastructure	• Provide early warning systems and rapid evacuation system. • Build Climate proof infrastructure	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.
Tsunami	• Provide early warning systems and rapid evacuation systems	• Provide early warning systems and rapid evacuation system	• Provide early warning systems and rapid evacuation system	• Unavailability of technology; • Insufficient financial resources; • Lack of mastery of technology.

ADAPTIVE CAPACITY AND STRATEGIES IN THE PUBLIC WORK SECTOR

The public works sector faces more climate hazard disaster in Puntland. **Table 28** lists some practices that will permit smart adaptation towards these hazards.

Table 28: Adaptive capacity and strategies in the public work sector of Puntland

Climate hazards	Adaptive practices	Constraints to their implementation
Extreme temperatures	• Mainstream climate-resilience construction into existing construction code, • Advocate and sensitise civil engineers on the use and respect of climate-smart code during all construction, • Respect of the construction norms in all sectors of public works (e.g., buildings, roads, airports, seaports, dams, reservoirs, etc.) • Enforcement of this code for construction by appropriate public agencies (judiciary, law	• Unavailability of technology; • Insufficient financial resources;

	enforcement officers, Ministry in charge of public works, etc.). • Prosecution and sanction all culprits by the laws of the land for non-respect of the code	
Drought	• Mainstream climate-resilience construction into existing construction code, • Advocate and sensitise civil engineers on the use and respect of this code during all construction, • Respect of the construction norms in all sectors of public works (e.g., buildings, roads, airports, seaports, dams, reservoirs, etc.) • Reinforcement of this code for construction by appropriate public agencies (law enforcement officers, Ministry in charge of public works, etc.). • Prosecution and sanction of culprits by the laws of the land for non-respect of the code	• Insufficient financial resources. • Unavailability of technology;
Floods	• Provide structural flood protection measures, • put in place an early warning systems. • develop a risk-informed land planning, • promote nature-based solutions, • support social protection and risk financing instruments. • Construct dykes to prevent water movement into public structure. • Construct water channels around public structures to facilitate drainage	• Insufficient financial resources; • Unavailability of technology; Lack of technological mastery.
Cyclone	• Plant wind breaks using adapted and resistant plants. • Put in place an early warning systems. • Promote nature-based solutions. • Support social protection and risk financing instruments.	• Unavailability of technology; • • Insufficient financial resources; • Lack of technological mastery

	• Support awareness raising.	
Tsunami	• Promote nature-based solutions, • Support social protection and risk financing instruments. • Support awareness raising. • Put in place an early warning systems,	• Unavailability of technology; • Insufficient financial resources; • Lack of technological mastery

CROSS-CUTTING ISSUES

8.2.1. Gender

Mainstreaming gender into hazard management and climate change adaptation in the face of climate change, is critical to building resilience in Puntland State of Somalia. Both male and female key/expert informants recognize that climate change-induced hazards adversely impact females in different socio-economic and environmental sectors including agriculture and food security, livestock, health, coastal and marine zones, water, disaster risk reduction, education, biodiversity, and public works (**Erreur ! Source du renvoi introuvable.29**).

Table 29: Gendered perspectives on climate change induced hazards in Puntland, Somalia

Sector	Intervention Yes/No	Specific Intervention on climate change
Agriculture and Food Security	Yes (50%)/ No (50%)	• Provide training, • Marketing opportunities, • Advocate local people to have local markets, • Encourage NGO partners to give financial and technical support to farmers in agriculture sector • Nutrition and feeding of effected women on droughts
Livestock	Yes (50%)/ No (50%)	• Provide training and capacity development on livestock, • Income opportunities,
Health	Yes (100%)	• Eliminating female genital mutilation ; • Awareness Campaigns for health promotions particularly women and children, • Provide sanitation kit, we work with MoH and health partners, • Mobile teams for droughts effected communities and we provide supports
Coastal and Marine zones	Yes (50%)/ No (50%)	• Promote food security and nutrition for women and children
Water	Yes (75%)/ No (25%)	• Rainwater harvesting

		• We work with our partners to provide a Clean water for the rural areas, chlorine tabs, emergency water tanks,
Disaster risk reduction	Yes (33%)/ No (67%)	• Awareness raising
Education	Yes (67%)/ No (33%)	• Literacy campaigns, • Capacity building training, • Skills for emergency,
Biodiversity	Yes (67%)/ No (33%)	• Provide training to all Biodiversity and conservation stakeholders and support them implement new techniques. • Advocate for the conservation of protected species. • Encourage NGO partners to give financial and technical support for conservation in the biodiversity sector. •
Public works	Yes (10%)	• Training on the use and respect of the climate-resilience construction code, • Advocate for technological tools and capacity support to foster climate resilience construction

Both male and female key/expert informants maintained that there were different interventions needed to counter climate-change induced hazards, notably through gender mainstreaming in Puntland State in Somalia. Currently, female gender is given particular attention during climate-change induced hazards such as droughts and floods with the most common ways being through an increase in women representatives in local government, prioritizing women from poor families, organizing meetings and forums targeting women and; different concerned ministries being involved in financial and material support to affected women, providing food and shelter, maternal support, as well as protection and health centres for vulnerable women.

There are however, several challenges in mainstreaming gender priority into hazard risk management and climate change adaptation in Puntland State, with the most common challenges being gender imbalance, insufficient financial support, limited political representation of women in local government, technical constraints in managing women's only committees, limited awareness on the importance of gender balance, limited female education, insufficient support to gender programmes, inaccessibility to women in remote areas, limited extension services directed towards women, limited funding opportunities for women, limited personnel to educate women on climate change issues, underutilised women in key services such as the police and marine forces, limited climate change knowledge among women, and limited capacity building opportunities for women.

Respondents suggested improvement in women's knowledge on climate change through frequent sensitization campaigns; more women advocacy; creation of more income generating activities; the establishment of more health facilities; construction of more schools with women/girls' friendly facilities; construction of hazard resilient buildings; better water supply systems and boreholes; better access roads; better sanitation facilities; more nutritious food;

efficient awareness raising mechanism, training and capacity building; livelihood diversification for women; more investments in sectors dominated by women; increase projects targeting women; livelihood projects targeting vulnerable women; sufficient support to the agriculture, livestock and water sectors; good information sharing and early warning systems; and the putting in place of effective climate-related hazard preparedness plans.

8.2.2. Disaster risk reduction

Common disasters faced by local communities in Puntland include drought, floods associated to sea level rise, tsunami, and cyclones. This along with violent winds, and sand dune. Several approaches have been used by both Puntland communities and the government, as well as international and local NGOs with the aim of reducing the loss of life and property by mitigating the impact of disasters. For mitigation to be effective, action must be taken before the next disaster, to reduce the human and financial consequences. **Erreur ! Source du renvoi introuvable.30** summarizes the steps in disaster risk reduction and approach used. Based on this Table, mitigation approaches adopted are mostly related to early warning systems and awareness of local communities in risk zone. In terms of preparedness, the respondents said that they do not have the capacity to cope with the winds and heavy rains, but they are preparing to use buildings with strong shelter roofs. Also, to prepare all necessary elements including early warning system, policies, strategies, awareness system, finance, equipment etc. For response, evacuation of affected communities, equipment supports and communities' mobilization was noted. For recovery, it was mostly related to the development of recovery strategies and plans", advocating district disaster management, rehabilitation of affected roads and other facilities, resource mobilization, food support, mosquito nets, hygiene kits, drinking water, health, etc.

Table 30: Approach employed to for disaster risk reduction.

Steps of disaster risk reduction	Approach/actions employed
Mitigation	• Put in place Early Warning Systems • Community awareness and orientation • Community encouraged to move away from the sea, • Tree planting • better preparation towards disaster recovery from a major natural catastrophe, • Community trained for good agricultural practices (climate hazard in agriculture and livestock sector) • Settling highlands • Sanitation and health and cholerization (epidemic and diseases climate hazards effect)
Preparedness	• Communicate with the government about potential disaster risk. • Community awareness • Increase community early warning system. • Prepare policies, strategies, awareness system, financial and equipment support to face the disaster. • Provide lifesaving Jackets for fishermen • use of modern irrigation techniques; • building strong roofs for shelter (to face or cope with heavy wind)

	• Available control equipment (for locust disaster) • Provide lifesaving. • Drip irrigation • Use of boreholes • Livestock's vaccination
Response	• Evacuation for effected communities by the local government authority • Equipment support • Saving and evacuation lost fishermen's which trap in the sea • Community mobilization • Advocacy for effected communities • impact assessments • Impacts monitoring • Provision of food and shelter to effected communities • Livestock treatment • Pest fighting and control
Recovery	• Resource mobilization from diaspora and cooperative, NGOs, etc. • Advocate district disasters management • Rehabilitation of affected roads and other facilities • Moving shelter from affected communities • Developing recovery strategies and plans" • Diverse support for affected communities to supply food, mosquito net, hygiene kit, drinking water, food, health, construction of shelters safety kits, etc. • International and local Ngo supports. • Rehabilitation of boreholes • Financial support pastoralist and agricultural communicates (locust)

The specific challenges faced by locals in managing climate disasters are:

- Lack/limited of adequate and technical resources
- Limited community awareness
- Financial challenges
- Challenges in response and recovery
- Improving early warning
- Sanitation, chlorination, availability of treatments related to epidemic climatic hazard

The summary of actions /options needed to enable the community to cope with climate-related disasters:

- Financial and material support
- Capacity building
- Mitigation and prevention
- Building dams, water storage and relief channels
- Building roofs and strong shelters.

- Clean environment after polluted settlements;
- Use of pest control

Treating of water before drinking for example during floods.

9. ADAPTATION OPTIONS

In this study, adaptation options were identified during consultations, but also from the literature (9.1). Expert's options were also presented, as well as the barriers (9.2.). This also captures the challenges encountered in course of carrying out this study (9.3.).

9.1. ADAPTIVE OPTIONS FROM COMMUNITY CONSULTATION AND EXISTING DOCUMENTS

The adaptation options identified for the sectors according to climate hazards are summarised in **Table 31.**

Table 31: Overview of identified sectoral adaptation options for the Puntland State

Sector	Climatic hazards	Identified adaptation options	
		From consultations	**From existing documents[58]**
Agriculture and food security	**Drought**	• Set up early warning system in the agriculture sector. • Construct dams, water reservoirs and dikes. • Prepare and implement drought plans, build dams, water banks, rebuild shallow wells, conserve water and dig wells. • Practice water harvesting, drip irrigation.	• Establishment of policy framework related to agriculture and food security. • Develop Climate-smart Agriculture diversification and value chain improvement. • Promotion of new crop varieties adapted to drought, high temperatures and heat stress. • Ensuring water availability during long periods of drought for crop diversification through the promotion of small-scale irrigation. • Support for capacity-building in crops good harvesting practices. • Introduction of heat stress resistant and climate smart species • Avoid the valorisation of floods zones
	Extreme temperature	• Develop the agroforestry system • Practice conservation agriculture, and • Plant shade tree species	
	Floods	• Construct f dikes • Improve early warning systems • Use proper land use planning • Open existing water paths	

[58] Options applicable to the entire nation.

