Participatory Climate Risk Assessment Report

Department of Water, Environment, Climate Change and Natural Resources

Garissa County

2023

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The success of this participatory climate risk assessment report is a testament to the dedication, expertise, and collective efforts of the technical working teams involved. I am truly thankful for their outstanding contributions, which have made this endeavor possible. ......**Error! Bookmark not defined.**

WORLD BANK GROUP   Kingdom of the Netherlands   KFW   german cooperation   DANIDA   Sweden Sverige

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FORWARD

I am delighted to present the Participatory Climate Risk Assessment (PCRA) report, a significant milestone in our ongoing efforts to address the challenges of climate change. This report represents the collective knowledge and expertise of numerous stakeholders and serves as a comprehensive resource for understanding and managing climate risks.

Climate change has emerged as one of the most pressing global issues of our time, affecting communities, ecosystems, and economies worldwide. As the County Executive Committee member in charge of climate change, it is both my privilege and responsibility to lead our county's efforts in mitigating and adapting to the impacts of climate change.

The PCRA report embodies a participatory approach, bringing together diverse perspectives from experts, policymakers, community representatives, and other stakeholders. This inclusive and collaborative process ensures that the report reflects the realities on the ground, incorporating local knowledge and experiences into our climate risk management strategies.

The report provides a comprehensive assessment of climate risks across various sectors, including but not limited to agriculture, livestock, water resources, infrastructure, environment and public health. It analyzes current and projected climate trends, identifies vulnerable areas, and offers a range of adaptation and resilience measures.

Moreover, the report highlights the importance of proactive engagement and coordination among stakeholders at all levels. It emphasizes the need for robust partnerships and integrated approaches to effectively address climate risks and foster sustainable development.

I would like to extend my deepest gratitude to all individuals and organizations who contributed to the development of this report. Your valuable insights, expertise, and dedication have been instrumental in producing this comprehensive assessment. I also commend the TWG team for their tireless efforts in collating and synthesizing the wealth of information contained within this report.
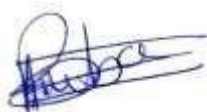
Moving forward, this report will serve as a foundation for evidence-based decision-making, guiding our policies and actions to build climate resilience. It will help us prioritize investments, inform resource allocation, and shape our strategies to mitigate and adapt to climate change.

I encourage all stakeholders to actively utilize this report as a valuable resource for informing their own planning, decision-making, and implementation processes. Together, we can forge a path towards a sustainable, climate-resilient future for our communities and future generations.

I am confident that with our collective commitment and concerted actions, we will effectively address the challenges posed by climate change and create a more resilient and prosperous world.

Thank you for your unwavering support and dedication to the cause of climate change mitigation and adaptation.

Sincerely,

COUNTY GOVERNMENT OF GARISSA
P. O. Box 563 - 70100, GARISSA

2 9 MAY 2023

CEC-WATER,ENVIRONMENT,CLIMATE CHANGE &
NATURAL RESOURCES

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Garissa County

ACKNOWLEDGEMENT

I would like to express my sincere appreciation and gratitude to the dedicated members of the technical working teams who have contributed their expertise and commitment to the development of this participatory climate risk assessment report. Their invaluable contributions have played a pivotal role in delivering a comprehensive and insightful document.

I extend my heartfelt thanks to each team member for their tireless efforts in data collection, analysis, and stakeholder engagement. Their rigorous research, thoughtful insights, and collaborative approach have greatly enhanced the quality and credibility of this report.

I am also deeply thankful for the generous support provided by the World Food Programme (WFP) during the entire process of the Participatory Climate Risk Assessment (PCRA). Their financial and technical assistance has been instrumental in ensuring the success of this endeavor.

Furthermore, I would like to express my gratitude to the individuals and organizations who generously shared their knowledge, data, and experiences during the assessment process. Their input has enriched our understanding of climate risks and their implications, enabling us to present a more holistic and accurate assessment.

Lastly, I would like to acknowledge the unwavering support and guidance provided by the FLLoCA PIU team and the County leadership. Their vision and strategic direction have been instrumental in shaping this report and ensuring its relevance and usefulness in addressing climate challenges.

The success of this participatory climate risk assessment report is a testament to the dedication, expertise, and collective efforts of the technical working teams involved, with special thanks to the World Food Programme (WFP) for their invaluable contributions. I am truly thankful for their outstanding efforts, which have made this endeavor possible.

Abdiladif Ahmed Haret
Director Climate Change
<u>Garissa County</u>

EXECUTIVE SUMMARY

The Garissa County Climate Risk Assessment Report provides a comprehensive analysis of the climate risks and vulnerabilities faced by Garissa County. This report serves as a crucial tool for understanding the potential impacts of climate change on our communities, infrastructure, and natural resources, and for guiding our efforts in building resilience and promoting sustainable development.

The assessment process involved a thorough examination of historical climate data, future climate projections, and stakeholder consultations. It considered various sectors, including agriculture, water resources, infrastructure, health, and ecosystems, to identify key climate-related risks and their potential consequences.

The report highlights that Garissa County is experiencing a gradual increase in average temperatures, leading to heat stress and potential impacts on human health, agricultural productivity, and livestock well-being. Measures to mitigate heat-related risks and enhance adaptive capacity are necessary.

The county is prone to variability in rainfall patterns, resulting in increased frequency and intensity of droughts and floods. These extremes pose significant challenges to agriculture, water availability, and infrastructure resilience. Therefore, strategies for efficient water management, drought preparedness, and flood mitigation are crucial for long-term sustainability.

Climate change impacts, such as reduced rainfall and increased temperature, pose risks to agricultural production and food security. Dwindling water resources, pests, and diseases further exacerbate these challenges. To ensure food security, there is a need to promote climate-smart agriculture, diversify livelihoods, and enhance irrigation systems.

The county faces increasing water scarcity due to changing climate patterns and high demand for water. This threatens both human consumption and livestock rearing, impacting overall well-being and livelihoods. Sustainable water management practices, such as rainwater harvesting, groundwater monitoring, and water conservation, are vital for addressing this issue.

Climate change poses risks to Garissa County's unique ecosystems and biodiversity. Habitat loss, species displacement, and reduced ecosystem services are significant concerns. Conservation efforts, restoration initiatives, and sustainable land-use practices are essential for preserving the county's ecological balance.

Based on these findings, the report presents a set of recommended strategies and measures to address the identified climate risks and vulnerabilities. These include strengthening early warning systems, promoting climate-resilient agriculture, enhancing water resource management, integrating climate change considerations into infrastructure planning, investing in climate-smart technologies, and fostering capacity building and awareness programs.

The adoption and implementation of this County Climate Risk Assessment Report will empower Garissa County to proactively address climate change challenges and build resilience across sectors. It will guide decision-making processes, inform policy development, and attract financial support from various climate financing mechanisms.

By taking proactive measures to mitigate climate risks and adapt to changing conditions, Garissa County can create a sustainable future that ensures the well-being and prosperity of its residents while preserving the unique environmental heritage of the County.

ACRONYMS AND ABBREVIATIONS

ASAL	-	Arid and Semi-Arid Lands
ASDSP	-	Agriculture Sector Development Support Program
CBP	-	Contagious Bovine Pleuropneumonia
CCKP	-	Climate Change Knowledge Portal
CCP	-	Contagious Caprine Pleuropneumonia
CFA	-	Community Forest Associations
CRA	-	Climate Risk Assessment
CIDP	-	County Integrated Development Plan
DRR	-	Disaster Risk Reduction
FCDC	-	Frontier Counties Development Council
FLLoCA	-	Financing Locally Led Climate Action
GEF	-	Global Environment Facility
IOD	-	Indian Ocean Dipole
ILRI	-	International Livestock Research Institute
ITCZ	-	Inter-Tropical Convergence Zone
KALRO	-	Kenya Agriculture and Livestock Research Organization
KEFRI	-	Kenya Forest Research Institute
KFS	-	Kenya Forest Service
KMC	-	Kenya Meat Commission
KMD	-	Kenya Meteorological Department
KWS	-	Kenya Wildlife Service
LSD	-	Lumpy Skin Disease
MAM	-	March – April - May
MCA	-	Members of County Assembly
MICS	-	Multiple Indicator Cluster Survey
NAP	-	National Adaptation Plan
NCCAP	-	National Climate Change Action Plan
NCCRS	-	National Climate Change Response Strategy
NDC	-	Nationally Determined Contributions
NDMA	-	National Drought Management Authority
NEMA	-	National Environment Management Authority
NGO	-	Non-Government Organization
NIA	-	National Irrigation Authority
OND	-	October – November - December
PBO	-	Public Benefit Organizations
PCRA	-	Participatory Climate Risk Assessment
PPR	-	Peste Des Petits Ruminants
PWD	-	People Living with Disabilities
RVF	-	Rift Valley Fever
SGP	-	Sheep and Goat Pox
SPI	-	Standard Precipitation Index
TOT	-	Training of Trainers
TWG	-	Technical Working Group
VCI	-	Vegetation Condition Index
WFP	-	World Food Program
WMO	-	World Meteorological Organization

1   CONTEXT TO PARTICIPATORY CLIMATE RISK ASSESSMENT

1.1   Background

Garissa County is located in the Northeastern region of Kenya, which is one of the most vulnerable areas to climate change in the country. The county is already experiencing the impacts of climate change, such as rising temperatures, decreasing precipitation, and more frequent and prolonged droughts. These impacts are having a significant effect on the livelihoods and well-being of the people of Garissa County, who are largely pastoralists and agro-pastoralists.

The Participatory Climate Risk Assessment (PCRA) is a process aimed at understanding and addressing the risks and vulnerabilities associated with climate change at the local level. It involves the active participation of stakeholders, including community members, County, National Government, Non- Governmental Organizations (NGOs), and other relevant organizations.

The need for a PCRA arises from the growing recognition of the significant impacts of climate change on communities and the urgency to develop effective adaptation and mitigation strategies. These efforts are often cascaded from national-level initiatives, where governments and international bodies have been working to address climate change through policy frameworks, agreements, and funding mechanisms.

At the national level, governments have been focusing on climate response by implementing National Climate Change Response Strategy (NCCRS 2010), Climate action plans, setting emission reduction targets through nationally determined contributions (NDCs), and implementing policies to promote renewable energy and energy efficiency. These efforts are often guided by international agreements like the Paris Agreement, which aims to limit global warming to well below 2 degrees Celsius. The national government has also been giving the county government support in terms of policies and capacity strengthening.

As climate change impacts are experienced locally, it has become crucial to assess the specific risks and vulnerabilities faced by communities. The PCRA process allows for a bottom-up approach, enabling local stakeholders to identify and prioritize climate-related risks, understand the social, economic, and environmental implications, and develop context-specific strategies for adaptation and resilience.

The PCRA process typically involves several key steps. First, there is a stakeholder engagement phase, where representatives from various sectors and community members come together to discuss and share their knowledge and experiences related to climate change impacts. This participatory approach ensures that diverse perspectives and local knowledge are considered. Next, a comprehensive assessment of climate risks is conducted, which includes analyzing historical data, climate projections, and socio-economic information. This assessment helps identify potential climate-related hazards, such as extreme weather events such as Drought, floods, or changing precipitation patterns, and their potential impacts on sectors like agriculture, water resources, natural environment, infrastructure, and human settlements.

Based on the risk assessment, stakeholders work together to prioritize the identified risks, considering factors such as vulnerability, exposure, and potential consequences. These prioritized risks then inform the development of adaptation and resilience strategies tailored to the local context. These strategies include measures like ecosystem restoration, infrastructure improvements, early warning systems, livelihood diversification, and community-based initiatives. The PCRA process also emphasizes capacity building and knowledge sharing, empowering local communities, and organizations to effectively respond to climate risks. It fosters collaboration among stakeholders and encourages the integration of climate change considerations into development planning and decision-making processes.

By engaging local stakeholders and incorporating their perspectives, the PCRA process helps ensure that climate change responses are contextually relevant, inclusive, and effective in reducing risks and building resilience at the local level.

In response to climate change effects, the county government of Garissa in partnership with the stakeholders (both

government agencies and non-state actors) is responding as follows:

- The county has established a dedicated County directorate in charge of Climate Change and other related issues for the purpose of coordinating, mainstreaming, and reporting climate change issues in the County.
- The County has developed and enacted County Climate Change Fund Act 2018 that has established climate financing in the county that directs the county government to set aside 2% of the annual County development budget to finance locally led climate actions which enhances community resilience.
- The Act has established three levels of climate change governing structures that aim to enhance coordination, planning, resources mobilizations, implementation, and monitoring of climate change investment initiatives. These structures include Ward Climate Change Planning Committee, Steering Committee and Garissa County Climate Change Fund board. Additionally, the County has undertaken several strides in enhancing the capacity of the governing structures and other relevant stakeholders.

- The County government of Garissa through the Agriculture directorate in partnership with national government and World bank is implementing Kenya climate smart agriculture project (KCSAP) that aims to build community resilience towards the vagaries of climate change by increasing productivity, providing alternative livelihood, and reducing the emissions of greenhouse gas emissions (GHGs).

- The County government in partnership with the ministry of agriculture is also implementing the Emergency Locust Response Project (ELRP). The project aims to prevent and respond to the threat posed by the Desert Locust outbreak and to strengthen Kenya's preparedness systems in the targeted smallholder farming and agro-pastoral communities. The project is being implemented in Garissa County in 10 wards and is reducing the community vulnerabilities.
- The County Government of Garissa through the partnership of World food Programme (WFP) is implementing a Sustainable food systems programme in the County that targets to deliver sustainable hunger solutions based on a food systems approach. The SFSP is designed with the overriding outcome of ensuring that food insecure households in the targeted areas benefit from improved food systems and nutrition to enable them to adapt and be resilient to climate shocks.

- The County Government of Garissa in partnership with NDMA is implementing The Dryland Climate Action for Community Drought Resilience Programme (DCADR) is a 4-year project co-funded by the European Union and the Government of Kenya. The project aims to enhance resilience to drought and other climate change effects of communities in arid and semi-arid lands. The DCADR Project focusses on introducing technical innovation and resource mobilization as core means for scaling the volume and improving the quality of NDMA's drought recovery, response, and preparedness investments. This will contribute to enhancing community resilience to drought and other effects of climate change (specific objective) and in turn contribute towards greener, more inclusive, and resilient rural development in Kenya (overall objective).
- The County Government of Garissa through the special programme directorate in partnership with NDMA is implementing the Hunger Safety Net Programme (HSNP). The programme is an unconditional Government cash transfer programme implemented by NDMA and is one of four cash transfer programmes under the National Safety Net Programme (NSNP) collectively called *Inua Jamii* with overall objective of ensuring effective, financially secure, and well-targeted use of safety net and cash transfer programmes to support some of the most vulnerable and poor in Garissa County. The other three programmes are;
    1. Older Persons Cash Transfer.
    2. Cash Transfers for Orphans and Vulnerable Children.
    3. Persons with Severe Disability Cash Transfer.

- The County of Garissa in partnership with NDMA and International Union for Conservation of Nature (IUCN) with the funding from Green Climate Fund (GCF) is implementing towards Ending drought Emergencies project (TWENDE). The projects aim to increase the resilience of the

livestock and other land-use sectors through restored and effectively governed rangeland ecosystems in Kenya's arid and semi-arid lands. The project is being implemented in 6 wards in the county and is targeting smallholder pastoral and agropastoral farmers in the County.

1.2   Policy Context

In Garissa County, the policy and legal frameworks related to climate change are interconnected with national-level policies and legal provisions. These frameworks provide the foundation for addressing climate change and supporting climate risk assessments. Here are the key policy and legal instruments at both national and county levels:

a)   National Level:

The Constitution of Kenya (2010): The Constitution recognizes the right to a clean and healthy environment and mandates the state to take measures to address climate change and promote sustainable development.

National Climate Change Response Strategy (NCCRS) 2010: The NCCRS sets out the national vision, goals, and objectives for climate change response in Kenya. It highlights the importance of conducting climate risk assessments to inform decision-making processes. The strategy promotes the use of risk assessments to identify vulnerable areas, sectors, and communities, and to develop appropriate adaptation and mitigation measures.

