COUNTY GOVERNMENT OF TANA RIVER

DEPARTMENT OF ENVIRONMENT

AND

CLIMATE CHANGE

PARTICIPATORY CLIMATE RISK ASSESSMENT REPORT

OCTOBER 2023

FOREWORD

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Climate change is a major challenge to sustainable socio-economic development globally. In Kenya and many other developing Nations, the impact of climate change hazards has had far reaching impacts, resulting in huge budgetary implications in attempting to deal with the impacts of climate change and improve adaptive capacity of communities.

Effectively, development aspirations have been slowed down. In Tana River, these impacts have and continue to wear down the county's productive assets. The county has had very little resources to deal with emergencies resulting from the impacts of these changes in climate. Tana River County is therefore among the most vulnerable areas in Kenya with the climate related hazards posing challenges to the County's development agenda.

In recent years, the County has experienced long periods of drought, instances of increased resource-based conflicts, occasional flooding in selected parts of the county mostly resulting from overflows in River Tana, high incidences of crop/livestock pest and diseases, rising sea levels that have submerged parts of our coastline. Consequently, we have had instances of crop failures, livestock mortalities, water shortage, destruction of property, loss of vegetation, human displacements among other direct impacts.

Tana River County recognizes the danger posed by these hazards and is proud to partner with the National Treasury through the FLLoCA program to design effective programs, projects and policies that will address climate change adaptation and mitigation with a view to enhancing the adaptive capacities of our communities. My Department has dedicated resources to this course and will continue to do so in the long term.

This Participatory Climate Risk Assessment report identifies critical hazards, to improve the adaptive capacity and increasing resilience of communities. We have committed strategies and priority actions in line with our CIDP III to address these impacts locally.

We, in Tana River County, understand that climate change affects nearly all sectors of our economy. As a government, I give my commitment to integrate climate change adaptation and mitigation considerations across all sectors and will prioritize and allocate sufficient resources to deal with these impacts and contribute to the National and global aspirations as contained in the United Nations Framework Convention on Climate Change (UNFCCC).

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COUNTY CHIEF OFFICER
DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE
COUNTY GOVERNMENT OF TANA RIVER

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ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

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As a county we're very grateful for the support we received from FLLoCA secretariat and the The National Treasury including Mr. Peter Odhengo, Mr. Malik Aman, Dr. Maurice Pedo, Dr. Dan Adino, Mr. Molu Huqa, Madam TumpeyoBaari to mention just a few. We thank Council of Governors Secretariat starting with the Chair Mary Mwiti, Benson Muthoka, Wendy Mutania and Veronica Wanyora for their support in giving us real time information on the FLLoCA Program.

Many thanks goes to our partner World Food Programme (WFP) and Nature Kenya for their financial support during the PCRA exercise. I acknowledge the technical support and cooperation we received from Kenya Meteorological Department (KMD) and National Drought Management Authority (NDMA).

Special thanks goes to our facilitators who trained the Cross-Technical Working Group and taken them through the PCRA tool including Mr. WinstoneMiima (Vihiga County Director of Climate Change), Philip Looniyo (WFP), Yvonne Khaemba (IUCN) and Brenda Okongo (ADS Western).

I would like to appreciate the cross-sectoral technical working group led by the sub-county team leaders including Mr. Odera George (Tana Delta), Komora Elias (Tana River/Galole) and MaamunAbubakar(Tana North) for their tireless effort during field data collection. I'm also grateful for all sub-county administrators for assisting the field team with logistical support as well as mobilizing the community members during the field visits.

I extend my sincere gratitude to members of the community in all the 15 wards who dedicated their time to give information during PCRA field data collection. The special mention goes to all Ward Administrators, Ward Managers, Ward Climate Change Planning Committees, the Ward Disaster Risk Management Committees and Local Chiefs/Assistant Chiefs.

While I am not able to mention each person individually, I am sincerely grateful to each person who in one way or another contributed to the success of this PCRA report.

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KUSO HUSSEIN KUSO
COUNTY DIRECTOR CLIMATE CHANGE
TANA RIVER COUNTY

EXECUTIVE SUMMARY

Climate change and its related impacts have increased over the years, negatively affecting the development agenda. This is particularly true in developing Nations which unfortunately contribute the least to global greenhouse gas emissions, but suffer the greatest impacts. Nations across the world are working round the clock to combat and/or increase the resilience of their populations by promoting best adaptation strategies.

In the process of working to combat and/or increase the resilience of communities, the County Government of Tana River is developing the County Climate Change Action Plan. The process of developing the plan requires that a County Participatory Climate Risk Assessment (PCRA) report be prepared from data collected from the communities in their respective Wards.

The County PCRA report therefore, consolidates the information on climate hazards generated during the ward level PCRA exercise and came up with adaptation strategies and actions that the County will adopt to respond to climate change impacts across all sectors.

The First Chapter of the report gives the background information on climate change at global, regional, national and county level and adaptation measures taken by the mention categories. It also provides a brief on the process taken by the County Government of Tana River in response to climate change and formation of PCRA.

Chapter Two covers on the profile of the County on climate hazards giving its current and historical hazards and trends with their distribution in space. It also provides the vulnerability profile of key interest groups and livelihood systems to climate change.

Chapter Threes provides the future climate scenario for the County and their impacts. It focused on latest national climate change projections as well as downscaled projections to County level.

Chapter Four describes the existing climate adaptation/resilience strategies differentiated by livelihood and economic systems and the stakeholders applying them. It also examined the effectiveness of the strategies and identified additional measures.

Chapter Five describes the climate change adaptation/mitigation plans to be executed as proposed by communities during the PCRA exercise conducted across all the wards. Under this specific priority interventions/activity are documented, the actors and timeline for which an action is implemented.

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ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semiarid Lands
ASDSP	Agricultural Sector Support Programme
BMU	Beach Management Unit
CCCAP	County Climate Change Action Plan
CBOs	Community Based Organizations
CCIS	County Climate Institutional Support
CCRI	County Climate Resilience Investment
CECM	County Executive Committee Member
CFA	Community Forest Association
CIDP	County Integrated Development Plan
CGL	County Government of Lamu
^{0}C	Degree Celsius
DRM	Disaster Risk Management
EMCA	Environment Management and Coordination Act
FLLoCA	Financing Locally-Led Climate Action
ITCZ	Intertropical Convergence Zone
IUCN	International Union for the Conservation of Nature
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Programme
KEFRI	Kenya Forestry Research Institute
KMFRI	Kenya Marine and Fisheries Research Institute
KEMFSED	Kenya Marine Fisheries and Socio-Economic Development
KeNHA	Kenya National Highways Authority
KEPHIS	Kenya Plant Health Inspectorate Service
KFS	Kenya Forest Service
KMD	Kenya Meteorological Department
KWS	Kenya Wildlife Service
TAWASCO	Tana Water and Sanitation Company
MCAs	Members of the County Assembly
MPCs	Minimum Performance Conditions
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution

NDMA	National Drought Management Authority
NDMU	National Disaster Management Unit
NEMA	National Environment Management Authority
NGAO	National Government Officers
NK	Nature Kenya
NMK	National Museums of Kenya
NRT	Northern Rangelands Trust
PCRA	Participatory Climate Risk Assessment
TNC	The Nature Conservancy
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change
WRA	Water Resources Authority
WV	World Vision
WSTF	Water Sector Trust Fund

DEFINITION OF TERMS

Adaptation: Adjustment in natural or human system in response to actual or expected climatic stimuli or their effects in order to moderate harm or exploit beneficial opportunities.

Adaptive Capacity: The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Afforestation: Planting of new forests on lands that historically have not contained forests.

Assets- Resource with economic value that is owned or controlled with expectation of future benefits

Biodiversity: The variability among living organisms from terrestrial, marine and other ecosystems. Biodiversity includes variability at the genetic, species and ecosystem levels.

Carbon Sequestration: The uptake of carbon containing substances, in particular carbon dioxide (CO_2), in terrestrial or marine reservoirs. Biological sequestration includes direct removal of CO_2 from the atmosphere through land-use change (LUC), afforestation, reforestation, revegetation, carbon storage in landfills and practices that enhance soil carbon in agriculture (cropland management, grazing land management).

Climate Change Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Climate Change Mitigation: A human intervention to reduce the sources or enhance the sinks of greenhouse gasses (GHGs).

Climate Change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically three decades or longer.

County: Tana River County

County Assembly: County Assembly of Tana River

County Government: County Government of Tana River

Constitution: Constitution of Kenya 2010

Deforestation: Conversion of forest to non-forest use.

Desertification- Conversion of fertile land into deserts resulting from drought, deforestation or inappropriate agriculture

Disaster: Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Drought: A period of abnormally dry weather long enough to cause a serious hydrological imbalance.

Ecosystem Services: Ecological processes or functions having monetary or non-monetary value to individuals or society at large.

Ecosystem: An ecosystem is a functional unit consisting of living organisms, their non-living environment and the interactions within, between and among them.

Environment: has the meaning assigned to it in section 2 of the Environment Management and Coordination Act

Exposure- state of having no protection from hazards

Forest and Landscape Restoration: An active long-term process to regain ecological integrity and enhance human wellbeing across deforested, degraded forests and landscapes

Forest: Land spanning more than 0.5 hectares with trees of at least 2 meters and a minimum canopy cover of 15%, and include natural and planted plantation forests on state, community and private land

Forest Cover: Refers to a land area of more than 0.5ha with a canopy cover of at least 15%, a minimum tree height of 2 meters which is not primarily under agricultural or other specific non-forest land use

Hazard: Refers to any source of potential damage/harm. The term is used synonymously with Risk

Land Use: The total of arrangements comprising human actions, activities and inputs undertaken in a certain land- cover type

Landscape: A social-ecological system that consists of a mosaic of natural and/or human-modified ecosystems, often with a characteristic configuration of topography, vegetation, land use, and settlements that is influenced by the ecological, historical, economic and cultural processes and activities of the area

Mitigation: preventing, reducing or slowing down the increase of atmospheric greenhouse gas concentrations by limiting current or future emissions and enhancing potential sinks for greenhouse gases.

Rangelands: Vast undisturbed natural resources and landscapes in the form of grasslands, bushland, woodlands, wetlands and deserts. They grow primarily indigenous vegetation, rather than plants established by humans.

Reforestation: Planting of forests on lands that have previously contained forests but that have been converted to some other use.

Rehabilitation: Restoration of the capacity of degraded landscape to deliver goods and services.

Resilience: the ability of a social, economic or ecological system to absorb disturbances while retaining the same basic structure and ways functioning, the capacity for self-organization and the capacity to adapt to stress and change.

Sustainability: A dynamic process that guarantees the persistence of natural and human systems in a trans-generational equitable manner

Tree Cover: Area covered by tree patches of less than 0.5 hectares outside recorded forest areas

Vulnerability: the condition determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a system to the impact of hazards

CHAPTER 1: INTRODUCTION

1.1 Background

In 2020, concentrations of global greenhouse gases reached new heights, and real-time data point to continued increases thus continually rising the Earth's temperature. In 2021, the global mean temperature was about 1.1°C above the pre-industrial level (from 1850 to 1900). The years from 2015 to 2021 were the seven warmest on record.

Climate change and its related impacts have increased over the years with Nations across the world working round the clock to either combat or increase the resilience of their populations by promoting best adaptation strategies. Climate change is known to increase disaster risk by altering the frequency and intensity of hazards, affecting vulnerability and changing exposure patterns including flooding, drought, sea-level rise in estuaries, drying up of rivers, poor water quality in surface and groundwater systems, precipitation, water vapor pattern distortions, snow and land ice distribution (Christensen *et al.,* 2007). These effects have devastating impacts on water resources and livelihoods of the communities.

In Kenya, just like in many parts of the world, temperatures have increased throughout the country with increased frequency of extreme weather events mainly droughts and floods while rainfall patterns have become irregular, unpredictable led to increase/water provision hence declining livelihoods (Maitima *et al.,* 2009). Droughts degrade the environment increasing resource-based conflicts and desertification in the country. The increase in droughts frequency and severity aggravates aridity of the drylands, making them drier which affects ecosystems balance and impacting on resultant livelihoods.

Tana River County has been experiencing climate change effects characterized by long-term shifts in temperatures and weather patterns. These shifts may be natural, but since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels (like coal, oil and gas), which produce heat-trapping gases. The population in Tana River County mainly relies on a variety of income generating activities with a bigger percentage mainly engage in marginal mixed farming, pastoral livestock keeping, charcoal burning, manual labor, fishing and trade activities. During floods farmers turn to floods farming as a means of livelihood. Agricultural activities are also largely practised in various irrigation schemes.

In Tana River County, three main climate change hazards include flooding, drought and sea water intrusions. These hazards have led to increase in poverty and hunger denying the community access to basic services and stifling economic growth and even causing conflict.

Compared to 10 and 20 years ago, flooding frequency in the county has reduced immensely this has stemmed from the reduction in quantity of rainfall and in worse scenario total failure of the rains. This failure of rains for two consecutive seasons leads to drought. The increase in temperature experienced during drought has resulted to increase in prevalence of pest and diseases. Humans experience an upsurge of cases of malnutrition while crop and livestock pest become more active.

Overstocking, expansion of settlements and charcoal burning reduces the tree cover in the range lands, farms and forests. Such activities give more room to the already rampant *Prosopis juliflora* to grow and establish itself. Its ability to withstand high levels of water scarcity, fast growth rate and its allelopathic nature, *Prosopis juliflora* has become one of leading causes of livelihoods loss in the county and wide spread in almost all 15 wards in Tana River County.

In response to climate change effects, the county government of Tana River is responding as follows:

- The county has established a special program department that carries out disaster response interventions and a county disaster fund under the DRM Act.
- The county has also started a resettlement program that is establishing eco villages to prevent communities from effects of riverine floods.
- The department of environment and climate change has established various climate change policies and acts that ensure that the climate changes effects affecting the communities are enhanced. There exist various climate change committees put in place. There is also established climate change development fund constituting 2% of the total Annual County Development Budget.
- Government of Kenya together with the World Bank, jointly funded the Financing Locally-Led Climate Action (FLLoCA) program, which is an innovative program meant to create resilience at the local (and community) levels to mitigate the impact of climate change. The FLLoCA program is being implemented at the county levels, with Tana River County being a beneficiary.