Water	**Cyclone**	• Improve on early warning systems, • Provide many water collection kiosks • Provide cyclone forecasting systems, information sharing and integration of stakeholders (radio communications, messaging) • Provide meteorological information. • Set up a warning system for all means of communication, such as messages and radios.	• Tree planting to serve as wind breaks. • Set risk mitigation mechanisms and improve awareness. • Increase water diversions perhaps by opening of existing channels or creating new ones • Develop water infrastructures this include storage and irrigation infrastructure; drought–resilient water supply and sanitation infrastructure[59]. This will support both disaster risk management and resilient rural livelihoods • Development of flood–resilient water supply and sanitation infrastructure; and flood defences for critical locations
	Drought	• Construct more wells (Shallow wells, boreholes), water reservoirs, boreholes • Improve on early warning system, • provide drought forecasting systems, • information sharing and stakeholder integration.	
	Floods	• Build infrastructure, raising community awareness • Construct dams, canals, conservation of water crossings to limit water damage in districts	○ Development of flood–resilient water supply and sanitation infrastructure; and flood defence for critical locations

[59] Somalia Climate Risk Review, World Bank Group, 156p

	Extreme temperature	• Construct rig wells, water reservoirs with plastics • Develop systems to increase water availability. • Planting more trees, that reduce evaporation of water, • build shallow wells, boreholes as well as water management system. • Cover the barked and construction for new sand dams	
	Tsunami	• Awareness and education. • Early warning system, Tsunami prediction, information sharing • Build strong water dams or barrages, provide weather information	
Livestock	**Livestock pest and diseases**	• provide vaccines and required treatment. • Raise awareness of breeding techniques adapted to climate change	• Livestock climate-smart. • Increase the quantity of water available through rehabilitation of dams, 'berkeds', boreholes and the construction of new dams, reservoirs, water diversions, livestock watering points and irrigation infrastructure. • The selection of sites for these boreholes should take into account livestock concentration in the area and should be accompanied by an Environmental Impact Assessment
	Cyclone	• provide weather information	
	Locust	• Support risk preparedness and response	
	Drought	• Enhance fodder production and provision of water points, Restock those who lose their livestock	

	Floods	• raise awareness and provide early warning system	•
	Extreme temperature	• build livestock shelter to reduce the heat stress	
	Tsunami	• promote preparedness and responses for the relevant disaster and risks	
Health	Extreme temperature (heat stress)	• Provide ventilated technologies for health facilities, •	• Improve health status through establishment and/or upgrading of health facilities, particularly for maternal and child • Re-training of doctors and nurses that are in the system to deal with climate related health problems • Develop a health preparedness plan for droughts and floods • address diseases related to malnutrition.
	Droughts	• Provide ventilated technologies for health facilities, • Raise awareness on health challenges and adaptive measures	
	Floods	• Pramote hygiene and sanitation	
	Vector-borne diseases	• Create awareness to the population. • Advocate for support from government development partners, • Provide preventive measures	
	Gastrointestinal diseases	• Create awareness to the population • Advocate for support from government development partners, • Provide preventive measures	

Education	**Drought**	• Educate and create awareness • Construct wells • Establish reserve blocks • Adapt and promote resilience initiatives • Produce disaster risk reduction framework – contingency plan"	•
Biodiversity	**Extreme temperature**	• Avoid or reduce exposure of biodiversity sectors to climate risk; • Accept the impacts; and implement to improve adaptation to climate in biodiversity sector; • promote build staying houses and shading under the trees. • plant more trees, burn charcoal, anti-deforestation and desertification policies and anti-fire plans, enforcethe regulatory framework, and reduce deforestation.	• Protection of forests (particularly Almadow forest) through charcoal reduction by developing alternative energy plan, encouraging the use of fuel-efficient cooking stoves, supporting alternative livelihoods and banning exports of charcoal. • Widespread awareness campaign on the impacts resulting from the destruction of forests and other natural resources. • Conservation of rare and indigenous species that are under threat of extinction. • Establish a research center that studies flora and fauna to understand the advantages and disadvantages of certain species and their impacts on land and water resources, and to further examine sustainable forestry, agriculture and fire management • Develop an agroforestry/rangeland management
	Droughts	• promote CSA practices to have positive impact on the biodiversity sector • Promote water harvesting and management system	
	Floods	• protect water creeks and valleys;	

		• build Gabions for soil protection	• Construction of check-dams to reduce flooding and destruction of trees
	Crop pest and diseases	• remove and control the invasive species • burn and modify the *Porospic julifera*	
	Locust	• prepare pesticides • Early warning systems	
	Cyclone	• Provide weather information • build strong houses	
	Tsunami	• Enhance early warning systems • Establish agroforests • Prepare and promote evacuation plans, • Educate and raise awareness • Enhance safety nets • Train professionals • Create intervention mechanism • Put in place contingency plans • Support resettlements plans"	
Coastal and marine areas/resources	Extreme temperature (Rising water temperature)	• promote plantation and protect vegetation, • improve early warning systems, • Educate and raise awareness • Appropriate site selection for schools • Adapt and promote resilience initiatives	○ • Establish and manage terrestrial and coastal protected areas and active restoration of critical habitats • Construction of check-dams to reduce flooding and destruction of trees

		• Prepare disaster risk reduction framework – contingency plan • Prepare and promote resettlements plans	
	Coastal flood	• WASH facilities	
	Sea level rise	• Promote plantation and vegetation, • Develop evacuation policies • Improve Early warning systems • Educate and create awareness • Promote safety nets • Train Professionals in the sector • Prepare intervention mechanism • Prepare contingency plans	
Public works	Extreme temperature	• Promote the use of climate-resilience construction code for all public infrastructure. • Train, advocate and sensitize the importance of using and respecting the climate-resilience construction code.	• Climate resilience building codes[60], • Adapt transport and road infrastructure to withstand heat stress. • Adjusting power plants and electricity grids

[60] Noble, I.R., S. Huq, Y.A. Anokhin, J. Carmin, D. Goudou, F.P. Lansigan, B. Osman-Elasha, and A. Villamizar, 2014: Adaptation needs and options. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 833-868.

	Drought	• Construct climate-proofed buildings that will withstand heat and drought from cracking, melting, and fading. Etc.	• Water storage and pump storage[61] • Climate resilience building codes • Adapt transport and road infrastructure drought stress. • adjusting power plants and electricity grids
	Floods	• Construct water drainage systems, dykes, and canals to facilitate water flow out during floods. • Plant trees, whose roots shall act as soil conservation, anti-erosion and prevent landslides. • Train Professionals in the sector • Prepare intervention mechanism. • Prepare contingency plans.	• Construct flood levees and culverts[62] • Improved drainage systems and canals, • Improved sewage work, • Build flood and cyclone shelters. • Climate resilience building codes • storm and wastewater management. • Adapt transport and road infrastructure withstand flood. • contruct floating houses
	Sea level rise	•	• Build Sea walls and coastal protection structure[63] • beach nourishment. • Climate resilience building codes • storm and wastewater management. • Adapt transport and road infrastructure to withstand sea level rise. • construct floating houses

[61] Ibid61
[62] Ibid61
[63] Ibid61

	Cyclone	• Construct and build wind belts using adapted plant species, that will serve as wind brake during cyclones. • Put in place disaster early warning system to alert users to take appropriate dispositions before the disaster arrive. • Advocacy and sensitisation of cyclones eventual cycles, appropriate measure needed before, during and after the disaster, • Prepare intervention mechanism. • Prepare contingency plans	• Build flood and cyclone shelters. • Climate resilience building codes • storm and wastewater management. • construct floating houses
	Tsunami	• Put in place disaster early warning system to alert users to take appropriate dispositions before the disaster arrive. • Advocacy and sensitisation of Tsunami eventual cycles, appropriate measure needed before, during and after the disaster, • Prepare contingency plans	• Adapt transport and road infrastructure to withstand Tsunami[64] • construct floating houses

[64] Ibid61

9.2. BARRIERS

The following barriers need to be considered when planning adaptation actions in Puntland State.

- Poor climate resilience institutional and enabling environment for climate resilience, despite the political will,
- limited technology despite willingness to receive technology transfer.
- Insufficient financial resources; and
- Lack of mastery (limited capacity).

10. STRATEGIC AXES

This study permitted the proposition of a few strategic axes to combat climate hazards in Puntland (**Table 32 and 33**)

Table 32 : strategic axes for climate resilience in Puntland

Strategic Axes	Problem	Objectives	Outcome	Activities
Enhancement of coordination and effective communication in both the FGS and Puntland disaster management institutions for efficient proactiveness	Insufficient coordination and communication and enabling environment for the management of climate disaster in Puntland	• Strengthen multi-institutional disaster management coordination in Puntland, • Digitalise disaster management communication platform and effective communication measures for climate disaster management in Puntland. • Create suitable enabling environment for coordination and digitalisation to be implemented	• Multi-institutional disaster management system coordinated, • Disaster management platform digitalised, and effective communication ensured. • suitable enabling environment for coordination and digitalisation to be implemented created.	• Support intersectoral and multi-stakeholder long-term coordination for climate action. • Strengthen capacity of the intersectoral and multi-stakeholder on long-term coordination for climate action • Build capacity of Federal and institutional stakeholder on policies requirement for implementation and sustainability climate-resilient disaster management • Enhance the mainstreaming of climate resilient policy framework to provide enabling environment for disaster management in Puntland.
Enhancement of the Early Warning Systems to build greater resilience to hydro and meteorological hazards in Puntland, and its platform that provide alert real time	limited early warning systems to hydro and meteorological hazards in Puntland	• improve early warning systems in Puntland, • improve early warning system platform and delivery mechanism for real time transmission of alert	• Early warning systems in Puntland improved, • Early warning system platform and delivery mechanism for real time transmission of alert improved	• Strengthen Federal climate services based on systematic data collection and risk knowledge, • Hydrometeorological service modernization for enhanced monitoring, impact-based forecasting, and early warning services

				• Strengthen dissemination and communication of risk information and early warning, and • Enhance climate risk management capacities
Strengthening of the agricultural and food security, livestock sectors by developing Climate Smart Agriculture in Puntland	Weak resilience of the agriculture, livestock, and food security sectors to climate hazards in Puntland	• improve Climate Smart Agriculture practices Puntland. • Enhance Commodities, fishery and animal products' value chains and markets in Puntland.	• Climate Smart Agriculture practices enhanced in Puntland. • Commodities, fishery and animal products value chains and markets enhanced in Puntland.	• Land restoration for climate resilience agricultural production system, • Promote climate-smart agriculture techniques to reduce the vulnerability of smallholder farmers to climate, • Restore and safeguard rangeland functions through restoration and sustainable land management practices in Puntland, • Systematic data collection and documenting commodities, fishery and animal value chains and market services in Puntland, • Strengthen dissemination and communication of value addition, services and market products to the local people.
Development of safe buildings and infrastructure in the health, education, and public works sectors for climate resilience in Puntland,	Less climate resilience infrastructural constructions in health and sanitary, education and public works sectors in Puntland	• Retrofit with climate resilient safe buildings and infrastructures in the health, education, and public works sectors	• Climate resilient safe buildings and infrastructures in the health, education and public works sectors are retrofitted	• Implement structural and non-structural measures to maintain the integrity of buildings during and after extreme weather events. • Install rainwater harvesting and storage systems and implement water efficiency measures in facilities to ensure supply during and after extreme weather events.

