

REPUBLIC OF KENYA



GOVERNMENT OF MAKUENI COUNTY



DEPARTMENT OF LANDS, URBAN PLANNING AND DEVELOPMENT, ENVIRONMENT &
CLIMATE CHANGE

P.O. BOX 78-90300 MAKUENI

MAKUENI COUNTY CLIMATE RISK ASSESSMENT REPORT



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FOREWORD

It is with great pleasure that I present the Makueni County Climate Risk Assessment Report. This comprehensive report signifies a significant milestone in our collective efforts to address the challenges posed by climate change within the county. Makueni County, located in the heart of Kenya, has long recognized the importance of understanding and responding to climate risks. With its diverse landscapes, vibrant communities, and rich biodiversity, the county is both a treasure trove of natural resources and a hub of economic activity. However, like many regions around the world, Makueni County being an ASAL is adversely affected by adverse impacts of the changing climate.

To mitigate the risks and build resilience, the county embarked on an ambitious journey to conduct the Participatory Climate Risk Assessment (PCRA) Process succeeding the previously done ward participatory climate vulnerability and capacity assessments (PVCA) county-wide. This and the previous initiative aimed to engage stakeholders from all walks of life, empowering them to actively contribute their knowledge and insights into identifying, analyzing, and prioritizing climate vulnerabilities and risks faced by the county.

Importantly, this report also emphasizes the vital role of financing in supporting locally led climate change action. Recognizing that addressing climate risks requires resources and investments, it highlights the need for innovative financing mechanisms and partnerships to mobilize the necessary funds at the local level. By ensuring the availability of financial resources, we can facilitate the implementation of climate adaptation and mitigation measures that safeguard livelihoods, protect ecosystems, and promote sustainable development.

I would like to express my gratitude to all the individuals and organizations involved in the PCRA Process. The collective wisdom, dedication, and expertise exhibited by the participants have been instrumental in shaping this report and charting a path towards a climate-resilient future for Makueni County.

I encourage all Makueni County policymakers, development agencies, civil society organizations, and other stakeholders to utilize this report as a valuable resource for informed decision-making, policy formulation, resource mobilization and climate proofed-project planning and implementation. Together, we can forge a strong alliance to address climate change and ensure an inclusive sustainable development and prosperous future for the people of Makueni County.

I extend my sincere appreciation to everyone who contributed to the realization of this report. Your commitment to tackling climate risks at the local level serves as an inspiration to others and reaffirms our shared determination to build a climate-resilient society.

Dr. Sonnia Nzilani Musyoka

CECMS – Lands, Urban Planning & Development, Environment and Climate Change.

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CCCAP Task Force



Special appreciation goes to the Technical Working Group; Jackline Kamusa (Ag. Climate Change Director), Jonathan Ngayai (Director Meteorological Services), Ajelicah Mulwa (Climate Change Liaison Officer), Christopher Mutunga (Climate Change Officer), Richard Mwendwa (Economist/Budget Officer), Kelvin Mutua (Environment Social Safeguard officer), Joshua Mutua (GIS expert), Brian Kiio (Environment Officer), Catherine Mbinya (Environment Officer), Julius Mwangangi Mutia (Climate Change Officer), Madeleine Mbatha (M&E Officer) and Tom Ndolo (Environment Officer).

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LIST OF ACRONYMS AND ABBREVIATIONS

ADSE	Anglican Development Services Eastern
AI	Artificial Insemination
CCAP	Climate Change Action Plan
CA	Conservation Agriculture
CCF	County Climate Change Fund
CCU	Climate Change Unit
CFA	Community Forest Association
CRA	Climate Risk Assessment
CIDP	County Integrated Development Plan
CSO	Civil Society Organizations
ETF	Enhanced Transparency Framework
FLLoCA	Financing Locally Led Climate Action
GHG	Green House Gases
GIS	Geographical Information Systems
KFS	Kenya Forest Service
KPHC	Kenya Population and Housing Census
KMD	Kenya Meteorological Department
KWS	Kenya Wildlife Services
LH	Lower High
LM	Lower Middle
LLITN	Long Lasting Insecticide Treated Nets
OVC	Orphans and Vulnerable Children
NAP	National Action Plan

NEMA	National Environment Management Authority
NCCC	National Climate Change Council
NDC	Nationally Determined Contributions
PMTCT	Prevention of Mother to Child Transmission
PCRA	Participatory Climate Risk Assessment
PWD	Persons with Disability
RA	Regenerative Agriculture
SEKEB	South Eastern Kenya Block
TWG	Technical Working Group
UM	Upper Middle
UNFCCC	United Nations Framework Convention on Climate Change
VSO	Voluntary Service Overseas
WAO	Ward Agricultural Officers
WRA	Water Resources Authority
WRUA	Water Resource Users Association

DEFINITION OF TERMS

Climate Change	Change in the climate system that is caused by significant changes in the concentration of greenhouse gases due to human activities, and which is in addition to the natural Climate Change that has been observed during a considerable period.
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Adaptive capacity	Ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences.
Global warming	Observed or projected gradual increase in global surface temperature. It is one of the consequences of Climate Change.
Greenhouse gases	Gases that absorb and emit radiant energy within the thermal infrared range. The main GHGs measured in a GHG inventory are, carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), per-fluorocarbons (PFCs), hydro-fluorocarbons (HFCs), sulphur hexafluoride (SF ₆) and nitrogen tri-fluoride (NF ₃).
Mitigation	Human interventions to prevent or slow down atmospheric GHG concentrations by limiting current or future emissions, and/or enhancing potential sinks for greenhouse gases.
Resilience	Capacity of social, economic and environmental systems to cope with a hazardous event, trend, or disturbance.
Climate Hazard	Are weather related hydro metrological events which can cause harm to humans, property, livelihoods, resources, and the environment.
Vulnerability	Propensity or predisposition to be adversely affected. It encompasses sensitivity or susceptibility to harm, and lack of capacity to cope and adapt.
Shocks	

Stresses	<p>Potential, uncertain, abrupt or long onset events, whose main consequence is shifting the city from its current state to a disturbed state</p> <p>Chronic and ongoing dynamic pressures originating within the system, whose cumulative impact undermine the city's capacity for sustainability and resilience and render it fragile and vulnerable</p>
Hazards	Phenomena, substances, or situations with potential to cause disruption or damage
Exposure	Refers to the presence of people, livelihoods, ecosystems and other assets in places that could suffer negative effects

EXECUTIVE SUMMARY

The Makueni County Participatory Climate Risk Assessment (PCRA) Report provides a comprehensive analysis of the climate change context, risks, vulnerabilities and recommended actions for Financing Locally Led Climate Change Action Program. The report reflects the outcomes of the PCRA process conducted throughout Makueni County, Kenya. It aims to guide decision makers, development agencies and stakeholders in addressing climate change challenges and building resilience at the local level. The climate change context in Makueni County is characterized by a range of environmental, social, and economic factors that interact to create vulnerabilities in the community and development sectors. The county is located in a semi-arid region, experiencing erratic rainfall patterns and prolonged droughts. Climate variability poses significant challenges to agriculture (crop and livestock farming) and water availability, affecting the livelihoods and food security of communities. Furthermore, extreme weather events, such as floods and Crop and Livestock diseases outbreaks, exacerbate vulnerabilities and contribute to infrastructure damage and economic losses.

The PCRA Process engaged a diverse range of stakeholders, including community members, local government officials, civil society organizations, and researchers. Through a participatory approach, stakeholders identified and prioritized climate risks across sectors, considering the interplay between climate change and socio-economic factors. The key climate risks identified include: Water Scarcity and Insecure Access: Changing rainfall patterns and prolonged droughts affect water availability, leading to water scarcity and insecure access for households, agriculture, and livestock. Declining Agricultural Productivity: Climate variability and extreme weather events impact crop and livestock productivity, threatening food security, income generation, and livelihoods. Ecosystem Degradation and Biodiversity Loss: Climate change exacerbates ecosystem degradation, including deforestation, soil erosion, and loss of biodiversity, leading to reduced ecosystem services and increased vulnerabilities. Health Risks: Climate change influences the spread of vector-borne diseases, such as malaria and dengue fever, and poses challenges to public health infrastructure and services and Infrastructure Vulnerability: Increasing frequency and intensity of extreme weather events heighten the risks to critical infrastructure, including roads, bridges, and water supply systems, impacting economic activities and social services.

The report presents a set of recommended actions for Financing Locally Led Climate Change Action Program in Makueni County. These actions emphasize the importance of a multi-sectoral and integrated approach, incorporating both adaptation and mitigation measures. They include: Strengthening Water Resource Management: Implementing water conservation practices, promoting efficient irrigation techniques, and investing in water storage infrastructure to enhance water security and management. Climate-Smart Agriculture and Livestock Management: Promoting climate-resilient farming practices, diversifying agricultural systems, and providing support for livestock management to enhance productivity and resilience; Ecosystem Restoration and Conservation; Implementing strategies to restore and conserve ecosystems, including reforestation initiatives, soil and watershed management, and protection of biodiversity hotspots; Health and Disaster Risk Management: Strengthening early warning systems, improving healthcare infrastructure and services, and enhancing community-based disease surveillance to address climate-related health risks and Climate-Resilient Infrastructure Development: Incorporating climate resilience considerations into infrastructure planning, construction, and maintenance, including nature-based solutions and climate-proofing existing infrastructure.

By implementing the recommended actions, Makueni County can enhance its climate resilience, safeguard livelihoods, protect ecosystems, and promote sustainable development. It is crucial to mobilize financial resources and engage stakeholders at all levels to support locally led climate change action and achieve a climate-resilient future for Makueni County.

CHAPTER ONE: MAKUENI COUNTY OVERVIEW

1.1. Introduction and Background

Makueni County is one of the 47 Counties in Kenya. The County has an average population density of 186 persons. The County is divided into six sub-counties which are further subdivided into 30 electoral wards. Makueni County is a member of the South Eastern Kenya Block (SEKEB). Makueni County is situated in the South Eastern part of the country Bordering Machakos to the North, Kitui to the East, Taita Taveta to the South and Kajiado to the West. The County lies between Latitude 1° 35' and 3° 00' South and Longitude 37°10' and 38°30' East with an area of 8,176.7 KM².

The County population is 987,653 consisting of 489,691 males, 497,942 females and 20 inter-sex. Majority of the population in Makueni are young people age 0-14 years (34.9%) and 15-24 years (20.5%); the county total dependency ratio is at 71.3% with child dependency (59.7%) and old age dependency (11.6%) (KNBS, 2019) Makueni County has a poverty index of 34.5% which is slightly lower than the national index of 35.7% This means approximately a third of the total population is highly vulnerable to climate risks.

The County is characterized by three main Agro-ecological zones namely; the Upper Middle, Lower High and the Lower Middle zones. The Upper Middle (UM) zone mainly covers the uplands of Mbooni and Kaiti that practice coffee, avocado, macadamia, maize and beans farming and Dairy farming. The Lower High (LH) zone is mainly found in Makueni and Kilome Sub-Counties where mango and citrus fruits, grains, and root tubers farming are practiced. The lower Middle (LM) zone covers Kibwezi West and Kibwezi East where cowpeas, pigeon peas, dolichols, green grams, sorghum are mainly grown and also characterized by rangelands suitable for livestock production. Other economic activities include quarrying and small-scale mining

The annual rainfall in upper zones ranges from 1,000MM to 1,250MM and mean temperature ranges from 21°C to 22°C. In the middle zone, the annual rainfall ranges from 750MM to 1,000MM and mean annual temperatures range from 22°C to 24°C while in the lower zone annual rainfall ranges from 250MM to 750MM and mean annual temperatures range from 24°C to 25°C. Given its geographical location and climatic conditions, Makueni County faces unique climate change risks and vulnerabilities. The County is an Arid and Semi-Arid Land (ASAL), characterized by irregular rainfall patterns and frequent droughts. The climate variations Have led to water and food insecurity hence affecting the overall well-being of the population.

The water sector aims to improve water access, environmental conservation and sustainable utilization of natural resources. The County has a forest cover of 5.1% and tree cover of 12.47 % with Gazetted Forest covering 150.2Km² and non- gazetted forest 76km². The major water resources in the county are Thwake, Kaiti, Kikuu and Muuoni Rivers, wetlands such as Mangelete, Kiu, Kiboko, springs such as; Mzima, Umanyi, Kibwezi. The County has 1,592 mapped water sources including Earthdams, Sand dams and boreholes with a 39,000m³ water production. The County has gazetted national parks covering an area of 1276.5km².

The average farm size in Makueni is 0.25Ha where main cash crops are coffee, macadamia, french beans and fruit trees. Food crops include maize, beans, green grams, cowpeas, cassava and sweet potatoes. The County promotes fruit value chains for Mango, Citrus, Macadamia, and Avocado, livestock value chains and pulse value chains. The area under green gram production is 69,955 Ha, while the area under pigeon peas is 65,279 Ha. The area under cowpeas increased is 63,564 Ha while the area under maize is 150,726 Ha. The area under

avocado is 270 Ha and area under mangoes is 21,309 Ha. To enhance the value chains the county has a Makueni Integrated Grain Value addition plant with a processing capacity of 2 metric tonnes per hour and the Makueni fruit processing plant. The county paved road network is 502.7 Km. The electricity connectivity is 25 % and ICT literacy is 57%.

The County has One level five hospital, 14 level four and 347 level 3. The leading cause of morbidity for the under-fives is the upper respiratory tract infection while upper respiratory tract infections and hypertension are the leading causes of morbidity among the over fives.

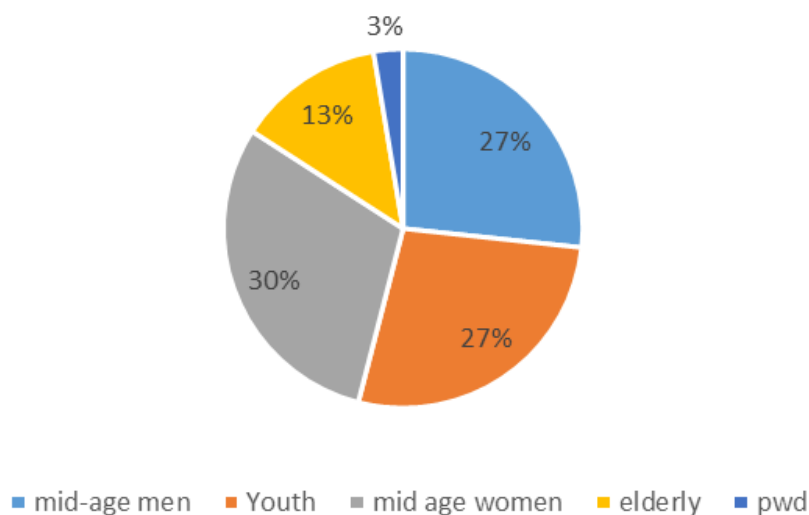
The number of registered PWDs in the County is 11,795 out of 36,369 PWDs in the County. The County has 1,620 registered community groups. The county has 2 talent centers and the main programs on social protection are food and non-food programmes, enrollment of elderly to NHIF, sponsorship to the needy and OVCs. The County boasts various trade and tourism sites such as national parks; Chyulu Hills and Tsavo West national parks. The area under National Parks and reserves is 1,276.5KM². The County's urbanization rate is 8% with main urban centers including, Wote, Emali, Kibwezi, Mtito Andei, Makindu, Kikima, Konza and Sultan Hamud. The County has 5,042.7KM² as arable land and 1,762.7KM² as non-arable land.

Participatory Climate Risk Assessment (PCRA) was conducted to understand the climate hazards and risks across the County. The process involved participatory analysis of the climate context in Makueni, related risks, vulnerabilities, existing and new strategies for adaptation identified by local communities and stakeholders in key sectors such as Agriculture, Environment and Natural resources for locally led climate actions.

The PCRA process integrated the Participatory Vulnerability Capacity Assessment (PVCA) previously conducted in the County to provide a comprehensive and informed strategies for Climate Actions that included climate resilient investments to increase access to potable water among which; Ngai Ndethya sand dam in Mtito Andei, Masue rock catchment in Mbitini, Kwa Mutuku & Kwa Kilii Sand dam in Nguu Masumba and Ngaamba-Masaa water project in Kiima Kiu/ Kalanzoni.

The PCRA process was undertaken in all the wards in the County, with community and stakeholder engagement forums involving 944 participants. The process adopted an inclusive approach, involving different interest groups. The analytical representation is as shown below.

Disaggregated data on the vulnerable groups reached during the PCRA process



1.2. Policy Context

1.2.1 International Policy Framework

Kyoto Protocol

The Kyoto Protocol was adopted on 11 December 1997 and entered into force on 16 February 2005. The Protocol operationalizes the United Nations Framework Convention on Climate Change (UNFCCC) by committing industrialized countries and economies in transition to limit and reduce greenhouse gasses (GHG) emissions. The convention requires member countries, Kenya being a party, to adopt policies and measures on mitigation and to report periodically. The County has sphere headed implementation of afforestation and reafforestation programs in key landscapes such as Makuli Nzau and Mbooni hills for carbon sequestration. Makueni County is currently implementing the REDD+ project in the chyulu landscape. There is a developed draft energy policy and action plan to guide the County towards transition to a low carbon emission.

Paris Agreement, 2015

The Paris Agreement is a legally binding international treaty on climate change adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015 and entered into force on 4 November 2016. The goal is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.” The Makueni County Draft energy policy depicts utilization of efficient energy technologies at household levels and in development projects. This feeds into the Makueni County Climate

Change Action plan 2023-2027 which provides for measures to adopt energy efficiency for climate change mitigation.

The Paris Agreement talks on Nationally Determined Contributions (NDCs) whereby Countries should communicate actions they will take to reduce their greenhouse gas emissions in order to reach the goals of the Paris Agreement. Countries also communicate in their NDCs actions they will take to build resilience to adapt to the impacts of climate change. The County has been reporting on Climate Actions annually, a report which feeds into the Nationally Determined Contributions (NDCs)

African Agenda 2063

This is a strategic framework for socio-economic transformation with the goal of having environmentally sustainable and climate resilient economies and a priority area on climate resilience and natural disaster preparedness. Makueni endeavors to adopt climate smart agriculture for enhanced community livelihoods and develop climate proof infrastructure as the County targets to build community resilience.

1.2.2 National Policy Framework

Constitution of Kenya, 2010

Article 42 of CoK 2010, provides for the right to a clean and healthy environment for every Kenyan which includes the right to have the environment protected for the benefit of the present and future generations, thereby establishing commitment to ecologically sustainable development. Makueni County has an Environment and Climate Change Department, mandated with the implementation of the devolved environmental functions.

Environmental Management and Coordination Act (EMCA) 1999 Rev 2015

The Act provides for environmental management and conservation, including climate change mitigation and adaptation. The Act makes provision for environmental protection through; Environmental impact assessment, Environmental audit and monitoring and Environmental restoration orders, conservation orders, and easements. Makueni county undertakes Environmental and Social Impact Assessments for development projects to ensure sustainability and has a gazetted County Environment Committee (CEC) that coordinates environmental matters

Climate Change Act, 2016

Its main objective is to enhance climate change resilience and low carbon development for sustainable development in Kenya. The Act establishes Climate Change institutional structures and climate change funds. The Makueni County Climate Change Act 2022 is aligned to the Climate Change Act 2016 and this provides for the County Climate Change Fund and a framework for strategic interventions to address climate change impacts in the County.

National Climate Change Response Strategy

The strategy focuses on strengthening national actions towards Climate Change assessments and adaptations and GHG emissions mitigation by ensuring commitment and engagement of all stakeholders in view of the vulnerable nature of Kenya's natural resources and society. The National Climate Change Response Strategy provides for vulnerability assessment which Makueni County undertook. The strategies

provide for interventions in key sectors which will inform the strategic actions in the County Climate Change Action Plan.

National Climate Change Action Plan 2018-2022

The objective of the plan is to encourage low carbon climate resilient development throughout the Country in a manner that prioritizes adaptation. It also considers the impact of climate change on Kenya's socio-economic sectors and further identifies strategic areas where climate action can be linked to the big four agenda. The County had domesticated the NCCAP by formulating and CCCAP.

National Climate Change Framework Policy, 2018

The document provides a framework to guide the development and implementation of detailed climate change interventions listed in the climate change action plans. The policy aims to integrate climate change considerations into planning, budgeting, implementation and decision making at the National and County level and across all sectors. It also established a funding mechanism and strategy that enables implementation of priority actions for climate resilience, adaptive capacity and low-carbon growth. The County has mainstreamed climate change into the CIDP

National Adaptation Plan (2015-2030)

The National Adaptation Plan details institutional arrangements, including monitoring and evaluation processes. It also provides an analysis of the current and future climate trends in Kenya, highlighting key institutional and policy coordination relevant to climate change and presents a climate risk profile for the Country. It further identifies priority actions in key planning sectors for the short, medium and long in line with the Country's development plan. The County has developed a County Adaptation Plan in line with the National Adaptation Plan (2015-2030)

Climate Smart Agriculture Strategy (2017-2026)

The broad objective of the strategy is to adapt to climate change resilience of agriculture systems while minimizing emissions for enhanced food and nutritional security and improved livelihoods. In this respect the strategy aims at enhancing the adaptive capacity and resilience of the actors in the agriculture sector by addressing cross-cutting issues that adversely impact climate -smart agriculture. The strategy recognizes the role of the Climate Change Act and NAP in improving coordination and collaboration among institutions and stakeholders in climate smart agriculture.

Energy Act, 2019

The Act promotes mitigation of climate change through energy efficiency and renewable energy, and provides for establishment of the Rural Electrification & Renewable Energy Corporation which under its mandate shall harness opportunities offered under clean development mechanism and other mechanisms including, but not limited to, carbon credit trading to promote the development and exploitation of renewable energy sources. The policy is aligned to the County Energy policy

1.2.3 Makueni County Policy Framework

In recent years, Makueni County has embarked on initiatives aimed at promoting sustainable development and resilience-building. The county government has demonstrated a strong commitment to addressing climate change challenges and integrating climate considerations into its policies and programs.

Makueni County Integrated Development Plan (CIDP) 2023-2027

The Makueni County CIDP 2023-2023 is centered on building a resilient economy for sustainable development. The plan incorporated both international and the Countries commitments on matters related to climate change among them the Paris Agreement on Climate Change, 2015, Sustainable Development Goals one of them being on Climate Action-SDG No. 13 which tasks Countries to take urgent actions to combat climate change and its impacts. The CIDP has outlined different sector programmes. In the Water, Environment & Natural Resources sector, a programme on climate change mainstreaming has been well outlined with an aim of mainstreaming climate change initiatives in the County.

Makueni County Spatial Plan 2019-2029

The plan was developed as a concerted effort to evaluate the County's physical, infrastructural and human resources and also to guide the development activities in the County. In the policy's objectives, one is to maintain a viable system of green and open spaces for a functioning ecosystem and to work towards the achieving and maintenance of a tree cover of at least 10% of the land area of Kenya.

The plan adopts the existing geophysical properties of the County territory as an entry point for formulating the County spatial development framework. Consequently, the three natural components (landforms, drainage and ecology) are integrated into one apparatus that will serve as a primary organizing element in a strategy of "structuring by nature". The strategy entails delineating all the areas within the County that are prone to degradation (steep hill slopes, riparian), hazard prone areas (scarps, volcanic fields), environmentally sensitive areas (wetlands, wildlife habitats). Specific intervention measures are then suggested in relation to each of the areas.

Makueni County Environment and Climate Change Policy, 2020

The Policy recognizes that climate change poses significant environmental implications for Makueni County as some of the adverse impacts are already being observed as evidenced by reduced supply of water from many water sources in the County. Other challenges brought by climate change include floods, mudslides and prolonged droughts. The policy addresses climate change issues in one of its objectives (3.2.7) which is to enhance climate resilience with a policy direction that the Government shall establish mechanisms for enhancing climate change resilience in the County. These will be achieved through implementation of the following strategies; mainstreaming climate change in County sectors, establishing a County climate fund mechanism, capacity building institutions to take up climate change actions and creation of partnership linkages.

Makueni County Climate Change Act 2022

The Act enhances climate resilience through mobilization of resources for development, management, implementation, regulation and monitoring of adaptation and mitigation measures and actions. The Act

establishes the CCF Board which shall mainstream climate change projects, programmes and activities in County planning and budgeting, and ensure their approval and inclusion in the CIDP. The Fund shall also be responsible for coordinating capacity building at Ward and County level and be responsible for financing cross ward and cross County climate change programmes and mobilize funds. The Act affirms allocation of 2% of the County's Development budget to be channeled into the climate change fund

Makueni County Climate Change Fund Regulations 2015

The regulation establishes a County Climate Change Fund with a purpose of providing funding for climate change activities identified in the Makueni County Integrated Development Plan and for connected purposes. The regulations also stipulate on sources of fund and establishes a County Climate Change Fund Management Board which shall manage the funds. Among the functions of the board; is mainstreaming climate change projects, programmes and activities in County planning and budgeting and ensure their approval and inclusion in the County Integrated Development Plan.

Makueni County Disaster Management and Special Programmes Policy, 2022

The policy seeks to prioritize disaster management and pursues to promote citizen empowerment within Makueni County by employing a bottom-up approach that focuses on the village level for Disaster preparedness, response, recovery and rehabilitation programmes. Building capacities of people living in disaster prone areas and improvement of their capabilities in order to cope with all hazards is therefore central and critical to the policy intentions of Makueni County.