Climate Change Act (2016): The Climate Change Act provides a comprehensive legal framework for climate change governance in Kenya. It establishes the legal basis for climate action, including the development and implementation of climate change policies and strategies at the national and county levels. The Act emphasizes the importance of mainstreaming climate change considerations in decision-making processes.

National Climate Change Policy (2010): The National Climate Change Policy provides guidance on addressing climate change impacts and promoting sustainable development in Kenya. It outlines key principles, strategies, and actions for climate change mitigation, adaptation, and resilience-building. The policy emphasizes the need for participatory approaches and collaboration among stakeholders.

National Adaptation Plan (NAP): The NAP provides a strategic framework for adaptation planning and implementation in Kenya. It outlines priority sectors and actions to address climate risks. The NAP promotes the integration of climate risk assessments at the county level, ensuring that adaptation measures are tailored to local contexts.

National Climate Change Action Plan (NCCAP): The NCCAP provides a comprehensive framework for addressing climate change in Kenya. It outlines strategies and actions to enhance resilience, reduce emissions, and promote sustainable development. The plan emphasizes the importance of climate risk assessment, adaptation, and mitigation strategies.

b)   County Level:

Garissa County Climate Change Policy (2021): The County has formulated and adopted a county climate change policy. The goal of this Policy is to enhance adaptive capacity and resilience to climate change and promote low carbon emission for sustainable development of Garissa County. The Policy establishes key institutions and interventions to respond to climate change appropriately. These include, among others establishing climate change legislation to provide the framework for a coordinated implementation of climate change responses and action plans and mainstream climate change into county planning processes including development plans. It emphasizes the need for climate risk assessments and resilience-building measures.

County Climate Change Fund Act 2018: Garissa County has established a Climate Change Fund to finance climate change adaptation and mitigation projects within the county. This fund supports the

implementation of policies and strategies related to climate change, including activities associated with

climate risk assessments. The Act has set aside 2% of the annual development budget to undertake specific actions that enhance the resilience of the local people.

Disaster Risk Management Policy (2021): The Disaster Risk Management Policy provides the County with an effective and efficient framework for disaster risk management focusing on suitable preparedness and response to disasters as part of the county planning mechanism and to facilitate effective and timely response to disasters. The policy outlines elaborate strategies, institutions, and funding mechanisms for various interventions for reducing disaster risk through enhanced participation of all stakeholders. It also lays the foundation for effective and better coordination of the stakeholders involved in managing disaster risks at all levels in the county. This policy will be of importance during the implementation of the climate change action plan especially in relation to projects and activities related to disasters in the county. The structures for implementation created by DRM policy will be used in the implementation of the County Climate Change Action Plan.

County Integrated Development Plan (CIDP): The County Integrated Development Plan serves as a strategic planning document for Garissa County. It integrates various sectors and outlines the county's development priorities, including climate change adaptation and mitigation. The CIDP incorporates policy statements supporting climate risk assessment and promotes climate-resilient development.

These policy and legal frameworks at the national and county levels emphasize the importance of climate risk assessments in addressing climate change challenges. They recognize the need for participatory approaches, collaboration among stakeholders, and integration of climate change considerations in decision-making processes. These frameworks provide a supportive environment for the implementation of Participatory Climate Risk Assessments (PCRA) in Garissa County, ensuring that climate risks are systematically identified, understood, and addressed in local development planning and decision-making.

Garissa County Environmental Management And Co-Ordination Act, 2018: The Act provides a framework for an integrated approach to planning and sustainable management of the County's environment and natural resources, strengthen the legal and institutional framework for good governance and effective coordination and management of the environment and natural resources, and encourage communities within Garissa County to effectively participate in the management of the environment and natural resources. The act also establishes a county environment committee whose function is to supervise and coordinate all matters related to the environment and natural resources and implementation of policies.

1.3 Purpose of the PCRA Report

The purpose of a Participatory Climate Risk Assessment (PCRA) report is to assess the risks and vulnerabilities associated with climate change. It is a collaborative and inclusive process that engages stakeholders and local communities in identifying, understanding, and prioritizing climate-related risks and their potential impacts.

By undertaking a participatory approach, the PCRA report ensures that the voices and needs of local communities are integrated into the assessment process. It empowers communities to actively contribute to decision-making processes and promotes ownership and collective action in addressing climate risks and building resilience.

For the purpose of determining the risks associated with climate change, the county conducted a participatory climate risk assessment for the all the 30 wards of Garissa County. The Ward level PCRA reports was used to develop a county climate change risk assessment report that subsequently led to the development of County Climate Change Action Plan thatwill be integrated into the national climate change action plan.

The purpose of this report is to help communities, governments, and development partners use local knowledge and information about climate change in ways that are most appropriate for their circumstances and needs. Additionally, this report provides details on ongoing and planned programs, projects, and community plans.

1.4 Key Steps in the County's PCRA Process

The PCRA process began with a County Climate Change Planning Committee meeting on 10th January 2023 at Governor's Boardroom which culminated in the formation of the Technical Working Group (TWG) to lead the PCRA process.

A multi-stakeholder analysis and engagement process was done where relevant departments and partners were identified and incorporated. The exercise was followed by a 5-day Training of Trainers (ToT) between 26th to 30th January 2023 at Ocean Beach Hotel in Malindi.

The TWG training was immediately followed by the sensitization and formation of the Ward Climate Change Planning Committee for all the wards. The committee consists of various key stakeholders such as representatives from area MCAs, Elders, PWD, Youth, Women, Ward administrator, Public Benefit Organization (PBO)' and religious leaders. The TWGs engaged the wards committee and other stakeholders on PCRA between 20th Feb– 26th February 2023 in all the wards with the help of the Sub County, MCAs and Ward Administrators. During the engagement the community identified hazards, mapped, prioritized, and developed priority action plans at their respective wards.

Thereafter the TWG has organized multi-sectoral stakeholder write-shop between 15th and 19th May 2023 to undertake data cleaning, analysis and development of CRA report. These write-shop has brought together technical officers drawn from both the County government departments, National Government agencies (KMD, NEMA, KEFRI), WCCPC representatives as well as non-state actors present in the county.

The County PCRA report underwent a public validation process at ATC hall in Garissa township to gather input from the public, technical departments, and other stakeholders, with the aim of ensuring ownership and inclusivity in the report.

Finally, the report was submitted to the County Executive Committee Members for adoption and approval.

Key Takeaways

- At the national level, there are 6 relevant documents that support climate change risk assessments and investments.

- At the county level, there are 5 relevant documents that support climate change risk assessments and investments.

- The county government of Garissa has completed participatory climate changerisk assessments at ward levels.

- That the ward level participatory assessment reports have led to the development of this harmonized county climate risk assessment report (CRA).

- This PCRA report will guide the development of County Climate Change Action Plan.

2   COUNTY CLIMATE HAZARD PROFILE

2.1   Garissa County Overview

Garissa county is located in the Northeastern region of Kenya, and it borders Somalia in the East, Lamu county in the South, Tana River County to the West, Isiolo to the Northwest and Wajir county in the North. The county has a land area of about 44736 km^2 making it the 7th largest counties in Kenya. It has 7 sub-counties, and which are further sub-divided into 30 county assembly wards as shown in fig. 2.1.

Figure 2.1: Garissa County Location Map
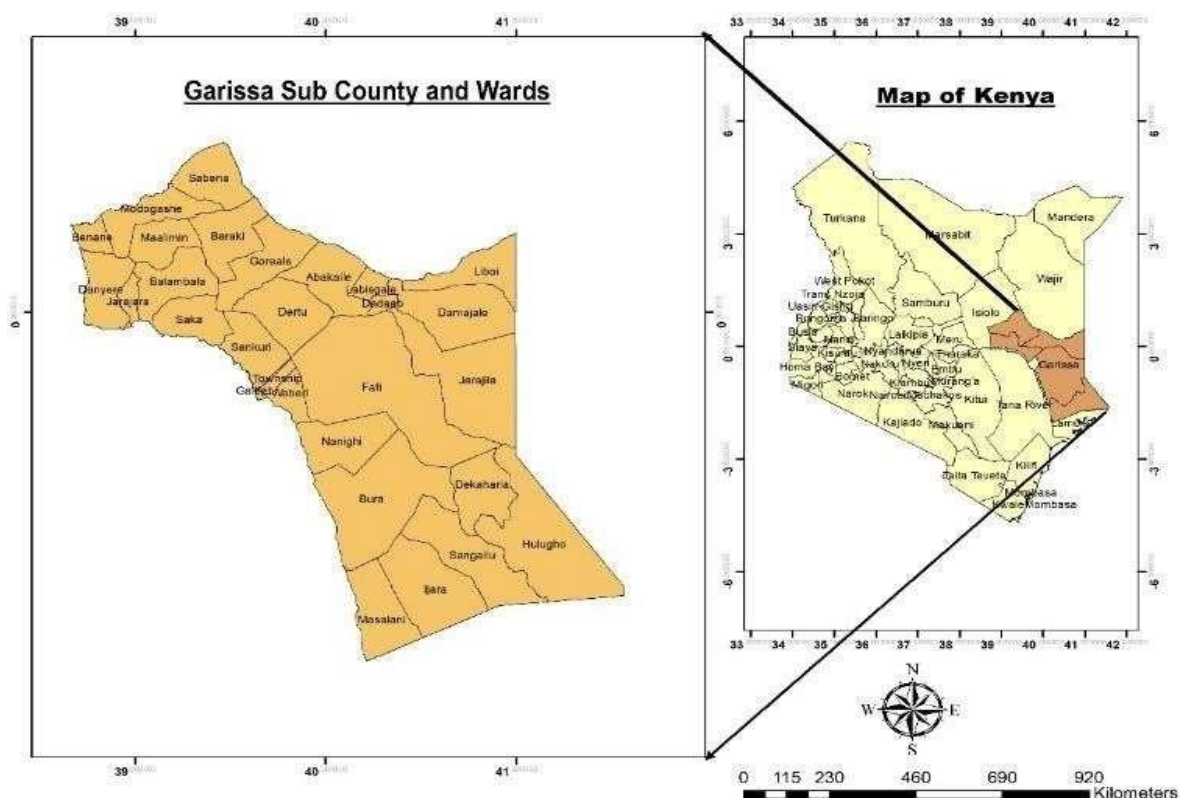
The County is characterized by a population of pastoralists and agro-pastoralists who are facing an array of challenges including drought, water scarcity, pest & diseases, food insecurity, poverty, and illiteracy. The County is home to a variety of ethnic groups, with the majority being the Somali people.

According to the Kenya Meteorological Department (KMD), the normal range of rainfall variability is +/- 25% from the normal, determined based on data from the 1961-1990 period. Between 1990 and 2010, the long rains (March-May) rains in Garissa were more than 50% lower than normal in the ten years, compared to only four years in the 1970- 1989 periods and none before the 1970s. This supports the communities' assertion that based solely on the long rains, then the climate conditions of the county can be described as being drier and getting worse.

The County is prone to major changes in climatic variables, every major change is accompanied by a climatic hazard which has a direct consequence on our livestock and human health. Specifically animal diseases like Rift Valley fever, Contagious Caprine Pleuro Pneumonia (CCPP) locally known as 'Geesdor' have a direct relationship with the season and the nature of climatic hazard manifested. (County Vet Director)

Other profound impacts of climate change in the County include increased demand for water by livestock due to escalating temperatures, decrease in the availability of livestock feeds due to the vegetation species composition and land use changes hence pastoralists are forced to trek long distances in search of both water and pasture for their livestock. There is a possibility of spread of both human and animal diseases as a result of changing climate conditions especially vector -borne diseases such as Rift-valley fever in animals and malaria (CIDP).

2.2   County Climate overview

a.   Winds and Weather Systems

The land-sea contrast between the continental land and the Indian Ocean influences on diurnal changes of wind. Typically, the winds would blow towards the ocean at night and in the early morning hours of the day, in the afternoon, the winds would blow inwards from the sea to the land.

The intertropical convergence zone (ITCZ) has a major influence on the direction of winds in Garissa County. In the northern hemisphere winter (December – February), the winds are blowing from north-east (north easterlies) passing through the Arabian desert. These winds would normally cause dry conditions in the county. As the seasons change to the northern spring and summer, the winds change from north easterlies to south easterlies. These are moisture rich (stronger) winds as a result of their path through the Indian Ocean. They are the main cause of the long rains in Garissa County.

There exists a permanent surface high pressure zone (called the Arabian High) in the Arabian Peninsula that is a major cause of dry conditions in the Arid and Semi-Arid Lands (ASAL) counties (and also the Arabian countries). It significantly reduces upward convention of winds in East Africa and can also be attributed to changes in wind direction. This high-pressure system oscillates in an east-west direction, and when it is closest to Africa, it causes drier than normal conditions.

Other regional systems that have been known to affect the climatology of Garissa County include the Indian-Ocean dipole (IOD), El-NINO (and the La-Nina) and Indian Ocean tropical cyclones (e.g., Tropical Freddy).

b.   Seasons

Garissa County is characterized by two main rainy seasons. These are the March-April-May (MAM) long rains and the October-November-December (OND) which are the short rains. The two seasons constitute the bi-modal rainfall patterns that are common in most tropical countries in accordance with the oscillation of the ITCZ belt to and from the northern and southern hemisphere. A time series of precipitation would depict this oscillating pattern as shown in fig. 2.2.

Figure 2.2: Time series of remote sensing derived ERA-5 and Chirps precipitation dataset

c. Climate Profile
i. Precipitation

Garissa County is principally a semi-arid area falling within the ecological zone V-VI that receives an average rainfall of 275 mm per year. Spatially, Lagdera, Dadaab and Garissa sub counties receive the least amount of rainfall. The Lower regions of Fafi, Ijara and Hulugho are the most wet regions of the county as shown in fig. 2.3. shows the graduation of these areas into precipitation zones based on the long term mean rainfall amounts.

Figure 2.3: Garissa rainfall zones and demarcation based on the mean precipitation.
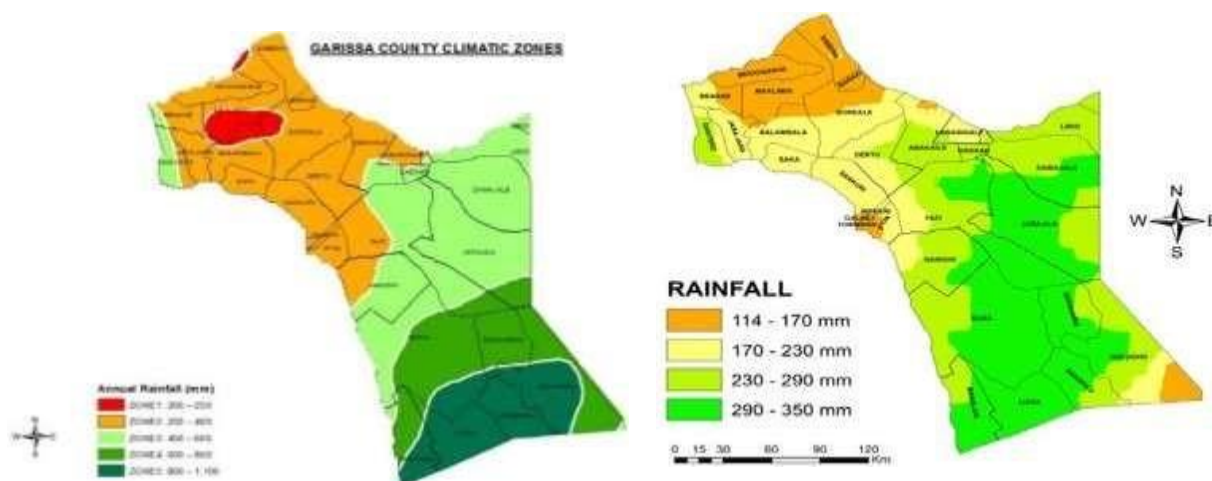
Source: KMD - Garissa

There is significant rainfall received in the short rains of the OND season with peak rainfall month of November. OND season is the most reliable rainfall season from historical performance, usually associated with the outcome of most economic activities (either failure or success). El-Nino episodes are experienced in OND with above normal rainfall. They can cause flooding in the flood risk areas as depicted in fig. 2.4. OND rainfall amount is also usually more than that from MAM, although MAM rainfall has been observed to persist into OND.