				• Construct climate-proof multipurpose storage units. • Retrofit a building into a laboratory to support the surveillance of climate-sensitive diseases.
Development of a sustainable financial mechanisms for smallholders in all priority sectors by creating green lines with concessional interest rates in Financial Institutions, and guarantees, risk coverage with insurance companies	Insufficient sustainable finance mechanism to boost climate resilience development at the grassroot level	• Develop green banks that will support smallholders in climate resilience activities. • Strengthened and capacitate institutions responsible for risk, guarantees and insurance coverage to support climate resilience development in Puntland state.	• Green banks that will support smallholders in climate resilience activities developed. • Institutions responsible for risk, guarantees and insurance coverage to support climate resilience development is strengthened and capacitated in Puntland state.	• Establish, and manage green lines of credits / loans, guarantees, and equity to boost investment in climate-resilient investments and value chains are by financial institutions. • Enhance Farmer Organisations, women, youth organizations, MSMEs, and cooperatives' activities, credit worthiness and access to green line of credits and guarantees to boost investment in climate-resilient projects. • Establish and adopt climate Risk Insurance system and products by investing in climate resilience activities along the value chains, • Enhance capacity of Financial Institutions and beneficiaries on new green financial products and instruments, • Strengthen FIs, and beneficiaries on climate risk insurance coverage and uptake
Enhancement of the energy sector to provide readymade / renewable energy options	Insufficient energy supply to boost the different priority sector development	• Enhance and integrate renewable energy development and supply in Puntland.	• Renewable energy development and supply enhanced and integrated in Puntland.	• Provide renewable energy and energy-efficient technologies to increase energy autonomy of the facilities.

to all the priority sectors study.				
Promotion of forest landscape restoration programmes to restore existing ecosystems and create new opportunities for rangelands, etc.	Rapid advancement of desertification, ecosystem resources and rangeland degradation in Puntland	• Restore degraded forest landscape and ecosystems in Puntland, • Develop rangelands for pasture production in Puntland.	• Degraded forest landscape and ecosystems restored in Puntland, • Rangeland for pasture production developed in Puntland.	• Enhance protected Area system policy, financing framework and physical management of the land, marine and coastal protected landscapes. • Restore and safeguard rangeland and forest ecosystem functions through forest restoration and sustainable land management practices in and around the Puntland. • Improved opportunities for and profitability of alternative sustainable livelihoods in and around ecosystems that decrease pressures on the land and support its continued rehabilitation.

SECTORAL STRATEGIC AXES IN PUNTLAND

The sectoral strategic axes are proposed in **Table 33**.

Table 33: Strategic axes for climate resilience in Puntland

Sectors	Strategic Axes	Problem	Objectives	Outcome	Activities
Agriculture and food security	Enhancement climate smart agriculture in Puntland State	• Insufficient climate resilient agricultural practices and innovative financial facilities for small holder farmers	• Strengthen climate smart Agricultural practices in Puntland, • Create Innovative Financing Facility to foster the best adaptation practices and use of renewable energy along agricultural value chains. • Strengthen Financial Institutions, and beneficiaries on climate risk insurance coverage and uptake.	• Climate smart Agricultural practices in Puntland Strengthened, • Innovative Financing Facility to foster the best adaptation practices and use of renewable energy along agricultural value chains created, • Financial Institutions, and beneficiaries on climate risk insurance coverage and	• Set up early warning system in the agriculture sector. • Promote the use of improved seeds/seedlings, organic manure, integrated pest management systems, • Construct dams, water reservoirs and dikes, rebuild shallow wells, dig wells for have water in drought seasons for agriculture. • Ensure propre communication on agriculture calendar. • Promote the use of renewable energy (PVC) for crop irrigation. • Practice water harvesting, drip irrigation in agriculture. • Prepare and implement drought plans instruments, • Develop the agroforestry systems to enhance climate resilient agriculture. • Practice conservation agriculture, and • Promote the planting of shade tree species. • Use proper land use planning techniques. • Create facility is to support Farmer Organisations, women and youth organizations, cooperatives and MSMEs. • Build capacity of banking system, private sector, technical agencies, policy makers to engagement (PSE) in Agri-food system insurance • Build capacity of the insurance sector on index-based insurance, enhance literacy, and build trust in the products in Puntland

				uptake are strengthened.	
Water	Enhancement of the water supply schemes in Puntland	• Limited or restricted water supply in Puntland	• Improve water supply schemes, • Revised enabling policy environment, • Enforce coordination between water management authorities. • Promote private initiatives in the water development systems.	• Water supply schemes, improved. • Enabling policy environment revised, • Coordination between water management authorities enforced. • Private and households' initiatives in the water development systems promoted.	• Protect water catchment areas by planting watershed trees, protect from anthropic activities. • Provide many waters collection kiosks. • Provide cyclone forecasting systems, information sharing and integration of stakeholders (radio communications, messaging) • Provide meteorological information on time. • Set up a warning system for all means of communication, such as messages and radios. • Construct more wells (Shallow wells, boreholes), boreholes, rig wells, water reservoirs with plastics and water management system. • Provide drought forecasting systems, • information sharing and stakeholder integration. • Construct dams, canals, and barrages, provide weather information, conserve water crossings to limit water damage in districts, • Develop systems to increase water availability. • Planting more trees, that reduce evaporation of water, • Cover the barked and construct new sand dams. • Raise awareness and build capacity on techniques of water conservation. • Provide boreholes as sustainable source of water for schools, • Increase the desalination of undrinkable borehole water and further scale up the percentage of the population with access to clean water.

					• Upgrade and prioritise green energy power systems in all water sources to minimize reliance on fossil fuels and create climate-friendly, cost-effective renewable systems
Livestock	Strengthening of the agricultural and food security, livestock sectors by developing Climate Smart Agriculture in Puntland	• Weak resilience of the livestock, sector to climate hazards in Puntland	• Improve climate resilience of livestock in Puntland. • Enhance, fishery and animal products' value chains and markets in Puntland.	• Climate resilience of livestock improved in Puntland. • Fishery and animal products value chains and markets enhanced in Puntland.	• Provide vaccines and required treatment to animals. • Build capacity on breeding techniques adapted to climate change. • provide weather information real time. • Establish climate risk preparedness and response mechanism. • Enhance fodder production and provision of water points, • Promote the restocking of livestock lost because of climate hazard. • Improve on the early warning system to reach every rangeland in Puntland, • build livestock shelter to reduce the heat stress. • promote meat, dairy products, and fish products in the market, • Put in place extension service of the veterinary assistance for animal health issues, vaccination and treatments.
Health	Development of safe buildings, equipment and staff in the health, sectors for climate resilience in Puntland,	• Less climate resilience infrastructural constructions, equipment, and staff in health and sanitary sectors in Puntland	• Retrofit with climate resilient safe buildings and infrastructures, equip and train staff in the health, sector	• Climate resilient safe buildings and infrastructures retrofitted, equipment installed, and staff trained in the health, sector	• Improve health status through establishment and/or upgrading of health facilities, particularly for maternal and child. • Re-training of doctors and nurses that are in the system to deal with climate related health problems. • Develop a health preparedness plan for droughts and floods. • Address diseases related to malnutrition. • Retrofit health buildings and infrastructure. • Train health personnel in adapted and new technologies in the managing patients,

					• Equip health units with appropriate technologies and medications.
Education	Development of safe buildings, equipment, and staff in the Education sector for climate resilience in Puntland,	• Limited climate resilience infrastructural constructions, equipment, and staff in Education and sanitary sectors in Puntland	• Retrofit with climate resilient safe buildings and infrastructures, equip and train staff in the Education sector	• Climate resilient safe buildings and infrastructures retrofitted, equipment installed, and staff trained in the Education sector	• Educate and create awareness on climate hazards, impacts, measures of adaptation, • Construct hand pump wells in school establishments • Promote resilience initiatives in school, • Produce disaster risk reduction framework – contingency plan, • Rebuild infrastructures with climate adaptation properties, • Train staff of education on climate resilience,
Public works and housing	Development of safe buildings, infrastructure in the public works and housing sector for climate resilience in Puntland,	• Insufficient climate resilience infrastructural constructions (roads, runways, bridges, dams, roads in the public works and housing sectors in Puntland	• Construct and maintain climate resilient infrastructures (roads, runways, bridges, dams, roads, public buildings in the public works and housing sector.	• Climate resilient infrastructures (roads, runways, bridges, dams, roads, public buildings in the public works and housing sector constructed and maintained.	• Revised building and construction code to mainstream climate resilient construction models. • Strengthen public works and housing capacity on the revised code, • Promote resilience initiatives in every public infrastructure in Puntland, • Create awareness on the proper use of public facilities by the populations, • Develop mechanism of constant maintenance of these infrastructures
Biodiversity	Promotion of forest landscape restoration programmes to restore	• Rapid advancement of desertification, ecosystem resources and	• Restore degraded forest landscape and ecosystems in Puntland,	• Degraded forest landscape and ecosystems restored in Puntland,	• Reduce exposure of biodiversity sectors to climate risk, ○ Build capacity of stakeholders in the conservation department in Puntland on climate resilient techniques, • Equip the conservation technicians with the state-of-the-art technology, • Implement adaptation to climate in biodiversity sector.

	existing ecosystems and create new opportunities for rangelands, etc.	rangeland degradation in Puntland	• Develop rangelands for pasture production in Puntland.	• Rangeland for pasture production developed in Puntland.	• promote build staying houses and shade trees. • Plant more trees, burn charcoal, promote anti-deforestation and desertification policies and anti-fire plans, enforce the regulatory framework, and reduce deforestation. • Create healthy vegetation on slope. • Provide terrestrial and inland water systems. • Promote landscape restoration efforts. • Create health awareness and education and protect climate refuges. • Conserve wildlife by creating more protected areas, • Protect water creeks and valleys by tree planting. • Build Gabions for soil protection, • Removes and control the invasive species, • Burn and modify the *Porospic julifera.* • Provide structural flood protection measures, • Put in place an early warning system, • Develop a risk-informed land planning, • Promote nature-based solutions, • Support social protection and risk financing instruments, • Promote nature-based solutions, • Support social protection and risk financing instruments;
Coastal and marine areas/resources	Development of Climate-Resilient Integrated Coastal Zone Management (ICZM) in Puntland	Extreme climate events degrade Coastal and Marine areas/resources of Puntland	• Strengthen coastal planning and protection against climate change.	• Coastal planning and protection against climate change Strengthened.	• Establish a framework for the effective coordination of proposed and ongoing climate change adaptation (CCA) initiatives and relevant institutions both vertically – between local and national levels – and horizontally between local Districts and sectors; • Build capacity at Federal and District levels for decision-making on CCA, including for developing District-led implementation plans for Puntland's Marine Spatial Plan (MSP) and Coastal Management Plan (CMP) to reduce the

					vulnerability of communities located within the coastal zone. • Provide technical support to relevant government ministries for the strengthening of regulatory systems in the coastal zone. • Develop and disseminate information on the economic benefits of ecosystem-based adaptation approaches. • Rehabilitate coastal and riparian ecosystems to provide essential ecosystem services that reduce climate change impacts on coastal communities and enhance food security through improved fish stocks, • Develop and implement a community-based monitoring and engagement strategy for rehabilitated marine and coastal ecosystems, including links to the fisheries, agriculture and tourism sectors, • Install coastal defence infrastructure at vulnerable sites on the west coast of Puntland

11. CONCLUSION AND RECOMMENDATIONS

CONCLUSION

In this study, the vulnerability and risk of different priority sectors to different climate hazards in the State of Puntland, Somalia was assessed. Observations of climate parameters from the period 1981 to 2021 show that the amount of precipitation in Puntland has decreased over time, but temperatures have increased. Project scenarios suggest that the same trends will be observed in the future or that precipitation will decrease. This was confirmed by local perceptions in the local communities. Regarding the level of vulnerability and risk of priority sectors (water, health, agriculture and food security, livestock, biodiversity, coastal and marine are/resources, public works, education) to climate hazards (extreme temperatures, floods, droughts, pests and diseases, locusts, tsunami, cyclones) in Puntland recorded **high**. However, the vulnerability and risk were **low** in the health sector. The impacts of these climate hazards in priority sectors were diverse and varied. In terms of adaptation, local people have developed several coping strategies which vary from one local community to another , and the most widely used being the use of smoke to deter locusts. As climate change is here to stay, the people need to adapt to live with it, and at the same time improve their resilience. Thus, vulnerability is a pacemaker and has opened gaps for policy rethinking to improve the living conditions of the community.