Makueni County Public Participation Policy, 2020

The policy recognizes that realization of responsive and people driven development requires effective public participation in all stages of project cycle. Active involvement of the citizens often legitimizes identification with development programmes and projects and ownership of the implemented interventions. The policy prioritizes operationalization of participatory development units through continuous community-based planning, project identification, proposal development and prioritization activities and initiatives. The policy also prescribes for adequate notification of public participation, and provision of timely and accurate information in accessible formats.

1.3. Purpose of the CRA Report

The County Climate Change Risk Assessment (CRA) serves as a strategic document that outlines the priorities, goals, and actions to address climate change risks and hazards within Makueni County. It provides a roadmap for integrating climate considerations into development planning, resource allocation, and policy formulation. The primary purpose of the CRA report is to enhance climate resilience, promote sustainable development, and safeguard the well-being of communities and ecosystems. CRA is one of the key requirements under the FLLoCA program for accessing the Climate Resilience Investment Grants from the National Treasury. The County carried out Participatory Climate Risk Assessment to identify major climate risks, sources of vulnerability and priority adaptation strategies to mitigate the challenges.

1.4. Makueni County PCRA Process

The development of the County Climate Risk Assessment Report involved a participatory and inclusive process to ensure that inclusion of diverse stakeholders, including women, youth, people living with disabilities, and other vulnerable groups. The process created a platform and an opportunity to contribute

their perspectives, knowledge, and experiences. The process sought to empower these groups and enable them to actively participate in decision-making and planning processes. Recognizing the urgency and importance of addressing climate change, Makueni County has undertaken the Participatory Climate Risk Assessment Process to identify and prioritize climate risks. This process engages stakeholders at all levels, ensuring their active participation in shaping locally led climate change action and resilience-building efforts. The following ten steps were used by Makueni County in development of the CRA report.

Step 1: Constitution of Sector Working Technical Group and Consultative Group (Directors) NDMA MET

The Chief Officer in charge Environment and Climate Change appointed a technical working group of County directors to steer the process. The representative directors were from various sectors which include Environment, M&E, Social Development, Gender, Planning, Agriculture & Irrigation, Water & Sanitation, Special Programmes, Health Services, Strategic Partnerships, Public Participation, and a member of Makueni Climate Change Board. The composition of the technical working group incorporated director MET, NEMA and NDMA for better coordination. The consultative taskforce supported the technical working group in preparing the CRA report which informed the development of CCAP.

Step 2: Capacity Building of Sector Working Technical Team

The Technical Working Group undertook comprehensive training on development, resource mobilization and implementation of CCAP. The training also involved PCRA process, guidelines and key templates for data collection and involved both the consultative taskforce and Technical Working Group. The training on the PCRA process involved roll-out of the process and was coordinated by the CCU.

Step 3: Mapping Stakeholders and Analysis

The technical team identified all stakeholders for climate change in building adaption and resilience through their actions and responses climate hazards and impacts. The analysis profiled stakeholder in terms of their influence and interests in matters related to climate change. Stakeholder Analysis is the technique used to identify the key partners for successful planning, identification of climate risks, its impacts and strategic adaptation interventions and implementation of climate actions. The benefits of using a stakeholder-based approach are that: The opinions of the most powerful stakeholders shape the program at an early stage, their input improves the quality of your project. Gaining support from stakeholders is useful in resource mobilization enhancing the Climate Change Fund for effective climate actions.

Stakeholder identification

The technical Working Group identified organizations and Departments which have interest in climate actions, are impacted by climate change or are involved in climate action in the County. The stakeholders identified are Community based organizations, civil society organizations, faith based organizations/representatives, customary groups, local producer groups, local experts, community leaders, business groups and financial organizations, youth groups, women groups, representatives of people living with disabilities and Government Agencies. Stakeholder list attached. In addition, the Technical Working Group identified stakeholders who have carried out climate risk and hazard assessment in the County.

Table 1: Stakeholder Analysis

<p>High Influence, Low Interest</p> <ul style="list-style-type: none"> • Financial Institutions (Equity Bank, ABSA, Family Bank) • Business community 	<p>High Influence High Interest,</p> <ul style="list-style-type: none"> • Gov agencies: KFS, KWS, NEMA, TARDA NDMA, KEFRI <p>Department of, Water, and sanitation Department of Environment, Natural Resources and Climate Change Department of Agriculture, livestock, fisheries and cooperative development Department of Meteorological Services;</p> <ul style="list-style-type: none"> • Civil Society Organizations (ADA Consortium, ADS Eastern) • County Assembly <p>WRA</p>
<p>Low influence, Low Interest</p> <ul style="list-style-type: none"> • Communication Officers • Secretarial staff <p>Academic and Research Institutions (Wote Technical Training institute)</p>	<p>Low Influence, High Interest</p> <ul style="list-style-type: none"> • Kenya Water Towers Agency <p>Department of Transport, infrastructure, Energy and public works County Environment Committee(CEC) members</p> <ul style="list-style-type: none"> • Academic and Research Institutions (SEKU, Lukenya University) <p>VSO Kenya Redcross</p>

The different stakeholders identified were engaged in every stage of the process as follows.

1. Representation in the Cross Sector Technical Working Group
2. Formation of an additional consultative Group for further consultation and advice
3. Community engagement and ward level stakeholder's engagement;
4. Stakeholder engagement at County level
5. County Assembly Engagement
6. County Executive engagement

Step 4: Preparation of Ward Level Community and Stakeholder Engagement

Climate Change Unit carried out sensitization forums through radio, other media platforms to inform citizens on the dates and reasons for carrying out PCRA exercise. The adverts were to mobilize communities and ward climate change planning committees through the support of office of administration and public participation. The technical team mapped and clustered the wards for efficiency and identification of accessible venues for all teams giving proximity of the wards. In addition, the technical team prepared the respective engagement tools, materials and programs for the exercise before the start of the exercise. The advert gave the communities 7-day notice for better preparation of the actual exercise.

Step 5: Community Engagement and Data Collection

Three wards were clustered for the actual participation and each ward had on average 30 participants. The participants consisted of all groups in the ward with high consideration of vulnerable and marginalized groups. The team leaders for each group gave the reasons for the PCRA and the participants were divided according to the wards for actual hazard profiling and analysis according to PCRA guidelines. The exercise involved the following procedure and activities;

Activity 1: Introduction of community members, WCCPCs, Ward Officers and Technical working group

Activity 2: Identification of resources and inputting into the map; Mapping of risks

Activity 3: Climate information discussion on historical, current and projected scenarios

Activity 4: Identification of Climate risks, Direct and Indirect Impacts; Identification of vulnerable groups

Activity 5: Group work working of priority Climate Risks discussing on adaptation strategies, effectiveness of the strategies, actions that support the strategies, Factors undermining the strategy, new adaptation

Activity 6: Action Planning

Activity 7: Validation of composition of Ward Climate Change Planning Committees

Step 6: Ward Level Data Cleaning and Compilation

The technical Working Group held working sessions to consolidate the data and information obtained from the ward level consultations.

Step 7: Development of Ward PCRA Reports

Working teams shared Ward reports to help draft PCRA reports

Step 8: Development of County CRA Report

The Technical Working Group held a four days retreat to compile the County level CRA report

Step 9: Multi-sector Engagement on County CRA Report

Activity 1: Soft copies of the draft County PCRA report as shared out to different stakeholders

Activity 2: Two days stakeholders' workshop to receive comments and views on how to improve the report

Activity 3: The Technical Working group produced an advanced County PCRA report after incorporating stakeholder comments

Step 10: Public Input County CRA Report

Activity 1: Send out the draft County CRA report to the public through the county website and individual emails

Activity 2: Receiving comments virtually

Activity 3: Drafting of the zero draft of the County CRA report

Step 11: Submission to Cabinet for Consideration and Approval

Activity 1: Printing the Zero Draft

Activity 2: Review by the County Steering Committee

Activity 3: Forwarding to Cabinet

Step 12: Approval by County Assembly

1.5 Differentiated Climate exposure and Vulnerability of key groups

Summary of Differentiated Climate exposure and Vulnerability of key groups and livelihoods in the County	
Vulnerable group	Group characteristics
Children and OVCs	<ul style="list-style-type: none">• In school, leading to lack of involvement in decision making• Resource poor• Depended on HH heads• Low immunity• Not involved in income generating activity• Low adaptive capacity• Very sensitive to climate stressors• Has no access and control of assets• Low immune systems• No access to information
Women	<ul style="list-style-type: none">• Resources poor and most are house wife's• Depended on HH heads• Depends on casual Labour and subsistence farming• Cultural Limitations and values• Left out and no equal opportunity in decision making• Low adaptive capacity.• Have access to HH assets but no control• Low control on resources such as land
Youth	<ul style="list-style-type: none">• Resource poor• Depended on HH heads• Depends on casual labour• Left out and not equal opportunity in decision making• High unemployment• Drug abuse• Limited access and control to HH assets
Elderly 65 years +	<ul style="list-style-type: none">• Depended on HH heads• Depends on casual labour• Low immunity• Not energetic• Old-age diseases reduce their adaptive capacity•

PWD and special needs	<ul style="list-style-type: none"> • Resource poor • Depended on HH heads • Depends on casual labour • Left and not equal opportunity in decision making • Stigmatization • Depressed • Discriminated and isolated • Cultural myths that they are cursed • Low access and control to assets • Low access to information
Chronically ill	<ul style="list-style-type: none"> • Resources poor • Highly depended on relatives • Depends on casual labour • Left and not given equal opportunity in decision making • Low immunity • Stigmatization • Depressed • Discriminated and isolated • Cultural myths terming them as cursed
Informal settlers - BOMA 4 (mikumboni) - Misongeni - Manyatta - Kismayu in kiboko, Kibwezi and Emali	<ul style="list-style-type: none"> • Informal housing • No access to information • Depends on casual labour • Left and not given equal opportunity in decision making • No access to basic production assets such as land

CHAPTER TWO: MAKUENI COUNTY HAZARD PROFILE

2.1 Historical and Current Climate Hazards and Trends

The main climatic hazards in Makueni County are drought, erratic rainfall patterns, prolonged dry spells, short leaved torrential rainfall episodes during the two rainy seasons, thunderstorms and lightning have also increased in frequency and intensity.

Table 2: Characteristics of Agro-ecological Zones

UPPER ZONE	MIDDLE ZONE	LOWER ZONE
1. Annual rainfall ranges from 1000 to 1250mm	1. Annual rainfall ranges from 750mm to 1000mm	1. Annual rainfall ranges from 250mm to 750mm
2. Mean annual temperature ranges from 21°C to 22°C	2. Mean annual temperatures 22°C to 24°C	2. Mean annual temperatures 24°C to >25°C
3. Upper midland semi-arid	3. Lower midland	3. Lower low land arid
4. Upper midland semi-arid to arid	transnational conditions	4. Lower midland semi-arid
5. Upper midland semi-humid conditions	4. Upper midland semi-arid conditions	5. Lower midland transitional
6. Lower highland sub-humid conditions	5. Sandy loams soils (main soils)	6. Upper midland sub-humid
7. Sandy loams soils (main soils)	6. Sandy clay loams	7. Sandy loams soils (major soils)
8. Sandy clay loams	7. Clay loams	8. Clay loams
		9. Sandy clay loams

2.2 Climate Trends in Makueni

Makueni county is largely an Arid and Semi-Arid land; prone to frequent droughts due to unreliable and erratic rainfall. The county experiences two rain seasons in a year. The long rains are experienced during the March-May-April-June season with the volume of rainfall averaging at 140 MM over the last five years. Short rains are experienced during the October – December season with higher volumes of precipitation being realized with a five-year average of 300MM.

The mean annual temperatures in Makueni range from 22.7 Degrees Celsius to 24 Degrees Celsius over the past years.

2.2.1 Historical mean temperatures in Makueni County

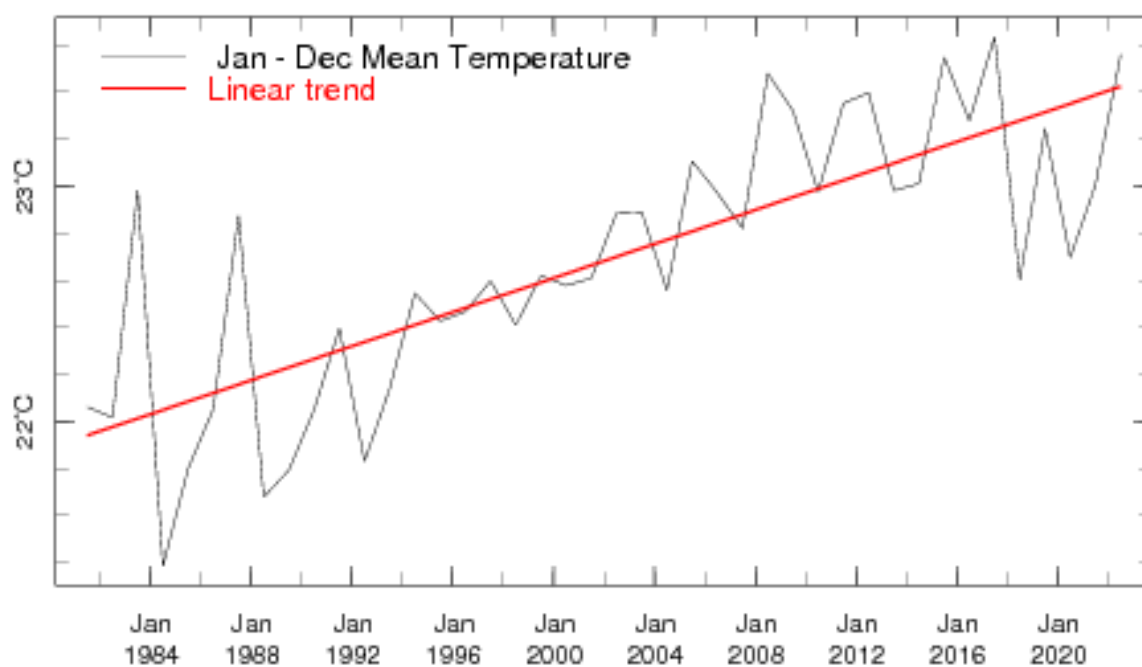


Figure 1: Historical mean temperatures in Makueni County

The linear trend (red) shows a steady increase in mean temperatures from 1984-2020(Source kmd map room)

Rainfall ranges from 1000mm -1250mm in the upper zone, 750mm - 1000mm in the middle zone and 250mm -750mm in the lower zone.

2.2.2 Historical average rainfall trend for Makueni County

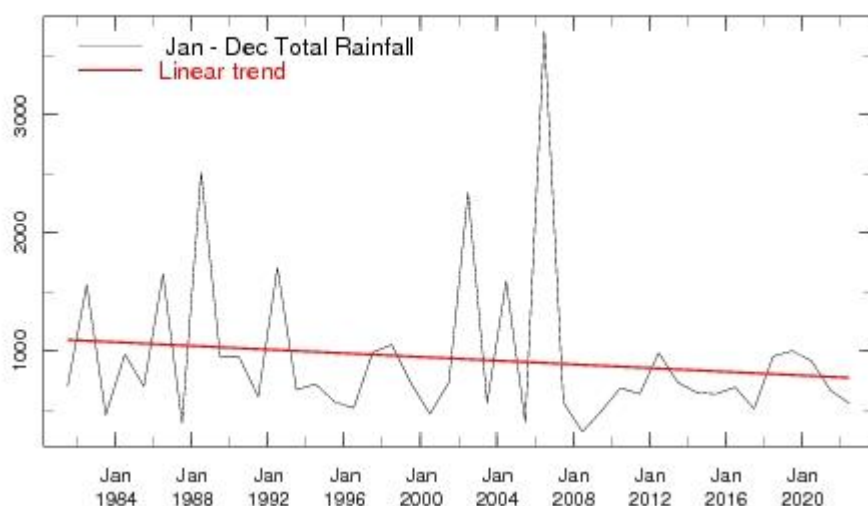


Figure 2: Historical average rainfall trend for Makueni County

The linear trend (red) shows a gradual decrease in rainfall annual amounts from 1984-2020(Source kmd map room)

2.2.3 Current Annual Climate Information for Makueni County

2.2.3.1 Rainfall

The rainy period of the year lasts for 7.8 months, from October 4 to May 29, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Makueni is November, with an average rainfall of 2.6 inches.

The rainless period of the year lasts for 4.2 months, from May 29 to October 4. The month with the least rain in Makueni is July, with an average rainfall of 0.0 inches.

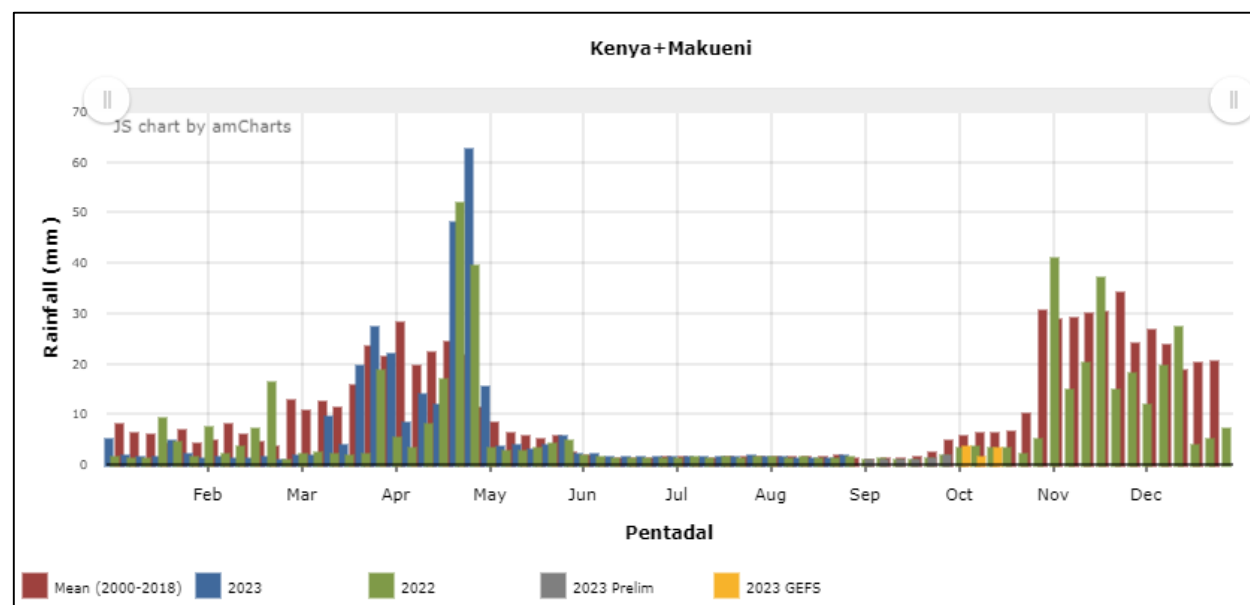


Figure 3: Current Annual rainfall in Makueni County

Source; Fewsnets tool

2.2.3.2 Average Annual Temperature in Makueni

The hot season lasts for 1.9 months, from February 2 to March 31, with an average daily high temperature above 84°F (28.8°C).

The cool season lasts for 2.6 months, from June 11 to August 29, with an average daily high temperature below 79°F (26°C). The coldest month of the year in Makueni is July, with an average low of 58°F (14.4°C) and high of 77°F (25.0°C).

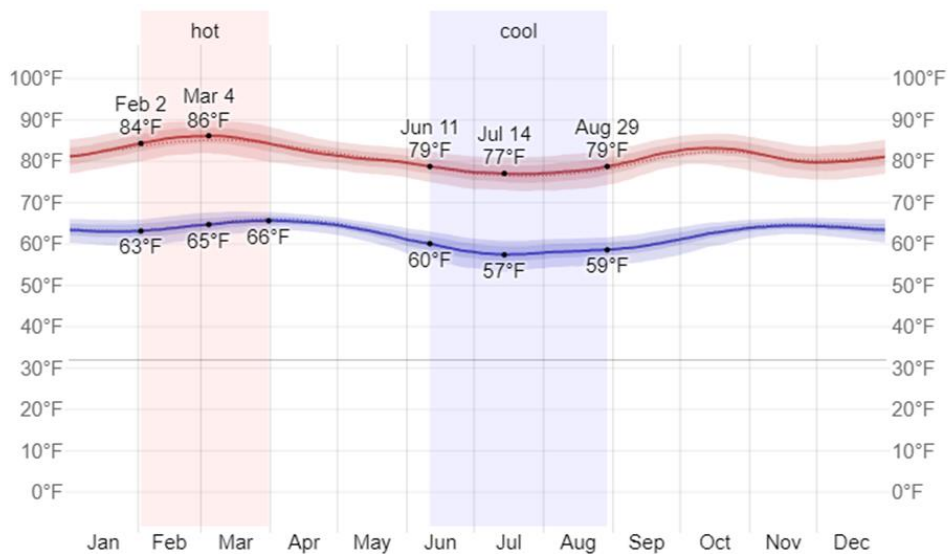


Figure 4: Current Annual minimum and maximum temperatures in Makueni

2.2.3.4 Humidity

We base the humidity comfort level on the dew point. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night.

Makueni County experiences *significant* seasonal variation in the perceived humidity.

The *muggier period* of the year lasts for 6.5 months, from November 2 to May 19, during which time the comfort level is *muggy*, *oppressive* or *miserable* at least 8% of the time. The month with the muggiest *days* in Makueni is *April*, with 8.8 days that are *muggy* or worse.

The month with the fewest *muggy days* in Makueni is *August*, with 0.0 days that are *muggy* or worse.

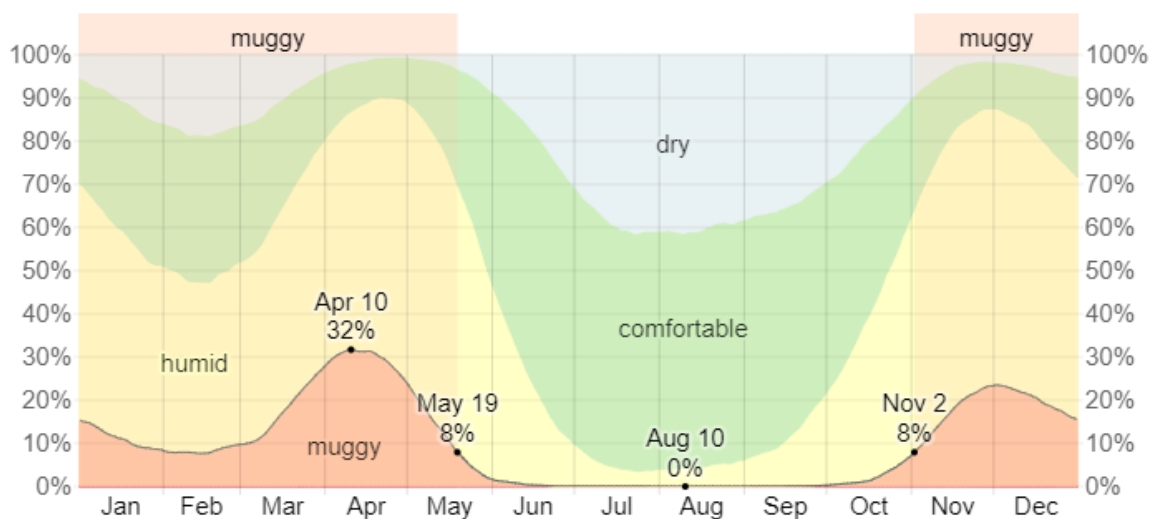


Figure 5: Humidity comfort level

2.2.3.5 Wind

The average wind speed in Makueni experiences *mild* seasonal variation over the course of the year.

The *windier* part of the year lasts for 3.1 months, from *July 28 to October 31*, with average wind speeds of more than 7.2 miles per hour. The *windiest* month of the year in Makueni is *September*, with an average wind speed of 8.3 miles per hour.

The *calmer* time of year lasts for 8.9 months, from *October 31 to July 28*. The *calmest* month of the year in Makueni is *June*, with an average wind speed of 6.1 miles per hour.

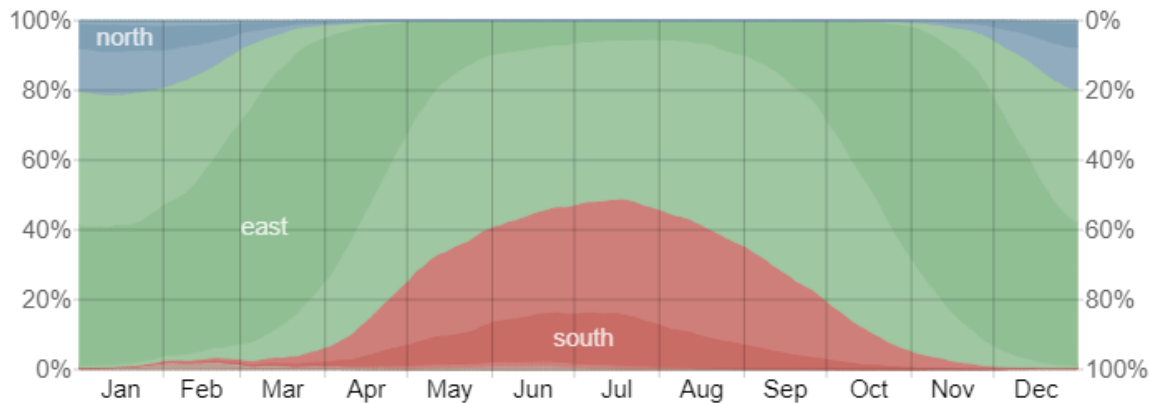


Figure 6: Average Wind Speed in Makueni County

The predominant average wind direction in Makueni County is from the East South *East* throughout the year.