The counties are expected to benefit from two (2) FLLoCA Grants:

1. County Climate Institutional Support (CCIS)
2. County Climate Resilience Investment (CCRI)

Among the Minimum Performance Conditions for County Climate Resilience Investment (CCRI) for counties is for the counties to conduct a County Level Participatory Climate Change Risk Assessment (PCRA) (assessing exposure to hazards and social vulnerability) and climate action planning process.

1.2 Policy Context

Climate change is a global challenge of our time and it is important that countries do not only implement actions that enhance adaptation to the already changing climate but also act to mitigate further temperature rise (GoK, 2018). The Paris Agreement adopted at Conference of the Parties (COP) 21 charts a new course in the global climate effort by building upon the United Nations Framework Convention on Climate Change (UNFCCC). It brings nearly all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries.

Policies and laws addressing mitigation have consistently expanded globally. The greenhouse gas (GHG) emissions are projected to exceed 1.50C during the 21st Century which makes it harder to limit warming below 2°C (IPCC AR6, 2021). There are gaps between projected

emissions (from implemented policies and those from NDCs) and finance flows. The short fall in finance flow make it difficult to attain the levels needed to meet climate goals across all sectors and regions.

Adaptation planning and implementation has progressed, with documented benefits and varying levels of effectiveness. Despite the progress, gaps exist, and will continue to grow at varying levels during implementation. Maladaptation is happening in some sectors and regions.

Africa is the most vulnerable continent to climate change impacts under all climate scenarios above 1.50C (Katy R. et al, 2022). Despite having contributed the least to global warming and having the lowest emissions, Africa faces exponential collateral damage, posing systemic risks to its economies, infrastructural investments, water and food systems, public health, agriculture, and livelihoods, threatening to undo its modest development gains and slip into higher levels of extreme poverty. In East Africa for example, climate change has impacted communities heavily even as the region experiences rapid population growth, urbanization and economic transformation. These impacts limit the attainment of the full growth potential of the region.

Nationally, Kenya has made policies and acts in relation to climate change which includes: The Constitution of Kenya 2010, Kenya Vision 2030 (2008) and its Medium Term Plans, Kenya Climate Smart Agriculture Strategy (2017-2016), National Climate Change Action Plan (2018-2022), National Climate Change Response Strategy (2010), Climate Risk Management Framework (2017), Kenya National Determine Contribution (NDC) (2016), National Climate Finance Policy (2018), National Climate Change Policy (2016), Climate Change Act (No 11 of 2016), Big Four Agenda (2018-2022), National Adaptation Plan (NAP) (2015-2030), National Climate Change Finance Framework Policy (2018), Public Finance Management (Climate Change Funds) Regulation (2023), The National Policy for the Sustainable Development of Northern Kenya and other Arid Lands, Environmental Management and Coordination Act (EMCA) (2015), The Agricultural Sector Development Strategy (2010-2020) and the County Governments Act (2012).

Climate change action in Kenya is guided by the Climate Change Act, (Number 11 of 2016), which provides a framework for mainstreaming climate change across sectors (GoK 2018). Temperatures in Kenya have increased with increased frequency of extreme weather events mainly droughts and floods being experienced. Rainfall patterns have however become irregular, resulting in declining livelihoods (Maitima et al., 2009). Droughts degrade the environment increasing resource conflicts and desertification. The increase in drought frequency and severity aggravates aridity of the drylands, making them drier which affects ecosystems balance and impacting on resultant livelihoods.

Tana River County has been experiencing climate change effects characterized by long-term shifts in temperatures and weather patterns. The main economic activities of Tana residents are crop farming, livestock keeping and fishing. The successes of these economic activities are heavily climate dependent with rainfall determining the success of both livestock and crop farming. The negative impacts of climate related hazards have pushed communities to activities such as charcoal burning, manual labor and small-scale trade, many of which are either

insufficient to address their household needs or cause further degradation and worsen their adaptive capacities.

The County Participatory Climate Risk Assessment Report (March 2023) identifies flooding, drought, invasive species and pest & diseases as priority hazards with the greatest negative impacts to community lives and livelihoods. The impact of these hazards was reported in all the 15 wards of the county and have directly been linked to increase in poverty and hunger; limiting access to basic assets, resources and services; stifling economic growth and even causing conflict.

Over the years, the damage caused by flooding has reduced mainly due to reduction in rainfall and/or occasional total failure of the rains. The increase in temperature experienced during drought has resulted to increase in prevalence of pest and diseases effectively resulting in increased cases of hunger and malnutrition resulting from crop failures and livestock mortalities.

In response to the negative impacts of climate change, the County Government of Tana River (CGTR) has taken steps to formulate the County Climate Change Action Plan (CCCAP). The climate change action planning is anchored in section 32(1) of the Tana River County Climate Change Act 2021 and is in line with the National Climate Change Action Plan (NCCAP). The action plan is also aligned to the County Integrated Development Plan (CIDP) 2023-2027 and aims to accelerative efforts to increase adaptive capacities of the local communities. Locally, the County Government of Tana River has made efforts in domesticating the national policies and to this effect, has legislated the following legal frameworks:

1.2.1 Tana River County Climate Change Finance Policy 2023

The policy aims to put Tana River County in a position to mobilize and access climate finance through a variety of mechanisms, and to manage and apply such finance to meet its climate change adaptation and mitigation goals and resilience to climate change while promoting low carbon developments.

1.2.2 The Draft Tana River County Environmental Policy 2023

The County Government seeks to establish an effective, efficient and sustainable system to manage and conserve the environment in order to facilitate realization of its development goals. This environment policy will be instrumental in advancing county social and economic development. The policy is developed to serve three main purposes:

Provide for a mechanism for implementing county functions related to Environment as assigned under the constitution of Kenya.

Facilitate adoption and compliance with relevant national and international standards for environment management and conservation in the county.

Facilitate the realization of Kenya Vision 2030 as it relates to management of the environment

1.2.3 The Tana River County Forest Policy 2023

The overall goal of this policy is to “ensure sustainable development, conservation and management of forest resources as a strategy to improve the County’s economy and livelihoods

of residents while protecting the county's rich biodiversity and cultural heritage that contribute to the national and global commitments". The County Forest Policy will also be expected to enhance the county's resilience to the impacts of climate change by adopting ecosystem conservation and restoration for biodiversity conservation and promoting restoration of degraded areas as a strategy to reduce emissions resulting from degradation and deforestation.

1.2.4 The Kenya Climate Change Act, No 11 of 2016

Directs the county government, in performance of its functions, to integrate and mainstream climate change actions, interventions and duties, as set out in the act and national climate change action plan into various sectors.

1.2.5 The Tana River County Climate Change Act 2021

Puts into place the framework and mechanisms for mobilization and facilitation of the county government, communities and other stakeholders to respond effectively to climate change through appropriate adaptation and mitigation measures and action for connected purposes.

1.2.6 County Integrated Development Plan (CIDP) (2023-2027)

The county, through the CIDP, is mainstreaming climate change mitigation and adaptation measures into the various sector plans.

1.3 Purpose of the PCRA Report

The 47 County Governments are required to establish County Climate Change Action Plan to be integrated into the national climate change action plan. To establish climate change action plan requires risks to be established. The county, through participatory approach, carried out a participatory climate risk assessment to establish climate change risks affecting the communities.

The report helps the local communities, the governments and the development partners to apply local knowledge and information on climate change, in a way that best suits the local communities' specific needs and situations. The report also serves to inform the ongoing and planned programs, projects and community planning.

1.4 Key Steps in the County's PCRA Process

The PCRA process began with a meeting on 12th January, 2023 at NDMA Boardroom which led to the formation of Technical Working Group (TWG) to lead PCRA process.
Stakeholder analysis process was done where relevant departments and partners were identified. The exercise was followed by a 5-day Training of Trainers (ToT) between 23rd to 27th January, 2023.
Stakeholders were engaged at all levels and each made aware of their roles and contribution in the PCRA process. Key national & county policies and plans were also reviewed.
Data collection and workshop preparation: All materials and presentations for workshop were developed and ready for use. The stakeholders held a workshop during which the stakeholders were inducted and data collection tool to be used. The stakeholders developed a prioritised list of key local actors that was socially inclusive, and included TWG members, Area MCAs,

county administration, Local leaders, County Climate Change Committee Members, representatives of the DRR committee, village elders, field monitors, youth representatives, religious leader, women representatives and members of the vulnerable/marginalised groups that were to be engaged in PCRA process. Meetings at Ward Level Data Collection on PCRA were scheduled between 30th January – 4th February 2023 in all wards through the Ward Administrators. Climate risk assessment report: The team assembled at Hola between 8th and 9th February, 2023 to work on ward reports. A team gathered between 16th and 17th March, 2023 to compile the county Participatory Climate Risk Assessment report.

CHAPTER 2: COUNTY CLIMATE HAZARD PROFILE

2.1 Historical Hazards and Trends

Tana River County has a relatively dry and hot climate throughout the year. The average temperature is greater than 25°C throughout the county, with area on the western side of the county averaging over 27°C. Over the years, both experts and farmers have acknowledged that there have been significant changes and variations in climatic conditions over the past years. These changes resulted to occurrence of;

2.1.1 Floods

Often occur during the rainy season. Intense precipitation within Tana River County can directly contribute to flooding. However, extreme precipitation in upstream parts of county or outside of the county are more important in causing flooding along the main stem riparian areas of River Tana. Flood events in the county include those of 2002, 2003 and 2010 (Huho and Kosonei et al., 2014), and the recent flood events of 2015,2016 and 2019 in areas such as Bura, Gubani, Masabubu and Tana Delta led to internal displacement of about 10,000 people and destruction of roads).

2.1.2 Drought

The failure of rainfall in two consecutive seasons in a single year leads to drought. In Tana River County, such conditions were experienced in 1975, 1976, 1980, 1981, 1983, 2001, 2004, and 2009 (Ngaina 2014), where the Central and North regions of the county were most affected. The most recent drought was experienced in 2021. As a result, about 92,000 people faced severe food shortage, water and livestock death (NDMA, 2022).

2.2 Current Hazards and Trends

Tana River County is known for its unique and diverse ecosystem as it is home to various wildlife and plant species. The county's climate is classified as tropical with high temperatures and humidity through the year. Historical climate data for Tana River County shows that the average temperature ranges between 22°C and 33°C. The hottest months are usually from December to March, with temperatures sometimes exceeding 35°C. The coolest months are from July to September, with temperatures sometimes dropping to 20°C at night. The county experiences two rainy seasons, the long rains from March to May and the short rains from October to December.

Historically, Tana River County has experienced periodic droughts and floods due to the erratic nature of rainfall in the region. In recent years, the frequency and severity of droughts have increased due to climate change, leading to food shortages and water scarcity in the area.

In terms of current climate, Tana River County continues to experience the effects of climate change, including increased temperatures and decreased rainfall. This has led to reduced crop yields and increased pressure on the limited water resources in the region.

2.2.1 Floods

Tana River County is prone to flooding, especially during the rainy season. The flooding is often caused by heavy rainfall, overflowing of rivers, and poor drainage systems. The floods

have led to loss of lives, displacement of people, destruction of property, and disruption of economic activities.

Wards that are mostly affected by floods are: Kipini East, Kipini West, Garsen North, Garsen South, Garsen West, Garsen Central, Hirimani, Madogo, Chewani, Chewele, Mikinduni, Kinakomba

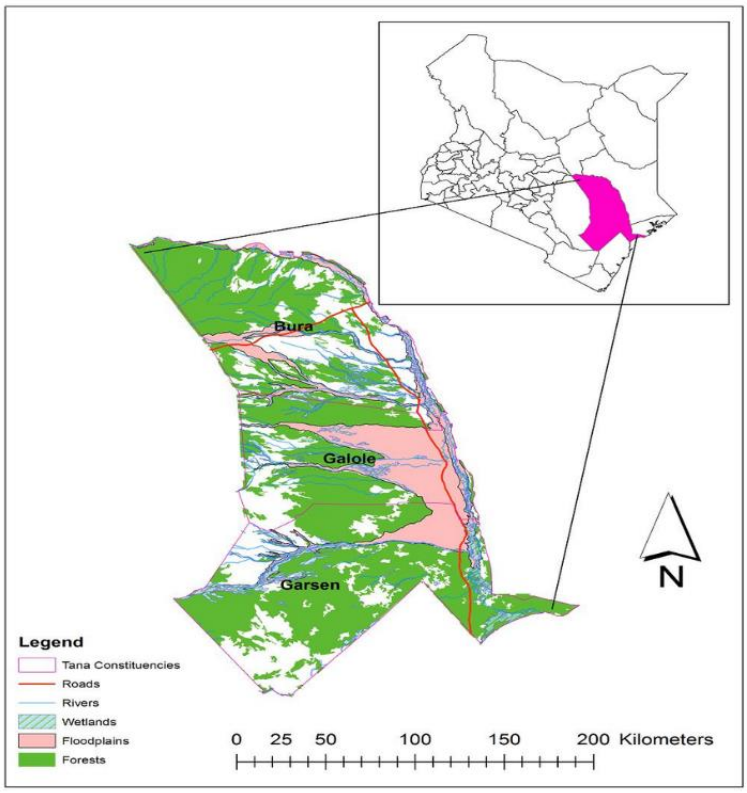

Figure 1: *Tana River County Flood risk map*

2.2.2 Drought

In recent years, Tana River County experienced prolonged drought has resulted to increase in prevalence of pest and diseases effectively resulting in increased cases of hunger and malnutrition resulting from crop failures and livestock mortalities leading to increase in poverty level, resource-based conflict and wide spread of *Prosopis juliflora* (Mathenge). The most recent drought was experienced in 2021. As a result, about 92,000 people faced severe food shortage, water and livestock death (NDMA, 2022).