COMMUNITY LEVEL BEST PRACTICES

Some good practices have been learned:

- The use of smoke as a deterrent to locust invasion by the local people. Local communities burn smoky firewood during locust invasions. This smoke acts as deterrent and prevents locusts from entering their communities and destroying their crops.
- The use of traditional knowledge to predict droughts, floods and providing additional information on disaster alerts through their phones and radios.
- Increasing community engagement in forest and rangeland restoration by planting trees and collecting of seeds of *Acacia* sp. for afforestation and reforestation (forest restoration) and establishing more rangeland reserves and more boreholes (rangeland restoration).
- Volunteer work to sensitise people on the importance of tree conservation; control and preservation of the few remaining vegetations in the area; distribution of animal dung; controlled grazing of animals in areas where there is grass and few trees.
- Formation of community fire brigades that are proactive in promoting indigenous fire management methods such as fire tracing, early burning of vulnerable areas to reduce grass fuel, and prevention awareness and advocacy.
- The promotion of traditional/customary laws that protect boreholes for water conservation, and rangelands for pasture protection in the area.
- Promoting awareness raising, community mobilisation, women's groups to advocate for women in the fishing sector, early warning systems, communities supporting each other during disasters, information sharing, fishermen's WhatsApp groups to share weather information, and the reconstruction of destroyed infrastructure.
- Community-driven efforts and cooperation for building roads (e.g. the case of El-Dahir-Erigavo Road construction).

RECOMMENDATIONS

Given that vulnerability and risk assessment is a fundamental step in action planning for appropriate coping and adaptation strategies, the recommendations provided are in relation to climatic hazards. In general, they include to:

- Strengthen the development of a concise climate information and early warning systems at the community level by creating a two-way communication system, communities to scientists and scientists to communities.
- Support existing adaptive strategies of marginalized groups such as women: this can be achieved cost-effectively by, for instance, the promotion of revenue producing activities such as home gardening, fish farming, poultry, sheep fattening, agricultural and livestock processing, and marketing of products.
- Strengthen the existing VSLA system of productive finance beyond women only by incorporating men too.
- Promote various agroecological methods, including crop varieties adapted to the climate and technologies which increase soil fertility and structure (such as Zai pits, semi-circular bunds, organic manure, and naturally assisted regeneration).
- Promote the cultivation of forage, especially *Caliandra calothrysus*, as it is suited to the ecologies in Somalia and will also contribute to the development of good soil quality.
- Increase support to livestock through a) animal health training and organization of producers and b) advocacy at the regional level to provide resources to the districts to strengthen the livestock sector infrastructure.
- Support community-based producer groups – livestock, vegetables, grains, etc. – by linking them more closely to state, national (Somalia) producer and marketing networks that provide personal profits.
- Promote innovative ideas (household scale fish farming, solar pumping systems for irrigated agriculture and home gardens).
- Integrate gender perspectives into mitigation and adaptation initiatives: investing in women as part of the climate change response leads to environmental gains and greater returns across the SDGs and broader development objectives.
- MoHADM activities and projects need to bring women into the planning,financing and implementation of climate responses, including adaptation and mitigation, food security and agriculture, health, water and sanitation, forestry, disaster risk reduction, energy and technologies, and infrastructure.
- Strengthen climate-resilient construction through building codes, capacity building of civil engineers, technology transfer and support for implementation of the law in all public works.
- Include climate change courses in the school curriculum (all subjects taught in schools). Train teachers on how to better integrate climate change into their teaching. Include awareness-raising and advocacy programmes in media houses and social media networks to raise awareness of climate change, mitigation and adaptation.
- Develop and improve financing opportunities for people; both financial institutions (providers) and demanders such as farmers' organisations, cooperatives, entrepreneurs, small business operators (SMEs), women and youth on green climate finance. This will make it easier for borrowers to take out loans and repay them by establishing green credit lines with concessional interest rates. Local people will have access to credit for their small businesses and be able to repay their loans promptly.
- Climate-proof all healthcare facilities (dispensaries, health centres, clinics), hygiene and sanitation facilities (toilets, sewage, and waste management systems), etc. Support capacity building of appropriate health and waste management personnel on climate-

resilient health management and rapid response methods in case of emergencies or disease outbreaks.

- Integrate climate change disaster management techniques and technologies into the biodiversity and nature conservation sector through integration of existing texts, capacity building, technology transfer and appropriate implementation.
- Strengthening the Coastal and Marine Management Plan through innovative management such as training to improve skills, providing technologies (both indigenous and advanced) for building sea walls and coastal protection structures, nourishing beaches, managing storms and wastewater, adapting transport and road infrastructure to withstand sea level rise, constructing floating houses, and building flood and cyclone shelters.

Difficulties encountered during the assessment include:

- **Timeline**

Due to heavy rainfall, the team that was supposed to collect data at Jibigale was unable to arrive because the road was so bad after the rainfall. As a result, there was no data collection in Jibigale, as was originally planned. Future similar studies should consider the season, during planning.

- **Tools and techniques**

There was a car breakdown which affected the team that visited Eyl. But this had no effect on the team's aim of visiting Eyl. Proper dispositions should be taken in transporting teams in future studies to minimise uncertainties.

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13. APPENDICES

APPENDIX 1. SCHEDULED FOLLOWED FOR FIELD WORK DATA COLLECTION

Date	Location	Sector	Enumerator	Days	FGDs/KII
Sept 18	Garawe	Training	5	1	
Sept 20	Garowe	KII 9 Sectors		1	
Sept 21	Garowe	Uploading tool to Kobo	all		
Sept 22-30	Gardo	• DRR (1KIIs) • Agriculture (2 FDG) • Livestock 2FGDS 1 KII)	• Eng • Farey	9	2 Kii/ 2 FGD
	Celdahahir	• Agriculture (2 FGDs and 1 KII) • Public Works (1 KIIs)			2 FGDs
	Calula	• DRR (1 KIIs) • Marine Coast (2 FGDs and 1 KIIs) • Public Works (1 KIIs)			
Sept 22-25	Jiriban(Dhinowda)	• DRR (Dhinowda) (1 KIIs) • Coastal Marine (2 FGDs and 1 KIIs)	• Warsam • Ainab	3	
Sept 23	Garowe Schools, TVETs, and principals)	• Education (3 KIIs)	• Hamid • Afyare	1	
Sept 24	Garowe-Rabable/laacd here /ligle	• Biodiversity (2 FGDs, and 1KIIs) • Water Sector (2 FGDs, and 1KIIs)	• Kediye • Abu • Ismail • Consultant • Hamid • Afyare		
Sept 25	Garowe (water companies and PAWDA) (IDPs water mgt committee)	• Water Sector (2 FGDs and 2 KIIs)	• Hamid • Kediye • Consultant • UNDP NAP	1	

Sept 26-27	Eyl (Fishery community in Badey, agriculture community in Dawad, and livestocks)	• Marine-Coastal (2 FGDs and 1 KIIs) • Agriculture (2 FGDs and 1 KIIs) • Livestock (2 FGDs and 1 KIIs)	• Aden • Warsame • Kediye • Afyare	2	
Sept 26	Cuun	• Agriculture (2 FGDs and 1 KIIs) • Livestock (2 FGDs and 1 KIIs) • Biodiversity (2 FGDs and 1 KIIs)	• Hamid • Abuu • Abdiqaal • Ainab	1	
Sept 27	Garowe (Health Centers) MCH, Garowe General Hospitals and Private Hospital)	• Health (3 KIIs)	• Abuu • Anab • Hamid • Consulat nt • UNDP Nap • KAALO	1	
Sept 28	Graowe (MWDAF and Women Groups)	• Gender (2 KIIs)	• Warsam • Kediye • Ismail	1	
01st Oct	Garowe-IDP(Jilab)	• DDR (1 KIIs) • Gender (1 KIIs) • Health (2 FGDs)	• Hamid • Afyare • Abuu • Warsame • Ainab • Consulat nt • UNDP NAp	2	

APPENDIX 2. QUESTIONNAIRES

SECTOR: AGRICULTURE AND FOOD SAFETY

PART A: COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. What is the most dominant form of farming? (Small, medium, or large-scale farms)?

2. What is the main purpose of growing crops within your community?
(a). Subsistence (for own use)
(b) Semi-commercial (a part is for own use and another part is sold)
(c) Entirely commercial (everything that is harvested is sold)

3. What are the main crops that are used as food sources by the community?

4. What are the main crops that are used for income by the community?

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact farming activities and food security in your community/village/jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on agriculture and food security?**
Extreme temperature (heat stress)		
Droughts		
Floods		
Crop pest and diseases		
Locust		
Cyclone		
Tsunami		

***Impacts**: 1=Disruption of the agricultural calendar; 2=Lower agricultural yields; 3=Risk of extinction of less resilient species; 4=Water shortage for farms; 5=Food insufficiency; 6=Lower incomes; 7=Soil leaching; 8=Crop losses; 9=Farm destruction; 10=Reduction in soil fertility;*

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is agriculture and food security to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on agriculture and food security within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Crop pest and diseases			
Locust			
Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. What is the average level of education of farmers in your community/village? *001= None ; 2= Primary ; 3= Secondary ; 4= Higher education*

2. Do farmers have access to improved production techniques ___ *1=Yes ; 2=No*

If so, which ones_____

*1=Climate-smart agriculture; 2=Agriculture-livestock integration; 3=Micro-irrigation; 4=improved seeds; 5=Others to be specified*_____

3. Do farmers have access to financial resources? _____ *1=Yes ; 2=No*

If so, which_____1=Recourse to *informal credit (Tontines, Families); 2=Recourse to formal credit; 3=Donations; 4= Others to be specified*_____

4. Are there saving groups that can provide loans for livelihoods? Are there specific saving groups for women?

5. Do farmers have access to climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Farming calendar; 3=Weather information; 4=Other to be specified*_____

6. Do farmers receive material support? _____ *1=Yes ; 2=No*

If yes, which_____1=Equipment*; 2=Improved seeds; 3=Other to be specified*_____

7. Do farmers have access to extension services?
If yes, what sort of support/advice do you receive?

8. Do farmers grow irrigated crops? *1=Yes ; 2=No. If yes,* which ones *?*

9. Where irrigation is practiced, how are farmers adapting irrigated systems to water scarcity?

10. Are there social networks that provide support during and after shocks such as floods, etc.?

11. Do you think farmers within your community will have a better capacity to cope with climate change impacts in the future?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices have farmers implemented?