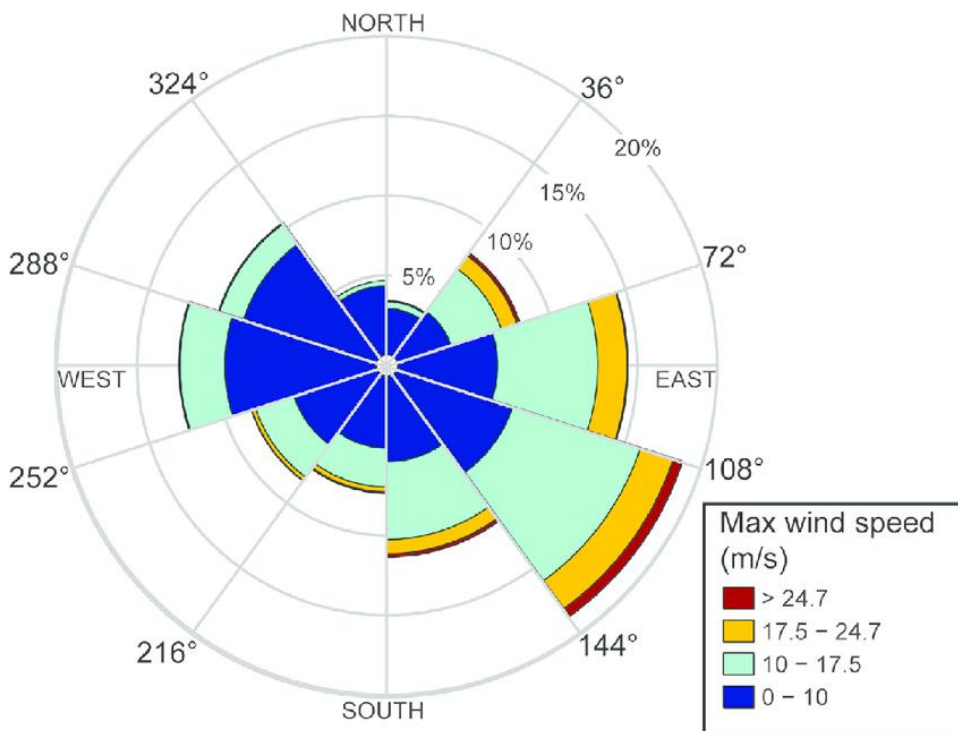


Figure 7: Wind Rose showing wind direction and speed in Makueni County

2.3 County Climate Change Scenarios

2.3.1 National Projections of Climate Change

The following national projections are sourced from the World Bank Kenya Climate Risk Country Profile. Each county's particular experience of climate change (as explored in the PCRA process) is likely to be localized and highly contextual and should be considered in conjunction with these national level trends when generating plausible future scenarios as part of Session Four of the PCRA county workshop (see template 9).

2.3.1.1 Temperature

Kenya's temperatures vary by altitude, with cooler temperatures in highland areas and warmer temperatures in lowland and coastal regions.

Nairobi, the capital, experiences a temperate climate, with temperatures averaging around 19-24°C (66-75°F).

Coastal areas, such as Mombasa, have a tropical climate with higher temperatures and humidity.

At the national level, under the worst case RCP8.5 scenario:

- Average temperatures nationally are expected to continue rising by 1.7% by the 2050s and by 3.5% at the end of the 21st century.
- The number of hot days and hot nights will increase, with hot days projected to occur on 19%-45% of days by mid-century. Hot nights are expected to increase even more rapidly, projected to occur on 45%-75% of nights by 2050.
- Cold days and nights are expected to become increasingly rare.

2.3.1.2 Rainfall

Kenya experiences a diverse range of rainfall patterns due to its geographical diversity.

The country has two rainy seasons: the long rains (March to May) and the short rains (October to December). Rainfall varies from arid and semi-arid regions in the north to more humid conditions in the highlands.

- Precipitation will remain highly variable and uncertain.
- Nationally, average rainfall is expected to increase slightly by 2050, especially for the 'short rains' which occur between October and December. However, each county's experience is likely to be highly contextual and localised, in particular:
 - Rainfall in arid zones is likely to decrease.
 - The pattern and temporal distribution of rainfall is likely to change
 - Extreme rainfall events (heavy downpours) are likely to increase in frequency, duration and intensity.
 - The period between heavy rainfall events is likely to increase.
 - The proportion of rainfall that occurs in extreme rainfall events (heavy downpours) is likely to increase

2.3.1.3 Relative humidity

Coastal areas have high humidity levels throughout the year due to their proximity to the Indian Ocean.

Humidity tends to decrease as you move inland and towards higher altitudes.

Inland areas, especially the arid and semi-arid regions, can experience low humidity levels.

- Relative humidity is expected to be low due to projected increase in temperatures.
- More humid days are expected

2.3.1.4 Wind

Kenya experiences various wind patterns, influenced by its position and topographical features. The Harmattan, a dry, dusty wind from the Sahara Desert, affects the northeastern region. The Indian Ocean brings the monsoon winds, impacting the coastal areas. Due to low humidity, strong winds are expected

No expected significant change in wind direction

2.3.1.5 Pressure:

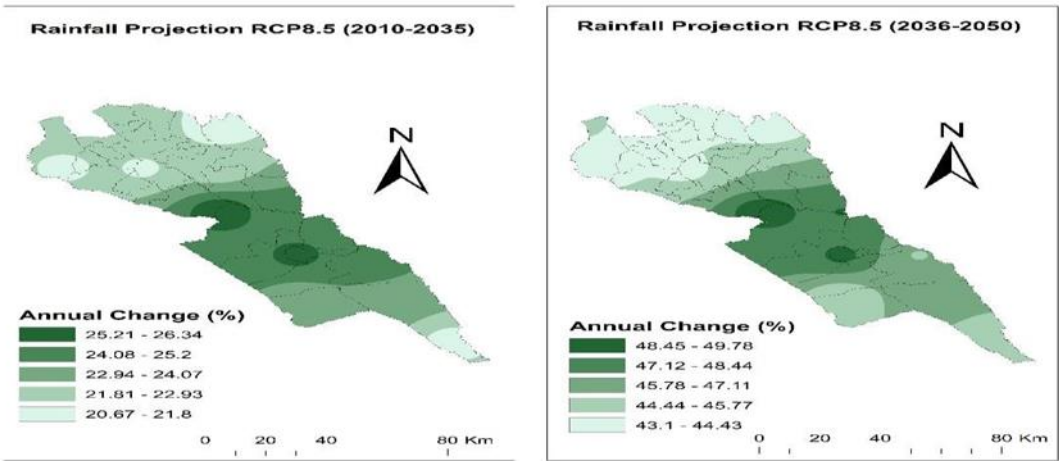
Atmospheric pressure in Kenya is influenced by the interplay of high and low-pressure systems. Seasonal changes in pressure patterns influence the onset and duration of the rainy seasons. Low-pressure systems bring heavy rainfall while high-pressure systems lead to drier conditions.

Table 3: Likely Impacts of the key trends

Climate trend	Impacts on key sectors			
	Agriculture	Water	Environment	Infrastructure
Increasing Temperature	<ul style="list-style-type: none"> • Low yields • Crop pests and diseases • Stunted growth of crops 	<ul style="list-style-type: none"> • Drying of water sources 	<ul style="list-style-type: none"> • Drying of plants • Loss of biodiversity • Drought 	<ul style="list-style-type: none"> • Heat related damages
Extreme Rainfall	<ul style="list-style-type: none"> • High yield • Healthy crops • Food and nutrition security 	<ul style="list-style-type: none"> • Adequate water supply • Damage to water infrastructure 	<ul style="list-style-type: none"> • Flooding • Mudslides/landslides • Soil erosion • Land degradation 	<ul style="list-style-type: none"> • Loss of properties • Destruction of roads
Decreased rainfall	<ul style="list-style-type: none"> • Low yields • Poor crops • Food and nutrition insecurity • Soil degradation 	<ul style="list-style-type: none"> • Water shortage • Low water table • Low recharge levels 	<ul style="list-style-type: none"> • Deluded land • Decreased tree cover • Loss of biodiversity 	<ul style="list-style-type: none"> • Low energy generation • Soil subsidence
Wind	<ul style="list-style-type: none"> • Pollination • Damage of crops • Low production • Soil erosion 	<ul style="list-style-type: none"> • Evaporation • Increase in evapotranspiration 	<ul style="list-style-type: none"> • Habitat destruction • Air pollution 	<ul style="list-style-type: none"> • Building damage • Power outages • Transportation disruption
Low Humidity	<ul style="list-style-type: none"> • Increased evapotranspiration 	<ul style="list-style-type: none"> • Decreased surface runoff 	<ul style="list-style-type: none"> • Low moderation of temperatures 	

2.4 Regional Level Projections (advanced users)

When combined with the lived experience of local stakeholders, broad national level projections are sufficient to generate plausible future climate scenarios for the PCRA (template 9). The county may also have access to downscaled projections derived from other sources (e.g. KMD) which may provide a more locally focused projection for key climate variables. One such source of information is the World Bank Climate Change Portal which allows a sophisticated exploration of the Kenyan national and sub-national (regional) climate projection data that supported both the IPCC’s Fifth Assessment Report (CIMP5) and Sixth Assessment report (CIMP6)¹. However, in most cases these data are highly technical and should only be analyzed by trained experts competent to interpret them. Profiles under the Kenya County Climate Risk Profile series may provide some off-the-shelf interpretation of some of this regional CIMP5 data, but the information is not comprehensively available for all counties.



2.4.1 County Projections of Climate Change

Climate trend	Future projections			
	Duration	Intensity	Frequency	Timing
Rainfall	Short	Increase	Seasonally	Poor
Temperature	Long	Increase	Daily	Fair
Wind	Normal	Normal	Normal	Normal
Pressure	Normal	Normal	Normal	Normal

¹ The CMIP (Coupled Model Inter-comparison Project) is a standard experimental framework for studying the output of coupled atmosphere-ocean general circulation models. This facilitates assessment of the strengths and weaknesses of climate models which can enhance and focus the development of future models.

2.5 Makueni County Agro Ecological Zones

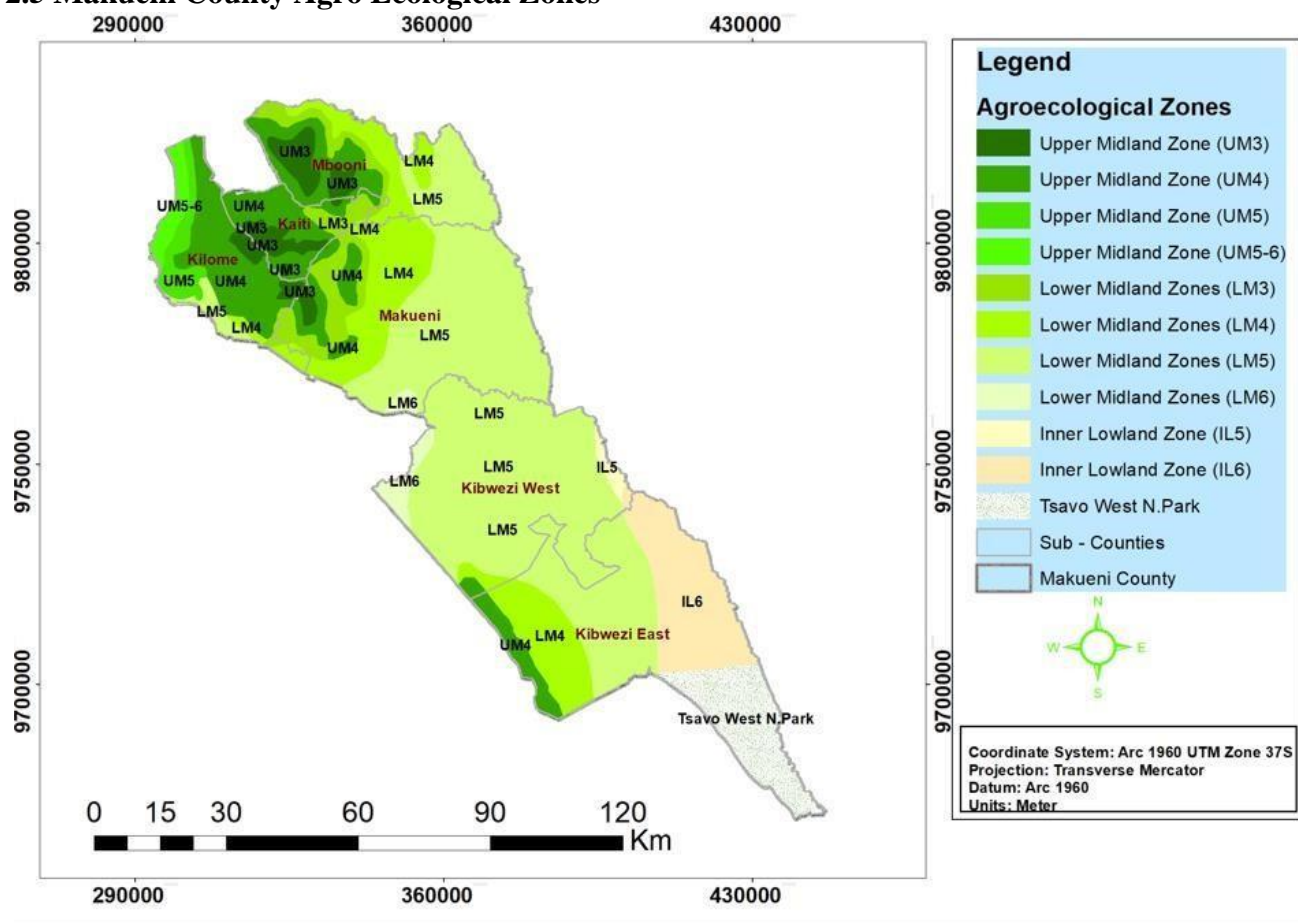


Figure 8: Makueni County Agro Ecological Zones

Table 4: Analysis of Agro Ecological Zones

Zones	Area in Km2	Description
INNER LOWLAND ZONES	670	
IL5	39	Inner Lowland Livestock-Millet Zone
IL6	631	Inner Lowland Ranching Zone
LOWER MIDLAND ZONES	5352	
LM3	389	Cotton Zone
LM4	1094	Marginal Cotton Zone
LM5	3757	Livestock - Millet Zone
LM6	112	Midland Ranching Zone
UPPER MIDLAND ZONES	1691	
UM3	311	Marginal Coffee Zone, Avacado, Macadamia
UM4	1150	Maize - Sunflower Zone-Cotton
UM5	138	Livestock - Sorghum Zone. Cotton
UM5-6	93	Livestock/Sorghum-Upper Midland Ranching Zone

2.6 Exposure and vulnerability of Makueni County to Climate Change Hazards

Makueni County through the PCRA process mapped and ranked risks and hazards. The hazards were ranked from drought, livestock and crop pests and diseases, environmental degradation, human diseases, pollution, and human-wildlife conflict. The identified vulnerable groups were elderly, women, children, PWDs, single parents, orphans, widows and widowers, PLHIV, the terminally sick, youth, teenagers (1318), senior bachelors, sex workers and child-headed families. The figure 9 below shows presentation of climate risks in the entire County. Drought, food insecurity and environmental degradation are the main climate risks identified during the Ward consultations meeting. The risks were further analyzed per sub county to give more insights on how the Sub County are exposed to the risks.

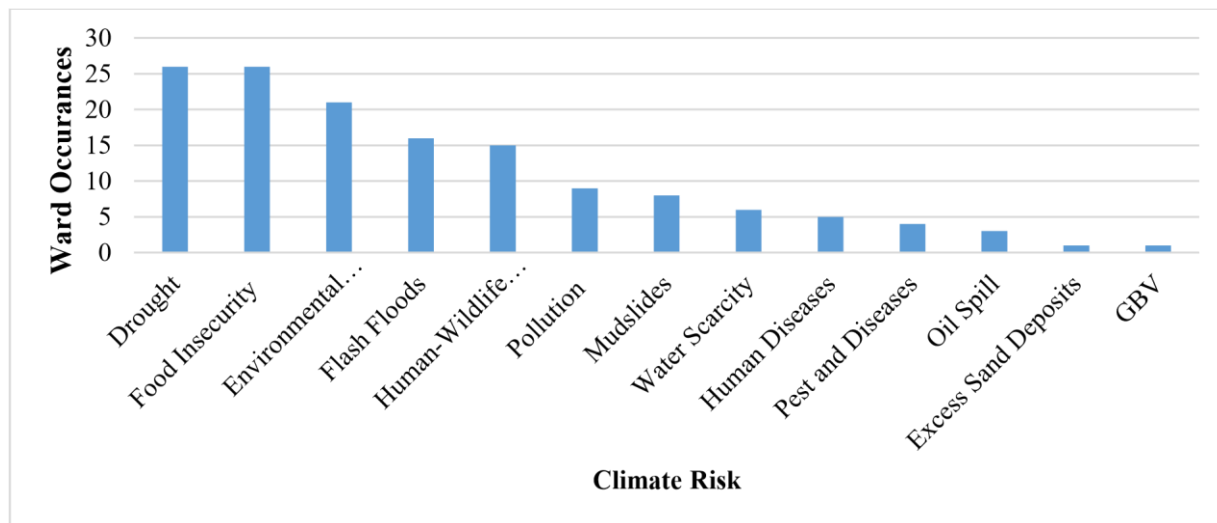


Figure 9: Makueni County Climate Risks and hazards

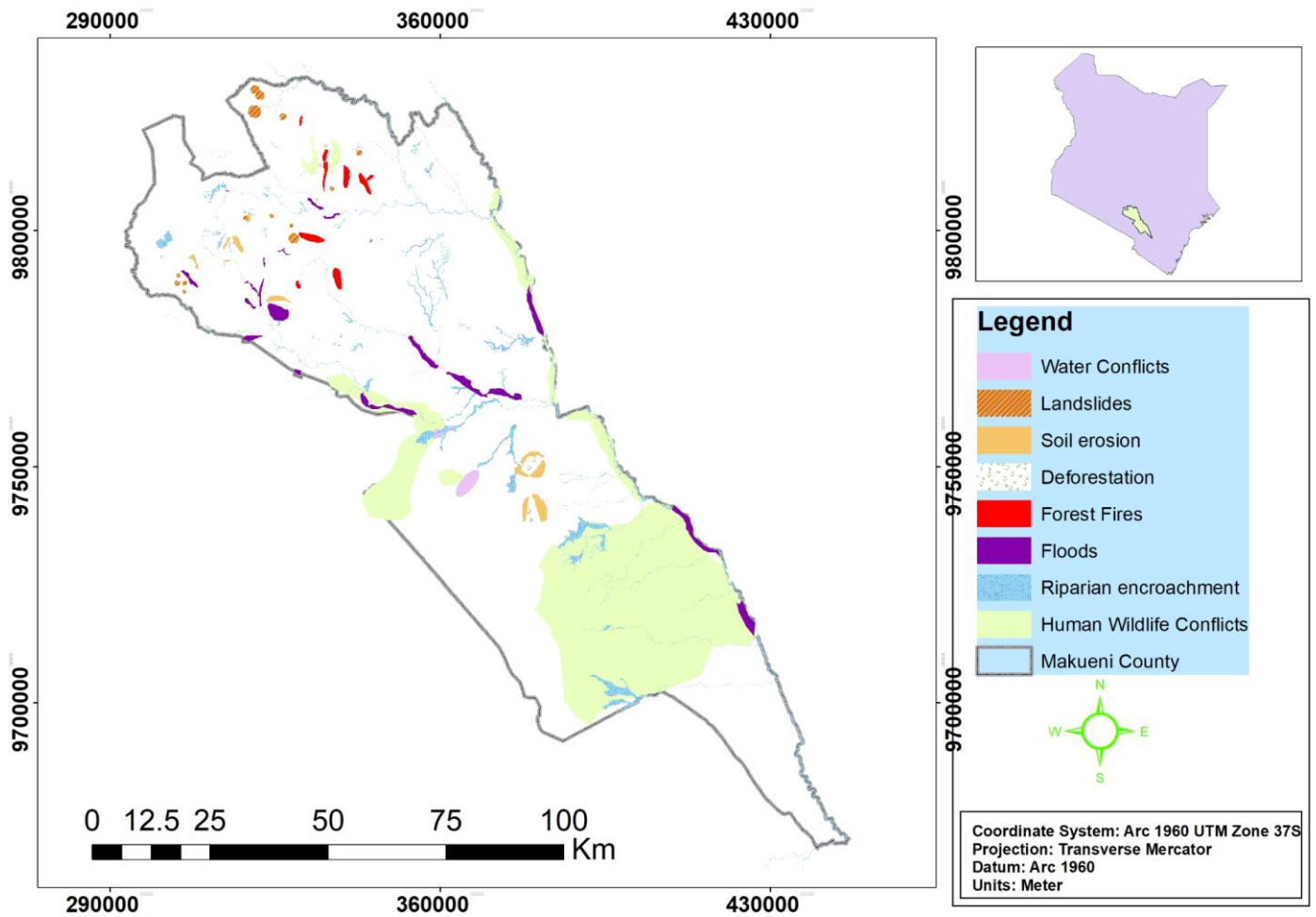


Figure 10: Makueni County Climate Risks and hazards map

2.6.1 Kaiti Sub County Climate Risks and Hazards

Kaiti sub-county is located to the north of Makueni County. It has a population of 116,010 as per 2019 census. The main land use practices are subsistence crop farming; fruit farming (mangoes and oranges, avocado, passion fruit and loquats); woodlot farming in Kilungu and Ilima wards; horticulture and mining of kaolin in parts of Kilungu, Kee and Ilima wards. Majority of the population (91%) use firewood as a source of energy which is the highest amongst the sub counties. Graph 11 below shows climate risks and hazards with environmental degradation identified as the highest climate risks affecting the four wards.

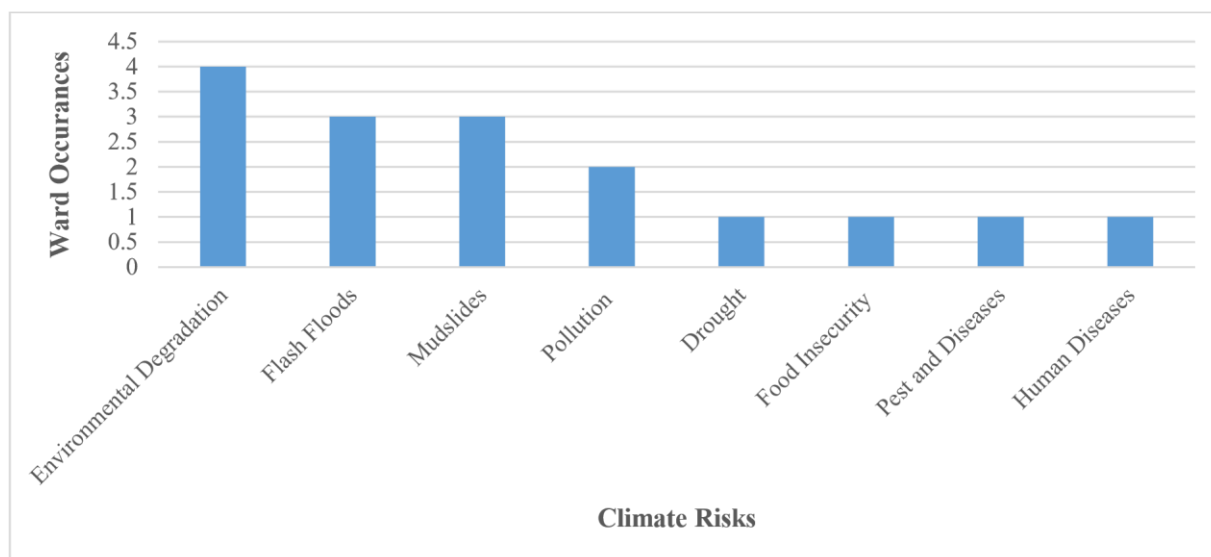


Figure 11: Kaiti Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 12 below.