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Long term OND and MAM rainfall series show a decline of rainfall amount in both seasons with OND having a decline of over 100mm while MAM has declined with approximately 50mm. It is also observed that extreme events have been frequent and highly pronounced in OND than MAM. While MAM season depicts an oscillation between water scarcity and excess water, OND has more pronounced and consecutive such episodes. That means that consecutive years would have either higher than normal or below normal rainfall episodes (fig. 2.5). It is important to note that there is a clear increase in the frequency of extreme lack and enhanced rainfall events in Garissa County. In the context of climate change, these episodes are expected to increase in their intensity and frequency.

Figure 2.4: OND and MAM rainfall trends for Garissa (1991 - 2022)

GARISSA COUNTY SEASONAL RAINFALL TOTAL AND TREND

$y = -3.1174x + 232.3$

$y = 0.2435x + 108.78$
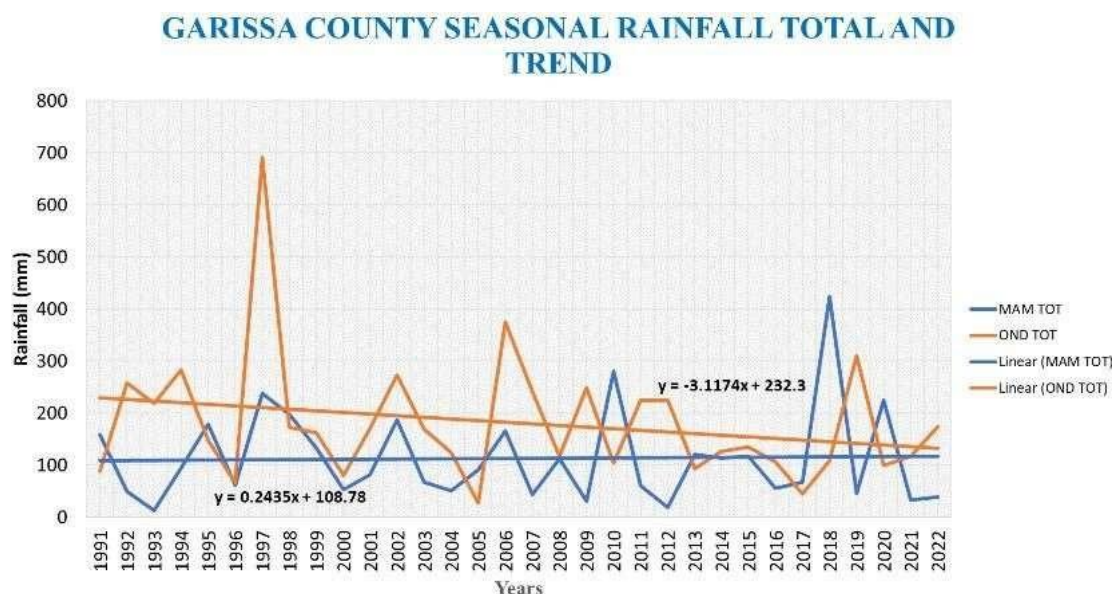
Figure 2.5: Declining annual rainfall, Garissa County

GARISSA COUNTY ANNUAL RAINFALL TOTAL

$y = -4.4439x + 9244.9$
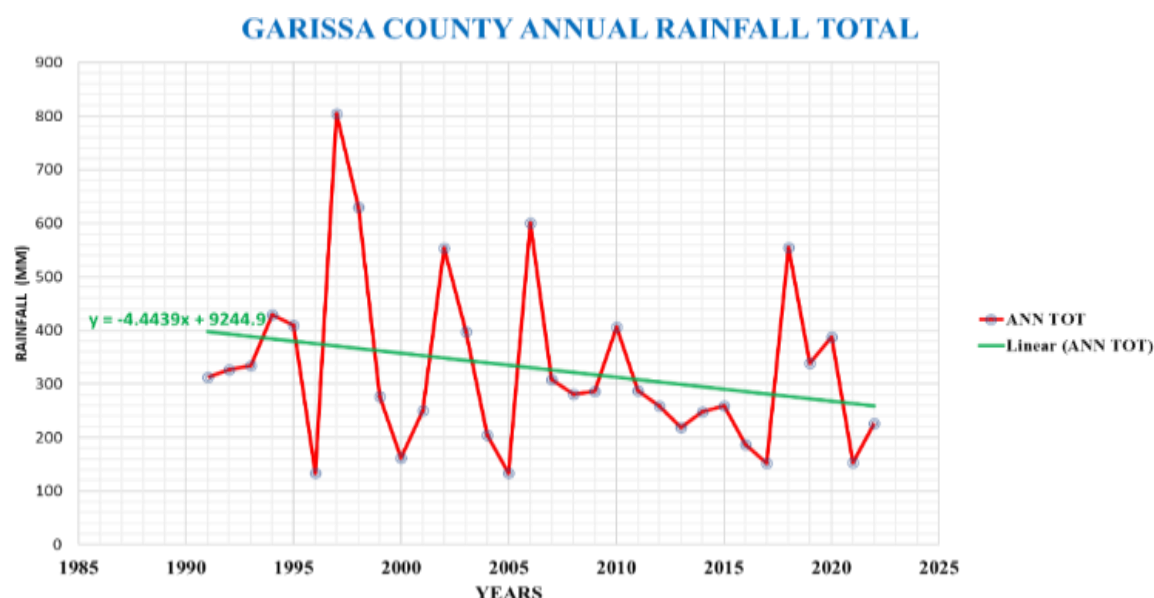
ii.   Temperature

Given the arid nature of the county, temperatures are generally high throughout the year and range from 22ºC to 39ºC. The average temperature is 36ºC, making it one of the hottest regions in Kenya. The hottest months are September and January to March, while the months of April to August are relatively cooler. The humidity averages 60 g/m^3 in the morning and 55 g/m^3 in the afternoon. An average of 9.5 hours of sunshine is received per day.

Temperature Trends: Mean temperature has risen by ~ 0.5 – 1ºC. While there is a general decline of minimum temperature by about 2^{0C}, the maximum temperature on the other hand has increased with >2ºC

Figure 2.6: Annual temperature trends for Garissa (1991 - 2022)
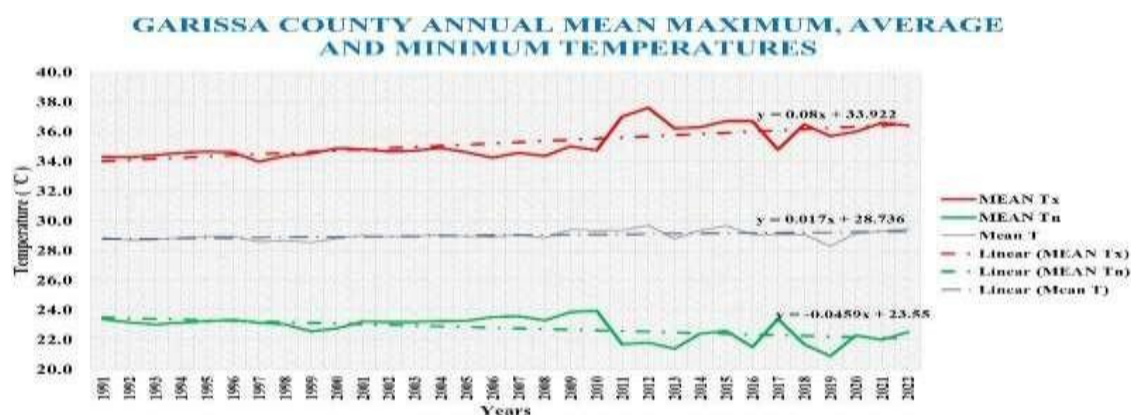
Figure 2.7: Observed average annual mean temperature, Northeastern Kenya (1901 - 2021)
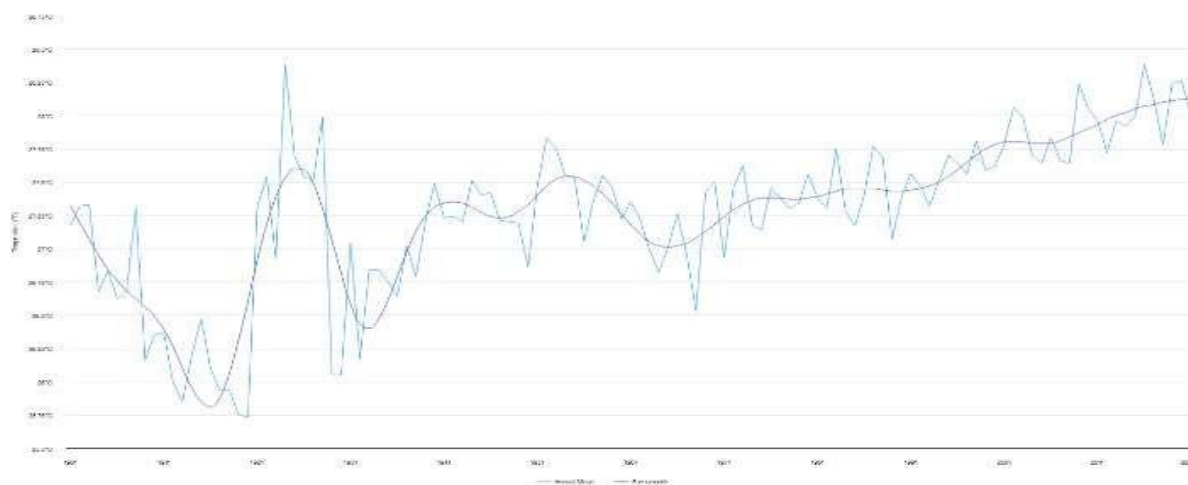
Figure 2.8: Resampled temperature distribution
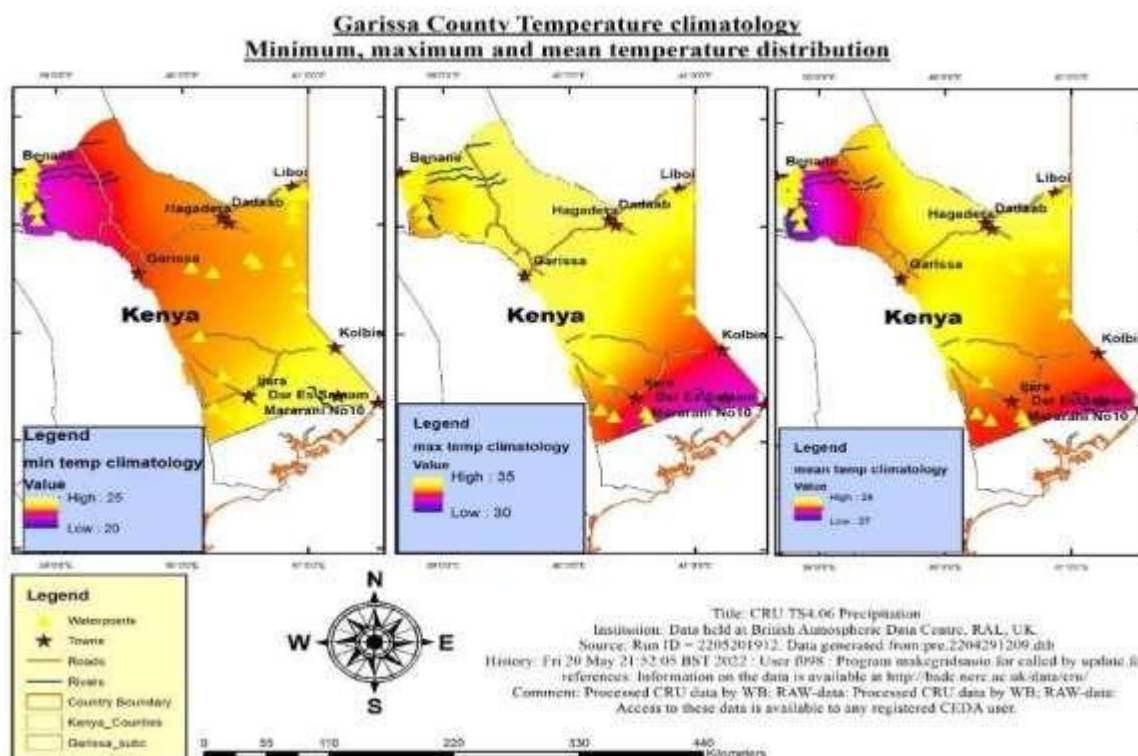
Figure 2.8 shows a spatial distribution of the temperature and clearly showing the influence of altitude and proximity to water resources to the distribution of temperature. Generally, the majority of the county has high temperatures. There is approximately a ~2° C difference between the temperatures in the southern areas and the highest area of the county, Benane, with areas like Garissa and Lagdera. This is explainable because Benane is the highest point of the county while the influence of moisture and the land-sea effect in the southern most parts of the county generally cause lower temperatures.

Data shared by the World Bank (fig. 2.9) and analyzed for the Northeastern province shows that the Jan-Feb-Mar are the hottest months of the region with the peak of minimum and maximum temperature experienced in the month of March. These are also the driest months of the year in terms of precipitation measured. April is the wettest month, and it coincides with the long rains of the MAM season. During this month, the temperature cools down to a minimum in the month of July. There is a drop in temperature change by about 4°C between the month of March and July.

Figure 2.9: Monthly Min-Max temperature and precipitation, 1991-2020 Northeastern Kenya
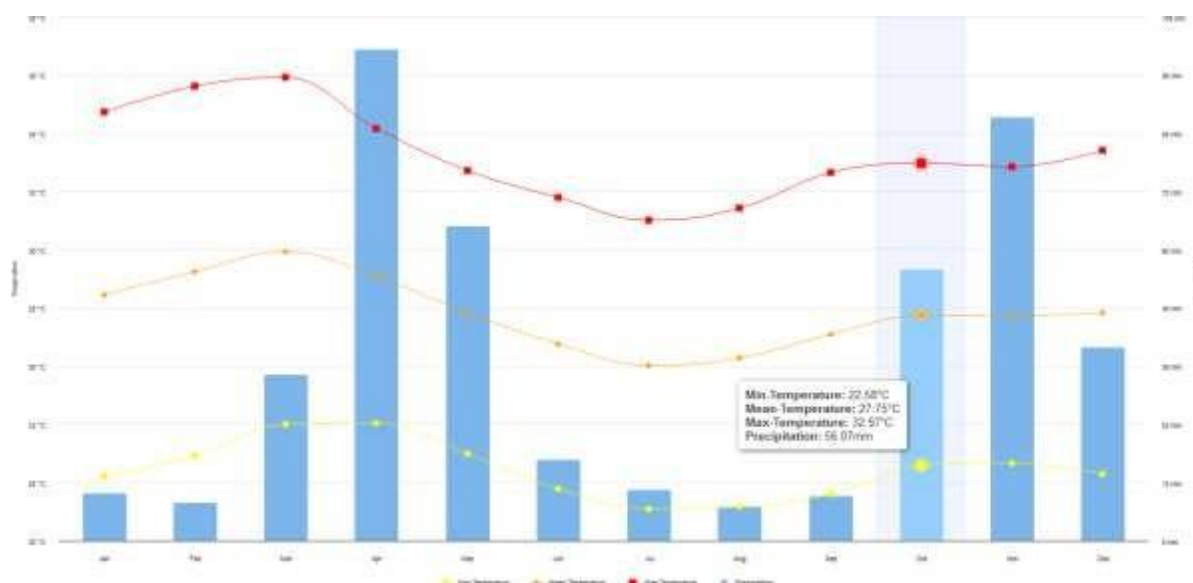
2.3 Current and Historical Climate Hazards and Trends

i. Floods

There are two types of floods experienced in the county namely, flash floods, which occur whenever there is a heavy and prolonged downpour, and riverine floods. In Garissa County, flash floods are the most common, usually abrupt and occurring in areas traversed by lagas. Flooding in Garissa County normally coincides with the two rainfall seasons in Mt. Kenya region (the long-rains and the short-rains).