Climatic hazards	**Adaptation practices**	**What are the constraints preventing their implementation? *1= Unavailability of technology; 2= Insufficient financial resources; 3= Lack of mastery of technology; 4= Others (please specify)***
Extreme temperature (heat stress)		
Droughts		
Floods		

Crop pest and diseases		
Locust		
Cyclone		
Tsunami		

2. What disaster preparedness and response are available?

Sector	Questions	Responses
Disaster preparedness and response	Describe the last disaster event that affected the community (e.g., cyclone, floods). How did the community respond?	
	Is there a disaster management plan in the settlement?	
	How is the community warned of an impending extreme weather event?	
	Do you use technology or social media to obtain information on climate change and/or DRR?	
	What sources of information (e.g., mobile phones, internet, radio, television, etc.) do you use to obtain information on climate change and/or DRR?	
	Is there a community evacuation centre?	
	Are there any issues with regards to the evacuation centres? Are there any community groups/members who cannot access these?	
	Are there any traditional knowledge-based practices that the community uses to address climate-induced disasters?	
	Are there external organizations that support the community in preparing and responding to disasters?	

PART B: Line ministries, Civil Society Organizations

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact farming activities and food security in your jurisdiction**

Climatic hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	If yes, how did this impact on agriculture and food security?
Extreme temperature (heat stress)		
Droughts		
Floods		
Crop pest and diseases		
Locust		
Cyclone		
Tsunami		

***Impacts**: 1=Disruption of the agricultural calendar; 2=Lower agricultural yields; 3=Risk of extinction of less resilient species; 4=Water shortage for farms; 5=Food insufficiency; 6=Lower incomes; 7=Soil leaching; 8=Crop losses; 9=Farm destruction; 10=Reduction in soil fertility;*

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is agriculture and food security to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on agriculture and food security within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Crop pest and diseases			
Locust			
Cyclone			
Tsunami			

c. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

d. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to farmers geared towards enhancing their access to improved production techniques ___ *1=Yes ; 2=No*

If so, which ones_____
*1=Climate-smart agriculture; 2=Agriculture-livestock integration; 3=Micro-irrigation; 4=Others to be specified*_____

2. Does your institution support farmers to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide farmers with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Farming calendar; 3=Weather information; 4=Other to be specified*_____

4. Does your institution provide material support to farmers? _____ *1=Yes ; 2=No*

If yes, which support do you provide_____1=Equipment*; 2=Improved seeds; 3=Other to be specified*_____

5. Does your institution provide extension services to farmers?
If yes, what sort of support/advice do you offer?

6. Does your institution support farmers with irrigation services?

7. In the event of climate-induced food shortages (e.g. caused by droughts), what actions does your institution implement to address food insecurity?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of agriculture and food security to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Crop pest and diseases	
Locust	
Cyclone	
Tsunami	

PART B: Line ministries, Civil Society Organizations

Name of institution:	

Name & position of respondent(s):	
Location (town/village):	
Date of interview	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact farming activities and food security in your jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on agriculture and food security?**
Extreme temperature (heat stress)		
Droughts		
Floods		
Crop pest and diseases		
Locust		
Cyclone		
Tsunami		

***Impacts**: 1=Disruption of the agricultural calendar; 2=Lower agricultural yields; 3=Risk of extinction of less resilient species; 4=Water shortage for farms; 5=Food insufficiency; 6=Lower incomes; 7=Soil leaching; 8=Crop losses; 9=Farm destruction; 10=Reduction in soil fertility;*

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is agriculture and food security to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on agriculture and food security within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Crop pest and diseases			
Locust			

Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to farmers geared towards enhancing their access to improved production techniques ___ *1=Yes ; 2=No*

If so, which ones_____
*1=Climate-smart agriculture; 2=Agriculture-livestock integration; 3=Micro-irrigation; 4=Others to be specified*_____

2. Does your institution support farmers to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide farmers with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Farming calendar; 3=Weather information; 4=Other to be specified*_____

4. Does your institution provide material support to farmers? _____ *1=Yes ; 2=No*

If yes, which support do you provide_____1=Equipment*; 2=Improved seeds; 3=Other to be specified*_____

5. Does your institution provide extension services to farmers?

If yes, what sort of support/advice do you offer?

6. Does your institution support farmers with irrigation services?

7. In the event of climate-induced food shortages (e.g. caused by droughts), what actions does your institution implement to address food insecurity?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of agriculture and food security to the following hazards?

Climatic hazards	Potential adaptation options
Extreme temperature (heat stress)	
Droughts	
Floods	
Crop pest and diseases	
Locust	
Cyclone	
Tsunami	

SECTOR: BIODIVERSITY

PART A: FOR COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. Are there forested areas within your community?
2. Do you collect resources from the forest for use? If yes, provide details of the resources and their uses
3. Are there rangelands (wetlands, natural grassland) within your community? If yes, how do you use them?
4. What are the dominant plants and animal species in your forests?

Common name or local name of plant species	Common name of animal species

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic Hazards impact biodiversity**

Climatic hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	If yes, how did this impact on forest biodiversity resources (plants and animals)?	If yes, how did this impact on rangelands (natural grasslands, wetlands, etc.)?
Extreme temperature			
Droughts / changing precipitation pattern			

Floods			
Infestation of invasive species (*Prosopis juliflora)*			
Cyclone			
Tsunami			
Locust			

Impacts: 1=biodiversity loss; 2=Erosion; 3=Fish driven out of rivers; 4=Wildlife migration; 5=Wildlife habitat destruction; 6=Increased mortality of perennial, woody and herbaceous plants; 7=Rarity of NTFPs, others specify _____

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is biodiversity to climatic events in your community/village?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**	
Climatic hazards	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	**Forest** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on biodiversity of forest ecosystem within your community?	**Rangelands** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on biodiversity of rangelands (wetlands, grasslands) within your community?
Extreme temperature				
Droughts / changing precipitation pattern				
Floods				
Infestation of invasive species (*Prosopis juliflora)*				
Cyclone				
Tsunami				
Locust				

2. How does changes in forest biodiversity and rangelands due to climate change impact on your livelihood and well-being? And what adaptation strategies have you been using

	Changes in forest resources due to climate change	**Changes in rangelands (wetlands, natural grasslands) due to climate change**

Impact on livelihood and wellbeing of community members		
Adaptation strategies to deal with the impacts on livelihood and wellbeing		

SECTION 3: ADAPTIVE CAPACITIES

1. Do local people implement action towards conserving the forests and rangelands?

If yes, please provide details

_____

2. Do community members engage in forest and rangeland restoration?

If yes, provide details :_____

PART B: Line ministries, Civil Society Organizations engaged in conservation

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	

Institution / position of respondent (for KIIs):	
Date:	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC EVENTS

1. Describe how climatic Hazards impact biodiversity

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on forest biodiversity resources (plants and animals)?**	**If yes, how did this impact on rangelands (natural grasslands, wetlands, etc.)?**
Extreme temperature			
Droughts / changing precipitation pattern			
Floods			
Infestation of invasive species (*Prosopis juliflora)*			
Cyclone			
Tsunami			
Locust			

Impacts: 1=biodiversity loss; 2=Erosion; 3=Fish driven out of rivers; 4=Wildlife migration; 5=Wildlife habitat destruction; 6=Increased mortality of perennial, woody and herbaceous plants; 7=Rarity of NTFPs, others specify _____

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. How exposed and sensitive is biodiversity to climatic events in your jurisdiction?

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity (b)**	
Climatic hazards	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	**Forest** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on biodiversity of forest ecosystem within your community?	**Rangelands** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on biodiversity of rangelands (wetlands, grasslands) within your community?
Extreme temperature				
Droughts / changing precipitation pattern				
Floods				
Infestation of invasive species				

(*Prosopis juliflora)*				
Cyclone				
Tsunami				
Locust				

a. *(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).*

b. *(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource*

SECTION 3: ADAPTIVE CAPACITIES

3. Does your organization implement actions toward conserving the forests and rangelands?

If yes, please provide details

_____

4. Does your organization engage in forest and rangeland restoration?

If yes, provide details :_____

SECTION 4: ADAPTATION STRATEGIES

1. What climate adaptation practices have been implemented or currently being implemented for forest biodiversity and rangeland within your jurisdiction? What other adaptation options could be adopted?

Climatic hazards	**Past/current adaptation practices**	**Potential adaptation options**
Extreme temperature		
Droughts / changing precipitation pattern		
Floods		
Infestation of invasive species (*Prosopis juliflora)*		
Cyclone		
Tsunami		
Locust		

SECTOR: COASTAL AND MARINE

PART A: FOR COMMUNITIES

Name of Village/community:	

Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. What are the different fish harvesting techniques practiced in the area?

2. What are the dominant fish species harvested? Please provide the names:

SECTION 1: IMPACT, FREQUENCY AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic events impact fishing activities?**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on fish resources?**	**Did the hazard have an impact on mangroves? If yes, provide details**
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			

2. If there have been coastal floods, what has been the impact of the floods on your community?

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is fishing to climatic events in your community/village?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on fish resources?
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			

a. *(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).*

b. *(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource*

2. Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of coastal floods on your community?

SECTOR: COASTAL AND MARINE

PART A: FOR COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. What are the different fish harvesting techniques practiced in the area?

2. What are the dominant fish species harvested? Please provide the names:

SECTION 1: IMPACT, FREQUENCY AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic events impact fishing activities?**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on fish resources?**	**Did the hazard have an impact on mangroves? If yes, provide details**
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			

2. If there have been coastal floods, what has been the impact of the floods on your community?

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is fishing to climatic events in your community/village?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or

	the last 10 years in your community?	hazard in the future (e.g next 10 years) in your community?	impact of each hazard on fish resources?
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise)			

a. *(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).*

b. *(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource*

2. Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of coastal floods on your community?

SECTOR: COASTAL AND MARINE

PART A: FOR COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. What are the different fish harvesting techniques practiced in the area?

2. What are the dominant fish species harvested? Please provide the names:

SECTION 1: IMPACT, FREQUENCY AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic events impact fishing activities?**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on fish resources?**	**Did the hazard have an impact on mangroves? If yes, provide details**
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise)			

2. If there have been coastal floods, what has been the impact of the floods on your community?

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is fishing to climatic events in your community/village?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on fish resources?
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			

a. *(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).*

b. *(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource*

2. Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of coastal floods on your community?

SECTION 3: ADAPTIVE CAPACITIES

1. What is the average level of education of fishermen in your community/village? *001= None ; 2= Primary ; 3= Secondary ; 4= Higher education*

2. Do fishermen have access to climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2= Weather information; 4= Other to be specified*_____

3. Do anglers have access to fish farming techniques? _____ *1=Yes ; 2=No*

If yes, which ones? _____ *1= Breeding and rearing in ponds, 2= Breeding and rearing in hapas and cages, 3= Breeding and rearing in tanks, raceways and arenas, 4= Breeding and rearing in aquariums.*

4. Do fishermen receive material support? _____ *1=Yes ; 2=No*

If yes, which_____1=Equipment*; 2= Other to be specified*_____

5. Do fishermen have access to financial resources? _____ *1=Yes ; 2=No*

If so, which_____1=Recourse to *informal credit (Tontines, Families); 2=Recourse to formal credit; 3=Donations; 4= Others to be specified*_____

6. Do you have access to appropriate storage facilities for the harvested fishes?

SECTION 4: ADAPTATION STRATEGIES

1. What are the adaptation options (if any) you have been implementing relating to the impact of climate hazard on fisheries?

Climatic hazards	**Adaptation practices**	**What are the constraints preventing the implementation of the adaptation measures**
Extreme temperature (Rising water temperature)		
Coastal flood		
Sea level rise*)*		
Cyclone		
Tsunami		

2. What other strategies could be employed to render you more capable to cope with the impacts of climate hazards on fisheries?

PART B: Line ministries, Civil Society, Private sector, etc.