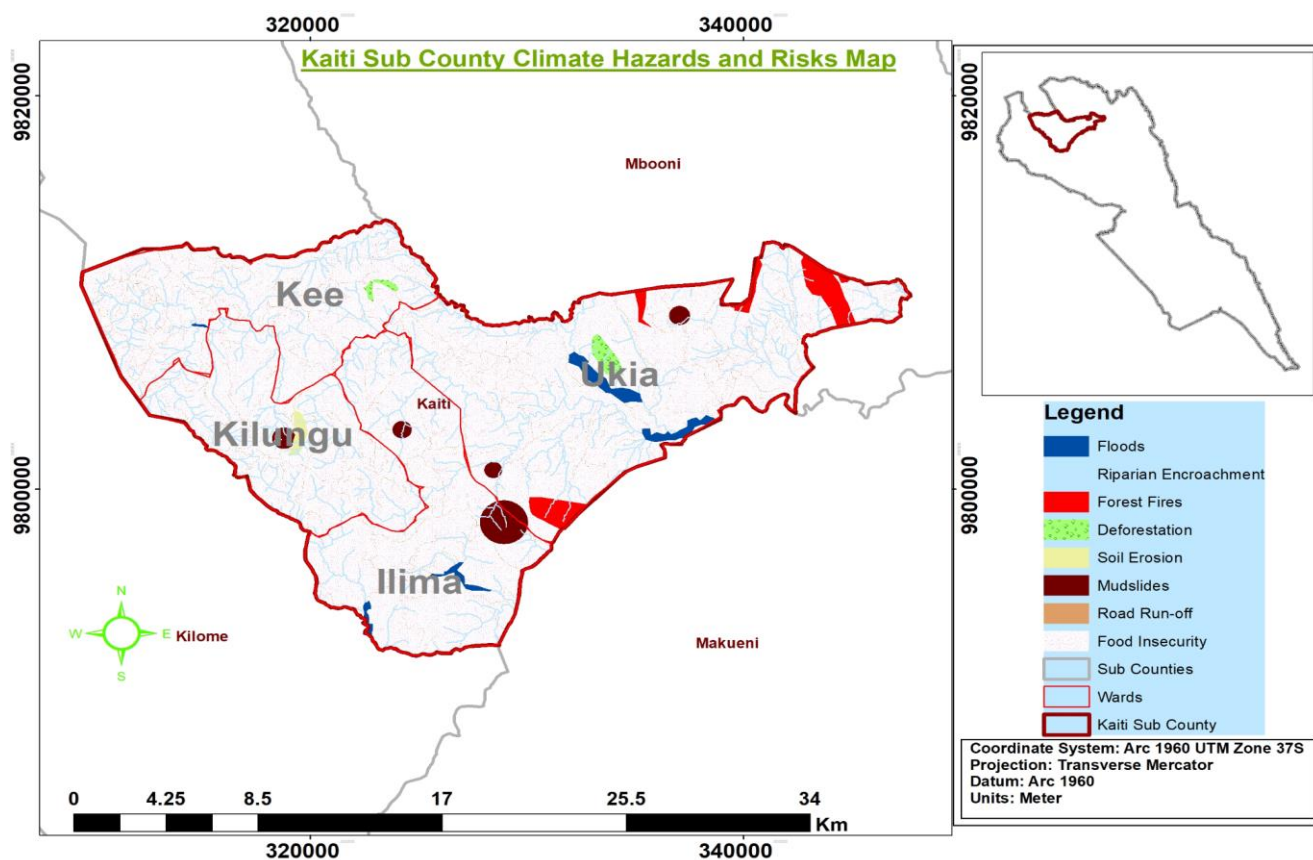


Figure 12: Kaiti Sub County Climate Hazard and Risk Map

2.6.2 Kilome Sub County Climate Risks and Hazards

Kilome sub-county borders Machakos County to the North, Kibwezi-West sub-county to the South, Kajiado County to the West and Makueni sub-county to the East. The population is 102,897 and the sub-county constitutes of three wards namely: Kiimakui/Kalanzoni, Mukaa, and Kasikeu. It is categorized as a semi-arid area receiving an approximate range of 500-750 mm of precipitation annually and temperatures of between 21-25°C annually. Climatic fluctuations within the sub-county such as dry spells, intense precipitation leading to floods, and heat stress, are all hazards that contribute to not only agricultural risk but also decreased vegetative cover in the sub-county. The risks are as shown in figure 13 below.

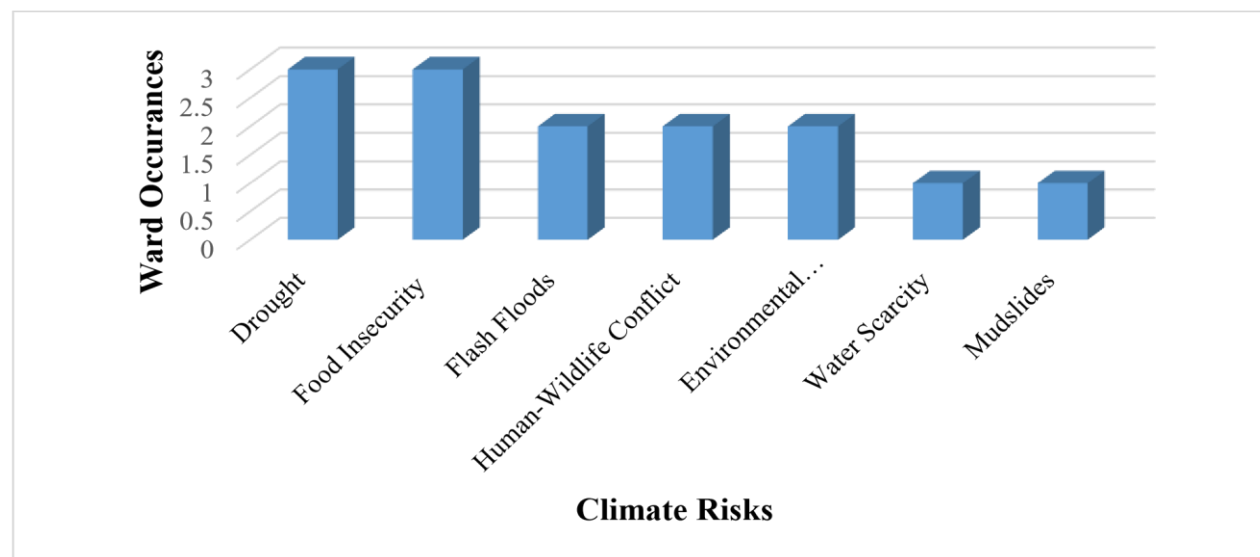


Figure 13: : Kilome Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 14 below.

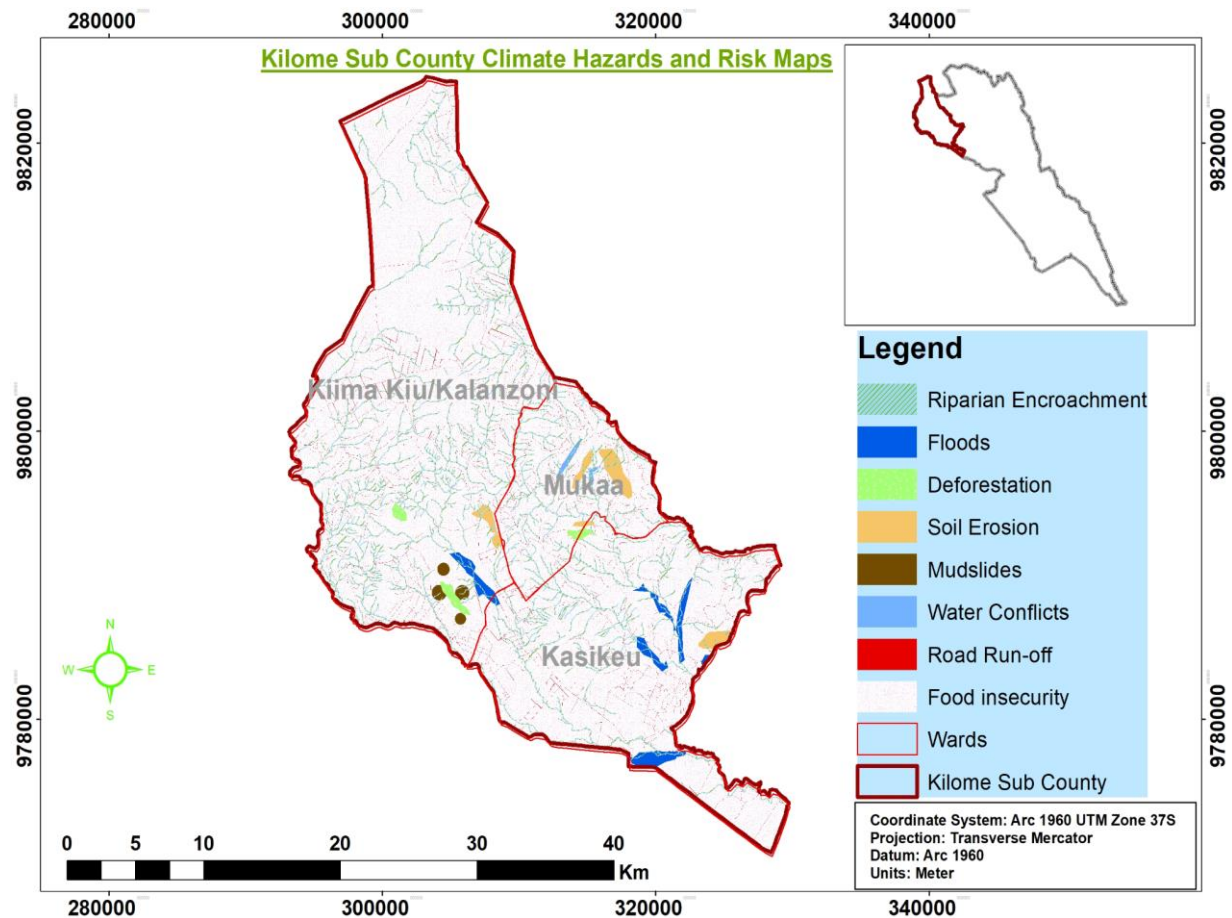


Figure 14: Kilome Sub County Climate Risk Map

2.6.3 Mbooni Sub County Climate Risks and Hazards

Mbooni sub county has a population of 181,046. It has the following wards; Mbooni, Tulimani, Kalawa, Kako/waia, Kisau/Kiteta and Kithungo/Kitundu. The climatic condition of the sub county is semi-arid, rainfall averages 800-1200mm and temperature ranging 16-24°C. The major climate risks and hazards are shown figure 15 below.

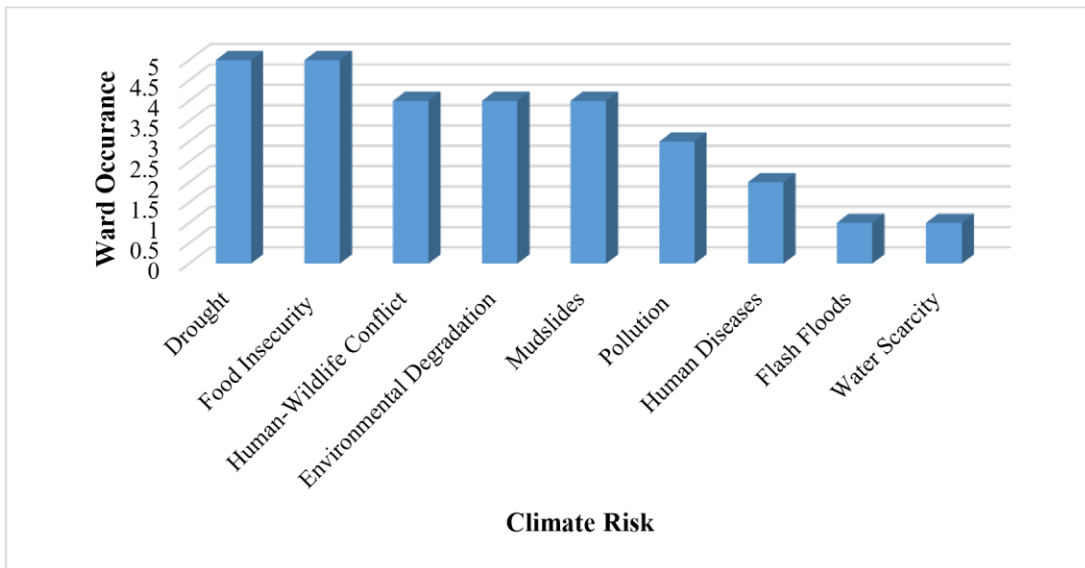


Figure 15: Mbooni Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 16 below.

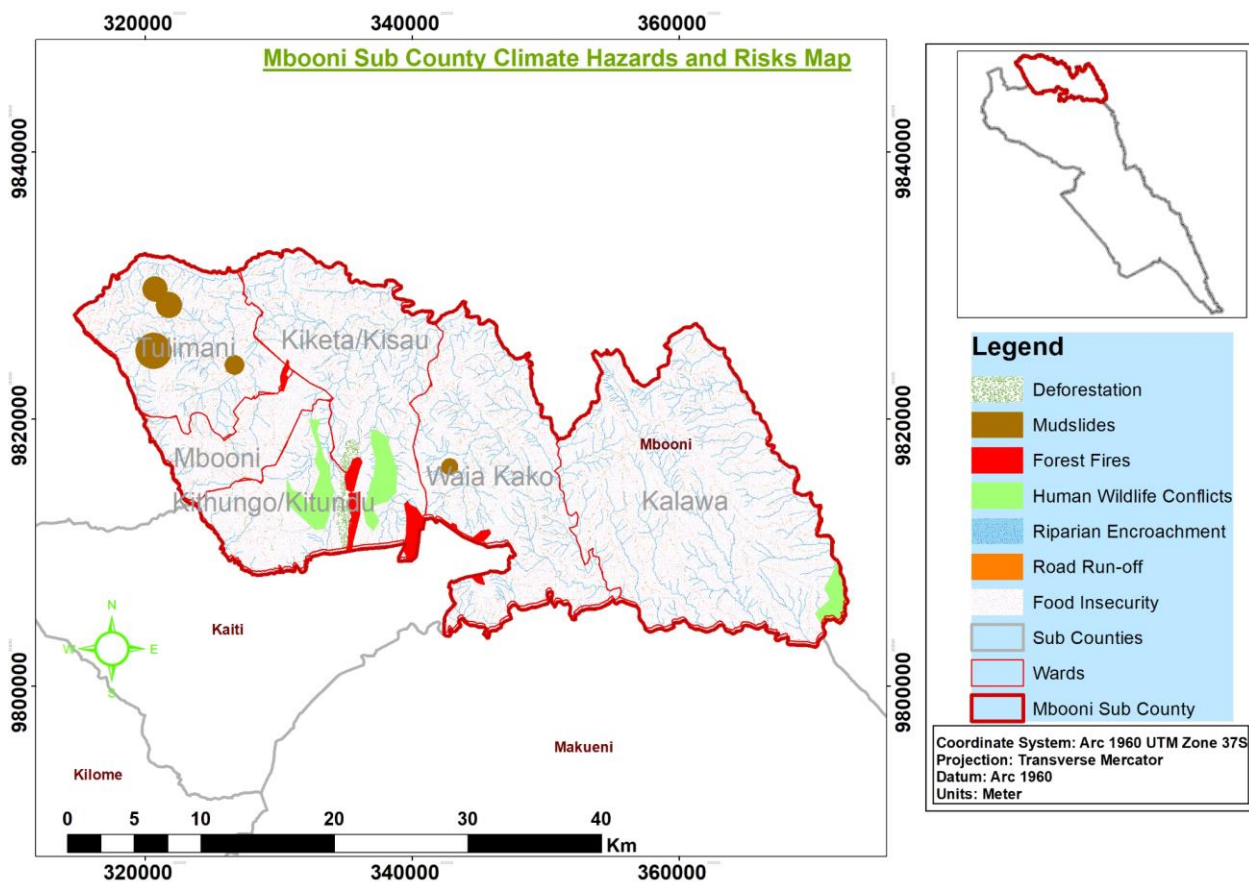


Figure 16: Mbooni Sub County Climate Risk Map

2.6.4 Makueni Sub County Climate Risks and Hazards

Makueni Sub-county is one of the six sub-Counties in Makueni County. It has a population of 203,560. It comprises the following County Assembly Wards: Wote/Nziu, Muvau/Kikumini, Mavindini, Kitise/Kithuki, Kathonzweni, Nzaui/Kilili/Kalamba and Mbitini. Temperatures range from a minimum of between 12°C to a maximum of 28°C. Rainfall ranges from 150mm to 650 mm per annum typical of ASALs in Kenya. The major economic activities include livestock rearing, crop farming, agroforestry, sand harvesting, charcoal burning, and brickmaking. The major livestock include cattle, pig, sheep, goat, poultry and donkey. The major crops produced include green gram, sorghum, maize, mango, cowpea, bean, pigeon pea and citrus. Figure 17 below shows the climate risks and hazard experienced in the Sub County.

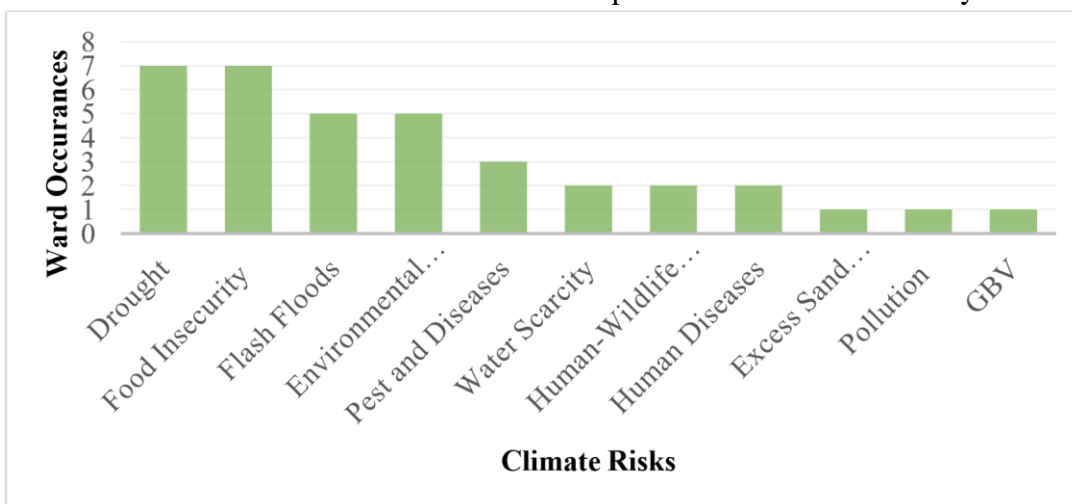


Figure 17: Makueni Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 18 below.

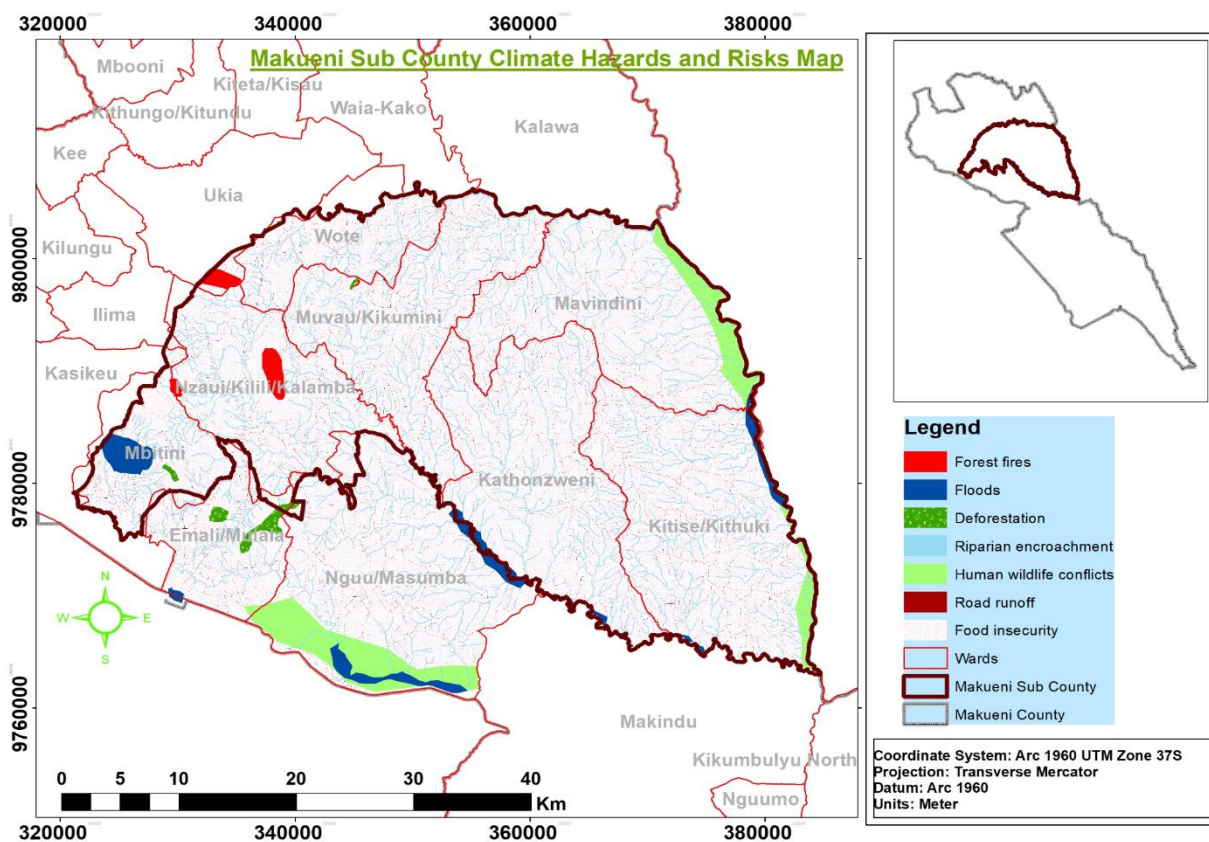


Figure 18: Makueni Sub County Climate Risk Map

2.6.5 Kibwezi West Sub County Climate Risks and Hazards

Kibwezi West has an approximate population of 203,102. It has six electorate wards which include Makindu, Nguumo, Kikumbulyu South, Kikumbulyu North, Emali/Mulala and Nguu/Masumba. The subcounty is largely arid and semi-arid and usually prone to frequent droughts, with rainfall ranging from 300-400mm annually. The depressed rains in the sub County hardly sustain the major staple food of maize and beans. Unfortunately, the traditional crops which are drought tolerant have largely been abandoned. This means livestock rearing remains the most common viable economic activity being undertaken by the local people in the region. The condition has negatively affected agriculture which is the main economic activity in the Sub County. Rain fed agriculture has been affected largely by impacts of climate change. The graph below shows the climate risks experienced in the Sub County.

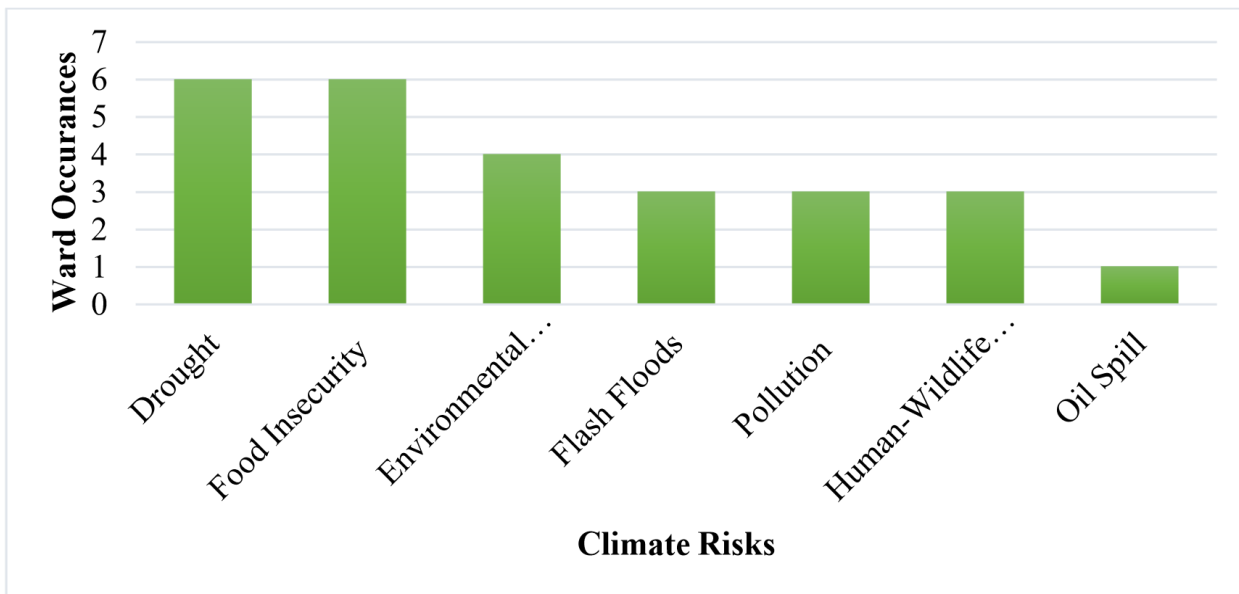


Figure 19: Kibwezi West Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 20 below.