Figure 2.10: Tana River water level measurement for 2023 MAM season
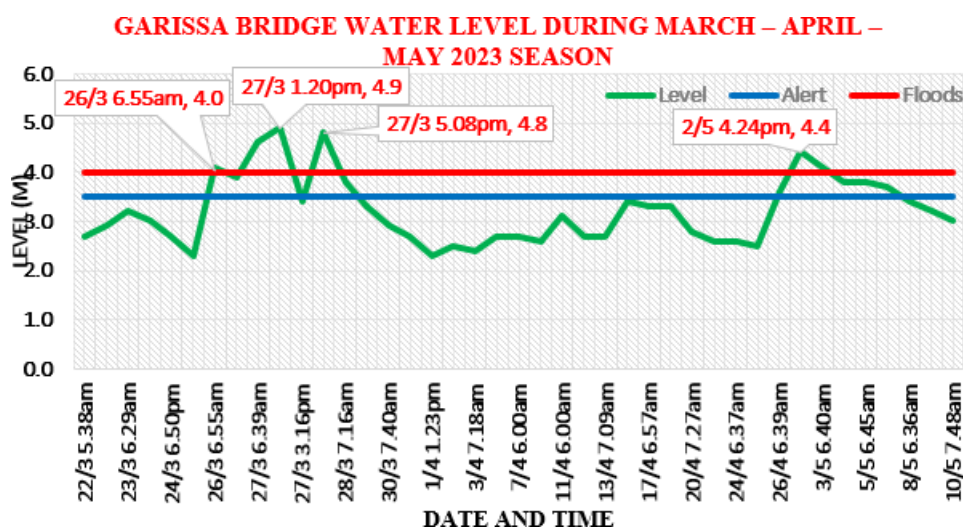
Riverine floods take place as a result of the river breaking its banks. River flooding is common in larger rivers when runoff from sustained heavy rainstorms causes a slower rise in river levels. This mostly happens when River Tana bursts its banks due to heavy rainfall upstream. The March, April May season started this

year with heavier than usual rains bringing floods, flash floods across the northern and southern parts of the country. At least 12 people have lost their lives and hundreds have been displaced from their homes in Kenya after intense flooding affected several counties over the week from 22 to 27 March 2023. In the case below where there is a water level sensor in Garissa town for river Tana, a preset threshold (in red) shows a river level that is associated with floods for downstream river dwellers.

Figure 2.10 shows Tana River measured water levels for 2023 MAM season, 27 March and 1st of May coincided with widespread flooding in Garissa town which shows that Garissa as a flood prone zone.

Figure 2.11: Garissa flood prone areas
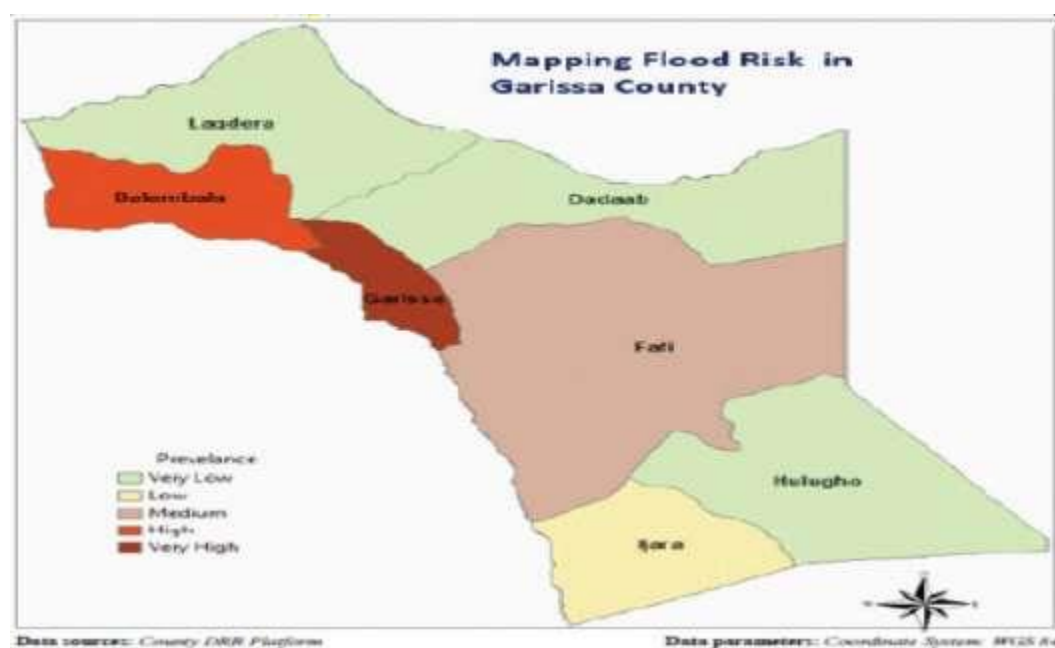
"Flooding is dependent on heavy rains in Mt. Kenya region."

Flash floods: Sometimes flash floods from major lagas in the county affect the County. Flash floods occur when runoff from heavy rainfall results in a sudden rise in water levels and overflow in streams and seasonal rivers. This is one of the common causes of flooding caused by prolonged rainfall. When it rains for a long time, the ground becomes saturated, and the soil will no longer be able to store water leading to increased surface runoff which results in higher discharge levels and floods.

The areas mostly affected by floods include Balambala, Garissa township, Madogashe, Bura town, Fafi, Baraki ward and town, Masalani, Mansabubu town, Warable, Nadhir, Kamuthe, Abaqdera, Taqal, Nanighi, Guyo Jambele, Ali Emij, Garasweyno, Winza, Saka Daley, Haley Daley (fig. 2.11).

The long rains of MAM for year 2020 caused a lot of destruction to the farms along the riverine sections within Garissa County as farmers were forced to abandon their farms due to inaccessibility.
provides an account of these losses.

Table 2.2: Riverine related losses for the season MAM, 2020

County	Sub-County	No. Of Farms	Farm Families	Area Under Crop (Ha)
Garissa	Garissa	212	11,600	2340
	Balambala	22	205	340
	Fafi	58	2200	750
Total		**293**	**14,005**	**3,430**

Recent major flood events were registered in 2018, 2020, 2010 – 2011, 2007 and 1997. In most scenarios, much as these floods brought about considerable destruction, while communities perceive their onset as blessings. Contrary to that, river floods which occur mainly along the river Tana channel are usually chronic and tend to register massive damage to resources and lives. Most floods come as an aftermath of heavy rains that precede severe droughts.

ii. Droughts

Recurrent drought has been a common phenomenon in Garissa County for the last two decades. Drought is the prime recurrent natural disaster in Garissa. It is an equally complex hazard to monitor and measure since it is a slow onset hazard. It is sub-divided into three types as per the definition by World Meteorological Organization (WMO).

Figure 2.12: Definition and sequencing of drought occurrence and impacts of drought types (National Drought Mitigation Centre, University of Nebraska-Lincoln, WMO, 2006
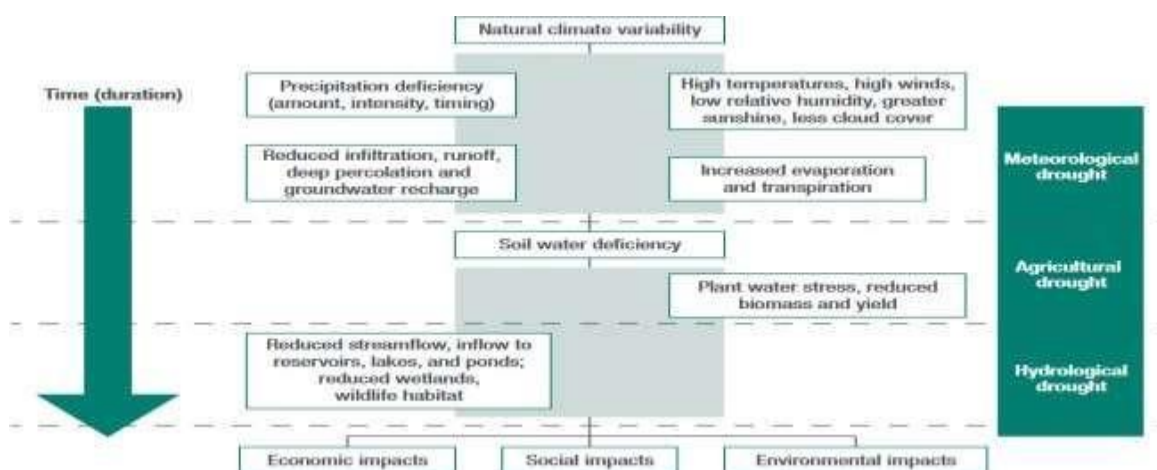
Meteorological Drought: Occurs when there is reduced precipitation, an increase in temperature resulting in evaporation.

Agricultural Drought: Due to reduced moisture to support vegetation growth, their health dwindles, leaves dry up while grass vegetation types turn yellow.

Hydrological Drought: As a result of recharging precipitation to support river streamflow, seasonal rivers, lagas etc. dry up while permanent rivers depict very low river levels.

Standard precipitation index (SPI) is a widely used indicator based on precipitation of meteorological drought. While vegetation condition index (VCI) is a well widely accepted measure of agricultural drought. Streamflow measurements are usually made from river level measurements as the one presented in fig. 2.13.

Figure 2.13: Standard precipitation index (SPI) for Garissa, for 5-consecutive failed rainfall seasons
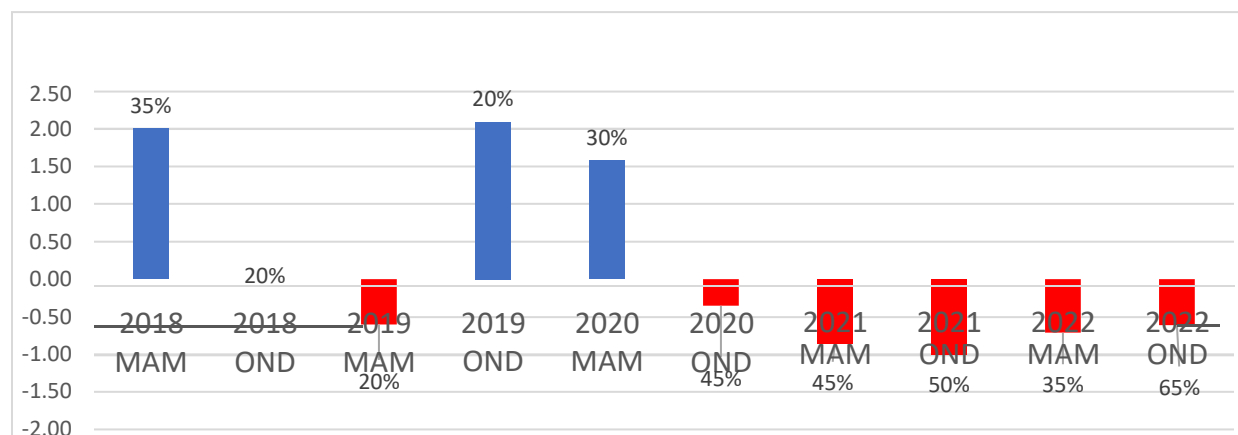
Figure 2.10 shows SPI calculations from 2018 to 2022 for Garissa County. The higher the bar, the higher the severity and blue bars indicate wet conditions while red indicate dry conditions. These measurements show that less severe meteorological drought conditions were experienced in 2018 and to a larger extent in 2019 for two consecutive seasons before a change in OND and MAM wet conditions. Thereafter, the county experienced 5 consecutive meteorological drought conditions.

Figure 2.14: NDMA VCI observations (from drought bulletins)
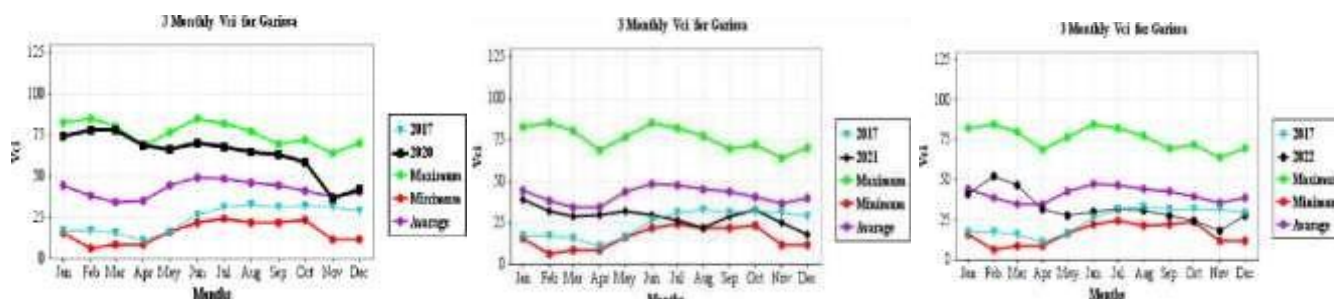
Consequently, the above is an analysis from the National Drought Management Authority (NDMA) in the drought bulletin of vegetation condition index to measure agricultural drought, for 2020, 2021 and 2022, against the minimum, maximum, long-term average and November 2017 VCI. The figures show that there was a sharp decline between the month of October and, followed by a slight increase in December 2020. Starting the year of 2021, the VCI was below the long-term average for the entire 2021 with worse conditions observed in July, August and December almost reaching below the long-term minimum values. There was slight improvement in 2022 Jan to April, however, the conditions deteriorated to below the long-term average for the rest of the year.

In recent times intense droughts have occurred in 1983/1984, 1991/1992, 1995/1996, 1998/2000, 2004/2005, and 2008/2012 (fig. 2.11).

shows the recorded episodes when the SPI was negative from 1981-2022. Each of these events caused severe pasture and livestock losses, famine and population displacement.

Figure 2.15: SPI OND trends from 1981 - 2022
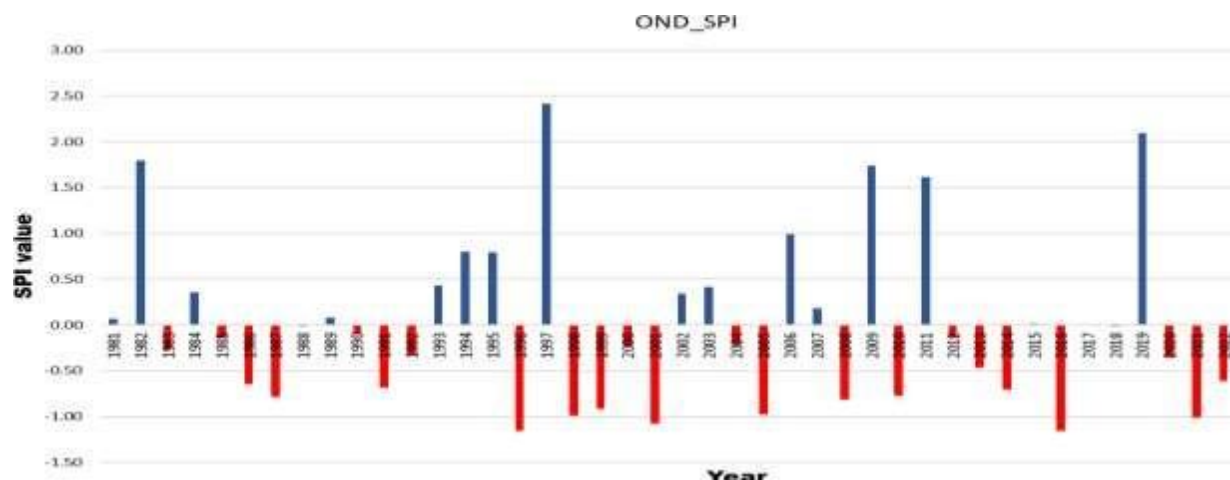
The losses caused by drought supersedes all other hazards combined with livelihood destruction being the main effect as well as continuing environmental degradation. During high stress periods, the natural resource base (water, pasture) becomes insufficient to support large numbers of livestock. This has forced several pastoralists to relocate livestock to neighbouring communities and to the coastal ranches in Benane, Balambala, Garbatula and Dertu thus increasing cost of production as well as directly resulting in resource stress and conflicts.