Name of institution:	
Name & position of respondent(s):	

Location (town/village):	
Date of interview	

SECTION 1: IMPACT, FREQUENCY AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic events impact fishing activities?**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on fish resources?**	**Did the hazard have an impact on mangroves? If yes, provide details**
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is fishing to climatic events in your jurisdiction/state?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on fish resources?
Extreme temperature (Rising water temperature)			
Coastal flood			
Sea level rise*)*			
Cyclone			
Tsunami			

a. *(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).*

b. *(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource*

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to fishermen to access climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2= Weather information; 4= Other to be specified*_____

2. Does your institution provide material support to fishermen? *1=Yes ; 2=No*

If yes, provide details :

3. Does your institution support fishermen to access financial resources? *1=Yes ; 2=No*

If yes, please provide details

SECTION 4: ADAPTATION STRATEGIES

1. What are the adaptation options that could be adopted to enhance the resilience of fisheries resources and fishermen to climate change?

Climatic hazards	**Adaptation practices**
Extreme temperature (Rising water temperature)	
Coastal flood	
Sea level rise*)*	
Cyclone	
Tsunami	

DISASTER RISK REDUCTION (DRR)

Part A: Tool for disaster risk reduction (DRR) (for relevant institutions)

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

1. What are the common disasters you deal with in this state/jurisdiction?

2. Overall, what are your approaches to disaster risk reduction?

Steps of disaster risk reduction	**Approaches employed by your institution**
Mitigation	
Preparedness	
Response	
Recovery	

3. To what extent is gender mainstreamed into your DRR approaches?

Steps of disaster risk reduction	**Extent of integration of gender into DRR approaches by your institution**
Mitigation	
Preparedness	
Response	

Recovery	

4. Does your approach to DRR integrate security risks or issues?

5. What are the specific DRR approaches/actions you have employed to climate disasters? For disasters which you have not implemented actions, indicate as NA (Not Applicable)

Climate disaster/hazard	**Approaches/actions employed by your institution**			
	Mitigation	**Preparedness**	**Response**	**Recovery**
Floods				
Droughts				
Heat waves				
Locust				
Pest and diseases (agriculture and livestock)				
Epidemics (e.g. cholera)				

6. What are the specific challenges you have encountered in managing climate disasters? For disasters which you have not implemented actions, indicate as NA (Not Applicable)

Climate disaster/hazard	**Approaches/actions employed by your institution**			
	Mitigation	**Preparedness**	**Response**	**Recovery**
Floods				
Droughts				
Heat waves				
Locust				
Pest and diseases (agriculture and livestock)				
Epidemics (e.g. cholera)				

7. What actions or options are needed to render your institution more capable to manage climate-related disasters?

Climate disaster/hazard	**Options to enhance climate disaster risk reduction**			
	Mitigation	**Preparedness**	**Response**	**Recovery**
Floods				
Droughts				
Heat waves				
Locust				
Pest and diseases (agriculture and livestock)				

Epidemics (e.g. cholera)				

8. Who are the partners with whom your institution has been working to handle climate disasters?

Climate disaster/hazard	**Partners with whom your institution manage climate disasters**			
	Mitigation	**Preparedness**	**Response**	**Recovery**
Floods				
Droughts				
Heat waves				
Locust				
Pest and diseases (agriculture and livestock)				
Epidemics (e.g. cholera)				

GENDER

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

1. To what extent is your institution engaged in climate change adaptation initiatives?

2. In which sector does your institution intervene on gender issues

Sector	Intervention (Yes/No)	Specific intervention on climate change (Yes/No), If yes, please specity
Agriculture and food security		
Livestock		
Health		
Coastal and Marine zones		
Water		
Disaster risk reduction		
Education		
Biodiversity		
Public works		

3. How does your institution strengthen the capacity of women and girls within your institution to fight or adapt to climate hazards in different sectors?

4. Does your institution have in place a gender policy or strategy for the Puntland state? If yes, what links are made to climate change in the policy or strategy?

5. Does your institution work together with other government or non-governmental institutions to provide support to communities during periods of climate disasters (e.g. floods, droughts, etc)?

If yes, what approaches do you employ to ensure that the needs of women are given particular attention?

6. What are some of the challenges you face in integrating or mainstreaming gender in climate change adaptation?

7. What do you need in order to better support women and girls within your jurisdiction to be more resilient to climate change?

SECTOR: EDUCATION

PART A: FOR SCHOOLS

Name of school:	
Location:	
Type of school (primary, secondary, tertiary):	
Name of respondent:	
Position of respondent:	
Date:	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic Hazards impact education**

Climatic hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	If yes, how did this impact on the students?	If yes, how did this impact on school staff?	If yes, how did this impact on school infrastructures (classrooms, other buildings, water supply, etc)?	If yes, how did this impact on parents (e.g. their inability to pay the fees of their children due to loss of livelihood)
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					

Locust					

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is education to climatic events in your school?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**		
Climatic hazards	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	**Students** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on students of your school?	**School staff** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on the staff of your school?	**School infrastructure** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on infrastructure (classrooms, buildings, etc) in your school?
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					
Locust					

SECTION 3: ADAPTIVE CAPACITIES

1. To what extent is climate change integrated within the school curricular?

2. Does your school have access to climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

3. Does your school receive material support from the government and other sources to strengthen the institution's resilience to climate change? _____ *1=Yes ; 2=No*

If yes, please specify

4. Has your institution received training on climate change and how to adapt to its impacts?

5. Are your classrooms equipped with air conditioners?

6. Does your institution have a reservoir for storing water for use by students during period of water scarcity/droughts?

7. Have the school buildings been constructed in a manner that makes them to withstand climate disasters ?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices has your school implemented?

Climatic hazards	**Adaptation practices**	**What are the constraints preventing their implementation? *1= Unavailability of technology; 2= Insufficient financial resources; 3= Lack of mastery of technology; 4= Others (please specify)***
Extreme temperature (heat stress)		
Droughts		
Floods		
Cyclone		
Tsunami		
Locust		

PART A: FOR SCHOOLS

Name of Institution	
Location:	
Name of respondent:	
Position of respondent:	
Date:	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC EVENTS

2. **Describe how climatic Hazards impact education**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10**	**If yes, how did this impact on the students?**	**If yes, how did this impact on school staff?**	**If yes, how did this impact on school infrastructures (classrooms, other**	**If yes, how did this impact on parents (e.g. their inability to pay the fees of their children due**

	years? (Yes/No)			buildings, water supply, etc)?	to loss of livelihood)
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					
Locust					

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is education to climatic events within your jurisdiction?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**		
Climatic hazards	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	**Students** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on students within your jurisdiction?	**School staff** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on teachers and school staff of within your jurisdiction?	**School infrastructure** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on infrastructure (classrooms, buildings, etc) within your jurisdiction ?
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					
Locust					

SECTION 3: ADAPTIVE CAPACITIES

1. To what extent is climate change integrated within the school curricular?

2. Does your institution have access to climate information for onward dissemination to schools within your jurisdiction? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

3. Does your institution provide material support to schools within your jurisdiction in order to strengthen their resilience to climate change? _____ *1=Yes ; 2=No*

If yes, please specify

4. Has your institution received training on climate change and how to adapt to its impacts? If yes, has such training(s) been equally provided to schools within your jurisdiction?

5. Are classrooms in schools within your jurisdiction equipped with air conditioners?

6. Do schools within your jurisdiction have a reservoir for storing water for use by students during period of water scarcity/droughts?

7. Have the school buildings been constructed in a manner that makes them to withstand climate disasters ?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of education to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Locust	
Cyclone	
Tsunami	

PART B: Line Ministries, CSOs, etc.

Name of Institution	
Location:	
Name of respondent:	
Position of respondent:	
Date:	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC EVENTS

1. **Describe how climatic Hazards impact education**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on the students?**	**If yes, how did this impact on school staff?**	**If yes, how did this impact on school infrastructures (classrooms, other buildings, water supply, etc)?**	**If yes, how did this impact on parents (e.g. their inability to pay the fees of their children due to loss of livelihood)**
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					
Locust					

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is education to climatic events within your jurisdiction?**

	Exposure (current/past) (a)	**Exposure (future) (a)**	**Sensitivity**		
Climatic hazards	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	**Students** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on students within your jurisdiction?	**School staff** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on teachers and school staff of within your jurisdiction?	**School infrastructure** Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of each hazard on infrastructure (classrooms, buildings, etc) within your jurisdiction ?
Extreme temperature					
Droughts					
Floods					
Cyclone					
Tsunami					
Locust					

SECTION 3: ADAPTIVE CAPACITIES

1. To what extent is climate change integrated within the school curricular?

2. Does your institution have access to climate information for onward dissemination to schools within your jurisdiction? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

3. Does your institution provide material support to schools within your jurisdiction in order to strengthen their resilience to climate change? _____ *1=Yes ; 2=No*

If yes, please specify

4. Has your institution received training on climate change and how to adapt to its impacts? If yes, has such training(s) been equally provided to schools within your jurisdiction?

5. Are classrooms in schools within your jurisdiction equipped with air conditioners?

6. Do schools within your jurisdiction have a reservoir for storing water for use by students during period of water scarcity/droughts?

7. Have the school buildings been constructed in a manner that makes them to withstand climate disasters ?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of education to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Locust	
Cyclone	
Tsunami	

Data collection tool for the health sector

Section A: for communities

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

A. Climate-sensitive health outcomes

Climate hazard	Question	Response
1. Extreme temperature (heat stress)	1.1. Is the population widely exposed to extreme heat? If so, which populations are exposed (e.g. populations of concern)?	
	1.2. Has there been cases of extreme temperature-related illnesses or deaths within your community? If yes, how many cases on average has been recorded annually for the past 5 years?	
	1.3. Is there a particular seasonality during which heat-related illnesses or deaths occur?	
	1.4. What is the current impact of extreme temperature on morbidity and/or mortality? How does this vary with changes in duration, intensity, and frequency of the hazard?	
2. Droughts	2.1. Is the population widely exposed to droughts? If so, which populations are exposed (e.g. populations of concern)?	
	2.2. Has there been cases of illnesses or deaths within your community caused by drought? If yes, how many cases on average has been recorded annually for the past 5 years?	
	2.3. Is there a particular seasonality during which drought-related illnesses or deaths occur?	
	2.4. What is the current impact of drought on morbidity and/or mortality? How does this vary with changes in duration, intensity, and frequency of the hazard?	
3. Floods	3.1. Is the population widely exposed to extreme floods? If so, which populations are exposed (e.g. populations of concern)?	
	3.2. Has there been cases of illnesses or deaths within your community caused by drought? If yes, how many cases on average has been recorded annually for the past 5 years?	
	3.3. Is there a particular seasonality during which drought-related illnesses or deaths occur?	

	3.4. What is the current impact of drought on morbidity and/or mortality? How does this vary with changes in duration, intensity, and frequency of the hazard?	
4. Vector-borne diseases (malaria, Dengue, Rift Valley Fever-RVF)	4.1. Is the population widely exposed to vector-borne diseases (malaria, Dengue, RVF)? If so, which populations are exposed (e.g. populations of concern)?	
	4.2. Has there been cases of illnesses or deaths within your community related to malaria, Degue or RVF? If yes, how many cases on average has been recorded annually for the past 5 years?	
	4.3. Is there a particular seasonality during which malaria, Dengue or Rift Valley Fever- or their associated deaths occur?	
	4.4. What is the current impact of malaria, Dengue and Rift Valley Fever on morbidity and/or mortality? How does this vary with changes in duration, intensity, and frequency of the hazard?	
5. Gastrointestinal diseases (e.g. cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A and B)	5.1. Is the population widely exposed to gastrointestinal diseases (such as cholera, etc.)? If so, which populations are exposed (e.g. populations of concern)?	
	5.2. Has there been cases of gastrointestinal illnesses or deaths within your community? If yes, how many cases on average has been recorded annually for the past 5 years?	
	5.3. Is there a particular seasonality during which gastrointestinal illnesses or deaths occur?	
	5.4. What is the current impact of gastrointestinal disease on morbidity and/or mortality? How does this vary with changes in duration, intensity, and frequency of the hazard?	