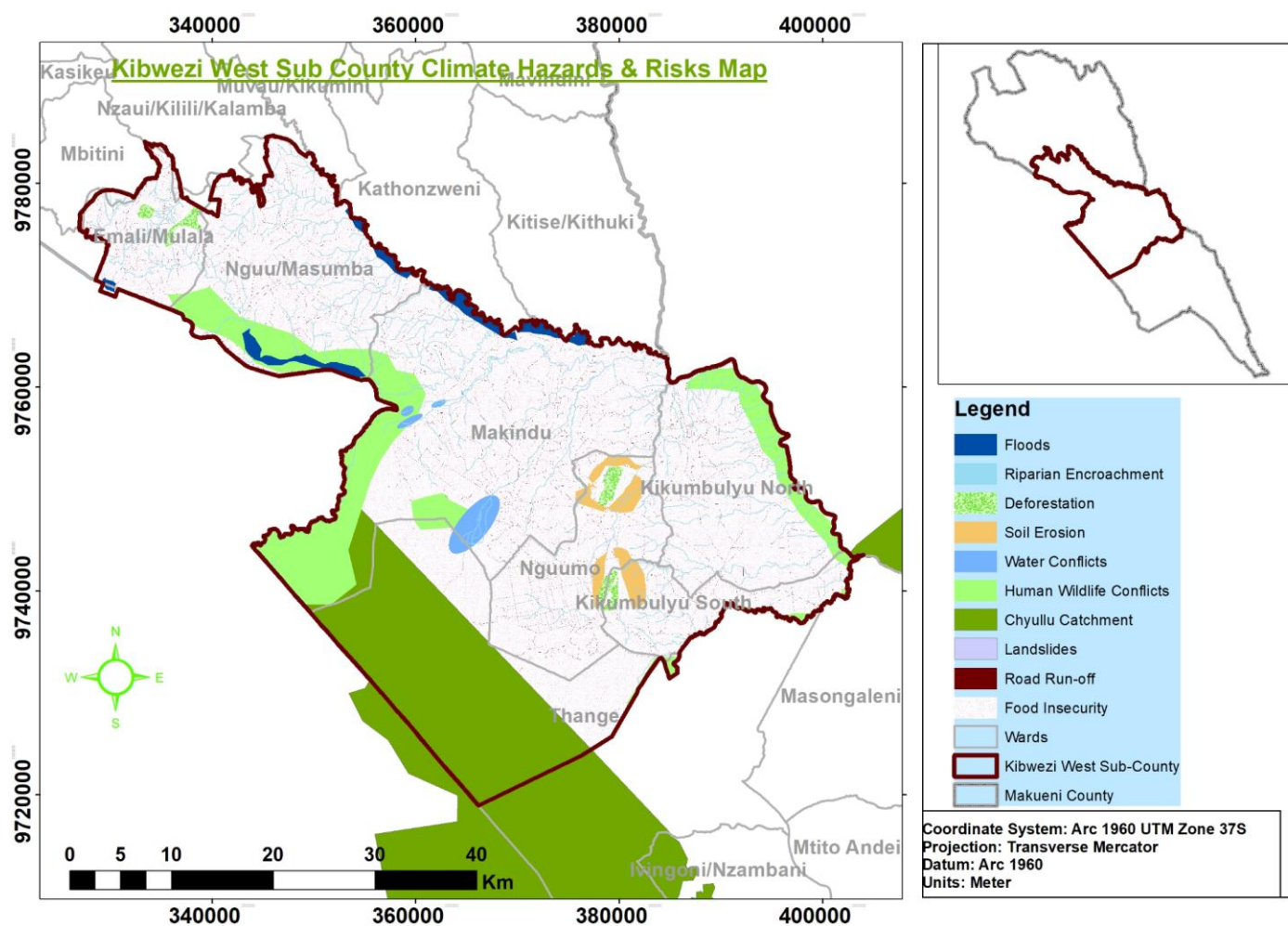


Figure 20: Kibwezi West Sub County Climate Risk Map

2.6.6 Kibwezi East Sub County Climate Risks and Hazards

Kibwezi East has a Population of 142,933. It comprises of the following wards Masongaleni, Mtito Andei, Thange, and Ivingoni/Nzambani. Drought, heat stress, increased precipitation, moisture stress, and increased temperatures are the most problematic climatic hazards in the subcounty. The sub-county receives an average of about 650-750mm of rainfall annually and the temperatures range between 20.2 and 35.8°C. The figure 21 below shows the climate risks in the Sub County.

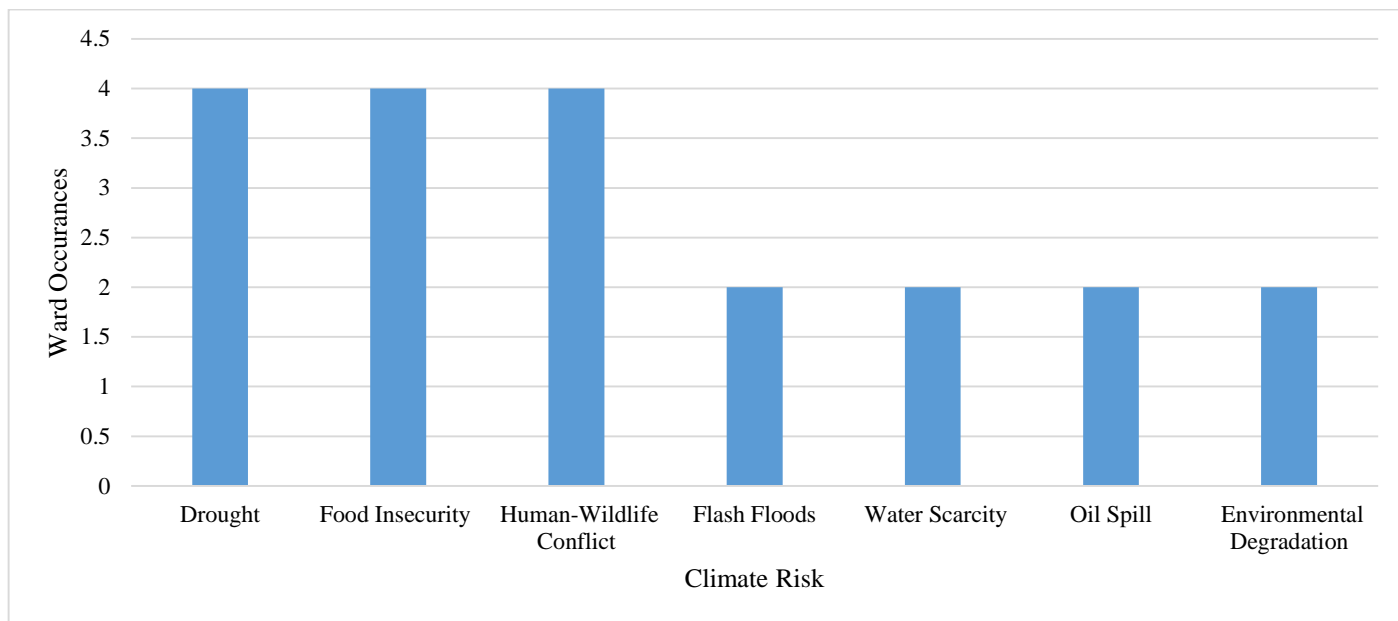


Figure 21: Kibwezi East Sub County Climate Risks and Hazards

Some of the risks and hazards identified by the communities were also represented using the maps as shown in figure 22 below.

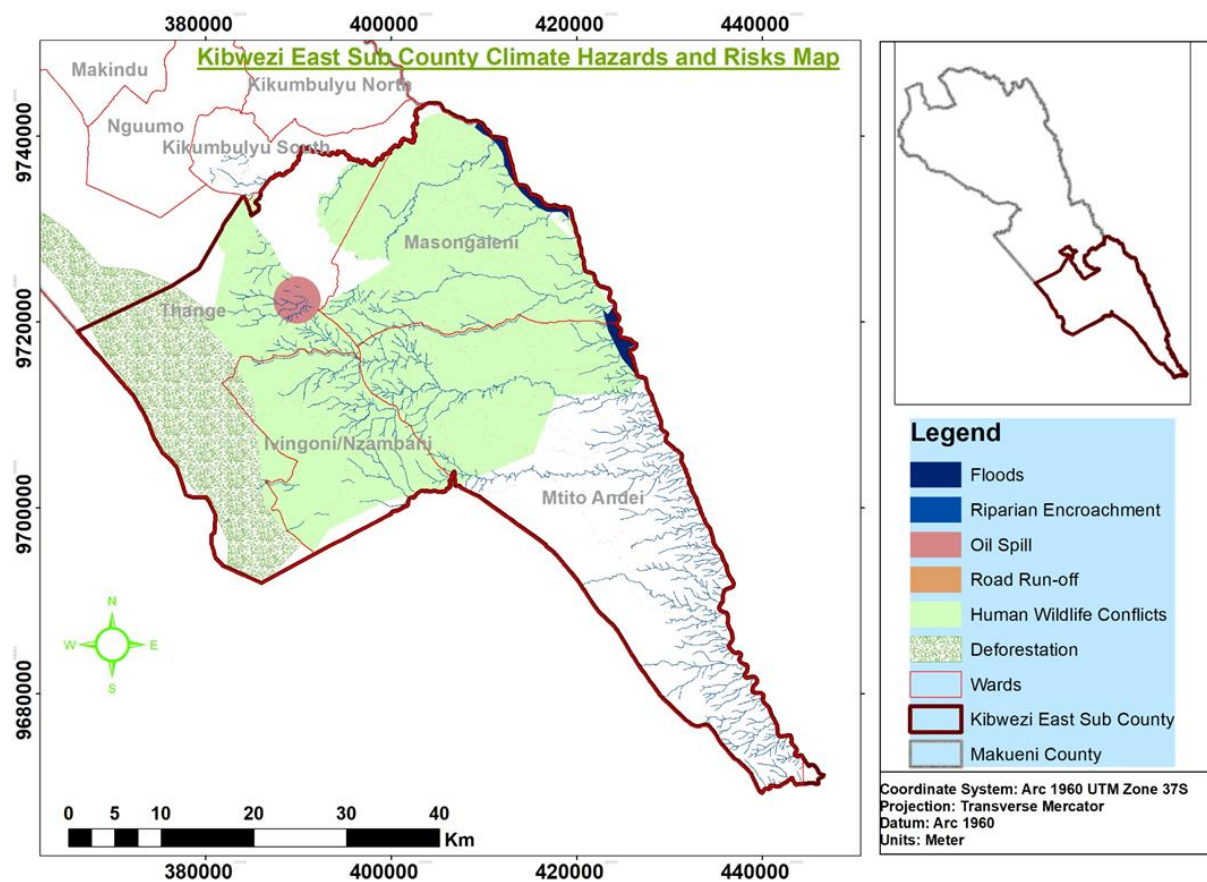


Figure 22: Kibwezi East Climate Hazards and Risk Map

CHAPTER THREE: DISTRIBUTION OF RISKS: EXISTING AND NEW STRATEGIES

3.1 Ecological Distribution of Risks and Existing Strategies

3.1.1 Upper Zones

Makueni County is categorized in three climatic zones: Upper zones, Middle zones and Lower zones. The upper zone has 5 Wards: Mbooni Ward, Mukaa Ward, Kilungu Ward, Ilima Ward and Kithungo/Kitundu Ward. The upper zone Wards have an annual rainfall average of 1000 – 1250 mm per year and an annual average temperature ranging between 21° - 22 °C. Other climatic conditions of the upper zones are sandy loam soils, upper mid-land semi-arid conditions, upper mid land subhumid conditions and lower highland sub humid conditions. The 5 wards prioritized 4 hazards which are drought, environmental degradation, pests and diseases and human diseases.

The four hazards have greatly impacted the agricultural sector, water sector, environment, infrastructural and health sector. The agricultural sector has been negatively affected by the climatic hazards because of drought, pests and diseases. The upper zone relies on human capita to carry out agricultural activities for both crop and livestock farming. Human diseases have also reduced the manpower put in agriculture as the sick cannot participate in farming. The other family members also invest less time in agriculture while taking care of the sick ones. Environmental degradation in upper zones entails mudslides, gullies, soil erosion, forest fires and deforestation.

The priority areas identified were as follows: Water harvesting structures where the communities proposed sand dam construction, water tank provisions and construction of earth pans. To tackle environmental degradation, the community proposed rehabilitation of existing gullies, planting of cover crops, water harvesting at both domestic level and in public facilities and enforcement of relevant policies to protect water catchment areas.

Lastly the hazard on pest and diseases in both crops and livestock farming was prioritized as it affects food production. Actions proposed to assist in tackling the hazard included: Provision of certified drought resistant seedlings, capacity building farmers on climate smart agriculture, provision of macadamia, mango and avocado seedlings, animal vaccinations, provision of AI services, provision of subsidized fertilizers and other farm inputs.

Table 5: Upper zone risks and existing strategies

1. Drought						
Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources/Actions required to make this strategy effective	Wards
Water	Water scarcity	Increased demand Over abstraction Over extraction of sand.	Water harvesting through:- Earth dams Sand dams, Roof catchments, Shallow wells, Boreholes and	Medium	<ul style="list-style-type: none"> • Water distribution • Effective water governance • Provision of water tanks • Implementation of water policies 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
	Water pollution	Leaching of agro-chemicals	Protection of water sources+	Medium	<ul style="list-style-type: none"> • Protection of water catchment areas • Implementation of water policies 	
	Salinization	Intrusion of salts from rocks	Desalinization		<ul style="list-style-type: none"> • Incentivize acquisition of desalinization equipments 	
Environment	Soil infertility	Soil erosion Deforestation Poor farming practices	Use of farm yard manure, Building of gabions Terracing and cut-off drains	Low	<ul style="list-style-type: none"> • Capacity building on organic farming • Raising of site specific tree seedlings • Promotion of SLM and Agroforestry 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
	Forest fires	Long dry seasons Rising temperatures, Accumulation of dry matter in forests	Establishment of forest fire breaks	Low	<ul style="list-style-type: none"> • Maintenance of fire breaks • Development of community forest management plans, 	Mbooni, Mukaa, Kithungo/Kitundu

1. Drought

Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources/Actions required to make this strategy effective	Wards
					<ul style="list-style-type: none"> • Early warning systems • Establishment and strengthening of CFAs 	
	Pasture loss	Over grazing and overstocking; Improver rangeland management	Growing and storage of pastures	Medium	<ul style="list-style-type: none"> • Provision of appropriate pasture seed varieties • Promotion of pasture development programs • Provision of subsidies and incentives for pasture management • Capacity building on rangeland management 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
	Loss of biodiversity	Over exploitation of natural resources; Inadequate rainfall	<p>Afforestation, Reforestation.</p> <p>Promotion of site specific tree species</p> <p>Protection and conservation of protected areas; In-situ and ex-situ</p>	Medium	<ul style="list-style-type: none"> • Promotion of landscape restoration activities; • Promotion of In-situ and ex-situ conservation of endemic and endangered species; • Development of water resources in protected areas 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu

1. Drought

Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources/Actions required to make this strategy effective	Wards
			conservation of endemic and endangered species			
Agriculture and livestock	Reduced crop yields	Loss of soil fertility Poor farming methods	Use of fertilizers, climate smart agriculture	Medium	<ul style="list-style-type: none"> Enhance promotion of Climate Smart Agriculture Promotion of good agricultural practices 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
		Low and poor distribution of rainfall	Supplementary irrigation, Early planting	Medium	<ul style="list-style-type: none"> Up-scaling water harvesting initiatives. Subsidies for irrigation equipments. Incentives to encourage irrigated agriculture Capacity building on good agricultural practices 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
		Crops pests and diseases	Selection of pest and disease tolerant crops	Medium	<ul style="list-style-type: none"> Integrated pest management, Provision of subsidies for farm inputs More Research on emerging pests and diseases 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
		Inappropriate seeds selection	Sensitization on right seeds,	Medium	<ul style="list-style-type: none"> Intensification of sensitization programs and subsidies 	Mbooni, Mukaa, Kilungu, Ilima,

1. Drought

Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources/Actions required to make this strategy effective	Wards
			Subsidies on seed acquisition			Kithungo/Kitundu
		Weeds competition	Weed control; Crop rotation;	Low	<ul style="list-style-type: none"> • Sensitization and provision of incentives for weed control, • Sensitization on regenerative agriculture 	
	Loss of livestock	Livestock pests and diseases	Promotion of veterinary extension services	Low	<ul style="list-style-type: none"> • Subsidizing veterinary services 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
		Diminishing pasture production	Provision of appropriate pasture seeds	Low	<ul style="list-style-type: none"> • Provide incentives to promote pasture production • Sensitization on pasture growing 	
Energy	In-door air pollution	Use of unclean sources of energy (firewood, kerosene)	Use of improved cooking stoves, Use of LPG	Medium	<ul style="list-style-type: none"> • Promotion of clean energy technologies through subsidies and tax incentives • Promotion of efficient energy technologies 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
	Power outage	Reduced water levels	Use of alternative energy sources	Low	<ul style="list-style-type: none"> • Subsidies on off-grid technologies (solar, wind) 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
Infrastructure	-	-	-	-	<ul style="list-style-type: none"> • - 	-
Health	Increased spread of water	Pollution of water sources,	Protection of water sources	Medium	<ul style="list-style-type: none"> • Fencing of water sources, 	Mbooni, Mukaa, Kilungu, Ilima,

1. Drought						
Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources/Actions required to make this strategy effective	Wards
	borne diseases		from pollutants, Enforcement of water quality regulations, Water treatment		<ul style="list-style-type: none"> Sensitization of community on water quality regulations. 	Kithungo/Kitundu
		Scarcity of water for sanitation	Water treatment	Medium	<ul style="list-style-type: none"> Sensitization on water treatment chemicals, Monitoring of water quality. 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu

Table 6: Upper zone risks and existing strategies

2. Mudslides						
Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Actions required to make this strategy effective	Wards
Water	Siltation	Loose water logged soils	Desilting; Relocation to safe grounds	Low	<ul style="list-style-type: none"> Development of climate proofed water infrastructure 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu
	Destruction of water infrastructure	Heavy rainfall	Use of galvanized iron pipes for water distribution	Medium	<ul style="list-style-type: none"> Use of heavy duty pipeline (HPE) 	
	Cross contamination	Leakage of storm water to domestic water distribution infrastructure	Use of galvanized iron pipes for water distribution	Medium	<ul style="list-style-type: none"> Use of heavy duty pipeline (HPE) 	
Environment	Destruction of landscapes and settlements	High moisture; Loose soils; Steep slopes	Use of SLM structures; Preparation of flat surface	Medium	<ul style="list-style-type: none"> Heavy investment to prepare farmlands and building areas 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitundu

2. Mudslides						
Sector	Risk	Stressor/shock/c ause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Actions required to make this strategy effective	Wards
			before construction		to make them stable <ul style="list-style-type: none"> • Avoid settlements on very steep slopes 	
Agric ulture and livesto ck	Destruction of farms and livestock death	High moisture; Loose soils; Steep slopes;	Use of SLM structures; Preparation of flat surface before construction	Medium	<ul style="list-style-type: none"> • Heavy investment to prepare farmlands to make them stable • Avoid farming on very steep slopes 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitun du
Infrast ructur e	Destruction of road infrastructu re and social amenities	High moisture; Loose soils; Steep slopes;	Use of water retention ditches along roads; Constructio n of gabions;	Medium	<ul style="list-style-type: none"> • Investment on climate proofed roads infrastructure 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitun du
Energ y	Destruction of energy grid	High moisture; Loose soils; Steep slopes;	Use of metallic pylons	Medium	<ul style="list-style-type: none"> • Investment on climate proofed energy distribution infrastructure 	Mbooni, Kilungu, Ilima, Kithungo/Kitun du
Health	Destruction of health facilities	High moisture; Loose soils; Steep slopes;	Constructio n of climate proofed health facilities	Medium	<ul style="list-style-type: none"> • Investment on climate proofed health facilities • Use of drone technology to deliver medical supplies in inaccessible health centers 	Mbooni, Mukaa, Kilungu, Ilima, Kithungo/Kitun du

3.1.2 Middle Zone

The middle Climatic zone of Makueni County is characterized by a unique set of climatic characteristics that significantly influence the region's weather patterns and agricultural activities. This zone is usually characterized by Lower midland transnational boundaries, Upper midland semi-arid

boundary and has Sandy Loam soils, which promote various agricultural value chains. The middle zone of Makueni County is characterized by a unique set of climatic characteristics that significantly influence the region's weather patterns and agricultural activities. It receives 750-1000 millimeters annually. In this zone belongs various wards including: Mbitini, Tulimani, Kako/waia, Kisau/Kiteta, Kasikeu, Kimakui/Kalanzoni, Nzaui/Kilili/ Kalamba, Email/Mulala, Ukiya, Wote/Nziu, Muvau/Kikumini and Kee.

Key hazards identified during the PCRA include Drought, Environmental degradation, Crop and Livestock pests and diseases and Human diseases. The hazards had different impacts on various natural resources, Livelihoods, service provision, Infrastructure, Trade and other aspect of human life. Amongst the impacts are: water scarcity, Low crop productivity/Crop failure, Loss/Lack of pasture, Forest fires, Decreased soil Moisture, Malnutrition, waterborne diseases, School absenteeism and Strained household income.

Community members analyzed the impacts and were able to describe traditional strategies of adaptation and building resilience against such impacts. They were also able to identify new strategies that would enhance adaptation. Amongst the existing strategies are: Community and household water harvesting, rehabilitation, expansion, distribution and protection of water sources, pasture/fodder development, Environmental management, establishment of Gabions construction, Agro forestry, Terracing, Contour Farming, Cover cropping, Conservation tillage. Firebreaks and Fuel Management. Fire Resistant Trees, Early detection and monitoring, Emergency response planning, Community Engagement and Education on forest dynamic, environment and climate matters.

Table 7: Middle Zone drought risks and existing adaptation strategies

HAZARD : DROUGHT						
Sector	Risk	Stressor/Shock/Cause/ What is causing the risk	Existing Adaptation strategies	Effectiveness of the Strategies	Actions/Resources to Make it effective	Wards
Water	Increased water scarcity	Deforestation Reduced rainfall amounts. Delayed onset of rains and early cessation	Earth dams Sand dams Farm ponds Boreholes Water storage tanks	Medium	<ul style="list-style-type: none"> • Expansion of the existing earth dams • Distribution of boreholes • Installation of dam liners at the farm ponds • Enhanced roof water catchment • Change from diesel machines to green energy 	Mbitini, Tulimani, Wote/Nziu, Kako/Waia, Kisau/Kiteta, Kasikeu, Kiima-Kiu Kalanzoni, Nzakika, Kee, Muvau-Kikumini
	Water pollution	Poor solid & liquid waste management Soil erosion	Routine market cleaning Waste collection, Transportation and Burning of waste	Medium	<ul style="list-style-type: none"> • Establishment of a sanitary landfill • Purchase of more skip bins, skip loader and equipment • Recruitment of more personnel 	Wote/Nziu ward Kalawa Emali/mulala

			Treatment through water boiling		<ul style="list-style-type: none"> • Water treatment facilities 	
Environment/Forest ry	Soil infertility Gully formation	Soil erosion Loss of vegetation cover	Conservation agriculture Growing of cover crops Mulching Terracing Agroforestry Environmental awareness	Medium	<ul style="list-style-type: none"> • Increase technical expertise • Incentivize seedlings • Establishment of local nurseries • Enhance agroforestry • Sustainable Land Management programs • Community participation 	Tulimani, Mbitini Nzakika Kako/Waia Kee Ukia Kalawa
	Deforestation	Forest fires Illegal logging of trees	Site matching seedlings Construction of forest fires Growing of fire resistant trees Early monitoring and detecting of forest fires	Low	<ul style="list-style-type: none"> • Prompt response to reported forest fires • Capacity building of CFAs • Enhance forest guard's skills • Enhance Stakeholder collaboration 	Tulimani Mbitini Nzakika Kisau/Kiteta Kiima/Kiu

			<p>Community participation in forest management</p> <p>Formation and</p>		<ul style="list-style-type: none"> • Research & monitoring • Infrastructure development in forests • Enhance community engagement • Enhance extension services 	
Agriculture & Livestock	Low crop productivity	<p>Loss of soil fertility</p> <p>Reduced rainfall amounts</p> <p>Delayed onset of rains and early cessation</p> <p>Crop pests & diseases</p>	<p>Crop rotation</p> <p>Crop diversification</p> <p>Planting drought resistant crops</p> <p>Use of farm manure</p> <p>Organic pest management options</p> <p>Use of certified seeds</p>	Medium	<ul style="list-style-type: none"> • Enhancement of extension services • Organic pest management • Incentivized certified seeds • Community awareness • Sustainable Land Management practices • Irrigated agriculture 	

			Weed management			
			Regenerative agriculture			
	Lack of pasture	<p>Reduced rainfall amounts</p> <p>Delayed onset of rains and early cessation</p> <p>Overstocking</p> <p>Soil erosion</p>	<p>Grass reseeding</p> <p>Livestock management</p> <p>Food supplements</p> <p>Pasture harvesting and storing</p> <p>Stocking of improved livestock breeds</p>	Medium	<ul style="list-style-type: none"> • Fodder and pasture development • Enhanced extension services • Incentivized Artificial Insemination services • Incentivized grass seeds 	
	Crop pests & diseases	<p>Change of weather patterns; high temperature, humidity, coldness</p> <p>Lack of weed control</p>	<p>Weed control</p> <p>Use of agrochemicals</p> <p>Organic pest management practices; ash</p> <p>Use of certified seeds</p>	Medium/High	<ul style="list-style-type: none"> • Enhance extension services • Incentivize certified seeds • Incentivize agrochemicals • Practice crop rotation 	
	Livestock pests & diseases	<p>Nomadism</p> <p>Lack of pasture</p>	Use of agrochemicals	Medium	<ul style="list-style-type: none"> • Paddock grazing • Zero grazing 	

		Change of weather patterns				
Health	Low human productivity	human diseases	Access to healthcare	Medium	<ul style="list-style-type: none"> • Preventive health education • Promotion of hygiene best practices • Access to Universal Health Care • Increase access to health facilities • Distribution of drugs to health facilities • Increase community health volunteers 	Kalawa Tulimani Wote/Nziu Kisau/Kiteta
	Water borne diseases	Drinking unsafe water Water scarcity	Local water treatment Protection of water sources Community awareness	Medium	<ul style="list-style-type: none"> • Establishment of water treatment facilities for all water sources • Community awareness on sanitation and hygiene best practices 	

					<ul style="list-style-type: none"> Water treatment chemicals at household levels 	
	Malnutrition	Poor nutrition Poverty	Provision of relief food Cash transfer	Medium	<ul style="list-style-type: none"> Community health promotion Kitchen gardens Agroforestry 	

Table 8: Middle zone flashfloods risks and existing adaptation strategies

Flashfloods						
Sector	Risk	Stressor/Shock/Cause/What is causing the risk	Existing Adaptation strategies	Effectiveness of the Strategies	Actions/Resources to Make it effective	Wards
Water	Destruction and silting of water infrastructure	Intense rainfall Absence of flood proof infrastructure	Desilting of dams Construction of check dams	Medium	Sustainable land management practices Climate proof infrastructure	Wote/Nziu
	Contamination of water sources	Poor waste disposal Soil erosion	Market cleaning Treatment through Boiling water and desalinization	Medium	Scaling of water treatment facilities Integrated waste management	Emali Mulala Wote Nziu

Agriculture	Loss of crops	Intense rainfall	Climate information sharing	Low	Crop insurance Early warning systems Afforestation	Mbitini Kasikeu Nzakika
	Loss of productive land	Excess sand deposits on farmlands Mudslides	Manual scooping of sand from farms Relocation	low	Sustainable utilization Enhance Community engagement and benefits	Mbitini
Livestock	Loss of livestock productivity	Destruction of pasture	Fodder farming	Low	Insurance Early warning systems	Mbitini Wote/Nziu Kasikeu
Infrastructure	Destruction of roads	Lack of drainage	Road maintenance Grading of roads	Medium	Roads for water projects Construction of climate proof infrastructure	Nzakika Ukia Kasikeu
Environment	Development of gullies	Loose soils Loss of vegetation cover Reduced tree cover Open mining pits	Installation of gabions Afforestation and Re-afforestation	Medium	Enhanced agroforestry Restoration of degraded lands and rangelands	Kee Mbitini
	Excess sand deposits	Intense rainfall Deforestation Soil erosion Community conflicts	Relocation of community Provision of basic needs	low	Sustainable sand harvesting Community awareness and involvement	Mbitini

3.1.3 Lower agro ecological zones

This area is Composed of 13 Wards characterized by mean annual rainfall ranging between 250mm – 750mm and mean annual temperature 24°C- 26⁰ C. The zone is further characterized by lower midland lowland conditions, lower midland transitional conditions and upper midland sub-humid conditions. The soils are sandy loam soils. The agro-ecological zones are zone IV and zone V which are the arid and semi-arid lands commonly referred to as ASALs. The area is predominantly inhabited by agropastoralists and pastoralists. These areas have potential for rangeland management. The areas are not suitable for rainfed agriculture due to physical conditions such as aridity and poor vegetation. Climate resilience in these areas is built more on net crop and livestock revenue combined rather than crop and livestock alone. The wards include in this zone are; Makindu, Nguu Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.