Figure 2.16: VCI observations (NDMA Bulletin)
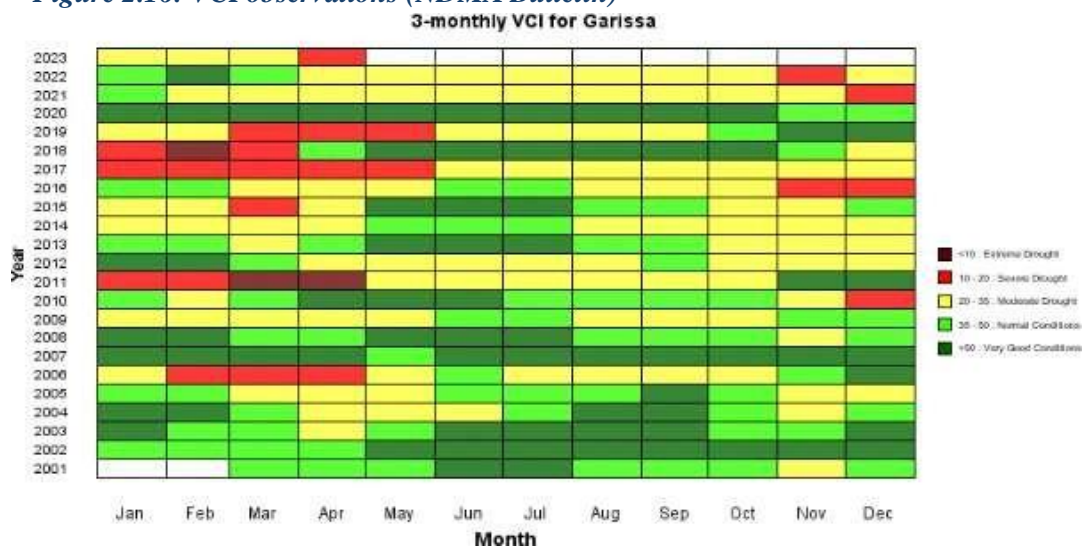
NDMA also produces 3-months moving average VCI outputs for Garissa County since 2001 for a better representation of the timeseries of the health of vegetation in Garissa County (fig. 2.16). The county has generally suffered from moderate drought since 2009. However, alternate moderate and severe drought episodes have increased. Notably, there is an increase in time of the drought episode as well as the recurrence.

    iii.   **Pests and Disease**
    iv.   **Crop**

There is vibrant irrigated crop farming in Garissa County, practiced majorly along the Tana riverine but

also in the hinterland around areas with reliable water resources (water pans, boreholes). Main crops include mangoes, bananas, melons, citrus, tomatoes, onions, and leafy vegetables. Rain fed farming is also practiced mainly for production of food crops (maize, cowpeas, sorghum, and green grams)

The sector has suffered significant impacts mainly as a result of migratory pests and invasive weed species. These being, Tomato leaf miner Tuta absoluta, which invaded in the year 2014, decimating tomato plantations up to over 90%. The county has experienced several invasions of the African Fall Army Worm whenever environmental conditions are favorable, as well as localized invasions of tree locusts.

The most destructive pest, the Desert Locust (DL), invaded in December 2019, following above normal rainfall experienced in the OND. Several swarms emanating from northeastern African through Somalia invaded. The effects of the first generation and second-generation DL were felt more on the cultivated crops as well as the pasture lands. Up to 17 wards in Garissa County were affected. Other significant pests include the red spider mites that become a menace during drought periods. Incidences of wildlife -crop farmers conflicts increase during drought periods.

v. Livestock

Most livestock diseases in Garissa County are driven by weather changes and are usually associated with their convergence at a single place, either at watering points or during migration in search for vegetation and water resources. Drought conditions trigger Peste Des Petits Ruminants (PPR), Contagious Caprine Pleuropneumonia (CCP), Contagious Bovine Pleuropneumonia (CBP). Precipitation on the other hand brings about: mosquitoes which further causes Rift Valley Fever (RVF), Lumpy Skin Disease (LSD), Sheep and Goat Pox (SGP) and Ephemeral Fever; ticks which brings anaplasmosis and Babesiosis; and tsetse fly and other biting flies which cause trypanosomiasis.

In general, most livestock diseases are sporadic in nature and are directly influenced by the frequently varying weather patterns mainly rainfall and dryness has resulted to unpredictability and lapse in the control of livestock disease outbreak and spread. The recurrence and intensity of livestock diseases have been high as they occur four times in a year, and it affects all locations in Garissa County. This is caused by repeated droughts and the migration of large numbers of livestock into the community.

Table 2.3: Historical occurrence and impact of livestock disease, Garissa County

Year	Disease Event	Remarks
2001	Last case of Rinderpest reported in a Buffalo in Kenya	
2006/7	**Rift Valley Fever - Garissa classified as high-risk County for RVF**	Elnino, Human deaths (57), Livestock deaths, Mass abortions, Economic loss estimated at **21B**
2007	First case of PPR reported from Turkana - Spread to the ASALs including Garissa	Control strategy in place - to be eradicated by 2030
2009/2010	Kenya receives accreditation for attaining a Rinderpest free status	
2015/16	Acute camel death syndrome (ACDS)	Following rainy season
2019	Camel respiratory syndrome	
2021	RVF Outbreak - Isiolo/Garissa Boarder	
2022/23	Camel mortalities in Dadaab and Fafi associated with **heamoparasites -**	
Jan-March2023	Sheep and Goat pox outbreak in Abakaile, Sabena and parts of Sankuri Ward	Ongoing Outbreak
2023	Anthrax Outbreak among Cattle in Sankuri	Ongoing Outbreak

Table 2.4 depicts percentage (%) mortality rates associated with diseases associated with various climatic hazards for selected time periods is provided.

Table 2.4: Livestock mortality losses associated with climate related livestock disease.

Livestock mortality rates (%)	Animals	Township	Balambala	Lagdera	Dadaab	Fafi	Ijara	Hulugho	County Data
2016 - 2017	Cattle	3	5	10	7	6	9	9	7.0
	Sheep	2	8	8	7	4	3	3	5.0
	Goats	2	8	8	7	4	3	3	5.0
	Camels	1	4	3	3	3	-	-	2.0
2020 - 2021	Cattle	2	12	15	14	12	11	11	11
	Sheep	4	14	16	13	10	14	13	12
	Goats	3	12	12	7	8	12	9	9
	Camels	1	5	7	8	7	-	-	4
2021 - 2022	Cattle	30	34	40	38	45	47	46	40
	Sheep	8	20	30	24	18	20	20	20
	Goats	6	20	22	18	15	12	12	15
	Camels	2	5	12	15	15	-	-	7

vi.   Human

Most of the disease outbreaks in Garissa County are influenced by the changing weather patterns.

Figure 2.12: Summary of the most prevalent diseases in Garissa County and their risk areas
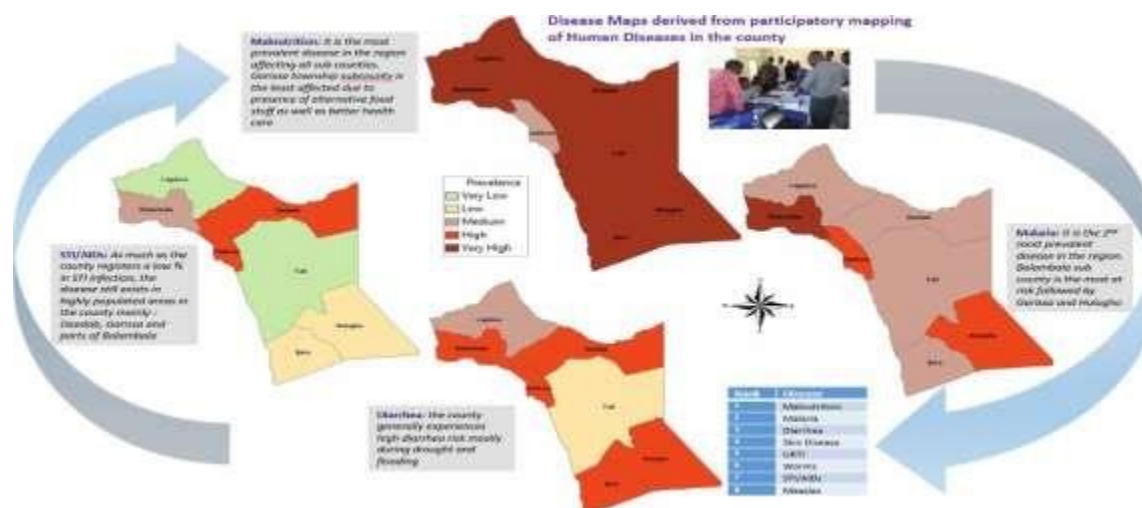
According to fig. 2.12, Malaria, Diarrhea, Cholera, and malnutrition are the most prevalent climate driven human diseases. Poor sanitation, the presence and influx of refugees from the neighboring countries and ignorance among the community's present further cause of concern for the spread of diseases in the region. The views from the DRR platform are backed by studies by Multiple Indicator Cluster survey (MICS), 2007 which established that the five most prevalent diseases in Garissa County are Malaria, Upper Respiratory Tract Infections, Stomach-ache, Diarrheal diseases, and Flu; with a prevalence of 46.6%, 5.2%,6.6%, 2.7% and 3.7% respectively.

2.4   Exposure and Vulnerability Profiles of the County

Climate Change Vulnerability is defined by the IPCC as the susceptibility of a species, system, or resource to the negative effects of climate change and other stressors, and includes three components: exposure, sensitivity, and adaptive capacity. *Exposure* is the amount and rate of change that a species or system experiences from the direct (e.g., temperature, precipitation changes) or indirect (e.g., habitat shifts due to changing vegetation composition) impacts of climate change. *Sensitivity* refers to characteristics of a species or system that are dependent on specific environmental conditions, and the degree to which it will likely be affected by climate change (e.g., temperature or hydrological requirements); and *Adaptive capacity* is the ability of a species to cope and persist under changing conditions through local or regional acclimation, dispersal or migration, adaptation (e.g., behavioral shifts), and/or evolution.

The objective of the community exposure and vulnerability assessment that was done during the PCRA community engagement was to determine the effects of the prioritized hazards on the different community resources and livelihoods. The community resources and livelihoods were categorized into four categories - Economic assets/resources, physical capital, social capital, and natural capital. From the participatory community vulnerability assessment, drought was found to have the most severe effects on the community resources. This is followed by Floods, Pest, and diseases. Overall, the vulnerability of these resources to the three priority hazards has been increasing over the years.

Human, economic, and social resources are the most vulnerable resources to priority hazards while physical resources are least vulnerable to climate hazards. Livestock and human health assets are most vulnerable to the hazards, followed by petty trade, families', women group and co-operatives, and water. Livestock vulnerability is due to migration from other areas, resulting in competition for pasture and herd mixing, increasing disease transmission, especially in water bodies. Resource based conflict with the pastoralists from neighboring counties causes insecurity in the region and in most cases community members lose their lives.

Climate change related human diseases that are emerging/remerging include respiratory diseases including mutating influenza viruses, Covid 19 and cases of cancer and waterborne diseases including Cholera. Common climate change related livestock diseases include Acute camel death syndrome (ACDS), upsurge of livestock pest and vector borne diseases.

Economic activities: The estimated number of Farms along the River Tana is **380 supporting over 18,000Agro-pastoral households**. Livestock keeping is the backbone of the county's economy, with an estimatedvalue of **Ksh. 122 billion** and contributes directly to the survival and livelihood of over 90% of the population. Extensive nomadic pastoralism is the predominant livestock production system. The main livestock produced are cattle (Boran), goats (Galla), sheep (black headed Persian) and camel (Somali camel). According to the KNBS 2019 Census, the County hosts **1.407 million** Cattle, **3.857 million** goats,**2.746 million** sheep, **0.816 million** Camels, **0.105 million** donkeys, **0.132 million** Chicken and about **13,500** exotic Cattle. Fish farming is attracting a lot of interest within the County due to growing demand for fish and changing consumption among the population in the County. Over 70% of the fish consumed inGarissa comes from other Counties. Local production of fish including artisanal fishing and capture fish farming contributes less than 20% of the fish consumed. The County government has collaborated with partners within the County to promote fish production and consumption. So far, four (4) fishponds with a capacity to produce 4 metric tons of fish per year have been established. The estimated number of households depending on capture fish farming (Fishponds) is **110** families.

Land Resources: The County has 710,000 hectares of arable land favorable for crop production and fodderpropagation, out of which 628,000 Hectares has rainfed potential and 32,000 Hectares has irrigation potential. Currently the land area utilized for crop farming is approximately **12,000 Hectares** in rainfed areas and **4,000 Hectares** in irrigated areas. Crops grown under the rain-fed farming system

are mostly cereals and legumes, these being Maize, Sorghum, Cowpeas, Green grams and Beans. Under irrigated agriculture: the crops grown are mainly the horticultural crops, i.e., fruits and vegetables. These include Mangoes, Bananas, Watermelons, and sweet melons, Citrus (lemons), Pawpaw and Guavas. The vegetablesgrown are Tomatoes, Onions, Capsicum, Kales and Chilies. Oil crops Sunflower and Simsim are emergingas important oil crops. Rice is grown under gravity-fed irrigation in Balambala sub-county. The average value of annual crop production is estimated at **Ksh. 0.354 billion**.

Forestry Resources: The county has a land area of about 44736 km^2. Garissa County has two non-gazettedindigenous forests, namely Boni and Woodlands, most of which are woody trees and shrubs. The county has 40 Community Forest Associations (CFAs) which are currently inactive (Kalua, 2018). Boni forest is an indigenous open canopy forest that forms part of the northern Zanzibar-Inhamdare coastal Forest Mosaic.A section of the forest, the Boni National Reserve, is under the management of the Kenya Wildlife Service(KWS) as a protected conservation area. The soil types are black cotton and alluvial types. Boni forest areais a source of water and pasture in abundance long after the rainy season has diminished, making it a high conflict region (Owange et al., 2014). Other protected areas include The Garissa Community Giraffe Sanctuary (also known as Bour Algi Giraffe Sanctuary) established in 1999 to protect reticulated giraffe inthe area (Giraffe Conservation Center, 2021), Ishaqbini in Masalani Ward, a program dedicated to the conservation of hirola antelope (*Beatragus Hunteri*) as well as the protection of all habitat and wildlife within the area, and Arawle Conservancy in Bura ward.

Wild Animals: The main wild animal types found in the county are: Elephants, Lions, Cheetahs, Leopards,Hippopotamus, Crocodiles, Grants Gazelles, Thompson Gazelle, Gerenuk, servo cat Jackals, Spotted Hyena, Buffalos, Grey Zebras, Topi, Reticulated Giraffes, white Giraffes, Dik-dik, Hirolas, Wild dogs, Warthogs, Monkeys, birds, butterflies and Baboons which move freely since they are not confined to parks.

Physical features: seasonal lagas that only flow during the rainy seasons and the Tana River which runs along the western border with Tana River County. The northern and central parts of the county lack groundwater, making them highly inhospitable during dry periods. The soils range from sandstones, dark clays to alluvial soils along the river Tana basin. White and red soils are found in Balambala Ward where terrain isrelatively uneven and well drained. The soil has low water retention capacity but supports vegetation, whichremains green long after the rains. These soils have potential for farming. The rest of the County has sandysoils that support scattered shrubs and grass. Alluvial soils are found along the Riverine zone of Tana and Lagas (Seasonal drifts).

Water scarcity: already affects the entire county with only 27,725 of the households (28% of total households in the county) directly connected to water sources. The main natural water source in the county is River Tana and various seasonal rivers ending in laghas. These are also the main sources of water for irrigation. Water use is distributed among livestock (53%), domestic (30%), irrigation (10%) and other uses (7%).

Prosopis Juliflora: Huho & Omar (2020) state that Aligaroob (Somali name) commonly known as Mathenge, is a common invasive plant species not only in Garissa County but in entire Northern Kenya. It was introduced as a forestry tree majorly to rehabilitate the degraded environment, ensure self-sufficiency in fuelwood and conservation of the existing natural plants against human destruction. The extent of rangeland colonization by Prosopis was increasing exacerbated by dispersion of its seeds by livestock, river flows and floods. Essentially, dense thickets of Prosopis were found along the roads and migration pathways, rivers or watering points, irrigation schemes and near settlements with relatively low volumes in open grasslands.

Energy: for cooking is primarily from the *Prosopis* as well as the various woodland and shrubland plant

species; most of the population in the county depend on firewood (79%) and charcoal (18%). Women and girls fetch firewood from surrounding bushes while charcoal is mostly sourced from burning of *Mathenge*.