B. Data on vulnerability analysis

Vulnerability category	**Vulnerability indicator/questions**	**Response**	**Vulnerability ranking**	
1. Extreme temperature (heat stress)				
1.1 Exposure	1.1.1 Have members of the community experienced an increase in temperature over time?		1.1.2. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of extreme temperature within the last 5 to 10 years in your community?	
			1.1.3. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of heat stress in the future (e.g next 10 years) in your community?	

1.2. Sensitivity	1.2.1. Are there individuals within the community suffering from cardiovascular diseases?		1.2.5. Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme),** how would you rate the severity or impact of heat stress on the health of members within your community?	
	1.2.2. What is the proportion (e.g. in percentage) of children of the population of your community?			
	1.2.3. What is the proportion (e.g. in percentage) of seniors (aged 65 years and above) of the population of your community?			
	1.2.4. What is the proportion (e.g. in percentage) of the individuals who work outdoor of the population of your community?			
1.3. Adaptive capacity	1.3.1. Does the community have available health and social services? If yes, are these accessible to community members?			
	1.3.2. What is the proportion of the population of your community with air conditioning in their homes?			
	1.3.3. Do members of your community have access to cooling centres?			
	1.3.4. Is your community serviced by an early warning system that provides heat waves early warning?			
	1.3.5. Do members of your community have access to financial resources (savings and loans)?			
2. Droughts				
2.1. Exposure	2.1.1. Within the past 5 to 10 years, how frequent has drought occurred within your community and what has been the average duration (days or months) of the event?		2.1.3. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of drought within the last 5 to 10 years in your community?	
	2.1.2. What has been the historical (for the past 10 years) rainfall patterns relating to intensity, duration and frequency in your community?		2.1.4. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of occurrence of droughts in the future (e.g next 10 years) in your community?	
2.2. Sensitivity	2.2.1. Are there members of your community who self-identify as economically disadvantage?		2.2.4. Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme),** how would	
	2.2.2. Are there people with mobility limitations in the areas			

	affected by droughts within your community?		you rate the severity or impact of droughts within your community?	
	2.2.3. Are there individuals/families within the community who are insured?			
2.3. Adaptive capacity (applies to droughts and floods)	2.3.1. Is the community in possession of a community Emergency management programs			
	2.3.2. Are there mental health programs focused on reducing negative mental health outcomes from floods, droughts and other extremes (e.g. mental health first aid) within the community?			
3. Floods				
3.1. Exposure	3.1.1. Within the past 5 to 10 years, how frequent has floods occurred within your community and what has been the average duration (days or months) of the event?		3.1.2. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of floods within the last 5 to 10 years in your community?	
			3.1.3. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of occurrence of floods in the future (e.g next 10 years) in your community?	
3.2. Sensitivity	3.2.1. Responses provided under the questions posed for droughts will be used here. Hence, no need of repetition		3.2.2. Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme),** how would you rate the severity or impact of floods on the health of members within your community?	
4. Vector-borne diseases (Malaria, Dengue, Rift Valley Fever-RVF)				
4.1. Exposure			4.1.1. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of malaria, Dengue and RVF within the last 5 to 10 years in your community?	
			4.1.1. Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of occurrence of malaria, Dengue and RVF	

			in the future (e.g next 10 years) in your community?	
4.2. Sensitivity	4.2.1. What is the proportion of seniors and children within the communituy? What is the proportion of persons working outdoors? (Responses to both questions should have already been provided under the sensitivity section for extreme temperatures, so no need to ask respondents again		4.2.2. Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme),** how would you rate the severity or impact of malaria, Dengue and RVF on the health of members within your community?	
4.3. Adaptive capacity	4.3.1. Are there integrated vector-borne diseases programmes (e.g. public awareness campaigns, surveillance and monitoring)?			
	4.3.2. Are there pest management programmes within your community? If yes, provide details			
	4.3.3. What is the proportion of households within the community with insecticide treated mosquito nets?			
5. Gastrointestinal diseases (e.g. cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A)				
5.1. Exposure	5.1.1. What is the proportion of individuals within your communities with access to potable water?		5.1.2. Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of water-borne diseases within the last 5 to 10 years in your community?	
			5.1.3. Using a scale of 1 to 5 (**1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of occurrence of water-borne diseases in the future (e.g next 10 years) in your community?	
5.2. Sensitivity			5.2.1. Using a scale of 1 to 5 (**1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme),** how would you rate the severity or impact of water-borne diseases on the health of members within your community?	
5.3. Adaptive capacity	5.3.1. Is there the existence of drinking water quality guidelines and regulations?			

	5.3.2. Does there exist water quality advisories and programs within the community?			
	5.3.3. Is there the surveillance of water-borne diseases?			
	5.3.4. Are there health promotion activities on drinking water safety?			

C. Adaptation strategies

6. What adaptation strategies have community members implemented relating to the climate-health hazards?

Hazard	Adaptation practices
6.1. Extreme temperature	
6.2. Droughts	
6.3. Floods	
6.4. Vector-borne diseases (Malaria, Dengue, Rift Valley Fever-RVF)	
6.5 Gastrointestinal diseases (e.g. cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A)	

Section B: Health stakeholders (Hospitals, Clinics, Line Ministries, etc.)

Assessing future climate/health risk

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

7. How is climate change expected to affect climate and (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.) in your territory?

Hazard	Possible future effects of climate change
7.1. Heat stress	
7.2. Floods	
7.3. Droughts	
7.4. Vector-borne diseases	
7.5. Gastrointestinal diseases	

8. How is adaptive capacity of the health sector and communities to climate and health hazards expected to change in the future?

Hazard	**Changes in adaptive capacity?**
8.1. Heat stress	
8.2. Floods	
8.3. Droughts	
8.4. Vector-borne diseases	
8.5. Gastrointestinal diseases	

Assessment of health system climate-resilience

9. Is there a climate change and health focal point in your state or jurisdiction?

10. Is there a climate change action plan for your state or jurisdiction that includes measures to support health systems?

11. Has a previous climate change and health vulnerability and adaptation assessment been completed in your state/territory?

12. Are there municipalities in your province/territory that have completed climate related resilience plans? If yes, what proportion?

13. Does the population within your state/jurisdiction have access to clean drinking water, adequate housing, affordable energy and food?

14. Have local public health agencies completed climate change and health vulnerability and adaptation assessments? If yes, what proportion?

15. Are there municipalities within your state/jurisdiction with established warning systems and communication strategies? If yes, what proportion?

16. Are there health units within your state/jurisdiction with established early warning information systems and communication strategies? If yes, what proportion?

17. Does there exist climate-focussed disease vector control programmes?

18. Does your state/jurisdiction have climate change focused programme targeting the health of communities?

19. Is there a disaster risk reduction strategy for your state/territory? If yes, do these incorporate climate related health risks?

20. Is there access to diagnosis and treatment for climate-related health conditions throughout your state/jurisdiction?

21. Do health authorities/facilities have adequate healthcare surge capacity following extreme weather events (e.g. storms, extreme heat, floods, wildfires, etc.)?

22. What adaptation options or strategies could be adopted for the climate-health hazards below in order to enhance the resilience of the health sector of your state/jurisdiction (use the table below)?

Hazard	**Adaptation practices**
22.1. Extreme temperature	
22.2. Droughts	
22.3. Floods	
22.4. Vector-borne diseases (Malaria, Dengue, Rift Valley Fever-RVF)	
22.5. Gastrointestinal diseases (e.g. cholera, cryptosporidium, E. coli infection, giardia, shigella, typhoid, and viruses such as hepatitis A)	

SECTOR: LIVESTOCK

PART A: COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	
Institution / position of respondent (for KIIs):	
Date:	

General

1. What is the main purpose for rearing livestock in your community?
(a). Subsistence (for own use)
(b) Semi-commercial (a part is for own use and another part is sold)
(c) Entirely commercial (all livestock is sold)
3. What are the main sources of fodder and pasture for your livestock?
4. What are the main types of livestock reared by the community?

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact on livestock activities community/village/jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on livestock and pasture availability and quality?**
Extreme temperature (heat stress)		
Droughts		
Floods		
Livestock pest and diseases		
Locust		
Tsunami		
Cyclone		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is livestock to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on livestock within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Livestock pest and diseases			
Locust			
Tsunami			
Cyclone			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. What is the average level of education of livestock farmers in your community/village? *001= None ; 2= Primary ; 3= Secondary ; 4= Higher education*

2. Do livestock farmers have access to improved livestock breeds? ___ *1=Yes ; 2=No*

If so, which ones_____

3. Do livestock farmers have access to financial resources? _____ *1=Yes ; 2=No*

If so, which_____1=Recourse to *informal credit (Tontines, Families); 2=Recourse to formal credit; 3=Donations; 4= Others to be specified*_____

4. Are there saving groups that can provide loans for livelihoods? Are there specific saving groups for women?

5. Do livestock farmers have access to climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

6. Do livestock farmers receive material support? _____ *1=Yes ; 2=No*

If yes, please specify?

7. Do livestock farmers have access to veterinary services?

8. Do livestock farmers have access to water points for their livestock all year round?

9. Is access to water points for livestock a common source of conflict?

10. Do livestock farmers have accessibility and availability to pasture for their livestock all year round?

11. Are there social networks that provide support during and after shocks such as floods, etc.?

12. Do you think farmers within your community will have a better capacity to cope with climate change impacts in the future?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices have farmers implemented?

Climatic hazards	**Adaptation practices**	**What are the constraints preventing their implementation?** ***1= Unavailability of technology; 2= Insufficient financial resources; 3= Lack of mastery of technology; 4= Others (please specify)***
Extreme temperature (heat stress)		
Droughts		
Floods		
Livestock pest and diseases		
Locust		
Tsunami		
Cyclone		

2. What disaster preparedness and response are available?

Sector	**Questions**	**Responses**

Disaster preparedness and response	Describe the last disaster event that affected the community (e.g., cyclone, floods). How did the community respond?	
	Is there a disaster management plan in the settlement?	
	How is the community warned of an impending extreme weather event?	
	Do you use technology or social media to obtain information on climate change and/or DRR?	
	What sources of information (e.g., mobile phones, internet, radio, television, etc.) do you use to obtain information on climate change and/or DRR?	
	Is there a community evacuation centre?	
	Are there any issues with regards to the evacuation centres? Are there any community groups/members who cannot access these?	
	Are there any traditional knowledge-based practices that the community uses to address climate-induced disasters?	
	Are there external organizations that support the community in preparing and responding to disasters?	