The climatic risks in this zone are; drought, environmental degradation, crop pests and diseases, livestock parasites and diseases, human diseases and animal wildlife conflicts in areas bordering Tsavo west, Tsavo east and Chyulu national parks. Several cases of human wildlife conflicts in wards bordering River Athi. in this zone, Climate change is altering the face of disaster risk by complicating disaster risk reduction and increasingly making it difficult not only to predict the timing and magnitude but also to effectively deal with the disaster as they occur due to the compounding effects.

Climate change is increasing the frequency and severity of disasters and thus undermines sustainable development. This calls for the need to integrate the new threats posed by climate change to ensure climate-Smart disaster risk management, which has been suggested as one way of enhancing disaster resilience in the face of a changing climate.

3.1.3.1 Drought

Drought in this zone is the most pressing climatic risk. This poses a serious threat to the areas socio economic development since most of the key sectors are climate-sensitive such as, Ecosystems, Agriculture, Health, Energy, Tourism and livestock. in this zone, drought has manifested itself more than in the other agro-ecological zones. the wide spreader impacts of drought are water scarcity, reduced food production, pasture shortages and environmental degradation. this has resulted to widespread social risks that have affected livelihood.

Table 9: Lower Zone Risks and Strategies

Drought						
Sector	Risk	Stressor/shock/cause/what is behind the risk	Existing Adaptation strategies	Effectiveness of the strategy	Resources to make them effective	Wards
Water	Increased scarcity	<ul style="list-style-type: none"> • Unreliable rainfall • Over abstraction of water • Destruction of water catchment areas/ watersheds • Over extraction of sand • Encroachment of water catchment areas and riparian zones • deforestation 	<ul style="list-style-type: none"> • Implementation of existing regulations • Water harvesting infrastructure – earth dams, sand dams, shallow wells and borehole 	High	<ul style="list-style-type: none"> • Capacity building programmes • policy strategies to support this strategy • Dissemination of climate information • Strong community and social networks and unity • Enhancement of water harvesting infrastructure • Protection and conservation of the environment • Sustainable utilization of natural resources 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.

	Water pollution	<ul style="list-style-type: none"> • Poor solid waste disposal • Use of agrochemicals in riparian zones or near water bodies • Waste water discharge in water ways 	<ul style="list-style-type: none"> • Enforcement of relevant legislations • Informal/ indigenous water treatment- use of ash, water treatments 	low	<ul style="list-style-type: none"> • Increase public awareness • SLM practices • Water treatment technologies • Adoption of integrated solid waste • Waste water treatment 	Makindu, kalawa, kikumbulyu north, masongaleni, Mavindini
Environment	Loss of biodiversity	<ul style="list-style-type: none"> • Delayed onset of rains • Habitat destruction-deforestation, encroachment • Recurrent and prolonged drought periods 	<ul style="list-style-type: none"> • Increase public awareness campaigns on natural resource and ecosystem management for communities in key biodiversity ecologies • Afforestation and reforestation programmes 	Medium	<ul style="list-style-type: none"> • Capacity building and awareness programmes • Enforcement of relevant legislations • Dissemination of climate information • Forest and landscape restoration • establish water points around key biodiversity ecosystems 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	Land degradation: Gulley formation	<ul style="list-style-type: none"> • Lack of soil and water conservation structures • Deforestation • Overstocking • Lack of soil cover 	<ul style="list-style-type: none"> • Terracing farms and denuded land • Planting soil cover • Practicing agroforestry 		<ul style="list-style-type: none"> • Capacity building and awareness programmes • Enforcement of relevant legislations • Dissemination of climate information 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito

		<ul style="list-style-type: none"> • Soil erosion 	<ul style="list-style-type: none"> • Traditional gabion construction using sacks and sisal • Using organic manure on farms 		<ul style="list-style-type: none"> • Timely planting of trees • Adoption of Clean cooking technologies • Alternative sources of energy 	Andei, Masongaleni, Mavindini.
	Human/wildlife conflicts	<ul style="list-style-type: none"> • Habitat destruction • Water scarcity – destruction of water infrastructure • Human in wildlife zones 	<ul style="list-style-type: none"> • Compensation • Bee keeping to scare away elephants • Capacity building on building behaviours 	medium	<ul style="list-style-type: none"> • Supply of water to wildlife • Increased wildlife surveillance systems • Mobile game warden camps • Electric fencing and protection of wildlife corridors 	Makindu, Kikumbulyu South, Kuikumbulyu North, Thange, Ivingoni Nzambani, Mtito Andei, Masongaleni, Kitise/Kithuki
Agriculture and Livestock production	Reduction in crop yield	<ul style="list-style-type: none"> • Low soil moisture • Unreliable rainfall • Pests and diseases • Delayed rainfall onset • Soil degradation 	<ul style="list-style-type: none"> • Invest in capacity building on soil management • Invest in early warning systems and infrastructure • Traditional seed varieties • Drought to tolerant crops • Mixed cropping and agroforestry 	high	<ul style="list-style-type: none"> • Provision of incentivized and quality pesticides and seeds • Formation and capacity building of cooperatives • Investments in water harvesting infrastructure for irrigated farming • Enhancement of extension services 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzwani, Mtito Andei, Masongaleni, Mavindini.

			<ul style="list-style-type: none"> • SLM practices 		<ul style="list-style-type: none"> • Soil testing • Climate smart agriculture, conservation agriculture • Creation and promotion of irrigation zones 	
	Low quality production	<ul style="list-style-type: none"> • Pests and diseases • Excessive use of agrochemicals 	<ul style="list-style-type: none"> • Crop diversification • Rearing of improved breeds 	Medium	<ul style="list-style-type: none"> • Provision of incentivized and quality pesticides and seeds • Soil testing 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	High crop production costs	<ul style="list-style-type: none"> • Poor soils • High cost of farm inputs 	<ul style="list-style-type: none"> • Peer to peer learning • Farm demonstration • Organic farming 	Medium	<ul style="list-style-type: none"> • Provision of incentivized and quality pesticides and seeds • Soil testing 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	Drying of pasture and fodder	<ul style="list-style-type: none"> • Insufficient rainfall 	<ul style="list-style-type: none"> • Destocking • Deliberate pasture 	medium	<ul style="list-style-type: none"> • Fodder development • Enhanced Extension services 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu

			development, harvesting and stocking. <ul style="list-style-type: none"> Food supplementation, keeping of hardy breeds. 		<ul style="list-style-type: none"> Soil and water conservation Capacity building on rangeland management 	South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	Stunted growth/Livestock emancipation	<ul style="list-style-type: none"> Pest and diseases Inadequate pasture High cost of animal feeds 	<ul style="list-style-type: none"> Use of integrated pest management Artificial insemination 	medium	<ul style="list-style-type: none"> Fodder development Enhanced Extension services 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
Health	malnutrition	<ul style="list-style-type: none"> Low agricultural production Increased water scarcity 	<ul style="list-style-type: none"> Food rationing Food supplements 	low	<ul style="list-style-type: none"> Increased investment in irrigated agriculture Kitchen gardening 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	Water borne diseases	<ul style="list-style-type: none"> Water scarcity Water pollution 	<ul style="list-style-type: none"> Water treatment 	Medium	<ul style="list-style-type: none"> Water treatment Sensitization and awareness 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo,

					<ul style="list-style-type: none"> • Solid waste management and waste water treatment 	Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
Energy	Increased emissions	<ul style="list-style-type: none"> • Use of fossil fuels • Deforestation 		Low	Adoption of clean cooking technologies	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.
	Shortage of fuelwood	<ul style="list-style-type: none"> • Drying of plants • Insufficient rainfall 	Use of improved jikos Use of LPG	Low	<ul style="list-style-type: none"> • Adoption of clean cooking technologies 	Makindu, Nguu/Masumba, Kalawa, Kikumbulyu North, Kikumbulyu South, Thange, Ivingoni/Nzambani, Nguumo, Kitise/Kithuki, Kathonzweni, Mtito Andei, Masongaleni, Mavindini.

3.2 Ecological Distribution of Risks and New Strategies

Table 10: Upper zone risks and new strategies

UPPER ZONES				
Drought				
Sector	Risk	New Adaptation strategies	Vulnerable groups	Resources required
Water	Water scarcity	<ul style="list-style-type: none"> • Soil and water conservation structures • Protection and rehabilitation of riparian land • Rehabilitation of existing water structures • Adoption of improved irrigation technology • Conservation and protection of water sources • Planting riverine vegetation • Water governance 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill • Teenagers 	<ul style="list-style-type: none"> • Funds • Human resources • Equipment • Political Good will
	Water pollution	<ul style="list-style-type: none"> • Pollution control • Integrated solid and liquid waste management • Sensitization of communities 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resources • Equipment • Political Good will
	Salinization	<ul style="list-style-type: none"> • Investment in modern desalinization technology and equipments 	<ul style="list-style-type: none"> • Elderly • Children & Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource • Equipment • Political Good will
Environment	Forest fires	<ul style="list-style-type: none"> • Preparing and adherence to forest management plans • Maintenance of forest roads, fire breaks and fire lines 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource • Equipment •
	Pasture loss	<ul style="list-style-type: none"> • Reseeding land with pasture seeds • SLM in the pasture lands • Processing and value addition (pasture development program) 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource
	Loss of biodiversity	<ul style="list-style-type: none"> • In-situ and ex-situ conservation of endangered and endemic species 	<ul style="list-style-type: none"> • Elderly • Children • Women • PLWDs 	<ul style="list-style-type: none"> • Funds • Human resource

UPPER ZONES

Drought

Sector	Risk	New Adaptation strategies	Vulnerable groups	Resources required
			<ul style="list-style-type: none"> • Terminally ill 	
	Land degradation	<ul style="list-style-type: none"> • Promotion of SLM on farms and conserved lands 	<ul style="list-style-type: none"> • Elderly • Children • Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> •
Agriculture and livestock	Reduced crop yields due to soil infertility	<ul style="list-style-type: none"> • Soil testing • Use of organic fertilizers (organic farming) • Promotion of Regenerative Agriculture and climate smart Agriculture • 	<ul style="list-style-type: none"> • Elderly • Children • Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource • Equipment • Political Good will
	Loss of livestock	<ul style="list-style-type: none"> • Destocking • Livestock breeding to ensure superior breeds are developed • Intensified disease surveillance and vaccination programs 	<ul style="list-style-type: none"> • Elderly • Children • Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource •
Energy	In-door air pollution	<ul style="list-style-type: none"> • Promotion of clean energy technologies 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource
	Power outage	<ul style="list-style-type: none"> • Promotion of renewable energy like solar and wind energy 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource
Health	Increased spread of water borne diseases	<ul style="list-style-type: none"> • Promotion of primary health care • Water treatment in major water projects • Promotion of WASH programs • Food supplementation and fortification of foods 	<ul style="list-style-type: none"> • Elderly • Children, Women • PLWDs • Terminally ill 	<ul style="list-style-type: none"> • Funds • Human resource

Mudslides				
Sector	Risk	New Adaptation strategies	Vulnerable groups	Resources required
Water	Siltation	<ul style="list-style-type: none"> Construction and maintenance of check dams 	<ul style="list-style-type: none"> Elderly Children, Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment
	Destruction of water infrastructure	<ul style="list-style-type: none"> Development of climate proof infrastructure 	<ul style="list-style-type: none"> Elderly Children Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment
	Cross contamination	<ul style="list-style-type: none"> Repair of pipelines to avoid leakage and contamination 	<ul style="list-style-type: none"> Elderly Children, Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment
Environment	Destruction of landscapes and settlements	<ul style="list-style-type: none"> Planting of bamboo and other trees for soil stabilization on sloppy areas Avoid farming and settlement on steep areas 	<ul style="list-style-type: none"> Elderly Children, Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment
Agriculture and livestock	Destruction of farms and livestock death	<ul style="list-style-type: none"> Avoid farming and livestock rearing in areas prone to mudslides 	<ul style="list-style-type: none"> Elderly Children, Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment Political Good will
Infrastructure	Destruction of road infrastructure and social amenities	<ul style="list-style-type: none"> Construction of climate proof roads Reinforcement of roads and doing proper drainage using culverts, gabions Adopting the roads for water technologies to have well drained roads. 	<ul style="list-style-type: none"> Elderly Children, Women PLWDs Terminally ill 	<ul style="list-style-type: none"> Funds Human resource Equipment
Energy	Destruction of energy grid	<ul style="list-style-type: none"> Avoid having power infrastructure development in mudslide prone areas 	<ul style="list-style-type: none"> Elderly & Terminally ill Children, Women PLWDs 	<ul style="list-style-type: none"> Political Good will

Health	Destruction of health facilities	<ul style="list-style-type: none"> • Avoid development of health infrastructure in mudslide zones • Construction of climate proofed health facilities 	<ul style="list-style-type: none"> • Elderly & Terminally ill • Children, Women • PLWDs 	<ul style="list-style-type: none"> • Funds • Human resource • Equipment • Political Good will
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Table 11: Middle zone risks and new strategies

MIDDLE ZONE				
Drought				
Sector	Risk	New Adaptation strategies	Vulnerable Groups	Resources required
Water	Increased water scarcity	<ul style="list-style-type: none"> • Enhanced rain water harvesting & storage • Catchment protection • Water resource management. • Use of green energy in powering water sources • Enhanced awareness creation 	Children, Women, PLWD, elderly	Funds Human Resource Political goodwill
	Water pollution	<ul style="list-style-type: none"> • Soil erosion control practices • Development and management of water sources • Integrated Solid & Liquid Waste Management • Holistic project design; Climate proof structures • Pollution control & enforcement • Enhanced environmental awareness 	Children Women PLWDs Elderly Poor	Funds Human resource Political goodwill
Environment/Forestry	Soil infertility	<ul style="list-style-type: none"> • Availability of adequate extension services. • Community engagement and sensitization on agricultural best practices • Environmental awareness and advocacy • Establishment and rehabilitation of gullies. • Sustainable Land Management Practices 	Women. Elderly. PWD's. Children, Terminally ill. All household farmers	Adequate funding Human Resource Political Goodwill Equipment
	Gully formation			
	Deforestation	<ul style="list-style-type: none"> • Promotion of agroforestry practices • Community Engagement and environmental education • Formation & strengthening of the existing CFAs 	Women. Elderly. PWD's. Children,	Adequate funding Human Resource Political goodwill

		<ul style="list-style-type: none"> • Availability of seeds and seedlings • Environmental awareness and advocacy • Enforcement of forest related legal frameworks • Enhanced forest extension services 	Terminally ill. All household farmers	Enabling policy & Legal provisions
Agriculture & Livestock	Low crop productivity	<ul style="list-style-type: none"> • Timely dissemination and application of Climate information. • Use of organic fertilizers • Combination of conservation and Conventional agriculture • Creation of pest free zones • Research and Growing crop pest resistant crops/seeds • Aerial spraying in case of mass infection. • Timely response management of crop pest and disease outbreaks 	Children, women, PLWD, Elderly Women Orphans and Vulnerable Children	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Lack of pasture	<ul style="list-style-type: none"> • Fodder development • Enhanced Extension services • Subsidized grass seeds • Reseeding land with pasture seeds • Establishment of pest free zones • Promotion of SLM programs 	Children, women, PLWD, Elderly.	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Crop pests & diseases	<ul style="list-style-type: none"> • Crop insurance • Subsidized pesticides • Establishment of pest free zone • Research and Growing crop pest resistant crops/seeds 	Women Children Elderly Sick Poor PLWDs	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Livestock pests & diseases	<ul style="list-style-type: none"> • Promotion of livestock vaccination programs • Capacity building of farmers on best agrochemicals for pests & disease prevention and control • Enhanced livestock extension officers 	Men Youth Women Sick	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions

Health	Low human productivity	<ul style="list-style-type: none"> Enhance the scope of universal health care. Ensure availability of drugs in health facilities More health personnel 	Children, women, PLWD, Elderly.	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Water borne diseases	<ul style="list-style-type: none"> Routine surveillance of water sources Disease surveillance Establishment of treatment facilities in all major community water sources. Establishment of disposal areas for agrochemical waste. Promotion of WASH programs 	Children, Women, PLWD, elderly Men	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions

Flash Floods				
Sector	Risk	New Adaptation Strategies	Vulnerable Groups	Resources Required
Water	Destruction and silting of water infrastructure	<ul style="list-style-type: none"> Construction of storm drains in urban areas Catchment protection and conservation Establishment of water climate proof infrastructures Maintenance of urban infrastructure 	Women Children Orphans PLWDs Elderly	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Contamination of water sources	<ul style="list-style-type: none"> Development of climate proof infrastructure Integrated solid & liquid waste management Routine water quality monitoring Water Treatment 	Children Women PLWDs	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
Agriculture	Loss of crops	<ul style="list-style-type: none"> Promotion of Sustainable Land Management Practices & Regenerative agriculture; Soil & water conservation Enforcement on encroachment into riparian zones 	Women Children Orphans PLWDs Elderly	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
	Loss of productive land	<ul style="list-style-type: none"> Planting riverine vegetation Mapping out of flood prone areas 	Women Children	Adequate funding Human Resource

		<ul style="list-style-type: none"> Enhance SLM activities Enforcement of relevant legal frameworks on riparian land 	Orphans PLWDs Elderly	Political goodwill Enabling policy & Legal provisions
Livestock	Loss of livestock productivity	<ul style="list-style-type: none"> Relocation to safe grounds' Timely dissemination of climate information Enhanced advocacy Real time early warning systems 	Women Children Orphans PLWDs Elderly	Adequate funding Human Resource Political goodwill Enabling policy & Legal provisions
Infrastructure	Destruction of roads	<ul style="list-style-type: none"> Establishment of climate proof infrastructure Promotion of roads for water harvesting 	Women Children Orphans PLWDs Elderly	Funding Human Resource Political goodwill Enabling policy and legal provisions
Environment	Development of gullies	<ul style="list-style-type: none"> Rehabilitation of gully areas Protection and conservation of catchment areas 	Elderly Children Women Children	Human Resource Funds Political good will
	Excess sand deposits	<ul style="list-style-type: none"> Promotion of Sustainable land management practices Enhanced environmental awareness and advocacy 	Children Women Orphans Terminally Ill	Human Resource Funds Equipment Political goodwill

Table 12: Lower zone risks and new strategies

LOWER ZONE				
Drought				
Sector	Risk	New Adaptation strategy	Vulnerable Groups	Resources
Water	Increased scarcity	<ul style="list-style-type: none"> Roof and surface water harvesting Enhancement of Water harvesting infrastructure (dams, water pans, 	<ul style="list-style-type: none"> PWD Special needs 	<ul style="list-style-type: none"> Funds/financial resources

		<p>water tanks) Construction of large/mega water harvesting and storage structures - earth dams sand dams</p> <ul style="list-style-type: none"> • Protection and conservation of water catchment areas • Merry go rounds based on purchase of water tanks • Desilting of existing dams • Sensitization and awareness programmes on water harvesting 	<ul style="list-style-type: none"> • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Technical expertise
	Water pollution	<ul style="list-style-type: none"> • Integrated waste management • Provision of water treatment chemicals • Holistic design of water projects • Surveillance and monitoring of water sources • Establishment of Treatment facilities in all major community water sources. • Establishment of disposal areas for waste. • On Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise
Environment	Loss of biodiversity	<ul style="list-style-type: none"> • Review and enforcement of relevant laws • landscape restoration • Alternative fuel sources • landscape restoration • Technical capacity building on threatened and endangered species • Certification of tree nurseries • Sustainable land management practices 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise

		<ul style="list-style-type: none"> • Sensitization, awareness and capacity building programmes 		
	Land degradation::gulley formation	<ul style="list-style-type: none"> • Promoting afforestation, reforestation and agroforestry • Forest and landscape restoration • Reducing overstocking and overgrazing • Promoting zero grazing • Grass reseeding • Farm terracing • Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise
	Human/ wildlife conflicts	<ul style="list-style-type: none"> • Electric fencing • Protection of wildlife corridors • Compensation • Supply of water to wildlife • Capacity building on human wildlife mitigation • Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> • Farmers • children 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise
Agriculture and Livestock Production	Reduction in crop yield	<ul style="list-style-type: none"> • Lined farm ponds at HH level to support irrigation • Promotion of irrigated agriculture • Reliance on meteorological weather forecast advisories Promote the use of climate information and Early warning systems • Promotion of micro irrigation • School feeding programme • Agroforestry, Afforestation • Use of climate smart agriculture (modern farming technologies) - 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise

		conservation agriculture, regeneration agriculture <ul style="list-style-type: none"> • Use of authentic certified seeds • Creation of irrigation zones • Promotion of vertical gardens (kitchen gardens) • Crop insurance programmes • Food aggregation • Soil testing and analysis • Diversification of agriculture- poultry, bee keeping • Drought tolerant crops • Subsidized farm inputs • Enhancement of extension services 		
	Low quality production	<ul style="list-style-type: none"> • Farm demonstration • Extension services • Pest and Disease surveillance and vaccination programmes • Peer to peer learning • Value addition of products • Integrated pest management • Artificial insemination • Organic farming 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise
	High production costs	<ul style="list-style-type: none"> • Promote the use of climate information • Crop and animal insurance programmes • Use of climate smart agriculture (modern farming technologies) - conservation agriculture, regeneration agriculture 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise

	Drying and of pasture and fodder	<ul style="list-style-type: none"> fodder and feed conservation and animal feed formulation destocking/livestock offtake range management (pasture farming) zero grazing and high value livestock species livestock insurance programme capacity building and investment in research 	<ul style="list-style-type: none"> PWD Special needs Children Women Pregnant and lactating mothers Elderly Youth 	<ul style="list-style-type: none"> Funds/financial resources Technical expertise
	Stunted growth/Livestock emancipation			
Health	malnutrition	<ul style="list-style-type: none"> Community health outreach Awareness creation 	<ul style="list-style-type: none"> PWD Special needs Children Women Pregnant and lactating mothers Elderly Youth 	<ul style="list-style-type: none"> Funds/financial resources Technical expertise
	Water borne diseases	<ul style="list-style-type: none"> Surveillance of water sources, water testing and analysis Establishment of Treatment facilities in all major community water sources. Establishment of disposal areas for agrochemical waste and other types of waste Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> PWD Special needs Children Women Pregnant and lactating mothers Elderly Youth 	<ul style="list-style-type: none"> Funds/financial resources Technical expertise
Energy	Increased emissions	<ul style="list-style-type: none"> Use of clean cooking technologies Incentivized renewable energy Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> PWD Special needs Children Women 	<ul style="list-style-type: none"> Funds/financial resources Technical expertise

			<ul style="list-style-type: none"> • Pregnant and lactating mothers • Elderly • Youth 	
	Shortage of fuelwood	<ul style="list-style-type: none"> • Promotion of Agroforestry • Afforestation and reforestation programmes • Use of clean cooking technologies • Incentivized renewable energy • Sensitization, awareness and capacity building programmes 	<ul style="list-style-type: none"> • PWD • Special needs • Children • Women • Pregnant and lactating mothers • Elderly • Youth 	<ul style="list-style-type: none"> • Funds/financial resources • Technical expertise