Tana River County has three types of livelihood zones namely *pastoral*, *marginal mixed* and *mixed farming* zones. These three zones are affected by drought in diverse ways. The water shortages in the pastoral and marginal mixed farming zones for example leads to crop failure, increases food shortages and massive human and livestock migration into the Tana delta area. This migration in turn leads to conflicts between pastoralists and farmers over the available water resource. The migration also leads to the spread of human and livestock diseases. Further, livestock body condition deteriorates for all species and market prices for livestock fall below 50% of long-term average. Milk production at household level in pastoral livelihood zones is reduced, affecting nutritional status of children under the age of five

The areas that are mostly affected by drought are: Bangale, Hirmani, Kamagur, Boka, Konekaliti, Malka Mansa, Lebile and Habaqiq in Tana North Sub-County; Wayu, Chifiri, Titila, Daba, Waldena, Gururi, Koticha, Haroresa, Lakole, Kesi and Hakoka in Tana River Sub-County and Hurara, Assa, Kone, Iddi, Odoganda, Ngao, Tarasaa, Kibusu and Gerarsa in Tana Delta Sub-County.

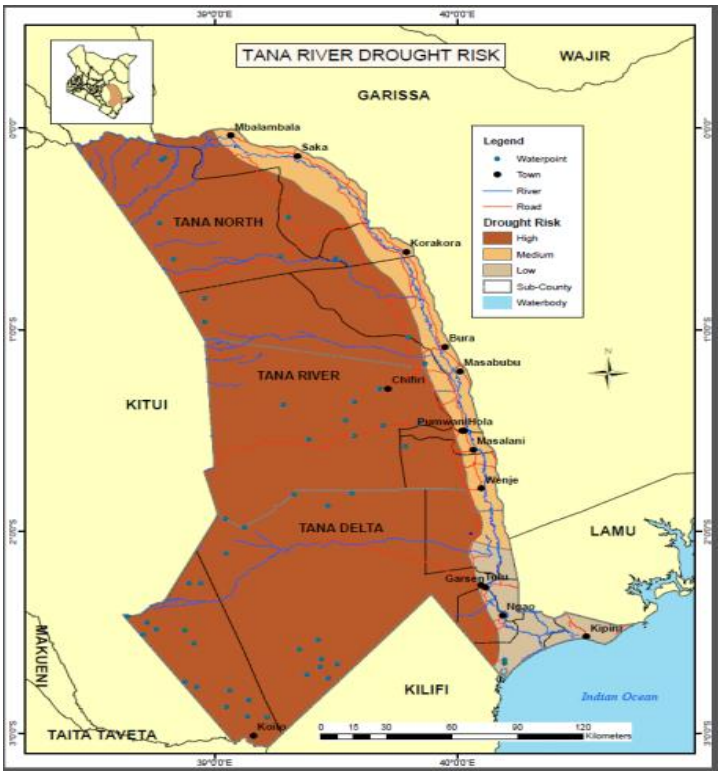

Figure 2: *Tana River County Arid and Semi-Arid classification Map*

2.2.2.1 Invasive Species (*Prosopis juliflora*)

Introduced as a means of greening the vast range lands of Tana River County, *Mathenge* (P*rosopis juliflora*) has been a source of building materials and fodder to livestock. Although, it provides some positive uses, *Mathenge* has more disadvantages than its rewards. These include drying up of water points, cause fatal injury or death to humans and livestock, reduce arable land and affect accessibility of roads.

2.2.2.2 Pest and Diseases

Climate change effects have increased the prevalence and occurrence of pest and diseases in humans, livestock and crops. During floods, waterborne disease outbreaks tend to increase in frequency. However, the recent climatic conditions have reduced the occurrence of floods and thus reduction in water borne disease outbreaks.

High temperatures are reported to have brought about increased incidences of pests and diseases such as the Rift Valley fever (RVF), ECF, and CCP in livestock, with areas such as Garsen, Assa, Nanighi and Kone being more affected. In February 2023, flash floods occasioned a cholera outbreak in Tana North Sub County, Bura and Madogo areas. According to the Department of Health, Tana River County, 708 cholera cases were reported; 645 in

Madogo and 63 in Bura area. Fatalities amounted to 17, with the rest of the affected isolated for medical intervention.

2.2.2.3 Resource Based Conflicts

Conflict between the sedentary agrarian and the pastoral communities has sporadically occurred since the 17th century. However, increasing environmental hardship has exacerbated the situation. The agrarian's community use the swamp-like river banks to cultivate tropical cash-crops such as rice, maize, green grams and mangos, while the pastoral community traditionally inhabit the hinterlands and only migrate to the river Tana when lack of water and grazing grounds force them to do so. These migratory movements have sometimes led to the destruction of crops by cattle and conflicts between the two communities have ensued. In recent years, such conflicts have become more frequent as erratic and unpredictable rains in the Tana River region combined with frequent droughts (at least one a year) to force pastoralists to travel to the river bank more often. The most recent resource-based conflict (human to human) happened in 2021 between the Orma and Munyoyaya communities which led to displacement, loss of lives and livelihoods.

2.2.3 Sea Water Intrusion

Tana River County has a 76-kilometer coastline located in Kipini East Ward, which has enabled nearby communities to engage in fishing. The delta is also situated in this coastal strip, but over the years, climate change has led to a reduction in the amount of water flowing into the Indian Ocean. The melting of icebergs from the North and South Arctic regions has contributed to an increase in sea levels. As a result, the reduction of water levels from River Tana flowing into the Indian Ocean and the rise in sea water levels have caused the intrusion of seawater into nearby fertile farms, resulting in the loss of diversity and indigenous species, pastureland, water scarcity, and a reduction in crop and fruit tree productivity.

2.3 Exposure and Vulnerability Profiles of the County

Vulnerability refers to the degree to which an asset or population group is susceptible to climate change hazards. In order to determine the vulnerability status of a community and its environs, the following exercises must be done;

- Identify the community's most important resources and assets.
- Identify the vulnerability of the assets and resources to the hazards.
- Determine which assets and resources are most at risk.
- Determine which hazards are most harmful to the resources and assets.

Tana River County has grouped its resources in five major classes as shown below:

- Natural resources- resources that people rely on for income, food, medicine, protection, fuel and other sustenance e.g., forests, water, air, soils etc.
- Physical resources include infrastructure for transport, water management, energy and communications such as roads, hospitals, dwellings and water tanks
- Economic and financial resources include income from sale of agricultural products, handicrafts, casual work and remittances

- Social resources include local community groupings, cooperatives, trade unions, churches, family etc.
    - Human resources include skills and knowledge, capacity and good health important to the pursuit of livelihoods including agricultural and leadership skills and gender specific knowledge The deadliest climatic threat faced by Tana River County is
    - drought which has severe impacts on all of the county's vital resources. The most significant resources affected are farming (crops) and livestock, which are vulnerable to all the identified hazards, including floods, drought and sea water intrusions.

Exposure and Vulnerability Table for Tana River County

Table 1: The degree of asset susceptibility to climate change hazards

	Hazard	**Affected Resources & Assets**	**Affected Wards**
1	Drought	Arable land, Grazing land, Forests, Rivers, Livestock, Dams/ Wells, Family	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala, Hirimani, Madogo, Mikinduni, Kinakomba
2	Floods	Arable land, Grazing land, Forests, Rivers, Livestock, Dams/ Wells, Family, Roads, Houses, Schools/Hospitals	Kipini East, Kipini West, Garsen North, Garsen South, Garsen West, Garsen Central, Hirimani, Madogo, Chewani, Chewele, Mikinduni, Kinakomba
3	Sea Water Intrusion	Arable land, Grazing land, Forests, Rivers, Livestock, Dams/ Wells	Kipini East, Kipini West

2.4 Differentiated Impacts of Climate Trends and Risks

Communities that reside in Tana River County rely heavily on agriculture and livestock for their livelihoods. However, climate trends and risks have different impacts on Tana River County. Some of the differentiated impacts of climate trends and risks in Tana River County include:

Drought and Water Scarcity: Tana River County is classified as an Arid and Semi-arid county. Due to this climatic condition, the County is prone to drought. The occurrence of climate change has exacerbated the situation. Drought has significant on the county's economy, particularly on agricultural production and livestock farming, which are the main sources of income for many households. Water scarcity also affects access to clean water, which can lead to health problems and conflicts over water resources.

Floods and Soil Erosion: Tana River County is prone to flooding, especially during the rainy season. The flooding is often caused by heavy rainfall upstream (Mt. Kenya and Aberdares),

overflowing of rivers, and poor drainage systems. The floods have led to loss of lives, displacement of people, destruction of property, disruption of economic activities, and soil erosion. The historical records show floods have been experienced in Tana River County from as early as 1947. Under normal circumstances, the floods occur during long and short rain seasons (March– May) and (October – December) respectively. There are years when the volume of rainfall within the catchment has been recorded as intensive and persistent up to 4 to 5 days such as in 1961-62, 1997-98, 2006-07, 2009-2010, 2018 and 2019. Tana River County receives an annual rainfall of 430 mm. Mount Kenya areas Meru and Embu receive an annual total of over 1300 mm. These Mt. Kenya areas happen to be the source of River Tana, which drains into the Indian Ocean. On its way it meanders through Tana River County and more than often causes flooding in the area when it bursts as a result of volumes of water gathered upstream (Kenya Meteorological Department, 2004). The flooding normally coincides with the two rainfall seasons in Mt. Kenya region (the long-rains and the short-rains).

Loss of Biodiversity: Climate change and anthropogenic activities, such as deforestation, habitat encroachment, and unsustainable land use practices in Lower Tana Delta, have led to threat and loss of biodiversity in Tana River County. Devastating effects of these creates ecological imbalance, which can have cascading effects on the environment, wildlife and local communities.

Health Impacts: Climate change and its associated risks, such as droughts and floods, can have significant impacts on the health of communities in Tana River County. Waterborne diseases, such as cholera and typhoid, are common during floods, while droughts can lead to malnutrition and other health problems. Early 2023, the effect of flash floods and its associated risk were experienced in Tana North Sub County, Bura and Madogo areas, where several cholera cases were reported.

Conflict and Migration: Climate change and its associated risks, such as water scarcity and loss of livelihoods, can lead to conflict and migration in Tana River County. Competition for resources, such as water and land, can lead to conflicts between communities, while loss of livelihoods can force people to migrate in search of better opportunities.

Habitat encroachments through farming along the riverine forest in Lower Tana Delta and human settlements and increase in population in Lower Tana Delta have increased human wildlife conflict in recent years. Iinaccessibility of both wildlife migratory corridors from Tsavo National Park to Lower Tana Delta and watering points renders difficulties for wildlife to access water and pasture lands during dry seasons hence reducing the biodiversity in the county.

2.5 Spatial Distribution of Risks

Tana River County covers an area of 35,375.8 square kilometers (13,658.7 M2) and a population of 315, 943 according to the 2019 census. It consists of three Sub-Counties within which there are 15 wards. Tana River Sub-County has Chewani, Kinakomba, Mikinduni and Wayu Wards; Tana North Sub-County has Bangale, Chewele, Hirimani, Madogo and Sala Wards; Tana Delta Sub-County has Garsen Central, Garsen South, Garsen North, Garsen West, Kipini East and Kipini West Wards.

The major livelihoods zones in Tana River County are Mixed farming livelihood zone, Marginal mixed farming and Pastoral livelihood zone. Tana River and Tana North Sub-Counties consist of Marginal mixed livelihood zones and pastoral livelihood zones while in Tana Delta there are mixed farming livelihood zone and pastoral livelihood zones.

Looking into the future in the years 2021-2065, both extreme precipitation and prolonged moisture stress are projected to occur, but the changes are different during different seasons. Within 30 years (by the early 2040's) temperature is projected to increase by (~0.5ºC), with the first wet season projected to experience even greater changes. And by this time, precipitation is projected to decrease by 5% in the first wet season, and increase 14% in the second wet season. Increased extreme precipitation is projected to occur during the second season, with the highest single day of precipitation increasing on the order of 25% (MoALF. 2016).

Table 2: Spatial distribution of risks in different wards

Number	**Hazard**	**Risk**	**Wards**
1	Drought	• Loss of biodiversity • Increased food shortages • Migration in search of pasture and water • Increase cases of human wildlife conflicts • Resource-based conflicts • Increased incidence of crop Pest, human and livestock diseases • Low productivity of crops and livestock • Loss of lives among both humans and livestock • Increased scarcity of water and pasture • Reduced meat and milk production.	Garsen Central, Garsen West, Garsen South, Garsen North, Mikinduni, Chewani, Chewele, Madogo, Kipini West, Kipini East, Hirimani, Sala, Wayu, Bangal Kinakomba
2	Sea Water intrusion	• Loss of fresh water ecosystems • Loss of biodiversity (fresh/aquatic ecosystems) • Displacements of indigenous tree species • The loss of pasture land and farm lands	Kipini East and Kipini West
3	Floods	• Loss of lives among both humans and livestock	Garsen Central, Garsen West,

		• Increased incidence of floods related human and livestock diseases • Increased food shortages • Destruction of properties (social amenities, critical infrastructure and houses) • Loss of livelihoods resources (farm lands and grazing lands) • Loss of biodiversity • Disruption of economic activities, and soil erosion.	Garsen South, Garsen North, Mikinduni, Chewani, Chewele, Madogo, Kipini West, Kipini East, Hirimani, Sala, Wayu, Bangal Kinakomba

2.5.1 Spatial Distribution of Risks in Tana River Sub County

Wayu Ward: is located in the western part of Galole Sub-County and is primarily a pastoral livelihood zone. The main sources of water in this area are boreholes, shallow wells, and water pans. On rare occasions, when there is sufficient precipitation in Kitui and Meru County, *laggas* fill up with water, allowing the community to engage in crop farming. In the recent Participatory Climate Risk Assessment exercise, drought was identified as the most significant climate hazard, followed by floods. The negative effects associated with combined two were, resource-conflict, pest and disease outbreaks, hunger, displacements. destructions of properties and disruptions of economic activities. The most affected resources were pastoralism, farming, health, and water.

Plate 1: Wayu Ward Community Participants developing Hazard map and Local Responses

Chewani, Kinakomba and Mikinduni Wards: These wards are located along the banks of the river Tana and mainly rely on marginal mixed livelihoods. In the recent Participatory Climate Risk Assessment (PCRA), drought was identified as the primary climatic hazard experienced in the three wards, affecting both livestock and crops. In livestock keeping, animals' conditions deteriorate due to the increased scarcity of water and pasture, leading to reduced meat and milk production. In crop farming, farmers experience total crop failure, and they resort to purchasing fuel and hiring water pumps to increase production.