PART B: Line ministries, Civil Society Organizations

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact livestock activities in your jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on livestock and fodder availability and quality?**
Extreme temperature (heat stress)		
Droughts		
Floods		
Livestock pest and diseases		
Locust		

Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is the livestock sector to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on livestock production within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Livestock pest and diseases			
Locust			
Cyclone			
Tsunami			

c. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

d. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to livestock farmers geared towards enhancing their access to improved livestock breeds or breeding techniques? ___ *1=Yes ; 2=No*

If so, please specify:

2. Does your institution support livestock farmers to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide livestock farmers with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

4. Does your institution provide support to livestock farmers to access veterinary services? _____ *1=Yes ; 2=No*

If yes, please specify

5. Does your institution provide extension services to livestock farmers?

6. Does your institution support livestock farmers in the construction and provision of water points?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of the livestock sector to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Livestock pest and diseases	
Cyclone	
Locust	
Tsunami	

PART B: Line ministries, Civil Society Organizations

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact livestock activities in your jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on livestock and fodder availability and quality?**
Extreme temperature (heat stress)		
Droughts		

Floods		
Livestock pest and diseases		
Locust		
Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is the livestock sector to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on livestock production within your community?
Extreme temperature (heat stress)			
Droughts			
Floods			
Livestock pest and diseases			
Locust			
Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to livestock farmers geared towards enhancing their access to improved livestock breeds or breeding techniques? ___ *1=Yes ; 2=No*

If so, please specify:

2. Does your institution support livestock farmers to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide livestock farmers with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

4. Does your institution provide support to livestock farmers to access veterinary services? _____ *1=Yes ; 2=No*

If yes, please specify

5. Does your institution provide extension services to livestock farmers?

6. Does your institution support livestock farmers in the construction and provision of water points?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of the livestock sector to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Livestock pest and diseases	
Cyclone	
Locust	
Tsunami	

SECTOR: WATER
PART A: COMMUNITIES

Name of Village/community:	
Data collection type (FGD or KIIs)	
Name of respondent or FDG type (men or women)	

Institution / position of respondent (for KIIs):	
Date:	

General

1. Where does your community obtain water for domestic use?

2. Is the community's water source available all year round?

3. What types of water harvesting is techniques are practiced within your community?

4. Do you engage in water storage? If yes, what water storage options are available within the community?

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact on water in your community/village/jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on the water sector (water supply?**
Extreme temperature (heat stress)		
Droughts		
Floods		
Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is the water sector (water resources water supply) to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on water (water supply and quality)?

Extreme temperature (heat stress)			
Droughts			
Floods/Extreme precipitation			
Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. What is the average level of education of community members? *001= None ; 2= Primary ; 3= Secondary ; 4= Higher education*

2. Do community members have access to financial resources? _____ *1=Yes ; 2=No*

If so, which_____1=Recourse to *informal credit (Tontines, Families); 2=Recourse to formal credit; 3=Donations; 4= Others to be specified*_____

3. Does the community have a water reservoir?

4. Do community members have access to climate information? _____ *1=Yes ; 2=No*

If so, *which*_____*1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

5. Do community members have access to traditional water management practices and technologies?

If yes, please specify?

6. Does the community have a contingency plan that ensures water availability during an emergency (e.g. floods)?

7. Are there social networks that provide support during and after shocks such as floods, etc.?

8. Do you members within your community will have a better capacity to cope with climate change impacts in the future?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices have community members implemented to ensure access to quality water?

Climatic hazards	**Adaptation practices**	**What are the constraints preventing their implementation?** ***1= Unavailability of technology; 2= Insufficient financial resources; 3= Lack of mastery of technology; 4= Others (please specify)***
Extreme temperature (heat stress)		
Droughts		
Floods		
Cyclone		
Tsunami		

2. What disaster preparedness and response are available?

Sector	**Questions**	**Responses**
Disaster preparedness and response	Describe the last disaster event that affected the community (e.g., cyclone, floods). How did the community respond?	
	Is there a disaster management plan in the settlement?	
	How is the community warned of an impending extreme weather event?	
	Do you use technology or social media to obtain information on climate change and/or DRR?	
	What sources of information (e.g., mobile phones, internet, radio, television, etc.) do you use to obtain information on climate change and/or DRR?	
	Is there a community evacuation centre?	
	Are there any issues with regards to the evacuation centres? Are there any community groups/members who cannot access these?	
	Are there any traditional knowledge-based practices that the community uses to address climate-induced disasters?	

	Are there external organizations that support the community in preparing and responding to disasters?	

PART B: Line ministries, Civil Society Organizations, private sector (water companies)

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

General

1. **Which of the following water sub-sectors are applicable to your jurisdiction?**

Water shed management
Water supply
Dams and reservoirs
Sanitation
Wastewater
Riverine flood protection
Juba and Shabelle basin development

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact the water sector in your jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on the water sector (water supply, etc.)?**
Extreme temperature (heat stress)		
Droughts		
Floods/Extreme precipitation		
Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is the water sector (water supply) to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the

	of each of the hazard within the last 10 years in your community?	likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	severity or impact of of each hazard on the water sector (water supply) within your jurisdiction?
Extreme temperature (heat stress)			
Droughts			
Floods/Extreme precipitation			
Cyclone			
Tsunami			

c. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

d. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to the population by providing water management practices and technologies? ___ *1=Yes ; 2=No*

If so, please specify:

2. Does your institution support communities to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide communities with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

4. Does your institution have a contingency plan that ensures water availability to the population during an emergency (e.g. floods, droughts)?

5. Is there a programme within your jurisdiction that seeks to strengthen resilience of the water sector to climate hazards?

6. Are there water supply companies within your jurisdiction with an established warning system?

7. Is there a disaster risk reduction strategy for your state/territory? If yes, do these incorporate climate related water risks?

8. Does your state/jurisdiction have climate change focused programme targeting the water supply?

9. Have water companies integrated climate resilience into the construction and operation of their water supply infrastructures?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of the water sector (water supply) to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods/Extreme precipitation	
Cyclone	
Tsunami	

PART B: Line ministries, Civil Society Organizations, private sector (water companies)

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview	

General

1. **Which of the following water sub-sectors are applicable to your jurisdiction?**

Water shed management
Water supply
Dams and reservoirs
Sanitation
Wastewater

Riverine flood protection
Juba and Shabelle basin development

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact the water sector in your jurisdiction**

Climatic hazards	**Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)**	**If yes, how did this impact on the water sector (water supply, etc.)?**
Extreme temperature (heat stress)		
Droughts		
Floods/Extreme precipitation		
Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

2. **How exposed and sensitive is the water sector (water supply) to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on the water sector (water supply) within your jurisdiction?
Extreme temperature (heat stress)			
Droughts			
Floods/Extreme precipitation			
Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution provide support to the population by providing water management practices and technologies? ___ *1=Yes ; 2=No*

If so, please specify:

2. Does your institution support communities to access to financial resources? _____ *1=Yes ; 2=No*

If so, how do you do this?

3. Does your institution provide communities with climate information? _____ *1=Yes ; 2=No*

If so, *which of these: 1=Warning* systems*; 2=Weather information; 3=Other to be specified*_____

4. Does your institution have a contingency plan that ensures water availability to the population during an emergency (e.g. floods, droughts)?

5. Is there a programme within your jurisdiction that seeks to strengthen resilience of the water sector to climate hazards?

6. Are there water supply companies within your jurisdiction with an established warning system?

7. Is there a disaster risk reduction strategy for your state/territory? If yes, do these incorporate climate related water risks?

8. Does your state/jurisdiction have climate change focused programme targeting the water supply?

9. Have water companies integrated climate resilience into the construction and operation of their water supply infrastructures?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of the water sector (water supply) to the following hazards?

Climatic hazards	Potential adaptation options
Extreme temperature (heat stress)	
Droughts	
Floods/Extreme precipitation	
Cyclone	
Tsunami	

Gender questionnaire:

Name of institution:	
Name & position of respondent(s):	
Location (town/village):	
Date of interview:	
Name of enumerator:	

1. To what extent is your institution engaged in climate change adaptation initiatives?

2. In which sector does your institution intervene on gender issues?

Sector	Intervention (Yes/No)	Specific intervention on climate change (Yes/No), If yes, please specity
Agriculture and food security		
Livestock		
Health		
Coastal and Marine zones		
Water		
Disaster risk reduction		
Education		
Biodiversity		
Public works		

3. How does your institution strengthen the capacity of women and girls within your institution to fight or adapt to climate hazards in different sectors?

4. Does your institution have in place a gender policy or strategy for the Puntland state? If yes, what links are made to climate change in the policy or strategy?

5. Does your institution work together with other government or non-governmental institutions to provide support to communities during periods of climate disasters (e.g. floods, droughts, etc)?

If yes, what approaches do you employ to ensure that the needs of women are given particular attention?

6. What are some of the challenges you face in integrating or mainstreaming gender in climate change adaptation?

7. What do you need in order to better support women and girls within your jurisdiction to be more resilient to climate change?

PUBLIC WORK SECTOR

PART B: Line ministries, Civil Society Organizations

Name of institution:	
Name & position of respondent(s):	
Email of respondent:	
Location (town/village):	
Date of interview	

SECTION 1: IMPACTS, FREQUENCIES AND SEVERITY OF CLIMATIC HAZARDS

1. **Describe how climatic hazards impact public work infrastructure**

Climatic hazards	Occurrence of climate hazard in the past 5 to 10 years? (Yes/No)	If yes, how did this impact on public work infrastructures (roads)?
Extreme temperature (heat stress)		
Droughts		
Floods		
Cyclone		
Tsunami		

SECTION 2: VULNERABILITY TO CLIMATIC EVENTS

1. **How exposed and sensitive is the public work sector to climatic hazards in your jurisdiction/community/village?**

	Exposure (current/past) (a)	Exposure (future) (a)	Sensitivity
Climatic hazards	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you rate the frequency of each of the hazard within the last 10 years in your community?	Using a scale of 1 to 5 **(1=Rare; 2=Unlikely; 3=Possible; 4=Likely; and 5=Almost Certain),** how will you assess the likelihood of the occurrence of each hazard in the future (e.g next 10 years) in your community?	Using a scale of 1 to 5 **(1=Insignificant; 2=Minor; 3=Moderate, 4=Major; and 5=Extreme) and** based on past experiences, how would you rate the severity or impact of of each hazard on public work infrastructure (roads, etc.)?
Extreme temperature (heat stress)			
Droughts			
Floods			
Cyclone			
Tsunami			

a. ***(1) rare (multidecadal); (2)Unlikely (once or twice a decade); (3) Possible (at least 50 percent of years); (4) Likely (generally every year); or (5) Almost certain (impacts are constant, not associated with discrete acute events).***

b. ***(1) risk has very low pressure on resource and activities; (2) low disturbance; (3) risk causes only moderate disturbance; 4) impact on activity or resource leading to threat of loss or substitution; (5) very significant impact leading to loss of activity or resource***

SECTION 3: ADAPTIVE CAPACITIES

1. Does your institution have access to climate information services? ___ *1=Yes ; 2=No*

If yes, please provide details_____

2. Does your institution integrate climate change dimensions in the construction, operation and renovation of public infrastructures? _____ *1=Yes ; 2=No*

If yes, please provide details:

3. Have your institution be trained on the potential impacts of climate change on public infrastructures and options for adapting to climate change? *1=Yes ; 2=No*

If yes, please provide details:

4. Does there exist a climate change adaptation plan for the public work sector of your jurisdiction? *1=Yes ; 2=No*

If yes, please provide details :

5. Does your institution engage in the construction of structures (e.g. flood control infrastructures) to reduce the impacts of climate chnage?

SECTION 4: ADAPTATION STRATEGIES

1. What adaptation practices could be adopted to strengthen the resilience of public work infrastructures to the following hazards?

Climatic hazards	**Potential adaptation options**
Extreme temperature (heat stress)	
Droughts	
Floods	
Cyclone	
Tsunami	