CHAPTER FOUR: ADATATION STRATEGIES

4.1 Ecological Zone Adaptation Priority Strategies

The thirty wards prioritized their climate actions, describing the priority action, the current and future scenario hazard the action will address and linkages between the impacts. The priority actions are as described below;

Table 13: Ecological Zone Adaptation Strategies

ZONE: UPPER ZONE		
Ward: Mbooni		
Priority 1 Water harvesting for irrigation & domestic use	Priority 2 Environmental restoration	Priority 3 Agricultural crop and livestock development
<ul style="list-style-type: none"> • Rehabilitation of Mulima Earth Dam with irrigation components- • Conservation of the earth dam catchment area, protection of the reservoir, water treatment, draw off system, rising main and distribution to farms and market centers (hybrid powered) 	<ul style="list-style-type: none"> • Strengthening of CFAs and establishment of CFAs in areas without • Environmental conservation structures • Terraces and stabilization • Road water harvesting • Gulley rehabilitation • Agro-forestry -coffee, avocado, mango, macadamia • Enforcement of relevant laws to stop forest deforestation 	<ul style="list-style-type: none"> • Capacity building of farmers on climate smart agriculture • Provision of certified seeds • Provision of subsidized AI services • Provision of avocado and macadamia seedlings • Provision of subsidized fertilizers and other farm inputs • Facilitating extension officers to ensure adequate farmer sensitization
Ward: Mukaa		
Priority 1. Water harvesting for irrigation & domestic use	Priority 2 Water Distribution	Priority 3 Environmental Conservation and restoration

Expansion and Desilting of Kwa Kakui Mega Earth Dam, irrigation components –dairy, fodder development. agricultural extensions.	<ul style="list-style-type: none"> ● Distribution of harvested water from Kwa Kakui Earthdam to; Maiani, Enzai, Itonguni, Kamuthiini, Kiongwani Clusters ● And all Schools and hospitals 	<ul style="list-style-type: none"> ● Kwa Kakui Tree planting project- avocado,mangoes. ● Gulley Rehabilitation in Kiongwani and Mutiluni.
Ward: Kithungo/Kitundu		

Priority 1 Water harvesting for irrigation & domestic use	Priority 2 Agricultural crop and livestock development	Priority 3 Environmental Conservation and restoration
<ul style="list-style-type: none"> ● Kyaula Kathambalani rivers weirs/sand dams, sump, solar pumping and distribution and tree nursery. distribution to farms and (primary, secondary, dispensary, market and community) <ul style="list-style-type: none"> ○ Kyaula, ○ Itulu, ○ Kavumbu, ○ Muumani, ○ Kitooni, ○ Matithi 	<ul style="list-style-type: none"> ● Subsidized farm inputs - certified seeds and agrochemicals ● Soil fertility management - soil testing ● Livestock breed improvement - viable AI (artificial insemination) ● Crop breed improvement - early maturing drought tolerant crops ● Agroforestry - avocado, mango, macadamia ● Water harvesting through weirs for irrigated agriculture ● Training and capacity building ● Extension services ● Demonstration farms ● Livestock vaccination programme 	<ul style="list-style-type: none"> ● Soil and water conservation structures ● Terraces and stabilization ● Road water harvesting ● Gulley rehabilitation ● Agro-forestry -avocado, mango, macadamia ● Enforcement of relevant laws to stop forest destruction
Ward:Kilungu		

Priority 1 Rehabilitation of Water catchment areas and water harvesting for irrigation and domestic use	Priority 2: Rehabilitation/ Restoration of degraded land/areas and renewable energy	Priority 3: Agricultural crop and livestock development
<ul style="list-style-type: none"> • Construction of sand dams in Kyumani, Ilovoto, Ndiani, Kyekolo, Nduu, and distribution of the water for irrigation. • Provision of water tanks in all health facilities and schools neighboring major gullies to reduce surface runoff. • Enforcement of EMCA, 1999 and Water Act along major rivers 	<ul style="list-style-type: none"> • Rehabilitation of existing gullies in Nthunguni, Kwa Malasi and Nunguni primary • Terracing/Cut off drains • Provision of climate friendly seedlings • Retraining groups with tree nurseries • Support farmer groups and tree nursery groups with water tanks • Renewable energy sources 	<ul style="list-style-type: none"> • Provision of avocado and macadamia seedlings • Provision of certified seeds • Provision of subsidized AI services • Provision of subsidized fertilizers and other farm inputs • Capacity building of farmers on climate smart agriculture
<ul style="list-style-type: none"> • Planting riverine species along the rivers along major rivers • Sensitization on water pollution • Check dam and gabion construction along major rivers • Community sensitization on environmental protection and conservation 	<input type="checkbox"/> Capacity building on best tree species to plant that conserve the soil and underground water systems	
Ward: Ilima		
Priority 1: Water harvesting for irrigation and domestic use and catchment protection	Priority 2: Agricultural crop and livestock development	Priority 3: Environmental conservation and Restoration

<ul style="list-style-type: none"> • Sand dam construction with sump at Wautu River, Kiusyi, Manyanzala, Mukilitwa, Kisuu, Malunda, Kasyelia, Ngele and Kaiti river and distribution of the water • Enforcement of relevant policies • Planting riverline species in riparian land □ Water governance 	<ul style="list-style-type: none"> • Training on climate smart agriculture • Provision of certified seeds to farmers • Capacity building of farmers through extension workers • Practicing irrigated agriculture • Pasture farming • Soil testing • Training some community members on soil testing and provision of required resources • Provision of a trained AI officer 	<ul style="list-style-type: none"> • Rehabilitation Kwa Kyalika, Kwa Katoni and Kwa Kithuku Gullies • Enforcement of relevant policies along major rivers • Tree nursery establishment (Fruit trees - Mango, Avocado and macadamia and indigenous trees) • Tree planting along Riparian land • Cover crop farming
MIDDLE ZONE		
Ward: Kee		
Priority 1: Water harvesting and distribution for irrigation and domestic use	Priority 2: Agricultural crop and livestock development	Priority 3: Environmental conservation and Restoration
<ul style="list-style-type: none"> ● Rehabilitation of earth dams such as Kyanduu, Kayumba, Kwa Kivinda, Kikonde, Ndumani, Kivaku , 	<ul style="list-style-type: none"> ● Adoption of new farming method such as Conservation agriculture and regenerative agriculture 	<ul style="list-style-type: none"> ● Rehabilitation of gullies such as Kwa Kivinda, Kwa Kimanyi, Ikalyoni, Kwa Mathuva Mutiso (Nguluni), Kwa Mukanzu

<p>Mutulani, Mbooni, Kivani, Kalii, Kitandi and Kyamuthyoi.</p> <ul style="list-style-type: none"> ● Distribution of boreholes such as Ngiitini, Kilia king'ang'a, Nguluni and Kitandi ● Establishment of new water sources in Ndumani, Kasunguni and Kilolo ● Excavation of farm ponds. ● Advocacy to alleviate pollution of water sources 	<ul style="list-style-type: none"> ● Practicing irrigated farming ● Pasture farming ● Establishment of model farms and demonstration farms ● Capacity building through extension officers and trainings 	<p>(Kola Police), Kwa Matheka (Ndumani), Near Matangi Primary school,</p> <ul style="list-style-type: none"> ● Terracing of farms ● Adopting agroforestry with high value plants ● Planting cover crops ● Planting pastures ● Conservation of cultural sites and shrines ● Establishment and support of existing tree nurseries for production of appropriate seedlings for land restoration and rehabilitation.
Ward: Tulimani		
Priority 1 Water Harvesting for irrigation and domestic use	Priority 2: Environmental conservation and restoration	Priority 3: Agricultural crop and livestock development
<ul style="list-style-type: none"> ● Sand Dam construction and distribution - Yaka ● Desilting and distribution of Mulima Earth Dam ● Distribution of water to farms and institutions ● Rock Catchment at Maa Meu and Kiambwa. 	<ul style="list-style-type: none"> ● Afforestation - institutions – Gully rehabilitation, Terracing and farm pond construction. ● Capacity building cfas ● Gully rehabilitation- ● Farm ponds and terraces 	<ul style="list-style-type: none"> ● Vaccines - all ward ● Artificial insemination ● Extension services
Ward: Kako/waia		
Priority 1. Water harvesting for irrigation and domestic use	Priority 2 Improve crop production	Priority 3 Environmental Conservation

<ul style="list-style-type: none"> • Construction of Mega Earth Dam at Kwa Mateng'e to promote irrigation for agricultural production. • Distribution of water to Kiimani Kya Kithendu to Ngoluni, 	<ul style="list-style-type: none"> • Provision of authentic certified seeds. • Provision of affordable AI services. • Promotion of extension services. • Capacity building on Conservation agriculture and Regenerative agriculture. 	<ul style="list-style-type: none"> • Restoration of degraded lands within the ward in order to address environmental issues that impact on climate change. • Planting of trees in all schools and Hospitals.
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Kyangondu, Mbumbuni, Sophia and Kavukoni.		
Ward: Kisau/Kiteta		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop development	Priority 3 Agricultural livestock development.
<ul style="list-style-type: none"> • Enhancement and distribution of Kinze Earth Dam. • Enhancement and distribution of Mulima Earth dam for irrigation • Protection of water sources: Ngoni • Kilisa, Kyala, Mukimwani, Musaa, Kanthale, Kwa ndaka, Kyati, Isauni, Kyendei dams. • Protection of Kyome Kuko springs. • Capacity building on water management and Governance 	<ul style="list-style-type: none"> • Provision of certified seeds. • Extension services. • Disease surveillance. • Training on conservation agriculture. 	<ul style="list-style-type: none"> • Breed improvement. • Extension services. • Vaccination and disease surveillance.
Ward: Kasikeu		
Priority 1 Water Harvesting for irrigation and domestic use	Priority 2 Infrastructure Development	Priority 3 Environmental Conservation and restoration

<ul style="list-style-type: none"> ● Earth dam construction and renovating sand dams (along Myani, Muangini, Mikuyu and Enguli) 	<ul style="list-style-type: none"> □ Infrastructural renovations especially roads leading to educational centers Kiongwani girls- Kaleo primary school- Kiou primary road 	<ul style="list-style-type: none"> □ Tree planting in the whole ward and gabions constructions along rivers road to reduce environmental degradation.
Ward: Kiimakiu/Kalanzoni		
Priority 1. Environmental Conservation and restoration	Priority 2 Water Harvesting for irrigation and domestic use	Priority 3 Agricultural crop and livestock development
<ul style="list-style-type: none"> ● Promotion of Sustainable land management- through Afforestation at Kavuko Hill, Mulamini, Kwemaa, Marwa. 	<ul style="list-style-type: none"> • Expansion, distribution and protection of Silanga Mbuu Mega Earth dam. • Expansion, distribution and protection of Kwa Mulela Earth dam. 	<ul style="list-style-type: none"> • Diversify crop production in att a sub wards. • Provision of certified seeds • Provision of Extension services

<ul style="list-style-type: none"> Gulley Rehabilitation at Ngiini, Kwa Kilungu, Nthaani, Kavuko, Kithata, Memea kwa Museu, Kasunguni, Kwa Ndiki, Kwa Katili, Mulumini, Kithea, Kiu Railway line, Ikaasu, Kwa Kaveki, Kikongoni, Mbondoni, Kwa Kikonyo, Mavivye Katatu, Kwa Ndone, Kyamuloi, Petrocity, Ndovoni, Kwekuyu, Kwandiki, Kwa Loa, Kwa Ndawa, Kisainguni, Ndivoo, Kyasimba, Kangemi and Mutumunyani. Gabion construction of Ikolya River, Mbuku River, Kavutu river and sand dam. 	<ul style="list-style-type: none"> Desilting, Expansion, distribution and protection of Kwa Loa and Ndivoo Earth Dams. Kwa Mulela along Kiu ranch. Desilting of Kwa Kaveki, Katatu, Uvevoni, Kwa Makumi, Masungu, Kwa Kakulu and Ikolya Rehabilitation of Kwa Ndeke earthdam, and Equipping of Salama Borehole. Extension lines for Ulu Borehole, Kwa Tuva, Kasalama and Kavuko. 	<ul style="list-style-type: none"> Increase crop disease surveillance Training on conservation agriculture, regenerative and crop rotation. Provision of Subsidized agricultural inputs.
Ward: Nzaui/Kilili/Kalamba		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop and livestock development	Priority 3 Environmental Conservation and Restoration
<ul style="list-style-type: none"> Construction of sand dams along Kikuu River. Provision of subsidized water tanks. Effective water governance. 	<ul style="list-style-type: none"> Promotion of climate smart Agriculture. Provision of more extension services. Provision of certified seeds and provision of improved livestock breeds. 	<ul style="list-style-type: none"> Gulley rehabilitation along river Kikuu. Provision of improved pasture seeds. Promotion of establishment of tree nurseries across the ward. Proper disposal of solid and liquid waste in all towns. Kalamba and Matiliku.
Ward: Ukia		

Priority 1:	Priority 2:	Priority 3:
Water harvesting for irrigation and domestic use	Infrastructure Development	Agricultural crop and livestock development
<ul style="list-style-type: none"> • Construction of Mega water infrastructure in Kaiti Kisusyo and Munyii kwa Musau • Construction of sand dams and water sumps across major streams at Yathonza river, Munyii Kwa Musau river and Natha stream 	<ul style="list-style-type: none"> • Improvement of rural infrastructure (Roads) through murraming and tarmacking of Kilala- Iuani-Kavutini- Kwa Kasamili- Kaseveni Itandi road and Kwa Thonza - Kyau- Makuli - Nzumani - Mumbai - Kivani road 	<ul style="list-style-type: none"> • Intensive farmer training on modern farming methods and on irrigation farming. • Training of extension officers. • Equipping extension officers with necessary tools/equipment
Ward: Emali/Mulala		
Priority 1: Water harvesting and distribution for irrigation and domestic use	Priority 2: Agricultural crop development	Priority 3: Agricultural livestock development

<ul style="list-style-type: none"> ● Desilting earthdams / water pans such as Matiku, Kwa Mutoa, Kwa Kaleli, Mwanyani, Ndwaani and Makupa ● Construction of new water pans and earthdams ● Water distribution from Yandia water sump, Kitandi, Kwa Muli and Kwa Kakulu boreholes ● Borehole rehabilitation such as Kiواني, Emali Primary school, Musovo, Kiliku, Tutini, Nduundune and Mwanayani ● Construction of new sand dams along Mwooni and Mwasang'ombe rivers ● Construction of farm ponds 	<ul style="list-style-type: none"> ● Embracing irrigated agriculture from earth dams, farm ponds and sand dams ● Provision of certified seeds as per prevalent climatic conditions ● Sensitization/capacity building by extension officers ● Soil testing ● Embracing climate smart agriculture and regenerative agriculture ● Crop insurance ● Formation of producer associations for different farm products ● Adoption of sustainable land management by terracing and planting cover crops. 	<ul style="list-style-type: none"> ● Capacity building by livestock extension officers ● Farming of pastures ● Use of improved breeds ● Livestock fattening and marketing ● Formation of producer associations for different farm products
Ward: Wote/nziu		
Priority 1	Priority 2	Priority 3
Water harvesting for irrigation and domestic use	Environmental conservation and management	Agricultural livestock development

<ul style="list-style-type: none"> • Community mega earth dams, • Construction of sand dams in Kaiti and distribution of water. Kaiti to Kituasi villages, kaiti to kwa nzangi, kilumwa/kyambui • Roof catchment water harvesting i.e water tanks • Conservation of water catchment areas 	<ul style="list-style-type: none"> • Pollution Management • Establishment of a waste management infrastructure in Wote town 	<ul style="list-style-type: none"> • Adoption of dry land agricultural technologies • Extension promotion –pulses, grains and fruits • Farmer training • Strengthening market systems
Ward: Muvau/Kikumini		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop development	Priority 3 Agricultural livestock development
<ul style="list-style-type: none"> • Expansion and desilting of earth dams with catchment and agroforestry programme; Kambi mawe, Kwa muia, Ngosinin east, Mango, Harambee, Isooni, Ngoso, Ngalaliki and Kithembe • Water harvesting through construction of sand dams; Thwake, Mauta, Mwilu, Ngosini and Mwinga • Subsidized water harvesting at household level by Farm ponds with liners and pumping systems and water tanks for roof water harvesting • Rehabilitation and restoration of water catchment areas - Nzueni hill, 	<ul style="list-style-type: none"> • Agricultural support programme - Certified Drought Tolerant Seeds-green grams, community seed production, Extension, Capacity Building and Agroforestry 	<ul style="list-style-type: none"> • Livestock improvement programme-extension services, breed improvement, high value pasture seed, pasture management and vaccination • Promotion of poultry production

muva hill, high value agroforestry trees		
Ward: Mbitini		
Priority 1: Water Harvesting for irrigation and domestic use	Priority 2: Environmental conservation and restoration	Priority 3 Agricultural crop and livestock development
<ul style="list-style-type: none"> ● Sand dams - Muuoni River ● Provision of subsidized Water tanks 	<ul style="list-style-type: none"> ● Gulley Rehabilitation through gabions ● Agroforestry ● Afforestation along Muambwani River ● Sustainable Land Management Practices ● Sustainable utilization of excess sand deposits. 	<ul style="list-style-type: none"> ● Provision of subsidized pesticides plus insecticides. ● Promotion of conservation Agriculture. ● Subsidized livestock vaccines ● Certified seeds ● Poultry development
LOWER ZONE		
Ward: Kalawa		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop and livestock development	Priority 3 Environmental Conservation and Restoration

<ul style="list-style-type: none"> • Construction of sand dams: Kalawa river, Kwandota river, Munyuni river, Kanzonzo river • Extension of piped water from earth dams (Mbasya,kyamakuthi, muusini, movie, mutembuku) to farms and HH's • Provision of water tanks for roof water harvesting in all locations. • Desilting of most earth dams in the ward to ensure maximum water harvesting during the rainy seasons. 	<ul style="list-style-type: none"> • Sensitization on climate-smart agriculture (Need for WAOs to sensitize community members on the need to plant crops that are suitable to their climate in order to adapt to a changing climate and mitigate its adverse effects in all locations) • Community to relinquish their cultural beliefs and cultures that are detrimental to adaptation and mitigation of climate change in all locations. • Grains and pulses • Goat improvement • Honey production 	<ul style="list-style-type: none"> • Restoration of degraded lands within the ward in order to address environmental issues that affect climate change. • Conservation and protection of riparian areas especially along Athi and Thwake rivers to ensure sustainable water sources in the ward. • Construction and rehabilitation of gullies.
Ward:Mtito Andei		
Priority 1	Priority 2	Priority 3
Water harvesting for irrigation and domestic use	Environmental conservation and Restoration	Agricultural crop and livestock development

<ul style="list-style-type: none"> • Construction of mega dams that can be recharged from Mtito River. • Extension of piped water to cover more locations in the ward. • Daming the seasonal Kambu River to harvest most of the seasonal runoff for use during the dry spell. • Desilting Kwa Matee dam to capture more volumes of water during the rainy seasons. • Excavation of on farm water structures such as farm ponds in all households to ensure surface runoff water harvesting during the rainy seasons. 	<ul style="list-style-type: none"> • Restoration of degraded areas of the ward (generally in all locations) • Sensitization on soil conservation methods in order to conserve the environment in all locations. • Growing of trees that can withstand high temperatures in all locations in order to prepare for adaptation to a warming climate in future. • Conservation and protection of riparian areas in order to ensure sustainable water sources. 	<ul style="list-style-type: none"> • Sensitization on control of crop and livestock pests in order to improve food and nutrition security in households. • Growing of crops that are drought tolerant and resistant to most common pests. • Rearing of livestock that are not very much impacted by the most common pests. • Researching on the best control methods for crop and livestock pests. • Sensitization on farm management practices. • Grains and pulses • Goat improvement • Honey production
Ward: Makindu		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop development	Priority 3 Agricultural livestock development
<ul style="list-style-type: none"> • Construction of sand dams along: Muooni river - kwa manzala- kwa kalii, mbiuni, malivini, kangii and itulani and Kikuu river - kwa mukosi/downstream of bridge-to serve kalii, nzaikoni, kawala, ngomano, kavatini, kyanda, ngakaa • Rehabilitation of kiu catchment • Mega surface water harvesting for irrigated agriculture and agroforestry 	<ul style="list-style-type: none"> • Purchase/ buying CA equipment and accessories, sensitization, certified seeds and demo farms • Promotion of irrigated agriculture • Grains and pulses • Goat improvement • Honey production • Pasture development 	<ul style="list-style-type: none"> • Construction/ and/or rehabilitation of cattle crushes and cattle dips across the ward, sensitization, AI (breed improvement) paste establishment and management, extension
Ward: Nguu/Masumba		

Priority 1	Priority 2	Priority 3
Agricultural crop and livestock development	Water Harvesting for irrigation and domestic use	Environmental conservation and restoration
<ul style="list-style-type: none"> • Certified seeds and drought resistant crops provision • Pasture development, • Goat improvement • Bee keeping 	<ul style="list-style-type: none"> • Harvesting of surface runoff to be used for irrigation and in cattle water points. 	<ul style="list-style-type: none"> • Construction and installation of soil and water conservation structures in farmlands.
Ward: Kikumbulyu South		
Priority 1 Environmental Conservation and Restoration	Priority 2 Agricultural crop and livestock development	Priority 3 Promotion of preventive promotion health
<ul style="list-style-type: none"> • Rehabilitation of gullies and re-afforestation across the ward. • Provision of seeds & seedlings for agroforestry 	<ul style="list-style-type: none"> • construction of terraces and farm ponds • Bee keeping • Goat keeping • Pulses and grains 	<ul style="list-style-type: none"> • Training more persons on health facilitation <ul style="list-style-type: none"> • Waste management
Ward: Kikumbulyu North		
Priority 1 Water Harvesting for irrigation and domestic use	Priority 2 Agricultural crop and livestock development	Priority 3 Environmental Conservation and Restoration
<ul style="list-style-type: none"> • Sump system in Athi river. to • Distribution of Athi water Ngaikini-Kiwanzani-Mukonzitunguni-Kathyaka for irrigation 	<ul style="list-style-type: none"> • Pasture development- Growing of pasture on large scale. • Mechanized feed harvesting and Feed formulation • Bee keeping • Goat keeping 	<ul style="list-style-type: none"> • Sensitization of community on environmental matters.