Plate 2: Mikinduni Ward Participants developing key data during PCRA field visit

2.5.2 Spatial Distribution of Risks in Tana North Sub-County

Bangale Ward: is 4,725 square kilometers with a population of 19,086 people (2019, KPHC). Pastoralism is the main economic activity. The recent PCRA shows that drought is the most affecting hazard affecting almost 85% of the resources/assets followed by resource-based conflicts and human and animal diseases. Drought has caused water sources to dry up and has also led to scarcity of pasture. Ground water levels has gone down therefore becoming difficult to access. Land has become inarable due to lack of moisture and dying of important microorganisms. The inadequate pasture, lack of water and increased pressure on the resources has affected wildlife severely.

Chewele, Hirimani, Madogo and Sala Wards: These wards have two livelihood activities, that is, marginal mixed livelihood and pastoral livelihood zones. The recent PCRA shows that drought is the most important climatic hazard. It causes scarcity of water, as water points dry up and the river Tana water level reduces. In livestock keeping, animals' conditions deteriorate due to the increased scarcity of water and pasture, leading to reduced meat and milk production. In crop farming, farmers experience total crop failure, and they resort to purchasing fuel and hiring water pumps to increase production.

Plate 3: Madogo Ward Community Members participating in PCRA process

2.5.3 Spatial Distribution of Risks in Tana Delta Sub-County

Garsen West Ward: is predominantly a pastoral livelihood zone that receives minimal rainfall, ranging from 200-500mm per annum, making it prone to frequent droughts. With the ongoing effects of climate change, these conditions have been exacerbated. During droughts, almost all the earth pans dry up, and pastoralists have to dig wells along the laggas to find water for both domestic and livestock use. During floods, access to markets and services, such as extension services, become impaired due to the destruction of roads.

Plate 4: Garsen West Ward Community Members participating in data

Garsen Central, North, and South Wards: Garsen Central Ward is home to several important ecological areas, including a Ramsar site, a Key Biodiversity Area (KBA), an Important Bird Area (IBA), and a Global Biodiversity Hotspot. The natural resources of the area, including its soils, vegetation (aquatic and terrestrial), and terrestrial and aquatic wildlife species, support many economic activities. The area is characterized by a rich mosaic of habitats, including grasslands, river channel meanders, massive ox-bow lakes, swamps, riverine forest pockets, open water, and river channels.

Garsen North Ward, located upstream, is over 90% arid and semi-arid land (ASAL) with a bimodal rainfall pattern averaging 600-800 mm p.a. The ward covers approximately 1585.5 sq.km and includes 32 villages in four locations: Galma, Mwina, Ndera, and Salama. Despite being home to the KWS conservancy where the only two extinct monkey species (the Red Columbus monkey and the Mangabay) exist, as well as the TARDA irrigation scheme known for rice production, vast ranches along the Garsen-Hola highway road, the river Tana, and two seasonal lakes, the ward has a poverty index of 70%. The main communities residing within the ward are Pokomos, Wardey, Watta, and Ormas, whose primary livelihood activities are pastoral and mixed farming.

Garsen South Ward, located south of the sub-county, has a population of 15,595 people and borders Garsen West, Garsen Central, and Kipini West. The ward has a river that traverses the land, with some water pans, dense thickets, and plain lands. The main livelihood activities include pastoral and mixed marginal.

The recent Participatory Climate Risk Assessment (PCRA) identified drought as the primary climatic hazard experienced in the three wards. Drought impacts include low productivity in crops and livestock, scarcity of food, pasture and water, resource-based conflicts, death in animals and humans, river diversion, and loss of livelihoods. Other hazards include floods,

pests and diseases, and invasive species. These climatic hazards cause stress to the economic avenues established by the communities residing in the three wards. As a result, poverty levels increase, even though the community continues to develop adaptive and mitigation measures to combat these impacts of climatic hazards

Kipini East Ward: This ward is situated along the Indian Ocean and has a coastline of approximately 76 kilometers. Mixed farming is the primary livelihood activity, and the ward is known for its abundant cultivation of industrial crops such as rice, cotton, tobacco, Sim Sim, coconut, and cashew nuts. The recent Participatory Climate Risk Assessment (PCRA) highlights the climatic hazards affecting the livelihoods of the communities in Kipini East ward. Drought was identified as the most significant climatic hazard, followed by floods and sea-water intrusion. Drought has resulted in food and water shortages, loss of livelihoods, and resource-based conflicts. Pest and diseases have caused low productivity of crops and livestock and have resulted in the loss of lives among both humans and livestock. Sea-water intrusion has led to the loss of biodiversity and indigenous species, the loss of pasture land, and low productivity of crops and fruit-bearing trees.

Kipini West Ward: has a population of 17,895 people, located west of the sub county. It borders Garsen south to the west and Kipini East to the east, Garsen central and Kipini west, Garsen Central to the North West, Lamu County to the north and Kilifi County to the south west. The major livelihood here is mixed farming. Drought was established as the most important climatic hazard experienced in the ward followed by floods, sea water intrusion and wide spread of natural invasive species (*Mathenge) within the ward*. These climatic hazards affect the communities' livelihoods by causing food and water scarcity, loss of biodiversity, loss of livelihoods, loss of pasture and farm land, increased cost of production and death to animal and humans.

CHAPTER 3: FUTURE CLIMATE SCENARIOS FOR TANA RIVER COUNTY

3.1. National and Downscaled Climate Change Projections

Provide an overview of the latest available national climate change projections and Tana River County specific

a) Rainfall trend projections for climatological period of 1981 to 2011

This discussion is for both Kenya in general and Tana River County specific for MAM AND OND periods.

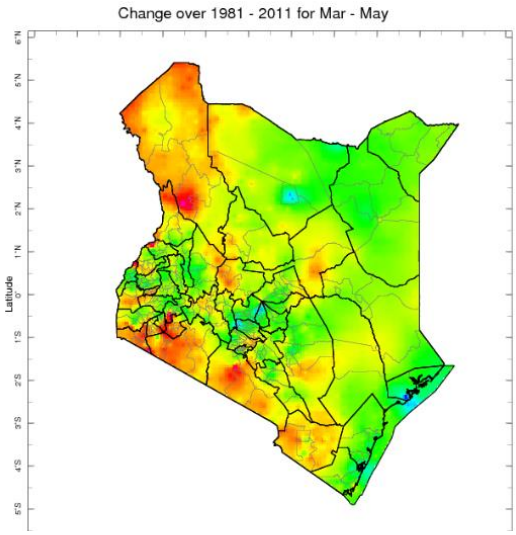

Figure 3: Kenya MAM Season 1981-2011

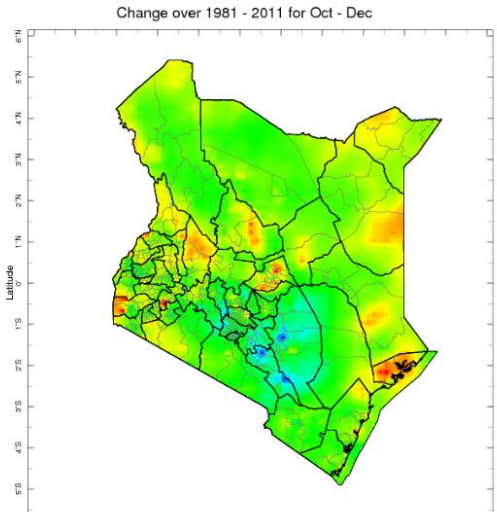

Figure 4: Kenya MAM Season 1981-2011

By looking at the national spatial map for both MAM and OND we notice a change in both the seasons in that there is less rainfall for the MAM season than the OND season. We can see that there has been a shift in the rainfall pattern for our County within this historical period. This clearly show wetter OND season than the MAM season. Analysis for downscaled projections for Tana River County for the climatological period 1981-2011 for both MAM and OND rainfall seasons below.

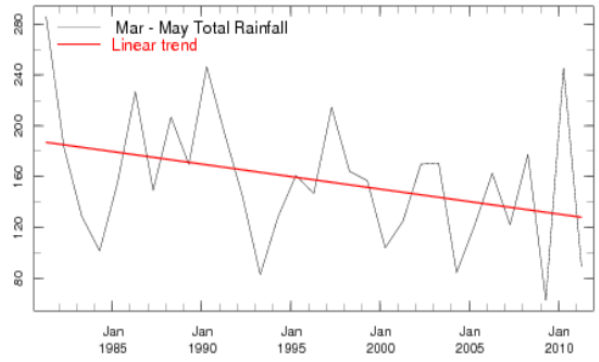

Figure 5: Tana River MAM Season 1981-2011

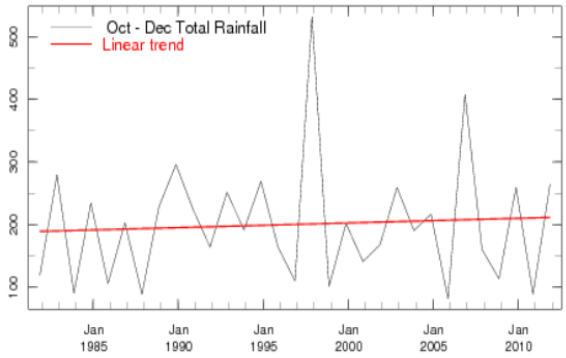

Figure 6: Tana River OND Season 1981-2011

For **Figure 5** Graph showing the trend of the MAM rainfall climatology of the county for the period 1981-2011(30 years) and for **Figure 6**. Graph showing the trend of the OND rainfall climatology of the county for the period 1981-2011 (30 years).

Below **Figure 7** is aspatial map of the county showing the spatial distribution of the MAM rainfall within the county for the said period1981-2011(30 years) and **Figure 8** below is a spatial map of the county showing the spatial distribution of the OND rainfall within the county for the period 1981-2011(30 years).

The climatological Rainfall trend for MAM **Figure 5** is showing decreasing trend showing there has been decreasing rainfall within the region for the MAM season within this period 1981-2011. This shows some evidence of meteorological drought, hence there has been some warming. Meaning that the season is turning out to be less reliable.

The climatological Rainfall trend for OND **Figure 6** is showing an increasing trend hence the people of Tana River County should be encouraged to rely on the short rains because we can see that there has been an increase in the rainfall trend and hence a shift for the historical period. Meaning that the season will be more reliable in the future

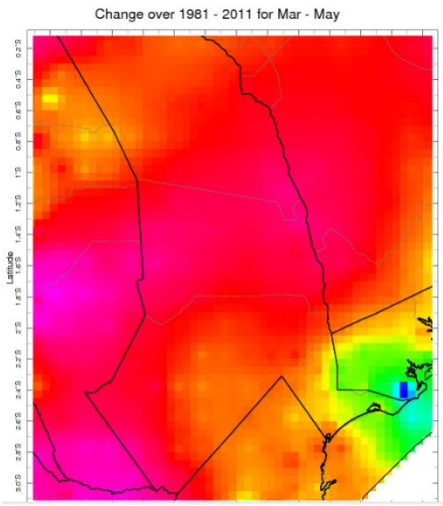

Figure 7: Tana River MAM Season 1981-2011

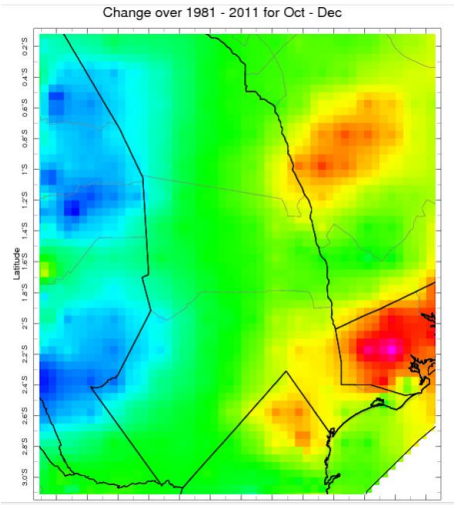

Figure 8: Tana River OND Season 1981-2011

For the MAM rainfall within the region there is warming and therefore the spatial map **Figure 7** showing the red coloration. Meaning that the season will be less reliable in the future.

For the OND rainfall within the region there is Less warming and therefore the spatial map **Figure 8** showing the blue green and part red coloration. Meaning that the season will be reliable in the future.

b) Temperature trend projections for climatological period of 1981 to 2011.

This discussion is for both Kenya in general and Tana River County specific for Jan-Mar and June to August periods.

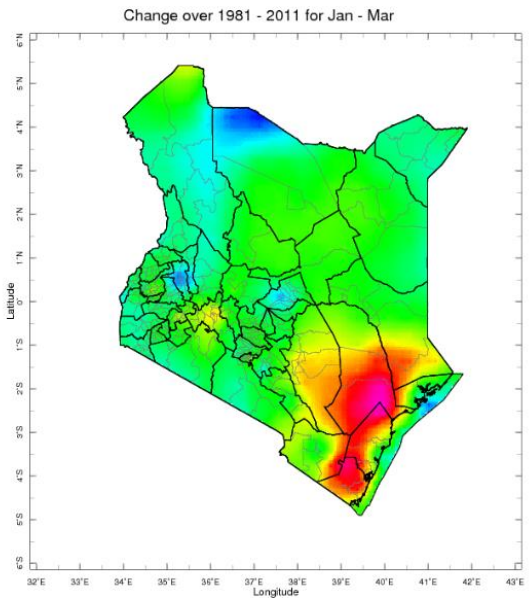

Figure 9: Kenya Temp 1981-2011(Jan-March)

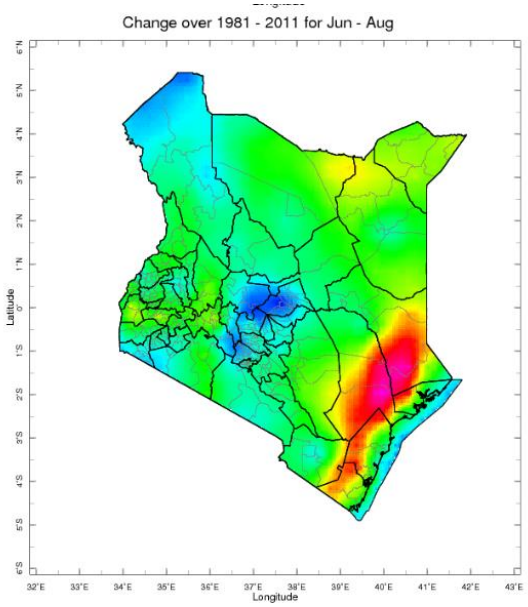

Figure 10: Kenya Temp 1981-2011 (Jun-Aug)

Generally, for both the spatial maps for Figure 9 and 10 what can be depicted is that for the two time periods on which the mean temperature was analysed show some warming by the red coloration. However, for the June to August period is mainly relied on when it comes to climate change projections. The reason being that normally for any higher recorded temperatures are normally influenced by topographical features within a region. This higher temperature records are normally during the January to march period, whereas the lowest temperature is recorded within the June to August periods. This warming trend for this period signifies climate change effects in our region.