Developed Facilities: The County has five (5) modern livestock markets and five (5) operational class B slaughterhouses. The County is one of the biggest suppliers of beef to main terminal markets in Nairobi, Mombasa and Kiambu, exporting an average of 38,000 cattle and 29,000 sheep and goats annually, with an estimated value of Ksh. 0.934 billion. The key livestock products are Camel meat, Goat meat, Mutton, camel milk, goat milk, Cattle milk, hides and skins, eggs and honey. In order to mitigate water scarcity, the county has dug 204 boreholes.

2.5   Differentiated Impacts of Climate Trends and Risks

i.   Droughts

Being a recurrent phenomenal drought impacts Garissa County on a varying scale and spatiality, however the magnitude of damage is usually dependent on the prolongation of the event and frequency of occurrence. Over time, the county government through various DRR initiatives and partnerships has worked in suppressing the effects of the onset of these hazards. The following still persist as direct impacts of drought in the region:

Environmental degradation: The status of environmental degradation in the county is known to accelerate during periods of drought, due to diminished water sources vegetation cover dry off exposing the topsoil to agents of erosion, this coupled with poor land use practices in the region such as cutting down of trees for fuel, wood and charcoal burning for income and overgrazing result to land degradation. Usually, the northern wards (Dadaab, Labasigale, liboi, Damajale, Abakaile, Dertu, Fafi, Jarajila) are the most affected before moving to the southern areas of Hulugho, Sangailu, Ijara and the other parts of the County.

Economic disintegration: Being a purely livestock driven economy, drought experienced in the county often leads to irregular movement of livestock by causing disruption in flows of livestock to both domestic and export markets, possibly by gluts during drought onset and probably by scarcities during drought and post-drought phases. This makes the physical and financial planning of livestock marketing more difficult, both for government authorities and for the private sector.

Escalation of Resource conflicts and insecurity: situational analysis on drought-related conflicts reflected that the drought situation has occasioned migrations of pastoralists within and without their traditional territorial grazing areas including movement to the neighboring counties such as Isiolo and Wajir. This has resulted in escalation of boarder disputes and inter-community resource-based conflicts. Benane and Fafi wards are hotspots for such conflicts.

Livestock Mortality and Morbidity: The livestock sector over the past decades has experienced massive losses to drought. The county has stepped up efforts to reduce livestock mortalities, though drought related deaths are common. This often depresses livestock productivity, altering herds' composition and usage.

School Disruption and premature closures: In the onset of drought, pastoralists' children in the county often drop out of school as they move with their parents in search of water and pasture. This situation impacts mostly the girl child whose education is severely hampered as they are withdrawn from school to support their mothers in search of food and water or take care of their siblings as their parents search for food. In other instances, they are married off early for the family to recover livestock and access food.

ii.   Floods

Floods register mixed reaction in the county, some community members find the floods to be of importance especially in the drought prone areas in the Western and Northern parts of the county like Modogashe, Goreale since floods provide the opportunity to access water for their livestock, farm crops and most importantly pasture regeneration. On the other hand, the flood prone areas of the county like Garissa Township, parts of Balambala and Ijara are highly impacted both economically and physically. Most harmful floods events in the region are associated with river floods with key reference to River Tana. Generally, some of the impacts associated with floods in the county include:

- Loss of livelihoods: farmers who settle near river systems (seasonal or permanent) lose theircrops from floods as well as their homesteads. Such communities are always vulnerable to rivers and flash flooding.
- Loss of lives: women and children are at risk of losing their lives from flash floods.
- Loss of property such as livestock, household items, farming equipment and machinery etc. In a flooding episode, loss of property and high loss of farm produce/ crops were reported where submerged farms in 3 sub-counties of Garissa, Balambala, and Fafi (A total of 293 Group farms were affected with an estimated 3,384 Ha of farmland affected) was observed. This episode led to massive loss of main livelihoods.
- Displacement and massive migration from the flooded areas.
- Escalation of waterborne diseases including cholera, diarrhea and typhoid.
- Inability for children to attend schools.
- Infrastructure damage e.g., schools, latrines, roads, health centers etc., robbing communities from essential amenities
- Rivers have been reported to change courses leading to wasted investments for farms that depend on irrigated water.
- Silting and soil that lead to blockages of pipes and other water infrastructure. It has been reported in Jarajara canal thus hindering water flow to the rice scheme.

iii.   Crop Pests and Diseases

Widespread of *Prosopis* as an invasive plant species has led to:

- Displacing all herbaceous and grass species wherever they are growing e.g., *Prosopis Juliflora* and *Ipomoea Kituensis*. As a result, livestock will suffer due to reduced availability of forage.
- Modification of the hydrological cycle
- Breeding ground for pests and diseases.
- Damage to goods and infrastructure - roads and pathways thereby restricting movements and displacing infrastructure.
- Land which used to be used for cropping and forage production for livestock has been taken over by invasive species hence leading to reduced productivity.
- Generally, economic losses effects are manifested in controlling costs and reduced productivity.

iv.   Livestock

The Key challenges affecting the livestock and crop sub-sectors include:

- Shortage of feeds and water due to frequent droughts, floods, endemic trade-sensitive diseases, Burden of pests, inadequate marketing framework, limited knowledge of farmers, Inadequate

> funding flow to the sector, limited number of extension staff (currently at 1:1,800 against the recommended average of 1:400), Resource based conflicts, limited logistics in terms of vehicles, motorbikes and office infrastructure. Other emerging challenges include migratory pest (Desert locust), Covid 19, Antimicrobial resistance and increased chemical residues in products).

- It causes increased livestock mortality and morbidity, low livestock productivity, closure of livestock market, reduced household income consequently increased household vulnerability and poverty.
- These are development challenges within the county since they divert development resources and productive labour in the delivery of services.
- The traditional knowledge of livestock farmers is not sufficient to deal with many diseases. Public services can only provide support during large outbreaks, but not routine control.
- Early warning systems do not support sufficient early warning information and support.
- Access to veterinary services and medicines from both public and private providers of animal health services is limited.

v. Human

   The biggest challenges in providing health care services in the Ward are the vastness of the region with poorly developed road networks, frequent disease outbreaks which are frequently brought about by sporadic climatic variability, poor sanitation, influx and the presence of large population of communities from the neighbouring counties and wards, recurrent hazards like drought and floods which are a major occurrence in the county.

vi. Conflict

Conflict over natural resources is commonplace in Garissa especially among pastoralist communities. Their conflicts involve disagreements around water and grazing sites, administrative and constituency boundaries. When the balance between clans is frequently lost, violence escalates beyond control. Many ofthese are even driven by external forces, with political and commercial interests.

Loss of life/injuries: Pastoral conflicts in most cases lead to some injuries and often result in considerable loss of life and property and maiming of people, particularly when they are armed conflicts or external-directed. The exact numbers of those who suffer or succumb to the wrath of the conflicts every year in Garissa County is not very clear since most often fatalities are not reported although number of events make it evident that there are indeed a very large number of fatalities and injuries.

Destitution and displacement of people: An internally displaced person is someone who is forced to flee his or her home but who remains within his or her country's borders. The large displacement from the region results from violent eviction or voluntary out-migration, or simply loss of all assets, property and livelihoods, and hence no option but to join relief camps. Due to Conflict, peasants have to run away from the agricultural zone for fear of loss of life.

Overexploitation of resources: The increased number of refugees in Dadaab camp due to conflicts causes overuse of resources in a region. For example, the number of refugees in the Dadaab camp keeps on increasing. Large numbers of refugees' camps have negative environmental impacts such as deforestation and water depletion. In addition, the increased demand for firewood for cooking has put a strain on the environment. Refugees now move long distances from the camps, leading to conflict with the host communities. Depletion of the underground water supplies is an additional concern. The refugee area lies on an aquifer, but the underground water level is receding.

Environmental degradation: The sustainable use of pastoral rangelands depends in large measure on mobility, which allows for rotational use of wet and dry season grazing areas. Mobility is the first and major casualty of conflict as the resulting insecurity forces the community to concentrate livestock within a fraction of its former territory. Loss of access to grazing land and water sources puts the pastoral system under pressure and gradually reduces its self-sufficiency. This means that the land use system is no longer able to respond to ecological and climatic variability resulting in ecological degradation.

Socioeconomic cost: Infrastructure, capital stock and household assets are destroyed during conflict, investment declines, and household and national incomes drop. The loss of livelihoods, due in part to the destruction of infrastructure and natural resources, and lack of employment opportunities coincides with a weakened social safety net and a decline in the capacity of the state to provide services, such as health and education. Socioeconomic indicators demonstrate that impacts of conflict include declining literacy, a drop in life expectancy and increased infant mortality.

2.6   Spatial Distribution of Risks

Common risks in Garissa County ward include.
- Poor pasture and browse
- Water shortage/ scarcity
- Environmental degradation
- Conflict and Insecurity
- High costs for water (own water tracking)
- Below normal rainfall
- Low livestock prices
- Disease outbreaks
- Long trekking distance to water sources
- Displacement and migration

Table 2.6: Attribute climate risks at different wards in Garissa County

Hazard	**Risks**	**Wards**
Drought	• Water scarcity • Food insecurity • Livestock mortality • Increased resource based conflicts • Environmental Degradation • Displacement and migration • Increased Pest & Diseases prevalence • Increased dependency of relief aid	Madogashe, Maalimin, Sabena, Goreale, Banane, Baraki Dadaab, labasigale, liboi, Damajale, Dertu, Abakaile, Fafi, Jarajila, Bura, Dekaharja, Nanighi, hulugho, Sangailu, Ijara, Masalani, Danyere, Jarajara, Balambala, Sankuri, Saka, Galbet, Iftin, Wagberi & Town
Floods	• Property damage and loss • Loss of lives and livelihoods • Crop and livestock loss • Food insecurity • Water contamination • Disruption of social services • Infrastructure damage • Increased vulnerability to diseases • Increased erosion & sedimentation • Dependency of relief aid	Madogashe, Maalimin, Sabena, Goreale, Banane, Baraki Dadaab, labasigale, liboi, Damajale, Dertu, Abakaile, Fafi, Jarajila, Bura, Dekaharja, Nanighi, hulugho, Sangailu, Ijara, Masalani, Danyere, Jarajara, Balambala, Sankuri, Saka, Galbet, Iftin, Wagberi & Town
Pest and diseases	• Reduced livestock health & productivity • Loss of livestock and crop • Food insecurity concerns • Trade restrictions • Limited inputs to inputs and markets	Madogashe, Maalimin, Sabena, Goreale, Banane, Baraki, Dadaab, labasigale, liboi, Damajale, Dertu, Abakaile, Fafi, Jarajila, Bura, Dekaharja, Nanighi, hulugho, Sangailu, Ijara, Masalani, Danyere, Jarajara, Balambala, Sankuri, Saka, Galbet, Iftin, Wagberi & Township

	• Increased cost for control measures • Dependency on chemical inputs • Food safety concerns • Loss biodiversity	

Key Takeaways

- Climate indicators show of a warming Garissa County and a lack (scarcity) of precipitation (rainfall).
- Garissa is prone to a number of climatic hazards, the main ones being droughts, floods and pests and diseases.
- In recent years, it has been observed that these hazards have been increasing in frequency and intensity.
- Economic activities, developed structures, existing natural resources, and population (varied in terms of sex and economic livelihood) in Garissa County are exposed to these climatic hazards.
- The severity of these climatic hazards is spatially distributed with identifiable hotspots/ areas.
- In general, the impacts of these climatic hazards are negative and detrimental to livelihoods and many a times leading to human and livestock mortality.

3   FUTURE CLIMATE SCENARIOS FOR THE COUNTY

3.1   Introduction

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Inter-comparison Project No.5) data ensemble, which builds the database for the global climate change projections presented in the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e., RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. Monthly Climatology is provided for in fig. 3.1.

Figure 3.1: Monthly mean, min and max temperature and precipitation, Kenya (1991 - 20200
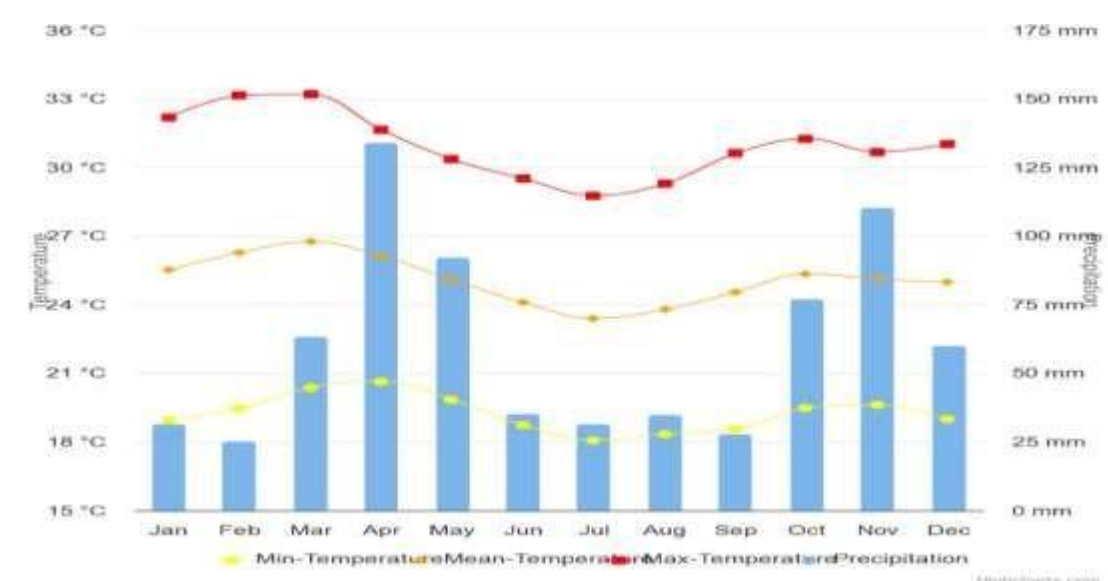
3.2   National and Downscaled Climate Change Projections

Temperatures in Kenya are projected to continue rising by 1.7°C by the 2050s and by approximately 3.5°C at the end of the century (Table 1).24 Additionally, the number of hot days and nights will increase, with 'hot days' projected to occur on 19%–45% of days by mid-century. Hot nights are expected to increase more quickly, projected to occur on 45%–75% of nights by mid-century and on 64%–93% of nights by end of century. Cold days and nights are expected to become increasingly rare.

Table 3.1: CMIPS ensemble projections under RCP 8.5

[1]CMIP 5 Ensemble Projection	2020-2039	2040-2059	2060-2079	2080-2099
Annual Temperature Anomaly (°C)	+0.5 to +2.4 (+ 1.0°C)	+1.2 to + 2.4 (+1.7 °C)	+2.0 to +3.7 (+2.5°C)	+2.7 to +5.1 (+3.5°C)
Annual Precipitation Anomaly (mm)	-13.7 to 21.6 (2.6 mm)	-17.1 to + 25.2 (3.5 mm)	-17.0 to +34.0 (6.7 mm)	-17.8 to 44.0 (10.5 mm)

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[1] *Bold values are the range (10th to 90th Percentile) and values in parenthesis show the median (or 50th Percentile)*

Figure 3.2: Projected precipitation for Kenya (1995 - 2100) with reference to 1995-2014 period
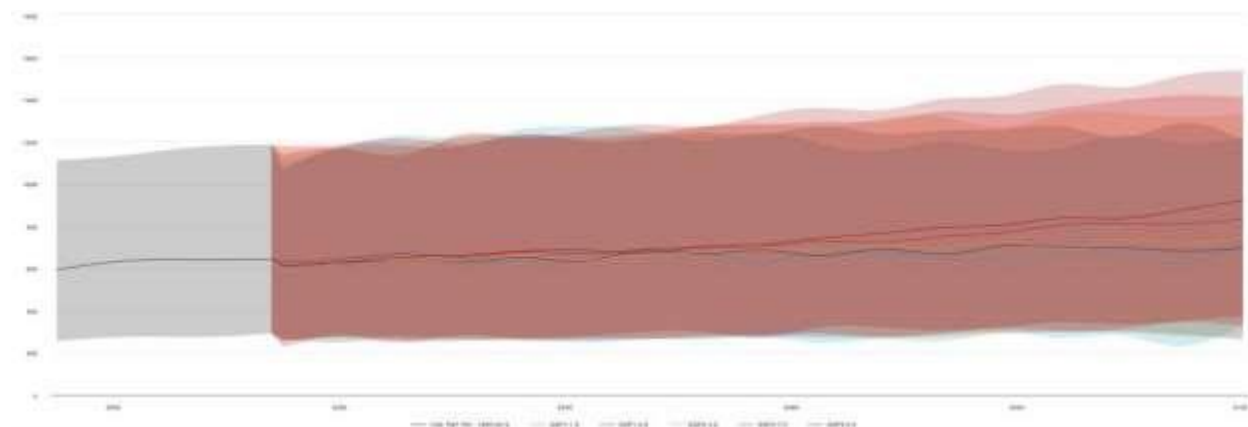
Across all emissions scenarios, temperatures in Kenya will continue to rise. As shown in

, under a high-emission scenario (RCP 8.5), average temperatures are expected to increase rapidly by mid-century. Increased heat and extreme heat conditions will result in significant implications for human and animal health, agriculture, and ecosystems.