	<ul style="list-style-type: none"> Pulses and grains 	
Ward: Nguumo		
Priority 1: Water harvesting and distribution for irrigation and domestic use	Priority 2: Environmental restoration and conservation	Priority 3: Agricultural crop and livestock development
<ul style="list-style-type: none"> Athi - Tunguni distribution to Umanyi water distribution ib Kikumbulyu North - Nguumo Ngambi ya Myunzyu - Ndovoini s location distribution Mbui nzau hill rock catchments 	<ul style="list-style-type: none"> Conservation of MbuiNzau and Kilema Hill (tree planting) Rehabilitation and conservation of Mbui Nzau Water tower Adopt sustainable land management practices 	<ul style="list-style-type: none"> Provision of appropriate certified seeds Selection of disease tolerant crops and livestock breeds Livestock breed Improvement program. Extension services Vaccination and disease surveillance
Ward: Thange		
Priority 1	Priority 2	Priority 3
Environmental Conservation and Restoration	Agricultural crop development	Agricultural livestock development

<ul style="list-style-type: none"> • Tree nursery establishment at community groups across the ward. • Water supply to the nurseries and households. • Construction of earth dam at River Thange. • Desilting of Maia, Muusini, Maikuu, Kwa Ngave, Ithaayoni, Kasasule, Kikunduku, Metava, Kinyambu, Kwa Gregory, Kwa Kasimba, Kwa Muvange and Isunguluni 	<ul style="list-style-type: none"> • Sensitization on smart agriculture • Subsidized fertilizers provision. • Capacity building of farmers on climate smart agriculture, regenerative agriculture and dryland agricultural technologies • Terracing and water run off harvesting • Provision of hybrid goats • 	<ul style="list-style-type: none"> • Provision of insecticides and pesticides for pest controls • Provision of Vaccination services to livestock
Ward: Ivingoni/Nzambani		
Priority 1 Water harvesting for irrigation and domestic use	Priority 2 Agricultural crop and livestock development	Priority 3 Environmental Conservation and Restoration
<ul style="list-style-type: none"> • Construction of mega earth dams in lower Nthongoni in Utu area • Construction of mega earth dam in kwa Mukonza and kwa Nzoongo • Water distribution from Utu, Kwa Mukonza borehole with rising mains to Utu hill • Water distribution from high yield water sources in upper Nthongoni to Makutano, Mangelete and Mtito andei areas 	Food insecurity <ul style="list-style-type: none"> • Capacity building of farmers on climate smart agriculture, regenerative agriculture and dryland agricultural technologies • Production and supply of certified seeds and improved breeds –pulses and grains • Formation of farmer cooperatives • Promotion of fodder crops • Mechanized agriculture 	<ul style="list-style-type: none"> • Provision of certified seedlings that are climate friendly/indigenous and water tanks • Training of farmers/Capacity building • Government to supply tree seedlings from the existing established nurseries and ensure monitoring is done • Improvement of existing tree nurseries and support them for certification and issuance of shade nets, water tanks and other equipment for tree nursery
Ward: Kathonzwi		
Priority 1	Priority 2	Priority 3

Water harvesting for irrigation and domestic use	Environmental conservation and restoration	Agricultural crop and livestock development
<ul style="list-style-type: none"> ● Construction of earthdam in Kathamboni, Kyuasini and Mutuuteni area ● Construction of sand dam across Kikuu river at Kwakavisi, sump tank and distribution to Kwa Kavisi location, ● Desilting and fencing of Matinga 1, treatment and distribution. 	<ul style="list-style-type: none"> ● Tree planting, ● Agroforestry, ● Rehabilitation of denuded land ● Grass reseeding and fencing ● Gulley rehabilitation, ● Soil and water conservation structures, ● Renewable energy sources, energy saving jikos/stoves 	<p>Kathonzweni integrated improved livestock project-</p> <p>Capacity building, o Improved/subsidized AI services, o Subsidized vaccination services o Pasture and fodder conservation and demonstration on pasture management, o Market and market linkages and Aggregation</p> <ul style="list-style-type: none"> • Pasture development, • Goat improvement <p>Bee keeping Fruitfly equipment- traps and pheromone,</p>
Ward: Kitise Kithuki		

Priority 1 Water Harvesting for irrigation and domestic use	Priority 2: Environmental Conservation, restoration and management.	Priority 3. Agricultural crop and livestock development
<ul style="list-style-type: none"> • Construction of a Mega Earth Dam at Londokwe at the border of Kitise and Kithuki sub wards • River athi irrigation program 	<ul style="list-style-type: none"> • Afforestation in all learning institutions and along the Londokwe Mega Earth Dam • Capacity building of community members on tree nurseries establishment and management. • Gully Rehabilitation across the ward • Farm ponds and terraces in every household • 	<ul style="list-style-type: none"> • Provision of Improved Heifer breeds. □ Provision of AI services • Provision of Pasture seeds. • Provision of subsidized veterinary services. • Pasture development, • Goat improvement • Bee keeping • Poultry keeping • Pulses and grains • Aggregation and market linkages • Horticultural produce <p>Capacity building of livestock farmers on new technologies.</p>

Ward: Masongaleni		
Priority 1: Water harvesting and distribution for irrigation and domestic use	Priority 2: Agricultural crop and livestock development	Priority 3: Human-Wildlife-Conflict Management

<ul style="list-style-type: none"> ● Distribution of Kibwezi high yielding borehole to Masongaleni pipeline network ● Desilting earthdams of Athi-salama, Elongole, Mukulu, Kivani, Kataa, Syaathi, Kyuasini, Kiange, Majee B and Ngovani and install livestock/human drawing points ● Enhancement of water storage and harvesting from Muliluni rock catchment ● Construct new water catchments on Ititi hills ● Distribution of Mikuyuni borehole ● Desilting of swamps in Yi nguvu, Kulumbus, Kwa Muli, Kwa Mbithe, Kwa Philip and Kwa Kavemba ● water harvesting from roof catchments 	<ul style="list-style-type: none"> ● Adoption of conservation agriculture ● Use of climate suitable crop seeds –green grams, ● Use of improved livestock breeds ● Embracing kitchen gardens ● Terracing and use of micro-water harvesting for agriculture ● Promotion of beekeeping ● Adoption of early maturing crop varieties ● Capacity building through extension ● Embracing energy efficient cooking technologies ● Use of improved charcoal making technologies ● Tree planting and terracing of Muliluli, Ititi and Kalimakoi hills 	<ul style="list-style-type: none"> ● Capacity building on co-existence of humans and wildlife ● Procurement of antivenoms for snake bites ● Introduction of insurance schemes for compensation of victims of wildlife damage, injury and death ● Erection of electric fence to keep off elephants
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Ward: Mavindini

Priority 1	Priority 2	Priority 3
Water Harvesting for irrigation and domestic use		
	Agricultural livestock development	Environmental conservation and restoration

<ul style="list-style-type: none"> <input type="checkbox"/> Distribution of Athi Mavindini water project to farms and HH's <input type="checkbox"/> Construction of farm ponds <input type="checkbox"/> Promotion of roof catchment at household level <input type="checkbox"/> Desilting of Kalala earth dam and Kwa Ndeti earthdam. 	<ul style="list-style-type: none"> • Livestock aggregation and Vaccination in Mavindini, Kanthuni, Ivinga Nzia markets • Promotion of pasture growth and harvesting program i.e. mechanized harvesting <ul style="list-style-type: none"> • Provision of Improved Heifer breeds. • Provision of Pasture seeds. • Provision of subsidized veterinary services. • Goat improvement <ul style="list-style-type: none"> • Bee keeping • Poultry keeping • Pulses and grains • Aggregation and market linkages • Horticultural produce <p>Capacity building of livestock farmers on new technologies.</p> <ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Protection of Kanyonga River and tree growing in Ivinga Nzia • Protection of Katumbua hill • Growing of trees at household level • sensitization on environmental management • Sustainable land management practices
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CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The Makueni County Participatory Climate Risk Assessment Report offers a thorough analysis of the climate change challenges faced by the county, providing valuable insights into the risks and vulnerabilities that need to be addressed.

The climate related hazard in Makueni County is majorly drought with several incidences of flash floods and strong winds. These hazards predispose the County to risks such as water scarcity, loss of biodiversity, low crop and livestock productivity exacerbating vulnerabilities among the local communities. The risks have been identified in a participatory manner which ensures that local voices and knowledge are incorporated into identifying community based strategic interventions and climate actions.

The identified climate risks are interconnected and therefore require a holistic and multi-sectoral approach for effective mitigation and adaptation measures. The involvement of different stakeholders will provide a platform for multi –sectoral development and implementation of climate actions and sustainable development for the county.

The County will use the findings in this report to develop the County Climate Change Action Plan which will guide implementation of climate actions in the county.

5.2 Recommendations

The Makueni County Participatory Climate Risk Assessment Report serves as a valuable resource for decision-makers, development partners, and stakeholders Makueni County, National level and International level through addressing the identified climate risks to enhance its resilience to climate change. The County Government will organize a stakeholder forum to sensitize on the report to enhance knowledge on the climate risks and foster partnerships for collaborative efforts towards strategic interventions.

The proposed strategic interventions outlined in the Participatory Climate Risk Assessment report will provide a basis for development of the County Climate Change Action Plan to which will provide the priority areas of intervention for the county for the next five years.

The County, Ward Climate risks reports and action plans will be integrated in the County Planning and Budgeting process through the CIDP and ADP to enhance climate change mainstreaming and ensure seamless implementation of climate actions in the County for sustainable and climate-resilient future for its communities

To enhance locally led climate actions it is recommended that the County will continuously review the PCRA report through a participatory process to enhance local and stakeholder engagement in the changing climate scenarios.

It is crucial for the County Government to mobilize financial resources and engage stakeholders; National government, county government, development partners, donors and community members in implementation of the report to support locally led climate change action through fostering partnerships and promoting knowledge sharing.

Furthermore, continuous monitoring and evaluation of the implemented actions will enable adaptive management and ensure the effectiveness of interventions.

ANNEXES

Hazard and Risk Analysis and Ranking

Table 14: Hazard and Risk Analysis and Ranking

Ward	Drought	Environmental Degradation	Crop Pest and Diseases	Livestock Parasites and Diseases	Human Diseases	Human-Wildlife Conflict	Poor Infrastructure	Water Scarcity	GBV	Food Insecurity and Nutrition	Pollution	Excess Sand Deposits	Others (Social Vices)
Wote/Nziu	1				2				3		4		
Muvau/Kikumini	1		2	3	4								
Nzakika	1	4	3					2					
Mbitini	1	4	2	2								3	
Kathonzweni	1	3	2	2		4							
Kitise/Kithuki	1	2	3	3	4								
Mavindini	1		2	3									
Mbooni	1	3	4	4	5			2					
Tulimani	1	4		3	2								
Kithungo/Kitundu	1	3	2	2									
Kisau/Kiteta	1		2	2	3								
Kako/Waia	1	2	4	3									
Kalawa	1	2	3	4									
Kilungu	1	3	4	4	5			2					
Ilima	1	2	4	4	5			3					
Kee	1	3	2										
Ukia	5	4	3				2	1					
Mukaa	1	2	3	3					4				
Kiimakiu/Kalanzoni	2	1	3										
Kasikeu	1	3	4				5	2					
Makindu	1		2	3									
Emali/Mulala	1	3	2				4						
Nguu/Masumba	1	2	3	3		4							

Nguumo	2	3	4	4	5			1					
Kikumbulyu South	1	2	4	4							3		
Kikumbulyu North	1	4	2	3									
Mtito Andei	1	2	3	3									
Masongaleni	3	4		5				1		2			
Ivingoni/Nzambani	2	4						1		3			
Thange	1	2	3	3				4					
	30	25	26	22	9	2	3	10	2	2	2	1	0

Mapping of Risks

Table 15: Spatial distribution of risks

Ward	Risk	Location	Risk	Location	Risk	Location	Risk	Location	Risk	Location	Risk	Location	Risk	Location	Risk	Location
Wote/Nzi u	Forest Fires	Nthangu Hill	Pollution	Wote Town	Pest & Diseases	Farm Lands										
Muvau/Kikumini	Forest Fires	Nzueni and Nzaui Hills	Floods	Nyunzu	Pest & Diseases											
Nzakika	Floods	Kwa Masa a, Kwa Moto	Famine	Nzaui Sub Ward	Pest & Diseases	All Ward	Forest Fires	Nzaui and Makuli Hill	Strong Wilds	All Ward	Pollution	Along Rivers				
Mbitini	Gulley s	Mutiswa, Ngesu	Forest Fires	Kalumbi	Soil Erosion	All Ward	Excess sand deposits	Lower Mbitini (Kwa Mbita, Mutya mbua, Ilengene, Barazani)	Encroachment of forests	Muambwani and Kyemundu						

Kathonzweni	Rock Falls	Mant hemb a	Floods	along Kikuu river, akathonzweni CTTI	strong winds	kwa kavisi										
Kitise/Kit huki	Floods	Kanz okea, Along Athi River	Water Borne Disease	Along Athi River	Human - Wildlife Conflict	Along Athi Rivr	Strong Winds	Maanza								
Mavindini	Blastin g	Thwa ke Dam	Human wildlife conflict	Along Athi River	Water pollution	Along Athi Rivr	iver									
Mbooni	Floods	Mutitu, Uthiuni, Kyuu	Water Pollution due to poor waste disposal	Kikima Town	Deforestation	Mbooni, Katen de	Air Pollution	Kikima Town	Mud Slides	Matondoni, Nzeveni, Mutitu, Kyuu, Uthiuni, Syiluni	Forest Fires	Katende Hill	Gullies	Kwa Mbi su, Syiluni, Ndo lo, Kwa Mun guti, Ngéle, Kin		

														yee, Mut wii		
Tulimani	Forest Fires	Mulo oni, Kitoo	Open pits from mining	Kakim a, Wanza uni, Itetani, Kalaw ani	Land Slides	Kakim a, Wanz auni, Itetani , Kalaw ani										
Kithungo/ Kitundu	Floods	Low Lands along rivers	Land slides	Kilami tho, Kalaku ni, Ivonge	Gulley s	Kathe mboni , Kilyav ati, Muva a	Human - Wildlif e Confli cts (Monk eys menac e)	Kithun go, Kitund u, Ngai,	Forest Fires	Katen de, Ngom angoni						
Kisau/Kite ta	Forest Fires	Katen de	Polltio n of Water Source s	Kize, Kantha le, Ngoni, Ngwan i, Tawa,	Human - Wildlif e Conflic ts (Monk eys	Katen de										

				Mwaa ni	menac e)											
Kako/Wai a	Huma n- Wildlif e Confli cts	Along Athi River	Land slides	Mwaa ni	Water Borne Diseas es	Along Athi Rivr										
Kalawa	Polluti on	Along River Athi	Water Borne Diseas e	Along River Athi	Human wildlif e conflic t	Along River Athi	Emergi ng Diseas es	Kyotuv ali								
Kilungu	Open Pits from Minin g	Ithem boni, Mitini	Land/ Mud Slides	Nduu	Gulley s	Nthun guni, Kwa Malasi , Nungu ni Primar y	Flash Floods	Nduu, Ndiani, Kyuma ni								
Ilima	Gulley s	Kyak atuli, Kwa Kithu ku, Kwa	Land/ Mud Slides	Mitini, Matwi ku	Flash Floods	Wautu , Ndolo										

		Kyali ka														
Kee	Open Pits from Minin g	Ikalyo ni, Kwa Kivin da, Kwa Kima nyi, Kwa Math avu, Kola Police , Ndum ani, Mata ngi	Flash Floods	Kaiti- Watem a Junctio n	Gulley s	Ikalyo ni, Kwa Kivin da										
Ukia	Mud Slides	Yiuan i	Flash Floods	Muing a, Kaiti and Kiloi Rivers	Forest Fires	Katen de, Makul i	Gulley s	Kinyon go, Kwa Kingoo , Mutam bukoni, Nthang athi, Kitutu	Pest and Diseas es	All Ward	Hu man Dise ases	All War ds	Su n Bur ns	All War d	Wat er Poll utio n	Kaiti River , Kam unyii , Kilo, Muin ga

Mukaa	Soil Erosion	Kitain go	Human wildlife conflict	Kitain go	Deforestation	Kenze										
Kiimakui/Kalanzoni	Deforestation	Kwemaa, Marwa Hill, Mulumini	Gulleys	Kwemaa, Kiu, Katilini, Mavisye, Kwakaveki, Petrol City	Mud Slides	Marwa Hill	Floods	Kima River	Human - Wildlife Conflict	Malili, Kiiimakiu Hill, Kapiti						
Kasikeu	Water Shortage	All Wards	Flash Floods	Mikuyuni and Muangini Rivers, Sultan Town												
Makindu	Floods	Kikuu River	Human wildlife conflict	Kiboko B&C	Open Pits	Along Msa-Nrb Roads (Ikoyo)	Bush Fires	KALRO	Prostitution	Makindu Town	Oil Spills	Kiboko				

Emali/Mulala	Open/Borrow Pits	Along SGR Corridor	Floods	Emali Town												
Nguu/Masumba	Flash Floods	Muoni, Kikuu	Soil Pollution	Ithumba, Kikumini	Human - Wildlife Conflict											
Nguumo	Deforestation	Mbui nzau Hill	Soil Erosion	Mbui nzau Hill												
Kikumbulu South	Pollution	Kibwezi River,	Deforestation	Mbui nzau Hill	Encroachment	Mbui nzau Hill										
Kikumbulu North	Human-Wildlife Conflicts	Along River Athi	Pollution-Asbestos Disposal	Kingutheni												
Mtito Andei	Oil Spills	Kambu	Floods	Along River Athi	Human wildlife conflict	All Ward										

Masongaleni	Floods	Subati, Along Athi River	Human wildlife conflict	All Ward												
Ivingoni/Nzambani	Human wildlife conflict	Along Kyulu Area	Encroachment of Hills	Kyulu Hill	Drying of Water Sources	All Ward	High Temperatures	All Ward								
Thange	Oil Spills	Thange River	Human wildlife conflict	All Ward	Soil Erosion	Along Thange River	Soil Fertility	All Ward	Drying of Water Sources	Thange River						

Stakeholders Multi-Stakeholder Engagements Inputs & Pictorials

Activity: PCRA/CCCAP Multistakeholder Engagement

Venue: ACACIA RESORT

Date: 29th – 30th May 30, 2023

GROUP 1: WATER SCARCITY



Figure 23: Multi stakeholder discussion on Water Scarcity issues

Risks and Threats

Table 16: Climate and Non Climate risks and Impacts

Climate Risks	Non Climate Risks	Direct Impacts	Non Direct Impacts
Crop failure	School dropouts/Child labour	<ul style="list-style-type: none">• Hunger• Loss of livelihoods	<input type="checkbox"/> Death

Drought	GBV	<ul style="list-style-type: none"> • Water scarcity • Food shortage • Livestock death • Loss of biodiversity • Degradation • Rural Urban migration □ • Loss of livelihoods. • Loss of property 	<ul style="list-style-type: none"> • Increased insecurity • Inflation • Family breakage • Mental problems • Illnesses and diseases
Pasture reduction	Corruption	<ul style="list-style-type: none"> • Livestock death • Reduced prices of livestock • Low yield • HWC 	<ul style="list-style-type: none"> • Behaviors change • Decreased stock
Human Wildlife conflict	Exploitation	<ul style="list-style-type: none"> • Overgrazing • Loss of life • Loss of human life • Injuries • Infrastructure and property damage • Death of wildlife 	<ul style="list-style-type: none"> • Insecurity • Pollution • Increased zoonotic diseases outbreak • Extinction of some wildlife
Human to human conflict	Malnutrition	<ul style="list-style-type: none"> • Insecurity • Loss of infrastructure • Poor human relations 	<ul style="list-style-type: none"> • Increased insecurity • Increased under development
Encroachment of reparation lands	Rural Urban Migration	<ul style="list-style-type: none"> • Drying of water sources • Pollution • Loss of biodiversity • Low food production • Increased deforestation • Reduced water quality and quantity 	<ul style="list-style-type: none"> • Human Conflicts • Human Wildlife conflict • Insecurity
Deforestation/ Soil degradation	Increased family breakups Increased insecurity	<ul style="list-style-type: none"> • Increased soil erosion • Gulley formation • Low production • Habitat loss • Drying up of water catchment 	<ul style="list-style-type: none"> • Reduced land value • Pollution • Increased temperature leading to global warming. • Changing weather patterns

Pollution	Reduction in value of money Loss of jobs Reduction in income Drug and Substance abuse	<input type="checkbox"/> Increased respiratory diseases both animal and human <input type="checkbox"/> Loss of ecosystem and biodiversity	<input type="checkbox"/> Death of human and Animals
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Vulnerable Groups

- Women
- Children
- Elderly
- PWDs
- Terminally ill
- The poor
- Farmers
- Youth

The theory of change

Water remains a critical resource in Makueni County. With well protected catchment areas, well managed water sources, good water harvesting infrastructures with effective governance the issue of water scarcity will be a story of the past. Adequate access and availability of water will in turn lead to improved health, sustainable food security, improved and alternative sources of livelihood, reduced poverty, biodiversity restoration, recharged wetlands, better education, improved hygiene and sanitation hence attainment of sustainable development goal (SDG) no 6 Access to clean water & sanitation for all and realization of the Governor's agenda on water provision.

GROUP 2: ENVIRONMENTAL DEGRADATION



Figure 24: Multistakeholder discussion on Environmental Risks

Climatic Hazards and Risks

S/NO	CLIMATIC HAZARDS/RISKS
1.	Prolonged drought

2.	Pollution
3.	Degraded lands
4.	Urbanization etc. Kibwezi
5.	Charcoal burning
6.	Encroachment of water catchment and protected areas
7.	Wild fires
8.	Deforestation
9.	Overgrazing
10.	Soil degradation
11.	Human wildlife conflicts etc Tsavo
12.	Strong winds
13.	Flash floods
14.	Infrastructure development
15.	Solid and liquid waste management
16.	Pests
17.	Land fragmentation
18.	Invasive plant species
19.	Agrochemical use
20.	Inadequate enforcement of environmental laws and policies
21.	Inadequate sensitization on policies
22.	Corruption
23.	Lack of resources

Group 3: AGRICULTURE SECTOR



Figure 25: Multistakeholder discussion on agricultural risks

Table 17: Agriculture stakeholder inputs

– Climate hazards	Non- climatic hazards	Direct impacts	Indirect impacts	Vulner- able groups	Current adaptation strategies	How sustain- able are they	New adaptation strategies in case it prolongs	Priority interventi- ons

1. Erratic rainfall	- Uncertified seeds	-Poor farm management techniques	- Malnutrition -High cost of living - School dropouts	-PWDs - Elderly -Youth - Children - Terminally ill - Women /children headed households - Women	• Agroecology • Conservation agriculture/ripping • Drip irrigation • Agroforestry • Mulching (cover crops) • Minimum tillage • Rain water harvesting (zai pits, terracing) • Regenerative agriculture • Adoption of resilience crops i.e., hybrid crops, early maturity • Pasture management and establishment i.e., Masai grass love grass	High High High High High	• Diversification of agriculture • Leverage on technology (hydroponics, green houses) • Diversify water harvesting and recycling • Enhance research and innovation • Enhance public-private partnership and other development partners • Identify gaps in existing legal frameworks and enhance implementation • Address corruption	• Adoption of conservation agriculture technology • Water harvesting (surface run off water, rock catchment, earth dams, roof water) • Value addition on agricultural value chains and pasture • Rangeland management • Diversification of agriculture (aquaculture fisheries, apiculture beekeeping)
2. Live stock and crop and pest diseases	-Flooded markets	- Crop failure - Low yields - Livestock predation	- GBV -Resource conflicts(water) - Transmission of pests - Collapse of dairy cooperatives -Loss of fodders			High High Medium Medium		
3. Soil erosion	- land fragmentation	-				High		
4. Human wildlife conflicts	- Invasive species	- Competition of food - Crop destruction - Retarded growth - Destruction of farm fractured - Competition for pasture				High High		
5. Flash floods						High		
6. Strong winds								

Theory of Change

GOAL: FOOD SECURITY AND SOCIO-ECONOMIC EMPOWERMENT



- Adopting of conservation agriculture
 - Water harvesting
- Value addition of agriculture and pasture value chain
 - Rangeland management
 - Diversification agriculture



Impacts

- Increased income at household level
- Improved livelihoods
- Increased agricultural productivity
- Decreased of malnutrition
- Increased water coverage



Output

Increased agricultural productivity, enhanced livelihoods and reduced poverty at household level

GROUP 4: HUMAN DISEASES



Figure 26: Multistakeholder discussion on Health issues

Table 18: Multistakeholder Inputs on health issues

Climate hazards	Direct impacts	Indirect impacts	Vulnerable groups	Current adaptation strategies	How sustainable are they	New adaptation strategies	Priority interventions

Human diseases (malaria, cholera, cancer)	Overcrowded hospitals Medication shortages Death of patients Ill health	Poverty and suffering Overburdened High cost of living Under development	Elderly Lactating mothers People living with chronic diseases Children especially below 5	<ul style="list-style-type: none"> • Prepositioning medical supplies in all health facilities • Preventive and control measures prior • Relief food for the vulnerable 	High High High- because they are not affecting big population	<ul style="list-style-type: none"> • Researching on drugs that can prevent the upsurge of the diseases • Provision of community health education • Provision of more health personnel's • Proper budgeting • Upscaling health insurance 	2 1 3
Drought	Malnutrition Water scarcity leading to consumption of contaminated water Lifestyle diseases	Stunted growth of children High mortality rates underweight babies	Children under 5 Pregnant and lactating women	<ul style="list-style-type: none"> • Provision of nutrition supplements • Awareness creation on health diets • Setting kitchen gardens 	High High Medium	Food preservation and storage Water harvesting programs and safe storage	6 4
				<ul style="list-style-type: none"> • Water tracking • Water treatment 			

Pollution	<ul style="list-style-type: none"> • Disease out breaks • Poor health • Death • Increase in disease causing micro organisms 	Poor economic productivity High cost of living Contaminated water sources	Women Elderly Lactating mothers People living with chronic diseases Terminally ill Children especially below	Treatment of water sources Sensitization Provision of drugs to prevent the disease	Highly sustainable Medium Low	<ul style="list-style-type: none"> • Proper disposal of waste • Clearing of environments that are conducive for diseases causing parasites 	5
Environmental degradation	<ul style="list-style-type: none"> • Malnutrition • Air pollution • Temperature rise 	Ill health		Restoring the environments through tree growing Clean ups to remove hazardous substances	High Medium	<input type="checkbox"/> Hygienic sensitization	

Non- climatic hazards

- Drug abuse
- Crime
- GBV
- Lifestyle diseases- obesity
- School dropouts

Priority intervention strategy- Provision of community health education THEORY OF CHANGE

1. **Provision of community health education-** helps the community to understand their own health issues, responsible living, and keeping diseases such as obesity at bay and therefore it will help in curbing lifestyle diseases and diseases emanating from malnutrition and improper dieting. Community based rehabilitations for PWDs and also diabetics. Educates traditional birth attendants in handling the expectant mothers and offering first aid to them before handing over to hospitals.
2. **Researching on drugs that can prevent the upsurge of the diseases-** helps researchers identify emerging diseases to produce drugs that curbs the upsurge of emanating diseases, for example, albinism lotions
3. **Proper budgeting-** helps health facilities to receive adequate funds to be able to purchase all the required medical requirements which improves on health status
4. **Water harvesting programs and safe storage-** will help in reducing water scarcity leading to contaminated water causing ill health and also malnutrition emanating from drought and environmental degradation, therefore, persons will be able to have safe drinking water and also enough water for kitchen gardens.

5. **Proper disposal of waste-** will help in reducing disease outbreaks resulting from pollution in which it is a curbing mechanism.
6. **Food preservation and storage-**will help deal with malnutrition and ill health in which they are a resultant of degraded environments and drought thus the two will be partially curbed.

A HEALTHY COMMUNITY IS A WEALTHY COMMUNITY

PCRA Community Engagement – Pictorials



Stakeholder and multi-stakeholder engagement.



Figure 2 ECM Gender Addressing Community stakeholders during PCRA Process at Wote Green Park Multipurpose hall.



Figure 3 PCRA Process



Figure 4 Group Discussions during PCRA Process.____*Figure 5 Group Photo during PCRA Process for Makindu, Nguu Masumba and Emali Mulala wards at Hunters Lodge.*



Figure 6 Chief Officer in charge of Environment, Natural Resources, mining and Climate Change addressing PCRA

Community stakeholders at Wote Green Park Multi-Purpose hall

Technical Working Sessions – Pictorials



Attendance Lists for all Engagements