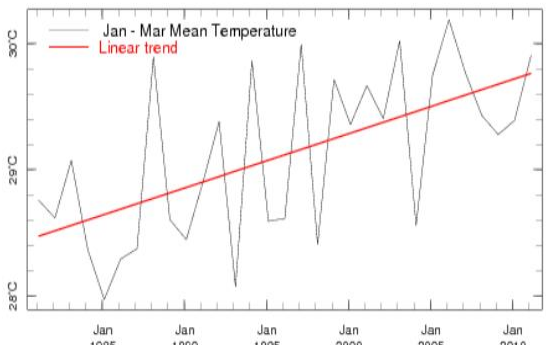

Figure 11: Tana River Temp Analysis 1981-2011 (Jan-March)

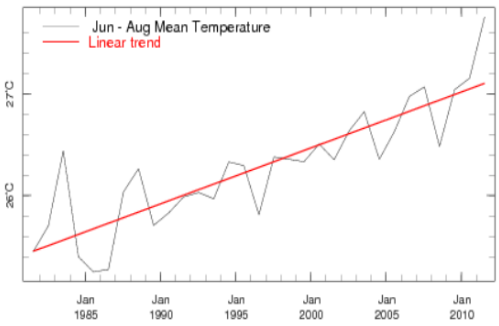

Figure 12: Tana River Temp Analysis 1981-2011 (Jun-Aug)

Generally, for both the trend graphs for **Figure 11 and 12** what can be depicted is that for the two time periods on which the mean temperature was analysed show some warming by the increasing trendline from left to right.

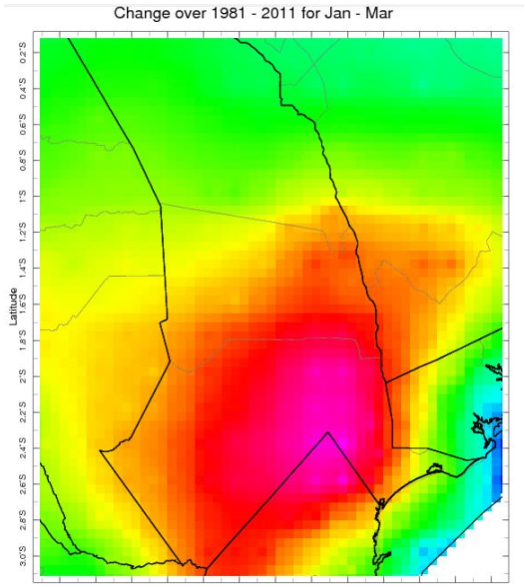

Figure 13: Tana River mean Temp 1981-2011 (Jan-March)

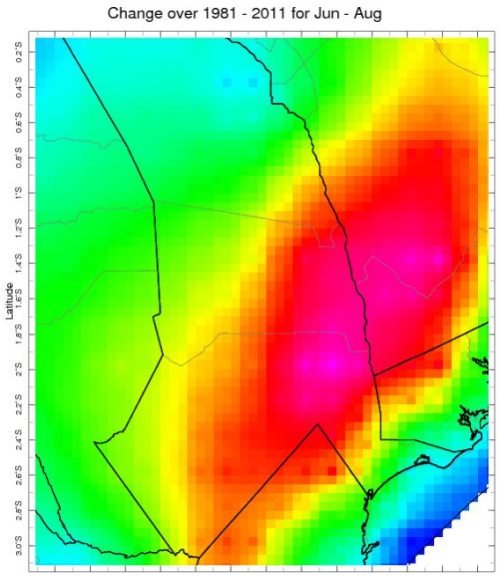

Figure 14: Tana River mean Temp 1981-2011 (Jun-Aug)

Generally, for both the spatial maps for **Figure 13 and 14** what can be depicted is that for the two time periods on which the mean temperature was analysed show some warming by the red coloration (red and yellow are warm colours and green blue are cold colours,)

3.2. County Future Climate Scenarios

Provide an overview of the latest available future national climate change projections and Tana River County specific. Assumption made is that the carbon dioxide emission ratios are in the business-as-usual scenarios, that is Representative concentration pathway –RCP 8.5. Again, there was less data for this simulated period. The data was only for ten years doesn't clearly show the future.

a) Rainfall trend projections for climatological period of 2011 to 2041.

This discussion is for both Kenya in general and Tana River County for MAM and OND period.

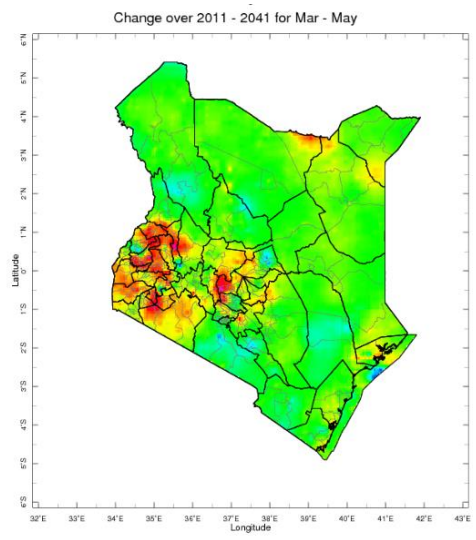

Figure 15: Kenya RF Change over 2011-2041 March-May

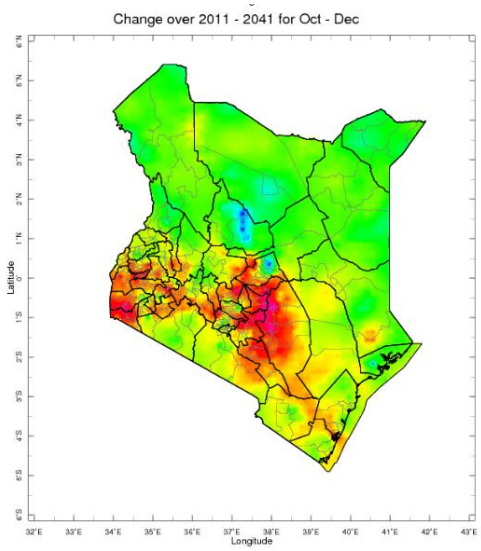

Figure 16: Kenya RF Change over 2011-2041 Oct- Dec

By looking at the national spatial map for both MAM and OND we notice a change in both the seasons in that there is less rainfall for the OND season than the MAM season. We can see that there has been a shift in the rainfall pattern for our County within the projected period. This clearly show wetter MAM season than the OND season. (this is called the East Africa paradox which researcher are yet to unravel, because model output data doesn't synchronise with surface data)

Analysis for the future projections for Tana River County for the climatological period 2011-2041 for both MAM and OND rainfall seasons below.

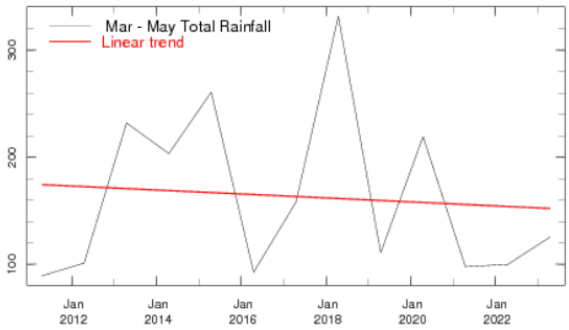

Figure 17: Tana River Mean RF 2011-2041 March- May

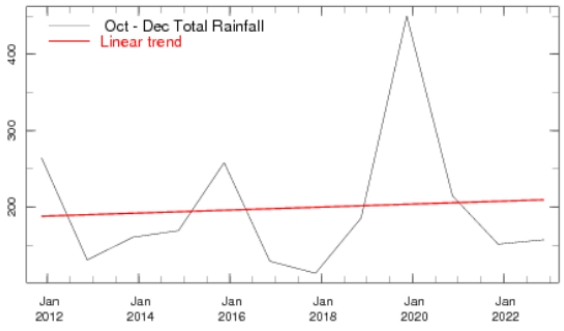

Figure 18: Tana River Mean RF 2011-2041 Oct-Dec

The climatological Rainfall trend for MAM **Figure 17** is showing decreasing trend showing high chances of decreasing rainfall in to the future within the region for the MAM season within this period 2011-2041. This evidence shows some warming, meaning that the seasons chances in the future being less reliable are high.

The climatological Rainfall trend for OND period 2011-2041 **Figure18** is showing slight increasing trend hence the chances of OND season being reliable for the people of Tana River in to the future is high.

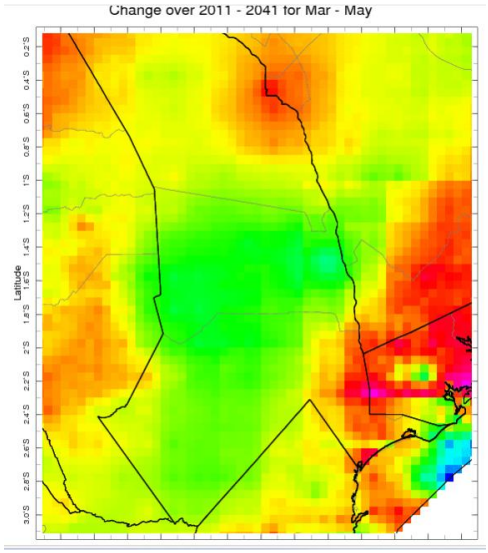

Figure 19: Tana River Mean RF 2011-2041 March- May

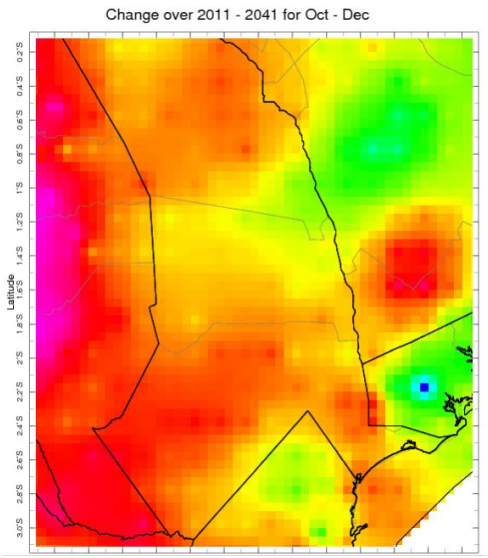

Figure 20: Tana River Mean RF 2011-2041 Oct-Dec

For both the March April May (MAM) **Figure 19** and October November December (OND) **Figure 20** rainfall seasons, for the period 2011 to 2041 within the County in to the future show projected warming from these spatial maps. Hence this calls for resilience building, mitigation and adaptive strategies and measures for our people and economic systems. This Means the future holds a lot of uncertainties for our people and economies.

b) Temperature trend projections for climatological period of 2011 to 2041.

This discussion is for both Kenya in general and Tana River County specific for Jan-Mar and June to August periods.

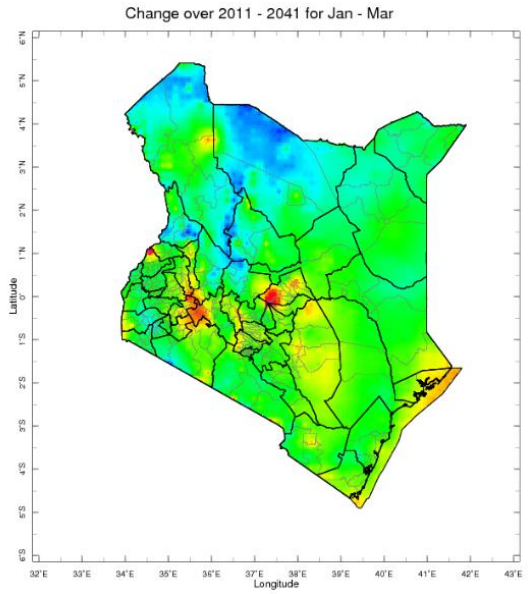

Figure 21: Kenya Temp 2011-2041 (Jan-March)

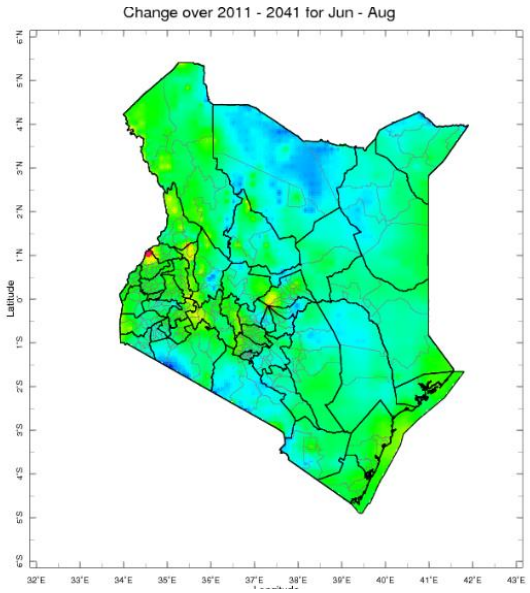

Figure 22: Kenya Temp 2011-2041 (Jun-Aug)

Generally, for both the Kenyan spatial maps for Figure 21 and 22 what can be depicted is that for the two time periods on which the mean temperature was analysed doesn't clearly show what the future temperature projection will likely be. This as earlier on indicated of less data.