Figure 3.3: Projected mean temperature for Kenya (1995 - 2100) with reference to 1995-2014 period
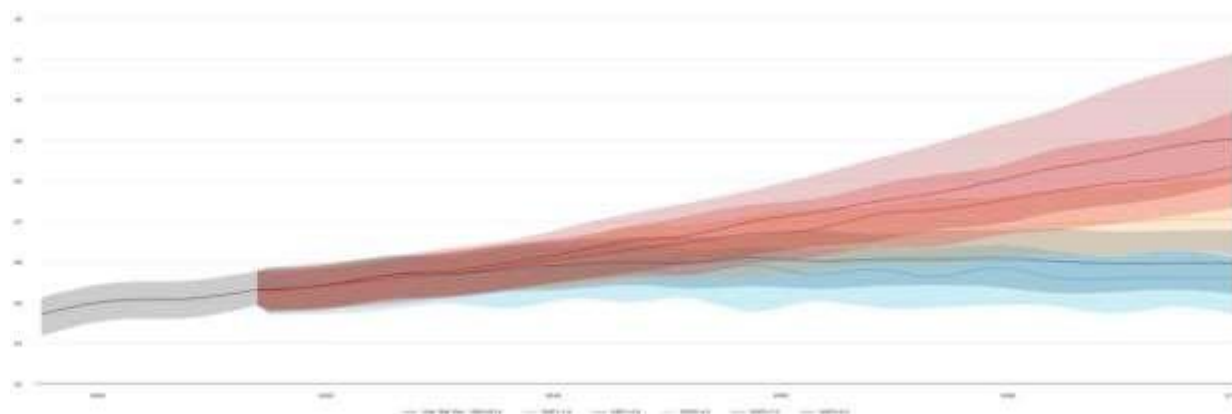
Precipitation in Kenya is projected to remain highly variable and uncertain, however average rainfall is expected to increase by mid-century, particularly during the 'short rains', which occur between October and December. Extreme rainfall events are also expected to increase in frequency, duration and intensity and the proportion of heavy rainfall that occurs in heavy events will increase. However, the period between heavy rainfall events may increase. Importantly, rainfall in the arid zones are generally projected to decrease. As seen in

, annual average precipitation is expected to increase slightly by the of the century under a high emissions scenario (RCP8.5).

3.3   County Future Climate Scenarios

Downscaling the information above shows agreements with global projections for Northeastern Kenya as per the analysis shows that the region will be experiencing an increase of about 0.6 ºC temperature throughout the century to a high of mean temperature of 31.41ºC as shown in table 3.2.

Table 3.2: CMIP 6 Projections of annual temperature and precipitation for scenario 8.5

CMIP 6 Ensemble Projection	2020-2039	2040-2059	2060-2079	2080-2099
Annual Temperature Anomaly (ºC)	**27.71 - 28.74 ºC** (28.31ºC)	**28.54 - 29.93ºC** (29.12 ºC)	**29.19 – 31.19 ºC** (30.11ºC)	**30.20 – 33.26ºC** (+31.41ºC)
Annual Precipitation Anomaly (mm)	512.86 mm	529.76 mm	608.08 mm	694.28 mm

For all the time period analyzed, precipitation is expected to have an increase in precipitation in the OND season (fig. 3.5), while the other months remain mostly dry. In the mid of century, MAM rains are expected to persist through the months and to the OND season. Temperatures are expected to be very high in January – May and to decline slightly to the OND season (fig. 3.4).

Figure 3.4: Projected mean temperature for Northeastern Kenya for scenario 8.5
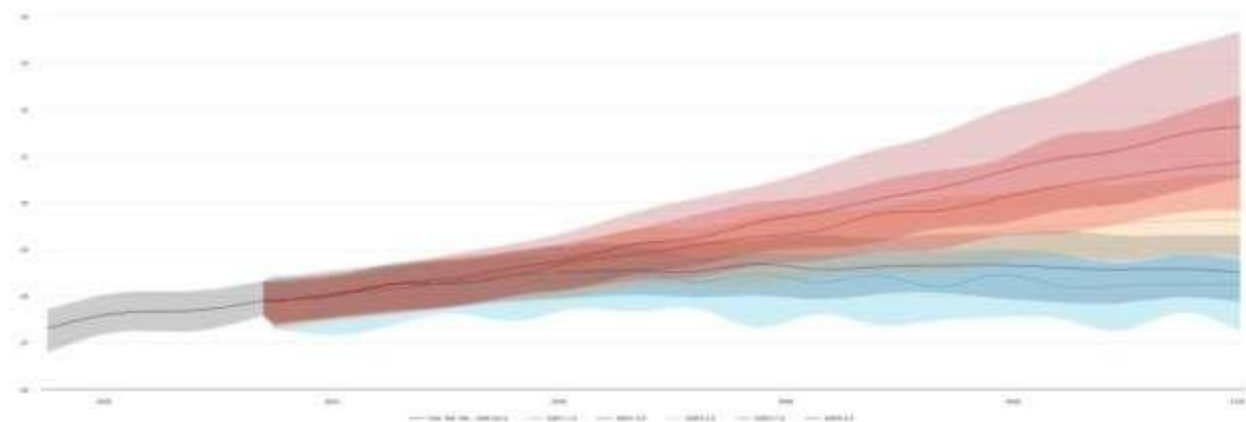
Figure 3.5: Projected precipitation trends for Northeastern Kenya under scenario 8.5
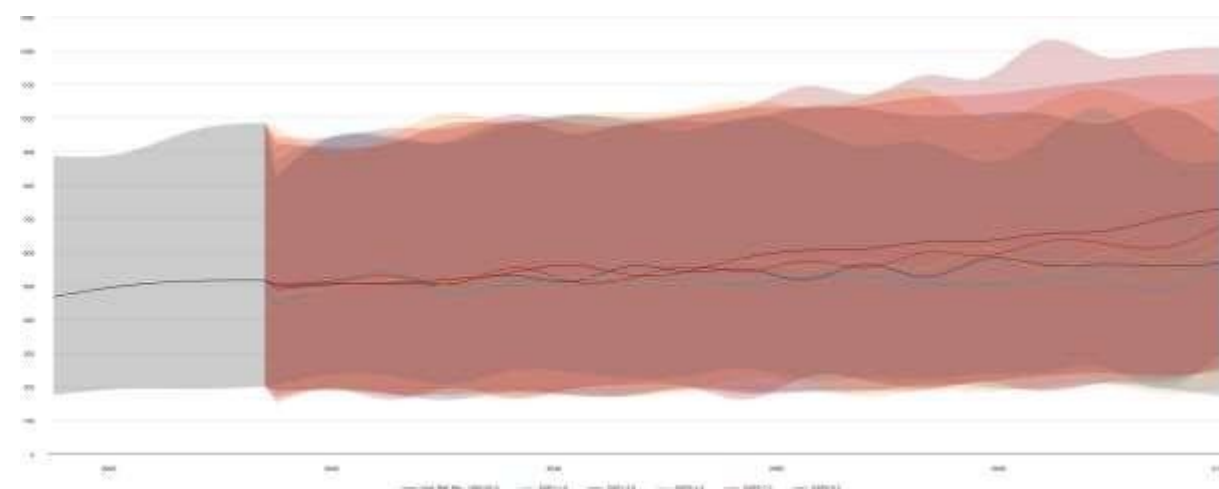
Figure 3.6: Rainfall on-set dates.
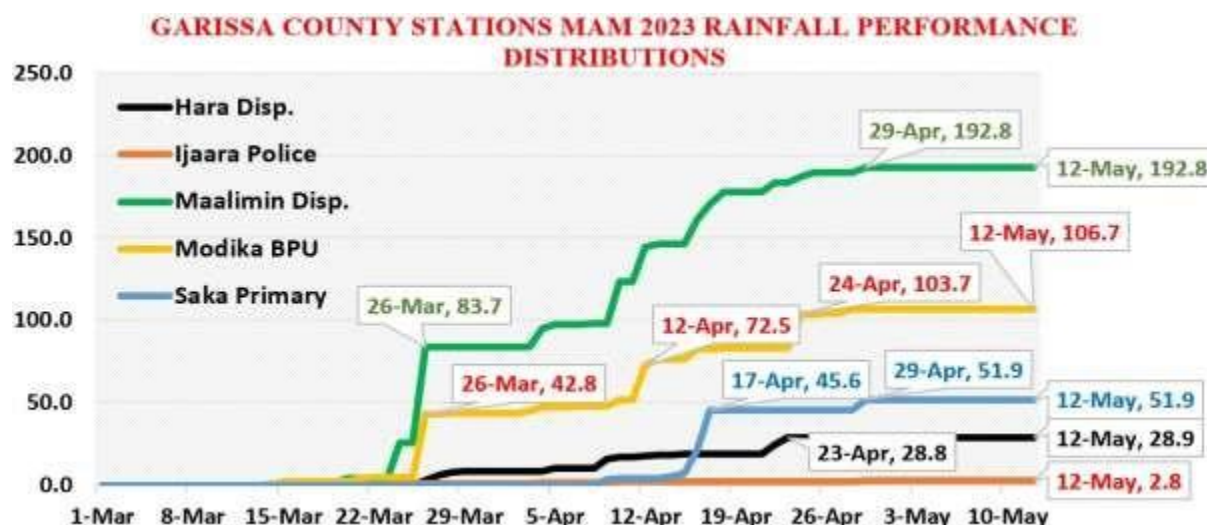
Key Takeaways

Overall, hazard causative weather patterns are projected to change in the century.

- Temperatures are expected to increase in the region resulting to drier conditions.
- Precipitation, overall, will increase but only for the OND season.
- Precipitation in other months will be reduced.
- Onset and cessation dates of rainfall are expected to change. This phenomenon has already been registered in the MAM. Onset dates have at times changed by over 2 weeks while OND has generally changed by 1 week.
- Vulnerable and exposed population will increase.

4 ANALYSIS OF EXISTING RESILIENCE/ ADAPTATION STRATEGIES TO CURRENT AND FUTURE CLIMATE RISKS

4.1 Overview of Existing Adaptation/ Resilience Strategies and their Effectiveness

Adaptation/resilience strategies for enhanced livelihoods to overcome climate risks and shocks involves planning for climate impacts, building resilience to those impacts, and improving society's capacity to respond and recover. This can help reduce damages and disruptions associated with climate change, The strategies include rehabilitation of strategic boreholes (Table 4.1), enhance large scale fodder production and preservation, restoration of degraded rangelands, integration climate service information – Early warning system, promotion of flood tolerant variety of crops and trees,development of flood control dams along seasonal and permanent rivers, improve vectors and disease surveillance and response, improve animal health service delivery, increase the resilience of livestock systems, legalize, revive and strengthen community peace and resource based institution structures and norms, develop climate friendly peace and conflict management policies and train and capacity build community and stakeholders

Table 4.1: Increase in the construction of boreholes to address water scarcity in Garissa.

Sub-County	Boreholes		Water pans		Bowsers		Water Tracking				
	2016-2017	2020-2023	2016-2017	2020-2023	2016-2017	2020-2023	2016	2017	2020	2021	2022
Balambala	12	32	28	35	0	2	18	20	38	40	42
Dadaab	50	55	26	26	0	1	5	10	15	18	20
Fafi	15	25	38	44	0	1	22	33	32	43	51
Hulugho	2	4	44	47	0	1	5	6	10	11	13
Ijara	2	4	41	45	0	1	5	8	10	13	14
Lagdera	10	15	30	38	0	2	20	25	40	45	51
Township	5	12	3	5	5	4	5	8	15	23	24

4.2   Effectiveness of Adaptation/ Resilience Strategies to Future Climate Risks

The adaptation/resilience strategies proposed were considered as highly effective for the vulnerable to overcome the current and future climate risks and shocks.

Table 4.2: Effectiveness of adaptation/resilience strategies to future climate risks

Hazard	Livelihood/Economic System	Climate Adaptation/Resilience Strategies	Current Effectiveness of the Strategy + (Low) ++ (medium) +++ (High)	Future Effectiveness of the Strategy + (Low) ++ (medium) +++ (High)	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Drought	**Pastoral Livelihoods**	Provision of water storage facilities & Water trucking	++	+	County Government, water department, /National Government /Development partners, & well-wishers	Develop gender and social inclusion framework and action plan
		Rehabilitation of strategic boreholes	+++	+++	County Government, water department, /National Government, Development partners & well-wishers	Develop gender and social inclusion framework and action plan
		Community Contribution of food items to the most vulnerable (HERSI)	++	+	Community and well-wishers	Develop gender and social inclusion framework and action plan
		Relief food distribution by the government and partners	++	+	County Government, /National Government /development partners, & well-wishers	Develop gender and social inclusion framework and action plan
		Procurement and distribution of Livestock supplementary feeds by Government and NGOs	++	+	County Government, /National Government /development partners, & well-wishers	Develop gender and social inclusion framework and action plan
		Cash transfer to food insecure households	+++	++	National Government /Development partners & well-wishers	Develop gender and social inclusion framework and action plan
		Enhance large scale fodder production and preservation	+++	+++	Community, Farmers, County government, National government, Development partners	Develop gender and social inclusion framework and action plan
		Rangeland restoration through reseeding,	++	+++	Community, Farmers, Conservancies, County	..

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				government, National government, Development partners	
	Early action and dialogue by community peace elders	++	+++	Community, peace committees, Conservancies, County government, National government, Development partners	
	Migration to Urban centers	++	+	Affected Community, Host community, Ministry of interior, National and County Administration, Development partners, Well-wishers	
	Herd separation and Migration to areas with pasture and water	++	+	Affected Community, Host community, Ministry of interior, National and County Administration, Development partners, Well-wishers	
	Community managed land use planning	++	+++	Range resource management committees, Communities, County livestock dept, Ministry of interior, Lands department,	
	Leasing of pastureland for grazing	++	+	Range resource management committees, Communities, County livestock dept, Ministry of interior, Lands department,	
	Linkage to grants, affordable credit facilities – revolving funds, Carbon credit	+	+++	Microfinance institutions, County Governments, Development partners, GEF, GCF	
	Enhancing Livestock offtake programs	++	+++	Livestock traders, producers, county government, National government - KMC, Development partners,	
	Conservation of pasture to be utilized during lean season	++	+++	Farmers, County department of livestock, Administration,	
	Integration climate service information – Early warning system	++	+++	KMD, NDMA, CCD, County government, Development partners,	
	Provision of school feeding program by Government	++	+++	National government, County government, Development partners,	

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		Provision of water storage facilities and water trucking to schools	++	+	County Government, National Government, Development partners, Well-wishers
		Promotion of drought tolerant species/breeds of livestock	++	+++	County department of livestock, State department for Livestock, KALRO, ILRI, Development partners,
		Forage index-based Livestock insurance programs	++	+++	Communities, County Government, National Government, Development partners, Private insurance Companies,
		Targeted research to improve knowledge and adaptation on climate change related impacts: - Pasture and fodder health in the rangelands, - Soils suitability for pasture and fodder production - Emerging and re-emerging Livestock diseases and Zoonosis	++	+++	National Government, KALRO, ILRI, Universities, County Government, Communities, Development partners,
	Agro-pastoral Livelihoods	Promotion of climate smart crop production – Drought tolerant crop varieties, conservation Agriculture	+	+++	County Government, KALRO, Development partners,
		Promotion of more efficient irrigation systems – Solar irrigation, use of closed conduit for water conveyance, lining of irrigation of canals, drip irrigation,	+	+++	County Government, KALRO, Development partners, Farmers,
		Enhance fodder production and preservation	+	+++	County Government, KALRO, Development partners, Farmers
		Linkage to affordable credit facilities – revolving funds, Carbon credit	+	+++	Microfinance institutions, County Governments, Development partners, GEF, GCF
		Promotion of Agroforestry technologies – Fruit trees	+	+++	Farmers, KFS, KEFRI, County Government, KALRO, Development partners,
		Map and maintain watering corridors (Malkas) along the river	++	+++	Farmers, Interior, County Government, KWS, Conservancies,
	Employment/	Enhance diversification of products and services	++	+++	Kenya National Chamber of Commerce and Industry,

	Wage/Businesses	Linkage to affordable credit facilities – revolving funds,	+	+++	Microfinance institutions, County Governments, Development partners, GEF, GCF	
		Enhance on business skills development/entrepreneurshipdevelopment	+	+++	County government, development partners and private service providers	
Floods	**Pastoral Livelihoods (Flash floods)**	Migration to higher/safer grounds	++	+	Local Community, Department of Special programmes, Ministry of Interior, KRC	Bulk SMSs, composition of multi-sector team
		Enhancement of Livestock - crop diversification				
		Integration climate service information – Early warning system	+	+++	Department of Special programmes, KMD, NDMA, WFP, Department of Agriculture, Livestock & Pastoral Economy	
		Promotion of climate smart agriculture	+	+++	Department of Water, Department of Agriculture, Livestock & Pastoral Economy, Department of Environment, WFP	
		Development of flood control dams (250M^3 liters) along seasonal and permanent rivers	+	+++	Department of Water, NDMA, NIA	Involvement of all stakeholders in conception, planning, resource mobilization and implementation
		Relief food and non-food items distribution by the government and partners	++	+	KRC, WFP, Ministry of Interior	Target to the vulnerable groups (women, children, elderly, PLWDs and other minorities)
	Agro pastoral (Flash & River floods)	Riverbank protection – Agroforestry, Gabions,	+	+++	Department of Water, Department of Agriculture, Livestock & Pastoral Economy, Department of Environment, WFP	Involvement of all stakeholders in conception, planning, resource mobilization and implementation
		Diversion of flood waters into reservoirs in the hinterlands,	+	+++	Department of Water, NIA, WRA	"
		Protection and restoration of degraded areas	+	+++	KFS, KEFRI, NEMA, County Government, Development partners,	
		Development of mega water pans/dams (250M^3 liters) along rivers	+	+++	Department of Water, NDMA, NIA	"

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		Migration to higher/safer grounds	++	+	Local Community, Department of Special programmes, Ministry of Interior, KRC	
		Adoption of flood-proof irrigation infrastructure (closed conduits)	+	++	Department of Agriculture, Livestock & Pastoral Economy, Dept. Of Irrigation, WFP	
		Provision of food and non-food items	++	+	KRC, WFP, Ministry of Interior	
		Promotion of proper sewers and drainage systems	+	+++	National government, County government, Municipality, Development partners,	
		Seeking alternative livelihoods	+	++	Local Community, Dept. Of Special programmes, Dept. Of Trade, Dept. of Gender & Social services	
	Employment/ Wage/Busines sses	Migration to safer grounds, or neighboring markets	++	+	Local Community, Department of Special programmes, Ministry of Interior, KRC	
		Seeking alternative businesses	+	++	Local Community, Dept. Of Special programmes, Dept. Of Trade, Dept of Gender & Social services	
Pests and Diseases	**Pastoral Livelihood**	**Improve Vectors and disease surveillance and response** – Risk based and participatory surveillance (investment and innovation in diseases surveillance system and laboratory capable of confirming diseases)	+	+++	Public and private veterinary and human health service providers, One health units in the Counties, Communities (CDRs, CHWs)	Gender and social inclusion action plans
		Increase the **capacity to forecast** near term occurrence of climate sensitive diseases, and to predict longer term distribution of diseases **through epidemiological models,**	+	+++	Public and private epidemiologists, One health units in the Counties, Communities (CDRs, CHWs)	
		Improve animal health service delivery by investing in the public sector and supporting innovations in the private sector (community animal health workers linked to private veterinarians. Promote "One Health" and Eco health approaches, Community managed vector control facilities)	+	+++	Public and private veterinary and human health service providers, One health units in the Counties, Communities (CDRs, CHWs)	

		Increase the resilience of livestock systems by supporting diversification of livestock and livelihoods, and integrating livestock farming with agriculture (Consider promotion of species and breeds that are more resistant to disease and climate change)	+	+++	Pastoralist, Agro pastoralist, Public and private livestock extension providers, KALRO, ILRI	
		Adopt evidence-based breeding programs focused on identifying and improving breeds that are better adapted to climate change impacts and disease.	+	+++	Pastoralist, Agro pastoralist, Public and private livestock extension providers, KALRO, ILRI	
		Understand the **potential land use** changes in response to climate change and monitor their impacts on animal disease to allow preventive or remedial actions.	+	+++	Pastoralist, Agro pastoralist, Public and private livestock extension providers, KALRO, ILRI	
	Agro-pastoral Livelihood	Adoption of Integrated Pest Management	+	+++	DoA, KCSAP, ASDSP, ELRP, Farmers,	
		Adoption of disease resistant breeds and crop varieties	+	+++	Agro pastoralist, Public and private livestock extension providers, KALRO, ILRI	
		Pest and diseases Surveillance and Farm pest scouting	+	+++	Agro pastoralist, Public and private livestock extension providers, KALRO, ILRI	
	Employment/ Wages/Businesses	Enhanced Vector and diseases surveillance and control	+	+++	County government of health, vet services, development partners, National government, Municipality	
		Enhanced vaccination of livestock and immunization of humans	++	+++	County government of health, vet services, development partners, National government, Municipality	
		Promotion of proper sewers and drainage systems	+	+++	National government, County government, Municipality, Development partners,	
Climate Induced Resource	**Pastoral Livelihood**	Legalize, revive and strengthen community peace and resource based institution structures and norms to strengthen	+++	+++	NDMA, IUCN, WFP, FAO, Swiss Embassy, FCDC, Min. Agriculture &Livestock, Office	Gender and Social inclusion action plans

Based Conflicts		surveillance, early warning systems & mechanism for resource sharing & dispute resolution mechanisms to overcome climate risks			of the President, National Steering Committee on Peacebuilding & Conflict Management (NSCPCM), Mercy Corp	
		Develop climate friendly peace and conflict management policies to build bridges across communities, counties, and countries	+++	+++	NDMA, IUCN, WFP, FAO, Swiss Embassy, FCDC, Office of the President, National Steering Committee on Peacebuilding & Conflict Management (NSCPCM), Mercy Corp	
		Provide adequate social protection programmes	+++	++	Ministry of interior, office of the president, county government, development partners	
		Increase information on resource-based conflicts	+++	+++	Ministry of interior, office of the president, county government, development partners, community	
		Increase cross-border joint resource management to build bridges across communities, counties and countries	+++	+++	Ministry of interior, office of the president, county government, development partners, community	
		Mainstream peacebuilding and conflict prevention and resolution strategies in all sectors	+++	++	Ministry of interior, office of the president, county government, development partners, community	
		Develop socio-economic infrastructure (roads, mobile networks, security, education, health and early warning systems)	+++	++		
		Promote youth and women socio-economic initiatives to diversify and provide alternative livelihoods	+++	++		
		Focused research into root causes of conflicts for sustainable peace and development	+++	+++		
		Train and capacity build community and stakeholders to overcome conflicts, build peace and enhance productivity	+++	+++		
		Regular joint peace caravans for the conflicting communities and their leaders	+++	+++		

		Revise land use plans to be compliant to traditional system for sustainable wet and dry season system adapted to climate risks	+++	+++	
		Clear markings of county, sub-county and community boundaries for sustainable peace and development	+++	++	
		Disarmament of the communities, militias, and herders of all illegal firearms by way of compulsion and amnesty	+++	++	
	Agro-pastoral Livelihood	Legalize, revive and strengthen community peace and resource-based institution structures and norms to strengthen surveillance, early warning systems & mechanism for resource sharing & dispute resolution mechanisms to overcome climate risks	+++	+++	
		Develop climate friendly peace and conflict management policies to build bridges across communities, counties and countries	+++	+++	
		Provide adequate social protection programmes	+++	++	
		Increase information on resource-based conflicts	+++	+++	
		Increase cross-border joint resource management to build bridges across communities, counties and countries	+++	+++	
		Mainstream peacebuilding and conflict prevention and resolution strategies in all sectors	+++	++	
		Develop socio-economic infrastructure (roads, mobile networks, security, education, health and early warning systems)	+++	++	
		Promote youth and women socio-economic initiatives to diversify and provide alternative livelihoods	+++	++	
		Focused research into root causes of conflicts for sustainable peace and development	+++	+++	

		Train and capacity build community and stakeholders to overcome conflicts, build peace and enhance productivity	+++	+++	
		Regular joint peace caravans for the conflicting communities and their leaders	+++	+++	
		Revise land use plans to be compliant to traditional system for sustainable wet and dry season system adapted to climate risks	+++	+++	
		Clear markings of county, sub-county and community boundaries for sustainable peace and development	+++	++	
		Disarmament of the communities, militias, and herders of all illegal firearms by way of compulsion and amnesty	+++	++	
	Employment/ Wages/Busine sses	Develop climate friendly peace and conflict management policies to build bridges across communities, counties and countries	+++	+++	
		Provide adequate social protection programmes	+++	++	
		Increase information on resource-based conflicts	+++	+++	
		Mainstream peacebuilding and conflict prevention and resolution strategies in all sectors	+++	+++	
		Develop socio-economic infrastructure (roads, mobile networks, security, education, health and early warning systems)	+++	+++	
		Promote youth and women socio-economic initiatives to diversify and provide alternative livelihoods	+++	++	
		Focused research into root causes of conflicts for sustainable peace and development	+++	+++	
		Train and capacity build community and stakeholders to overcome conflicts, build peace and enhance productivity	+++	+++	
		Regular joint peace caravans for the conflicting communities and their leaders	+++	+++	

		Clear markings of county, sub-county and community boundaries for sustainable peace and development	+++	++	
		Disarmament of the communities, militias, and herders of all illegal firearms by way of compulsion and amnesty	+++	++	

4.3   Garissa County Climate Strategic Adaptation Investment/ Action Priorities

The PCRA takes cognizance of the climate hazards in the county and their impacts on all the livelihoods and socio-economic sectors and focuses on the adaptation strategies. From the data findings in the wards, this chapter, takes a cross-sectoral perspective and focus on strategic investment priorities that strengthen the adaptive capacity and resilience of socio-economic systems that are in line with the third generation CIDP. The strategic adaptation investments address the needs of all vulnerable wards/populations/communities to enhance their resilience.

Table 4.3: County strategic adaptation investment/action priorities

Hazard	#	Priority Areas of Investment
Drought	1	Rehabilitation of strategic boreholes
	2	Enhance large scale fodder production and preservation (Conservation of pasture to be utilized during lean season)
	3	Restoration of degraded rangelands
	4	Early action and dialogue by community peace elders
	5	Community managed land use planning (Map and maintain watering corridors (Malka's) along the river)
	6	Linkage to grants, affordable credit facilities – revolving funds, Carbon credit
	7	Enhancing Livestock offtake programs
	8	Integration of climate service information – Early warning system
	9	Provision of school feeding program by Government
	10	Promotion of drought tolerant species/breeds of livestock
	11	Targeted research to improve knowledge and adaptation on climate change related impacts: • Pasture and fodder health in the rangelands, • Soils suitability for pasture and fodder production • Emerging and re-emerging Livestock diseases and Zoonosis (Understand the **potential land use** changes in response to climate change and monitor their impacts on animal disease to allow preventive or remedial actions) • Peace and conflict
	12	Promotion of climate smart crop production – Drought tolerant crop varieties, conservation Agriculture
	13	Promotion of more efficient irrigation systems – Solar irrigation, use of closed conduit for water conveyance, lining of irrigation of canals, drip irrigation,
	14	Linkage to affordable credit facilities – revolving funds, Carbon credit
	15	Promotion of Agroforestry technologies – Fruit trees
	16	Enhance diversification of products and services
	17	Enhance on business skills development/entrepreneurship development
FLOODS	1	Integration climate service information – Early warning system
	2	Promotion of flood tolerant variety of crops and trees
	3	Development of flood control dams (250M^3 liters) along seasonal and permanent rivers
	4	Riverbank protection – Agroforestry, Gabions,
	5	Diversion of flood waters into reservoirs in the hinterlands,
	6	Protection and restoration of degraded areas
	7	Promotion of proper sewers and drainage systems
Climate Induced Pest, Vectors and Diseases	1	**Improve Vectors and disease surveillance and response** – Risk based and participatory surveillance (investment and innovation in diseases surveillance system and laboratory capable of confirming diseases)
	2	Increase the **capacity to forecast** near term occurrence of climate sensitive diseases, and to predict longer term distribution of diseases **through epidemiological models,**

Hazard	#	Priority Areas of Investment
	3	**Improve animal health service delivery** by investing in the public sector and supporting innovations in the private sector (community animal health workers linked to private veterinarians. Promote "One Health" and Eco-health approaches, Community managed vector control facilities)
	4	**Increase the resilience of livestock systems** by supporting diversification of livestock and livelihoods, and integrating livestock farming with agriculture (Consider promotion of species and breeds that are more resistant to disease and climate change)
	5	**Adopt evidence-based breeding programs** focused on identifying and improving breeds that are better adapted to climate change impacts and disease.
Climate Induced Resource Based Conflicts	1	Legalize, revive and strengthen community peace and resource-based institution structures and norms to strengthen surveillance, early warning systems & mechanism for resource sharing & dispute resolution mechanisms to overcome climate risks
	2	Develop climate friendly peace and conflict management policies to build bridges across communities, counties, and countries
	3	Development of early warning system on peace and conflict (Increase information on resource-based conflicts)
	4	Increase cross-border joint resource management to build bridges across communities, counties and countries
	5	Focused research into root causes of conflicts for sustainable peace and development
	6	Train and capacity build community and stakeholders to overcome conflicts, build peace and enhance productivity
	7	Regular joint peace caravans for the conflicting communities and their leaders
	8	Revise land use plans to be compliant to traditional system for sustainable wet and dry season system adapted to climate risks

5   CONCLUSION

Garissa County boasts a wealth of natural and developed resources, which form the backbone of its population's livelihoods, predominantly centered around pastoralism and agropastoralism. These resources are intricately woven into the fabric of the community's way of life. However, in recent times, the county has grappled with escalating climate change-related challenges. These include a surge in climatic hazards such as droughts, floods, and outbreaks of pests and diseases. These hazards, in turn, have left the livelihoods of the population susceptible to significant risks of loss and damage.

Projections indicate that key climatic indicators, namely precipitation and temperature, are poised to rise in the coming century. However, these changes are anticipated to vary in magnitude and impact across different regions of the county. In response to these impending shifts, both communities and the government have taken proactive measures to fortify their resilience. These adaptive strategies serve as a vital buffer against the potential shocks that could be induced by these climatic hazards. They play a crucial role in safeguarding livelihoods and ensuring sustained well-being in the face of evolving environmental conditions.

Yet, despite commendable efforts, there remain discernible gaps in the existing adaptation strategies. These gaps translate to lingering vulnerabilities, leaving communities still exposed to the formidable challenges posed by climatic hazards. Recognizing these gaps is an essential step towards bolstering the county's preparedness and capacity to navigate a climate-altered future. Therefore, there is an imperative need to invest further in these adaptation strategies, bolstering the resilience of communities and mitigating the potential impacts of future climatic shifts. By doing so, Garissa County can foster a more sustainable and secure environment for its inhabitants, safeguarding their livelihoods and well-being in the face of a changing climate.

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