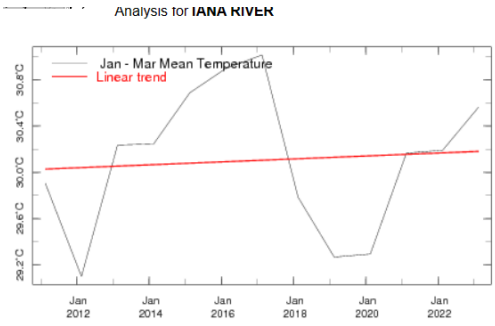

Figure 23: Tana River mean Temp 2011-2041 (Jan-March)

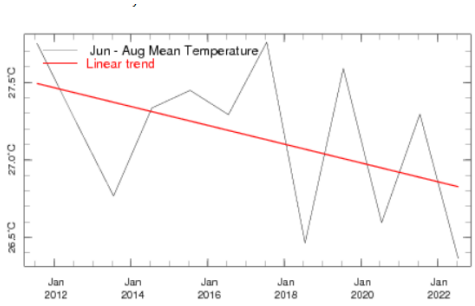

Figure 24: Tana River mean Temp 2011-2041 (Jun-Aug)

Generally, for both the trend graphs for **Figure 23 and 24** what can be depicted is that for the Jan –March period shows the mean temperature for the future projection warming by the increasing trendline and the other decreasing trendline from left to right. the decreasing temperature trend within the June to August periods signifies changing climate for the county in to the future.

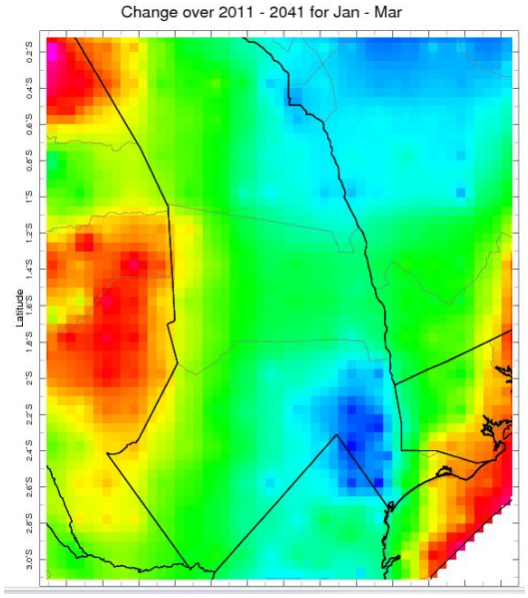

Figure 25: Tana River mean Temp 2011-2041(Jan-March)

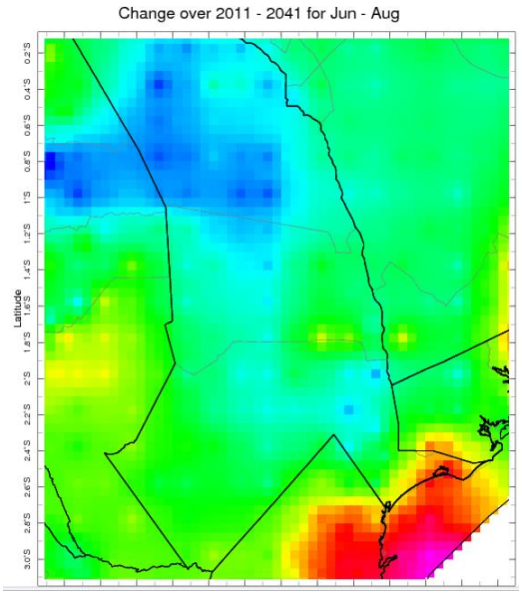

Figure 26: Tana River mean Temp 2011-2041(Jun-Aug)

Generally, for both the spatial maps for **Figure 25 and 26** what can be depicted is that for the two time periods on which the mean temperature was analysed shows that the future projection for the county is generally some warming trend by the red coloration (red and yellow are warm colours and green blue are cold colours,). This implies that the various stakeholders in the county should generally be away of this warming for the county and come up with policies and strategies that will help the people and the economy of Tana River County.

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

Table 3: Analysis of existing resilience/adaptation strategies to current and future climate risks

Risk/ Hazard	Livelihood /Economic System	Climate Resilience Strategies	Stakeholder applying the strategy	Gender and social inclusion information (effectiveness of the strategy)
Drought	**Crop Production**	Targeted research to improve knowledge base of specific climate change related impacts. • Research on drought tolerant crops • Research on soil health • Research on pests and diseases • Establishing on model farms	KALRO, KEFRI, NDMA, Universities, KEMFRI.	• Effective dissemination strategy
		Improved water resources management e.g., increasing use of irrigation, water storage etc as an adaptive strategy, to improve production • Capacity assessment of WRUAS and other water resource management institutions • Strengthening capacities of WRUAs & other water resource management institutions on water utilization • Cross-county & Multi stakeholders coordination platform	NDMA, MoA, KCSAP, NK, NIA, GAA, Concern Worldwide, World Vision, CISP, Groots KE, ASDSP, WSTF, WRA, NRT,	• 1/3 gender rule to all committees
		• Improved access to seasonal information to better inform farmers and fisher-folk on decisions regarding planting and the timing • Ensuring seasonally-appropriate cropping sequences that are environmentally sound to support the conservation of natural grasslands and native forests.	MoA, KMD, NDMA, KCSAP, ASDSP, Local Radio Stations, Department of Fisheries, KMFRI, NGAO, Concern Worldwide	• Adoption of Bulk mobile-based SMS/texts

		• Streamline marketing systems through investments and policy framework e.g., Mango bill 2014 • PSP and advisories • Enhanced early warning systems • Enhancement of capacities for cooperatives and BMUs		
		• Policy on Improving the horizontal integration of producers on management of water, prioritizing the development of water management models at basin scales to improve water management tools.	Ministry of Water and Irrigation, County Department of Water, WRA, NK, Counties along River Tana Basin, TARDA.	• Involve all stakeholders from inception.
		Implementing sustainable land management practices (SLM) • Activation of village land use plans • Land adjudication • Prevent/mitigate land degradation • Landscape restoration	Ministry of Lands, County department of Lands and Physical Planning, MoA, KALRO, CISP, NK, GAA, GROOTS Kenya, Department of Livestock, TWENDE Project, NRT, TNC, WI, IUCN, Concern Worldwide, World Vision Kenya.	• Enhanced extension services provision and community engagement
		• Encouraging the use of new agriculture technologies that are water efficient (e.g., drip irrigation), or more resilient crop varieties to support a shift away from water-intensive crops and reduce inputs. • Knowledge transfer that targets community and household level	MoA, KCSAP, NK, CISP, GROOTS Kenya, GAA, World Vision Kenya, Concern Worldwide, NDMA, ASD Pwani	• Enhanced extension services provision and community engagement
		Encouraging the culture of food storage especially grains during plenty harvests • Develop community storage store/post-harvest handling • Diversification of livelihoods	MoA, NDMA, KCSAP, ASDSP, NCPB	• Enhanced extension services provision and community engagement

		• Streamline marketing systems through cooperatives, policy framework		
		Migration of people and livestock to fall back areas • Mapping of fallback areas • Control of the influx of Livestock Grazing by-laws	Department of Livestock, NGAO	• Enhanced extension services provision and community engagement
		Institutionalizing cash transfers and relief food including school feeding programs. • this can be restricted to the vulnerable, • cash for assets/cash for work	NDMA, Special programs, CISP, World Vision Kenya	• Enhanced extension services provision and community engagement
		Encourage consumption of diverse foods and adoptions of various food systems	Local communities. Department of Nutrition	• Focus on awareness creation at the grassroots with village champions and village leadership taking lead
		Encourage cultivation of pasture as an alternative to crop production (commercial) including establishment of pasture seed banks	Department of Livestock production, NK, NDMA, CISP, Groots KE, World Vision, NRT,	• Focus on small scale farmers emphasizing the role of women and youth • Subsidize and support the production • Embrace technologies in pasture production and storage • Find markets for pasture
		Diversification of livelihood streams e.g., mixed farming, bee keeping, small businesses	MoA, Department of Livestock, Fisheries, KCSAP, NK, CISP, GAA, ADS Pwani, NDMA, World Vision	• Conduct village-based meetings with learning case studies/role models • Enhancing extension service provision both by agriculture, Livestock production and fisheries units

		Formation/strengthening of Natural Resource Management and Community Forest Association/ local institutions to help deal with impacts of drought and enhance restoration actions	NK, KFS, KWS, WV, NRT, NGAO, Conservancies, TNC	• Community mobilizations, focusing on gender integration in formation of all community institutions • Deliberate policy interventions to enhance participation of communities in restoration actions
	Livestock production	Growing of pastures/ Embracing pasture storage for emergency periods	Department of Livestock production, NK, NDMA, CISP, Groots KE, World Vision, NRT,	• Focus on small scale farmers emphasizing the role of women and youth • Subsidize and support the production • Embrace technologies in pasture production and storage
		Provision of emergency alternative livestock feeds such as hay and pellets • Campaigns for destocking/ livestock insurance during drought • Planting of trees suitable for livestock feeding	Special Programs, NDMA, Livestock production, CISP, Red Cross, World Vision	• Effective targeting to the most vulnerable households • Prior offtake and insurance programs to cushion households
		Adopting alternative livestock breeds (browsers as opposed to grazers), Poultry	Livestock production, Department of Vet Services, NDMA, NK, Groots KE,	• Purchase and distribute improved high-quality browsers/poultry etc to select communities • Monitor performance and enhance communication for increased adoption
		Map out and improve all livestock watering and grazing points across the county • Support development of by-laws to enhance watering and grazing in communal areas	Department of livestock production, Lands and Physical planning, NDMA, Department of Water, GAA, WSTF, NK,	• Conducting capacity Needs Assessments • Enhancing community participation at all levels of decision making including in

		• Establish/strengthen water resource/grazing committees		management of the watering/grazing areas • Effective use of traditional/cultural institutions e.g., *GASA*, *MATADEDA* etc.
		Land use planning and development of village grazing plans	Livestock Production, NDMA, Lands & Physical planning, NGAO, NK, NEMA, NRT, IUCN, FAO,	• Enhancing community participation at all levels of decision making including in management of the watering/grazing areas Effective use of traditional/cultural institutions e.g., *GASA*, *MATADEDA* etc
		Migration of people and livestock to fall back areas	Department of Livestock, NDMA, MET, KRC	Early warning systems and provision of essential amenities in the fallback areas
Water scarcity	**Development and domestic use**	Adopt improved efficiencies in the use of water resources to enhance restoration of critical regenerative ecological and physical functions of water bodies. Enactment of adaptation strategies alongside sub-basin management plans that take into account the sector's current and future needs and vulnerabilities are key	WSTF, WRA, GAA, Conservancies	• Restoration of catchment areas. • Awareness creation.
		Targeted research to identify water resource challenges at community and county level, with results used to inform adaptation efforts	WSTF, WRA, NDMA	• The research should be participatory & capture community views.

		Large-scale irrigation projects to use existing vulnerability assessments in order to appropriately coordinate with adaptation measures	NIB, TARDA	• Community awareness creation
		Improved water management to provide a wide range of benefits for various sectors, including agriculture, safeguarding food security and water access. • Restoration of water flows from diversions (Matomba brook, Kitere inlets)	TAWASCO, NIA, TARDA, GAA, Team & Team, WRUAs, Conservancies	• Strengthening Inter-governmental relations on water management at basin level • Enhancing capacities of Community Institutions including WRUAs
		Implementing guidelines and mainstreaming activities identified in the National Water Master Plan to support the joint work between institutions in charge of water resource management and ensure there is available water for development and continued quality water for domestic consumption.	Ministry of Water, County Department of Water, WRA, WSTF	• Strengthening Inter-governmental relations on water management at basin level • Enhancing capacities of National and Community Institutions including WRUAs involved in water resource management
Sea level Rise/ Sea water intrusion	**Farming, Fishing, Conservation and Tourism activities**	Enhance capacity-building initiatives for ecosystem-based adaptation, both at county and local levels, to strengthen and restore coastal ecosystems, restoring the critical buffering and wave energy dissipation services they provide during extreme climate events.	County Government, NK, KFS, NEMA, NRT, WI, Fisheries, Coast Guard, KMA	• Undertake hydrological studies and enhance communication with all affected communities • Train county technical officers on appropriate adaptation strategies to enhance extension services to communities
		Undertake Vulnerability maps of coastal areas to pinpoint hotspots of risk along the coast.	County Government (Lands & Physical Planning -GIS Unit), NMK	• Enhance collaborative research with other relevant government agencies • Facilitate information flows and actions at the local level
		Implement adaptation strategies to protect the shores of Kipini in light of its criticality with respect to the economy and livelihoods.	NEMA, County Government, KFS, NK, Fisheries, Eden Restoration, NRT	• Promote inclusive restoration actions that involve all community institutions e.g., BMUs, CFAs, WRUAs, CBOs

				and other community and government formations
		Integrate Land use planning with local infrastructure and development plans in order to incorporate climate change concerns into county policies for coastal protection and management	County Government (Physical planning, public works, Fisheries) NK, NEMA,	• Development of joint work-plans and implementation strategies between infrastructure development agencies, local communities and conservation/climate change experts to enhance integration
		Adoption of saline tolerant species	KALRO, MOA, Local communities	• Collaboration with research institutions including KALRO to develop site specific crop varieties including rice
		Conduct Research to inform interventions necessary for dealing with sea water intrusion along the brooks in lower Tana Delta	Local communities, NEMA	• Collaboration with research institutions and experts including hydrologists, oceanographers among others
Invasive species	**Access to critical resources by communities**	Designate livestock holding areas to allow defecation and manage spread of *Prosopis juliflora* (Mathenge)	Department of livestock production, Department of Environment, Local communities	• Strengthen local livestock movement and grazing committees
		Support constant uprooting of the young and replace with indigenous trees	County Department of Environment, Local communities	• Individual household trainings and awareness exercises
		Encourage use of chemical and biological control of prosopis	MoA, Research Insititutions Local communities, Woody Weeds Plus,	• Partnerships with partners and research institutions,

	Forestry	Support landscape restoration actions at community levels	NK, KFS, Department of Environment, WV, NRT, TNC	
		Implementation of policies and plans that enhance forest growth and embrace restoration of landscapes	County Government (Department of Environment), KFS, NEMA, NK	
		Pruning	Local communities	
		Human use including Charcoal production, building construction, firewood etc	Local communities	
		Generation	Department of Livestock production	
Pests and Diseases	**Crop and livestock production**	Vaccination and immunizations	Department of Veterinary Services, Livestock production, GAA, Groots KE, NK, NDMA	
		Adoption of IPM	MoA, KCSAP, NK, CISP, ASDSP, GAA, World Vision,	
		Adoption of disease resistant breeds and crop varieties	MoA, KCSAP, NK, CISP, ASDSP, GAA, World Vision,	
		Burring/burning dead animal carcass	Livestock production, veterinary services, Public Health, Local communities	
		Treatment using herbal plant species	Local communities	
		Crop rotation	MoA, ASDSP,	
		Surveillance and farm scouting	MoA, ASDSP,	

		Application of inorganic pesticides and accaricides	MoA, NDMA, GAA, Department of Livestock Production, Veterinary Services,	
		Awareness creation among local farmers and pastoralists on identification and simple management strategies for various pests and diseases	Department of Veterinary services, Livestock production, GAA, NK, Groots KE,	
		Livestock migration to disease free zones	Livestock Production, Veterinary services, Local communities	
		Quarantine	Department of Livestock production, Health, Veterinary services, Local communities	
Floods	**Farming, fishing, infrastructure e.g. Roads, settlements. Schools**	Raising alarm	KMD, NDMA, WRA, County Government (special programmes)	
		Evacuation of the vulnerable (elderly, sick, children)	Redcross, Special program, NDMA	
		Resettlement/ movement to higher grounds (Cluster program)	County Government, local communities, Red Cross,	
		Building gabions		
		Boiling water	Local communities	
		Water treatment using indigenous tree species	Local communities	
		Provision of food and non food items	Red cross, NDMA, special programmes, GAA, Worldwide Concern,	
Human wildlife/ Resourc	**Human security, crop and**	Awareness creation and sensitization	KWS, Ministry of interior, NK, NRT,	
		Fencing of property	Local communities	

e based conflicts	**livestock production**	Compensation	KWS	
		Security patrols and peace meetings/reconciliations	Ministry of interior, Tana Peace, CISP, KECOSCE,	
		Relocation of farms	Local communities, KWS, County Government	
		Strengthening of local traditional alternative dispute resolution mechanisms	Ministry of interior, Tana Peace, CISP, KECOSCE,	
		inter-marriages	Local communities	

CHAPTER 5: COUNTY CLIMATE STRATEGIC ADAPTATION INVESTMENT

5.1 Introduction

The climatic conditions have changed gradually over the years exposing communities to increased levels of vulnerabilities to climate change impacts. In Tana, prolonged droughts, depressed rainfall, increased livestock and crop pest and disease incidences, invasive species and sea water intrusion among other manifestations of climate change are already at the doorsteps of communities.

These changes have impacted negatively on the lives and livelihoods of the communities, causing in some cases untold suffering. Instances of food shortages, hunger and malnutrition have increased over the years, agricultural production has decreased while livestock deaths are on the rise.

Efforts by the National and County government to help local communities adapt includes water tracking system, expanding land for irrigation by creating small minor irrigation schemes, supporting pasture production, reclamation of degraded land, early warning systems, evacuation and water quality management among others. The national and county government has solicited resources from the World Bank through FLLoCA to help finance proposals from communities and this will be critical in addressing the negative impacts of climate hazards. Essentially therefore, everyone from communities to government including the civil society has a role to play in enhancing resilience of local communities.

5.2 Adaptation Strategies

The CCCAP 2023-2027 takes cognizance of the climate hazards in the county and their impacts in all the livelihoods and socio-economic sectors and focus 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 CIDP. The strategic adaptation investments address the needs of all vulnerable wards/populations/communities to enhance their resilience.

Table 4: County adaptive investment strategies for the risks in various sectors

A	**Drought**					
	Sector	**Risk**	**Stressors**	**Adaptive Strategies**	**Affected Wards**	**Vulnerable Groups**
1	**Environment and Forestry**	-Increased spreads of invasive species *Prosopis juliflora* (Mathenge), within the county -Reduced visibility and accessibility issues on roads and water points (Affects access to critical infrastructure by communities) -Loss of farmlands -Loss of pasture lands Affects visibility on major roads Causes injuries for both humans and animals	Overstocking (livestock's & wildlife as a propagating agents)	• Designate livestock holding areas to allow defecation and manage spread of *Prosopis juliflora* (Mathenge) • Mechanical uprooting of Mathenge and bush clearing for other productive land use. • Promote Mathenge species as an alternative source of energy. • Conduct further research on management and control of the spread of Prosopis. • Training and capacity building of communities on management and control of Prosopis. • Reseeding of rangeland	Garsen Central, Garsen West, Garsen South, Garsen North, Mikinduni, Chewani, Chewele, Madogo	Elderly people, Unskilled people, school children, women
		Increased loss of biodiversity	Charcoal burning, Deforestation, unsustainable land use practice	• Reclamation of degraded areas through reseeding, tree planting, protection against encroachment etc. • Practicing on-farm agroforestry	Garsen Central, Garsen West, Garsen South, Garsen North, Mikinduni, Chewani, Chewele, Madogo,	

			Habitat encroachments	• Provision of indigenous tree seedlings and planting of trees in institutions • Support communities and conservation groups to establish tree nurseries • Formation and capacity building of BMUs, CFAs, WRUAs and other CBOs on protection and management of forests and natural resources • Sporadic monitoring of forests • Gazettement of forests • Empowerment of community rangers to support forest management • Implementation of TIPS • Sensitization of communities to adopt renewable energy sources		
2	**Agriculture, Water, Fisheries and Livestock Production**	Increased food shortages	Reduced and erratic rainfalls	• Crops production through irrigation • Establishment of new irrigation schemes • Procurement of drought resistant seeds.	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala, Hirimani, Madogo,	Elderly people, Unskilled people, school children, women

				• Having subsidized agricultural inputs to increase production. • Training and capacity building of farmers on climate Smart Agriculture • Enhance crop insurance initiatives • Establish food storage facilities • Promote use of simple improved storage technologies e.g., hermetic bags • Enhance aflatoxin control • Cash transfer to the vulnerable groups and school feeding programs for schools • Adopt diversified adaptive enterprises/value chains for sustained livelihood and nutrition security. e.g., mixed farming, bee keeping • Strengthening of market and financial linkages • Adopt alternative extension approaches e.g., lead farmers, FFS model etc.	Mikinduni, Kinakomba	

				• Educate farmers on post-harvest handling and management.		
		Increased scarcity of drinking water	Rivers changing course Drying up of water pans Extreme heat	• Conducting hydrological surveys and mapping of all water sources • Desilting and construction of water pans, silted lakes, earth dams • Drilling and desalination of boreholes in drought prone areas • Upgrading and solarization of existing boreholes and wells • Supply and installation of rain water harvesting structures • Water tracking • Strengthening of the urban water supply systems • Construction of water structures on *laggas* • Restoration of the Boka spring and its environments • Installation and extension of water pipelines from the river Tana to Bangale, Wayu, Garsen West Wards	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala, Hirimani, Madogo, Mikinduni, Kinakomba	

				and other areas far from the river with water scarcity. • Provision of water storage tanks/ facilities to schools, homes and health facilities • Extension of water supply to all villages • Adoption and implementation of the Tana River water Act 2020 • Formation and capacity building of WRUAs on water catchments in the county.		
		Loss of livestock's	Diminishing pastures Water scarcity	• Rangeland reseeding • Supply of drought resistant pasture seeds to livestock keepers • Improving livestock breeds • Sustainable livestock insurance • Establish pasture storage facilities • Conservation of pastures for use in the drought season. • Training and capacity building of communities on fodder production and		

				conservation to enhance feed lotting. • Formation and training of range management committees • Provision of livestock supplementary feeds • Capacity building on destocking of livestock • Adoption of the Grazing land Act • Diversification of livelihoods i.e poultry farming, apiculture • Strengthening market linkages • Vaccination of livestock • Slaughter offtakes • Improve of watering points for livestock • The county government to give land to communities for pasture production		
		Increased cases of Resource based conflict(human-human) and HWC	Diminishing pasture Water scarcity Water points	• Mark and secure livestock/wildlife grazing areas, malkas, water points corridors and routes. • Establishment of electric fences for wildlife habitats.	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala,	

				• Capacity building of community on natural resource management • Adopting the county grazing act. • Compensation for damages caused by wildlife i.e., crop, livestock, human life • Community barazas/ meeting for peacemaking/reconciliation • Security patrols to beaf up security in villages.	Hirimani, Madogo, Mikinduni, Kinakomba	
		Increased spreads of crop pest and diseases		• Adopt disease tolerate crops • Leverage on ITK (indigenous technical knowledge) on management of pests and diseases in crops and livestock • Procurement of improved breeds and disease tolerant crops • Support extension services *mashinani* • Capacity-build local based research on pests and		

				disease identification and control • Strengthen linkages with research institutions i.e KALRO • Training and capacity building of community groups on Integrated pests and crop management using farmer centered methodologies such as FFS and PFS. • Creation of awareness on pests and diseases through radio talk shows and barazas		
B	**Floods**					
	Sector	**Risk**	**Stressors**	**Adaptive Strategies**	**Affected Wards**	**Vulnerable Groups**
1	**Health, Agriculture, Water, Fisheries and Livestock Production**	Increased cases of water borne diseases	Water quality	• Capacity building and sensitization of water treatment methods at household levels. • Distribution of water chemicals at household levels • Sensitization on water use efficiency • Regular water quality monitoring	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala, Hirimani, Madogo, Mikinduni, Kinakomba	Elderly people, Unskilled people, school children, women

				• Chemical analysis of water and sites • Distribution of NFIs • Promote sanitation and hygiene		
		Loss of properties Displacements of people	Low land area Lack of information	• Continuous dissemination of early warning information using innovative technologies such as mobile phones • Implement the County cluster program on eco-villages to resettle communities from flood zones to higher grounds. • Support community with food, toiletries and temporary shelters. • Develop an evacuation plan • Sensitization on Water treatment methods, hygiene promotions and distribution of water chemicals to the affected populations • Cash transfer to the affected population • Capacity development of WRUAs, CFAs and other CBOs	Garsen Central, Garsen West, Garsen South, Garsen North, Kipini East, Kipini West, Mikinduni, Chewani, Wayu, Chewele, Sala, Hirimani, Madogo, Mikinduni, Kinakomba	Vulnerable groups like children, women and PLWD

C	Sea Water Intrusion					
	Sector	**Risk**	**Stressors**	**Adaptive Strategies**	**Affected Wards**	**Vulnerable Groups**
1	**Environments, forestry and wildlife**	Increased coastal erosion Increased loss of biodiversity (fresh water ecosystem) Loss of wetlands/ freshwater ecosystem	Over extraction of water from River Tana which reduces volume of the water flowing in River Tana Deforestation in water catchments areas	• Constructions of sea walls and gabion • Enhance capacity-building initiatives for ecosystem-based adaptation, both at county and local levels, to strengthen and restore coastal ecosystems, restoring the critical buffering and wave energy dissipation services they provide during extreme climate events. • Undertake Vulnerability maps of coastal areas to pinpoint hotspots of risk along the coast. • Implement adaptation strategies to protect the shores of Kipini in light of its criticality with respect to the economy and livelihoods. • Integrate Land use planning with local infrastructure and development plans in order to incorporate climate change concerns into county policies for coastal protection and management • Adoption of saline tolerant species	Kipini East and Kipini west	

				• Conduct Research to inform interventions necessary for dealing with sea water intrusion along the brooks in lower Tana Delta		
2	**Agriculture, Fisheries and livestock Productions**	Diminishing fishing grounds (freshwater)	Increase loss of fresh water ecosystem (loss fresh water fish breeding ground)	• More awareness creation • Promotion of aquaculture, polyculture and aqua phonic • Promotion of low carbon aquaculture productions • Capacity building of best aquaculture practice • Strengthens market linkages		

5.3 County Climate Action Priorities

Table 5: CCCAP 2023-2027 with the county priority actions

Hazard	**Adaptation strategy**	**Livelihood/Economic System**	**Priority Actions**	**Actors**	**Timeline**
Drought	Enhance community resilience	Crop Production	• Crops production through irrigation • Procurement of drought resistant seeds. • Having subsidized agricultural inputs to increase production. • Training and capacity building of farmers on climate Smart Agriculture • Establishment of new irrigation schemes • Enhance crop insurance initiatives • Establish food storage facilities • Promote use of simple improved storage technologies e.g., hermetic bags • Enhance aflatoxin control • Enhance value addition and processing of key crops • Cash transfer to the vulnerable groups and school feeding programs for schools • Adopt diversified adaptive enterprises/value chains for sustained livelihood and nutrition security. E.g mixed farming, bee keeping	CG, Nature Kenya, KFS, CISP, KEFRI, KALRO, Concern Worldwide, World Vision, WHH, ASDSP, MoA, NIA, KMD, GROOTS Kenya, Department. of Trade, KCSAP, ADS *Pwani*, IAS Kenya, Public Health	2023/2024, 2024/2025, 2025/2026 3FYs

			• Strengthening of market and financial linkages • Adopt alternative extension approaches e.g., lead farmers, FFS model etc. • Educate farmers on post-harvest handling and management.		
		Livestock production	• Rangeland reseeding • Supply of drought resistant pasture seeds to livestock keepers • Improving livestock breeds • Sustainable livestock insurance • Establish pasture storage facilities • Conservation of pastures for use in the drought season. • Training and capacity building of communities on fodder production and conservation to enhance feed lotting. • Formation and training of range management committees • Provision of livestock supplementary feeds • Capacity building on destocking of livestock • Adoption of the Grazing land Act • Diversification of livelihoods i.e., poultry farming, apiculture • Strengthening market linkages	Department. of Livestock, KCSAP, CISP, NK, WHH, Concern Worldwide, World Vision, World Concern ADS Pwani, groots kenya, ADSP, National Government, Red Cross, NDMA,	2023-2026 3FYs

			• Vaccination of livestock • Slaughter offtakes • Improve of watering points for livestock • The county government to give land to communities for pasture production		
		Fish farming	• Low-carbon aquaculture productions and promotion of fish farming. • Restocking of fish in fish farms and ponds. • Procurement and supply of fish farming equipment. • Capacity building on best aquaculture practices, hygienic fish handling, processing, storage and value addition. • Strengthen market linkages	KEMFRI, Department. of Fisheries and Environment, NEMA, ADS Pwani, KEMFSED, farm Africa, Nature Kenya, CISP, WHH	2023-2026 3 FYs
	Enhance continuous supply of safe and adequate water	Water Access	• Conducting hydrological surveys and mapping of all water sources • Desilting and construction of water pans, silted lakes, earth dams • Drilling and desalination of boreholes in drought prone areas • Upgrading and solarization of existing boreholes and wells • Supply and installation of rain	NEMA, CG, WRMA, Nature Kenya, NG, Department. of Water, CISP, Concern Worldwide, World Vision, WFP, WHH, GIS, CDA, CWWDA, ADS Pwani, Islamic Relief, Well-wisher, Team and Team, KWAHO, Red cross,	2023-2027

			water harvesting structures. • Water tracking • Strengthening of the urban water supply systems • Construction of water structures on *laggas* • Restoration of the Boka spring and its environments • Installation and extension of water pipelines from the river Tana to Bangale, Wayu, Garsen West Wards and other areas far from the river with water scarcity. • Provision of water storage tanks/ facilities to schools, homes and health facilities • Extension of water supply to all villages • Adoption and implementation of the Tana River water Act 2020 • Formation and capacity building of WRUAs on water catchments in the county.		
		Water Quality control	• Capacity building and sensitization of water treatment methods at household levels. • Distribution of water chemicals at household levels • Sensitization on water use efficiency	NEMA, CG, WRA, Nature Kenya, National Government, Department. of Water, CISP, Concern Worldwide, World Vision, WFP, WHH, public health CDA, NDMA, CWWDA,	

			• Regular water quality monitoring • Chemical analysis of water and sites • Distribution of NFIs • Promote sanitation and hygiene		
	Increase forest coverage	Forestry	• Reclamation of degraded areas through reseeding, tree planting, protection against encroachment etc. • Practicing on-farm agroforestry • Provision of tree seedlings and planting of trees in institutions • Support communities and conservation groups to establish tree nurseries • Formation and capacity building of CFAs, WRUAs and other CBOs on protection and management of forests and natural resources • Sporadic monitoring of forests • Gazettement of forests • Empowerment of community rangers to support forest management • Implementation of TIPS • Sensitization of communities to	CG, Nature Kenya, CISP, KEFRI, KALRO, KEMFRI, NEMA, ADS Pwani, World Vision, KCSA, WFP, communities, National government, KFS, Conservancies, Eden restoration, WHH	2023-2026

			adopt renewable energy sources		
	Enhance harmony in the use of natural resources.	Resource based conflicts	• Mark and secure livestock/wildlife grazing areas, malkas, water points corridors and routes. • Establishment of electric fences for wildlife habitats. • Capacity building of community on natural resource management • Adopting the county grazing act. • Compensation for damages caused by wildlife i.e., crop, livestock, human life • Community barazas/ meeting for peacemaking/reconciliation • Security patrols to beef-up security in villages.	KECOSCE, KWS, Community, village elders/peace committees, KPLC, CG, Ministry of interior and Coordination, conservancies	
Floods	Resettlement program	Human settlements	• Implement the County cluster program on eco-villages to resettle communities from flood zones to higher grounds. • Support community with food, toiletries and temporary shelters. • Develop an evacuation plan • Sensitization on Water treatment methods, hygiene promotions and distribution of water	CG, NG, Red Cross, WFP, FAO, Concern Worldwide, World Vision, WFP, WHH, public Health, WHH	2023-2026

			chemicals to the affected populations • Cash transfer to the affected population • Capacity development of WRUAs, CFAs and other CBOs • Community awareness and sensitization on issues related to floods with inclusive of vulnerable groups like children, women and PLWD		
	Early warning information systems	Disaster response	• Continuous dissemination of early warning information using innovative technologies such as mobile phones • Capacity building, enhanced resilience and sensitization of communities on impacts of floods and other related disasters	KMD, NDMA, CG, Red cross, community, concern worldwide,	2023-2026
	Invest in infrastructure	Infrastructure Development	• Construction of dams, dykes to harness excess waters, • Construction of storm water drainage systems in towns. • Construction of flood-proof bridges and roads in floods prone areas and *laggas.* • Protection and restoration of riparian land and	NEMA, KFS, Eden Restoration, NK, KeRRA, NCA, KenHA, municipality	2023-2027

			other water catchment areas. • Tree planting along the shoreline, riparian and bare land • Building gabions • Construction of emergency response centers for emergencies		
			• Enhance utilization of mobile clinics for immediate response on diseases outbreak.	Department. of Health	
Pests and Diseases	Enhance pest and disease control	Crops and Livestock Production	• Training and capacity building of community groups on Integrated pests and crop management using farmer centered methodologies such as FFS and PFS. • Creation of awareness on pests and diseases through radio talk shows and barazas	Department. of Agriculture and Livestock, KCSAP, NK, CISP, NK, WHH, Concern Worldwide, World Vision, World Concern ADS Pwani, KMD, Local Communities	2023-2027
			• Adopt disease tolerate crops and improve livestock breeds • Conduct vaccination and immunization programs • Leverage on ITK (indigenous technical knowledge) on management of pests and diseases in crops and livestock • Livestock and crop disease surveillance and monitoring • Construction of cattle dips and cattle crush	Department. of Agriculture and Livestock, KCSAP, NK, CISP, NK, WHH, Concern Worldwide, World Vision, World Concern ADS Pwani, KMD, Local Communities	

			• Invest in livestock and crop insurance • Destocking of livestock • Procurement of improved livestock breeds and disease tolerant crops • Support extension services *mashinani* • Capacity-build local based research on pests and disease identification and control • Strengthen linkages with research institutions i.e., KALRO		
Invasive species (P.juliflora)	Sustainable management of P. *juliflora*	Land use	• Mechanical uprooting of Mathenge and bush clearing for other productive land use. • Promote *Prosopis juliflora* species as an alternative source of energy. • Conduct further research on management and control of the spread of *Prosopis juliflora*. • Training and capacity building of communities on management and control of *Prosopis juliflora.* • Reseeding of rangelands	NK, Eden Restoration, CG, Department. of Environment, NG, KEFRI, KMD, World Vision, Concern Worldwide, World Concern, NEMA, WHH NDMA, ADS Pwani, wood weed	2023-2027

Sea water intrusion	Improve shoreline eco system	Sustainable utilization of the shoreline ecosystem	• Construction of sea walls and gabions • Training, capacity building and sensitization on restoration initiatives along the coastline. • Construction of brooks in water channels leading to surface sea water intrusion. Among them is Kalota, Handaraku brook. • Tree Planting along the coast line. • Monitoring sea water intrusion	CG, NG, NK, WFP, ADS Pwani, KEMFRI, Department. of Fisheries and Environment	2023-2027
			• Promote crops tolerant in saline environment to maximize production	KALRO, MoA, Department. of Agriculture, ASDSP, KEPHIS, CISP, WHH, World Vision, Concern Worldwide, World Concern,	

CONCLUSION

The Tana River County Participatory Climate Risk Assessment (PCRA) was done towards the end of January and the start of February 2023 and covered all the 15 wards of the County. The PCRA was commissioned to assess the exposure to climate hazards and risks and social vulnerability to climate change. During the assessment at the ward level community involvement was at the centre stage having them providing key information. According to the PCRA findings the main hazards affecting the people of Tana River County is drought, floods and sea water intrusion (affecting Kipini West and Kipini East Wards). These findings were used to develop a tailor made action plan to combat climate change in Tana River County through resilience building and mitigation strategies.

ANNEXES

Annex 1: List of participants during stakeholders' meeting held on 12th January 2023 at NDMA, Hall Hola

S/No	Names	Organization
1.	Fatuma Hiribae	Nature Kenya
2.	Gregory Mwangome	Welthungerhilfe
3.	Samuel M. Baya	TRCG
4.	Yvonne Ouma	Concern Worldwide
5.	Eunia Miruka	Concern Worldwide
6.	Dr. Renson Bakari	Veterinary
7.	Komora Elias	TRCG
8.	Kalu Nyale	KMD-MET
9.	Abdulahi Omar Said	TRCG
10.	Maamun Abubakari	NDMA
11.	Mohamed Godana	TRCG
12.	George Kase	TRCG
13.	Mary Lulutya	NDMA
14.	Amina Omar	GWS
15.	Alphan Salim	CISP
16.	Milicent Ondiek	TRCG
17.	Bryan Owino	WFP
18.	Philip Looniyo	WFP
19.	Abdulkadir Sirad	NDMA
20.	Idris Mahat	TRCG
21.	John Dhadho	IAS-Kenya
22.	Ngeli Kimayu	World Vision Kenya
23.	Jackbed Mugo	TRCG
24.	Salim Awiwah	NDMA
25.	Kuso Hussein	TRCG

Annex 2: List of participants ror Training of Cross Sectoral Technical Working Group Held on 23rd – 27th January 2023 at Ocean Beach Resort and SPA, Malindi

S/No	Names	Organization	Designation
1.	Hon. Yahya Borrow	CGTR	CECM Water and Environment
2.	George K. Jilo	CGTR	Chief Officer Environment and Climate Chnage
3.	Kuso Hussein Kuso	CGTR	Director Climate Change
4.	Abdulahi Omar	CGTR	Director Environment
5.	Teresa Bonaya	CGTR	Snr. Water Analyst
6.	Kalu Nyale	KMD-MET	Director
7.	Mohamed G. Shambaro	CGTR	Sub County Admin
8.	Komora Elias	CGTR	Forest Officer
9.	Ibrahim Jarso Jilo	CGTR	Forest Officer
10.	Mohamed Abubakar	CGTR	Environment Officer
11.	Bakari Mghana	CGTR	Forest Officer
12.	Laura Mikali	CGTR	Energy Officer
13.	George Amurono	CGTR	SC Water Officer
14.	Anna Gwiyo	CGTR	Director Special Program
15.	Alex Kubende	CGTR	Agriculture Officer
16.	Joseph Soy	CGTR	Agriculture Officer
17.	Maamun Abubakar	CGTR	Resilience Officer
18.	George Odera	Nature Kenya	Project Manager
19.	Philip Looniyo	WFP	Program Policy Officer
20.	Winstone Miima	Vihiga County	Director Climate Change
21.	Ivyone Khaemba	IUCN	Program Officer
22.	Brenda Okongo	ADS-Western	
23.	Vincent Kiarie	CGTR	GIS-specialist
24.	Jackbed Mugo	CGTR	Renewable Energy Officer

Annex 3: List of participants during the compilation of Ward PCRA Reports

	Names	**Organization**	**Designation**
1.	Teresa Bonaya	TRCG	Snr. Water Analyst
2.	Kalu Nyale	KMD-MET	Director
3.	Komora Elias	TRCG	Forest Officer
4.	Ibrahim Jarso Jilo	TRCG	Forest Officer
5.	Mohamed Abubakar	TRCG	Environment Officer
6.	Bakari Mghana	TRCG	Forest Officer
7.	Laura Mikali	TRCG	Energy Officer
8.	George Amurono	TRCG	SC Water Officer
9.	Joseph Soy	TRCG	Agriculture Officer
10.	Maamun Abubakar	TRCG	Resilience Officer
11.	George Odera	Nature Kenya	Project Manager
12.	Vincent Kiarie	TRCG	GIS-specialist
13.	Jackbed Mugo	TRCG	Renewable Energy Officer

Annex 5: List of participants during drafting of Tana River County PCRA Report on 16th – 17th March 2023 At Lantern Hotel, Garissa.

	Names	**Organization**	**Designation**
1.	Kalu Nyale	KMD-MET	Director
2.	Komora Elias	TRCG	Forest Officer
3.	Joseph Soy	TRCG	Agriculture Officer
4.	George Odera	Nature Kenya	Project Manager
5.	Jackbed Mugo	TRCG	Renewable Energy Officer
6.	Philip Looniyo	WFP	Programme Policy Officer

Annex 6: Attendance list for the multi-stakeholder meetings held at Laza Leisure on 23rd and 24th March 2023

S/No	Name	Designation	Organization
1.	George K. Jilloh	County Chief Officer Environment and Climate Change	CGTR
2.	Abdullahi Omar	County Director Environment	CGTR
3.	Simon Mwangi	Deputy County Commissioner, Galedertu Sub-County	CGTR
4.	Philip Looniyo	Programme Policy Officer, Garissa Field Office	WFP
5.	Zipporah Joshua	Livestock Officer	CGTR
6.	Sharon M. Galana	Fisheries Officer	CGTR
7.	Kalu Nyale	County Director	KMD
8.	Jamal Shobe	Ward Administrator, Mikinduni Ward	CGTR
9.	Teresia Bonaya	Senior Water Analyst, CGTR	CGTR
10.	Vincent Kiarie	GIS Officer	CGTR
11.	George Odera	Project Manager	Nature Kenya
12.	Juliana Jilloh	Community Engagement Officer	CISP
13.	Maamun Abubakar	Resilience Officer	NDMA
14.	Oyoko Omondi	Project Manager	World Vision Kenya
15.	Sarah Maiyo	Project Manager	*Welthungerhilfe*
16.	Mwanamisi Jillo	Manager	Lower Tana Delta Community Conservancy
17.	Malika Dota	Manager	Ndera Community Conservancy
18.	Jackbed Mugo	County Renewable Energy Officer	CGTR
19.	Aldina Galugalu	Chairman	Chewani Conservancy
20.	Komora Elias	Forest Officer	CGTR
21.	Bakari Mghana	Forest Officer	CGTR
22.	Koshi Riadha	Environment Officer	CGTR
23.	Thomas Wambua	Project Manager	ADS Pwani

24.	Mohammed Shambaro	Sub-County Administrator, Tana River Sub-County	CGTR
25.	Amani Bawata	Assistant Director M/E	CGTR
26.	Omara Moses	Field Officer, Special Program	CGTR
27.	Kuso Iddi Ahmed	Deputy Regional Director	NRT - Coast