MURANG'A COUNTY GOVERNMENT

Participatory Climate Risk Assessment Report

(PCRA-REPORT)

MAY, 2023

Foreword

The manifestations of climate change in the form of rising temperature, variability of precipitation, the risks of more droughts, floods, heat waves, and forest fires have impacts on the economy, environment and communities. Given its geographical location, Topographic formation in the Mountain region, and its population distribution, Murang'a is greatly vulnerable to the impacts of climate change, and has already experienced noticeable adverse effects in recent years. Without concerted National and County action, the challenges the County will face as a result of climate change are expected to intensify in the medium or long term. In response to what has essentially become a global crisis, the government has enacted the Climate Change Act (2016) that provides the policy framework with which systematically addresses the growing threats on community life and its impact on the environment. The Climate Change Act establishes an organizational structure, the Climate Change Commission, and allocates budgetary resources for its important functions. These functions include: The formulation of a framework strategy and program in consultation with the global effort to manage climate change, the main streaming of climate risk reduction into national, sector and County Government's development plans and programs, the recommendation of policies and key development investments in climate-sensitive sectors, and the assessments of vulnerability and facilitation of capacity building.

The national climate change framework strategy has recently been translated into a County Climate Change Action Plan (CCCAP), which prioritizes; Reduction of risks to communities and infrastructure resulting from climate-related disasters such as droughts and floods, Increase in food and nutrition security through enhanced productivity and resilience of the agricultural sector in as low- carbon manner as possible, Enhanced resilience of the Blue Economy and water sector by ensuring access to and efficient use of water for agriculture, manufacturing, domestic, wildlife and other uses, Increased forest cover to 10% of total land area; rehabilitate degraded lands, including range lands increase resilience of the wildlife and tourism sector, Main streaming climate change adaptation into the health sector; and increase the resilienceof human settlements, including improved solid waste management in urban areas, Improve energy and resource efficiency in the manufacturing sector, and Climate-proof energy and transport infrastructure; encourage electricity supply based on renewable energy; encouragethe transition to clean cooking; and develop sustainable transport systems.

This document assesses the current situation of the County with regard to climate change risk and outlines the CCCAP's strategic direction for 2022 to 2027 as a response to the current situation and projected impact.

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Acknowledgement

The Participatory Vulnerability and Capacity Assessment (PVCA) reports for all thirty-five (35) Wards in Murang'a county together led to development of County Participatory Climate Risk Assessment Report (MCPCRA) From which the Murang'a County Climate Change Action Plan was derived. This Document was prepared with support from various Departments, institutions and individuals. The Murang'a County Government and specifically the Department of Environment and Natural Resource Management provided logistical as well as constituted County Multi-departmental PCRA steering team. To this end we are grateful to the County top management led by the County Governor, His Excellency Dr. Irungu Kang'ata, the CEC Environment and Natural Resources, Hon. Mary Magochi, the Chief Officer, Madam Bridget Irungu and Director Mr. Julius Mwangi and all the county staff who provided their support to the County FLLOCA secretariat and County FLLOCA Technical Working Group during training, field work and preparation of the reports and this Action Plan.

We acknowledge the Ward Members of County Assembly, and the other members of the Ward Climate Change Planning Committees (WCCPC) for their role in providing the bulk of the data and information on climate change in their ward based on the PVCA Tools.

Last but not least we thank the county staff; County Climate Change Technical Working Group for spearheading the preparation of the Murang'a County Climate Change Action Plan (MCCCAP), which will guide in mitigation and adaptation of Climate change in the county for the next five years.

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MURANG'A COUNTY

Executive Summary

Murang'a County Climate Change Action Plan (MCCCAP) 2019 - 2022 is a five-year plan to steer Murang'a climate change action. The Plan derives from the Climate Change Act (Number11 of 2016), which requires the County Governments to develop Action Plans to guide the mainstreaming of climate change into their functions and development. MCCCAP 2019 - 2022 will further the achievement of Murang'a County development goals by providing mechanisms to realize low carbon climate resilient development. It emphasizes sustainability, while prioritizing adaptation and enhanced climate resilience for vulnerable groups, including women, youth, persons with disabilities, and marginalized and minority communities. Murang'a County Climate Change Action Plan 2019- 2022 was developed at a time when significant changes in Murang'a climate were evident. Climate-related disasters, particularly landslides, droughts and floods, were frequent, and their impacts adversely affected the economy and livelihoods in the county. The frequency of cold days and nights, had greatly increased. Temperature rise spanned across all seasons, and rainfall patterns had changed. With an economy that is dependent on climate-sensitive sectors, such as agriculture, water, energy, tourism, wildlife, and health, these changes in the county climate were singled out as severe threats to the well-being of Murang'a county Communities. The priority climate actions are in the six mitigation sectors set out in the United Nation Framework Convention on Climate Change (UNFCCC); agriculture, energy, forestry, industry, transport, and waste. The actions are expected to lower GHG emissions. The Plan was developed through an extensively consultative process led by a Task force (County Climate Change Steering Committee) that conducted over 1,000 stakeholder consultations, supported by the Adaptation, and Mitigation. The task force produced Adaptation and Mitigation report which are part of Murang'a County Climate Change Climate Change Action Plan. Priority areas underpin Murang'a County Climate Change Action Plan 2019-2022; Disaster Risk Management; Food and Nutrition Security; Water and the Blue Economy; Forestry; Wildlife, and Tourism; Health, Sanitation, and Human Settlements; Manufacturing; and Energy and Transport. Through these priority areas, climate change action is aligned to the Government's Big Four Agenda, and the Sustainable Development Goals (SDGs). Murang'a County Climate Change Action Plan 2019-2022 seeks to increase the number of

households and entities benefiting from devolved adaptive services. These actions are also mainstreamed in Murang'a County Integrated Development Plan (CIDP), to ensure that they are taken up in Murang'a county government developments

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ABBREVIATIONS AND ACRONYMS

AI	Artificial Insemination
ARD	Agriculture & Rural Development
ASAL	Arid & Semi- Arid Lands
ASL	Above Sea Level
BOG	Board of Governors
CAN	Calcium Ammonium Nitrogen
CBO	Community Based Organization
CCSP	Community Capacity Support Programme
CCT	County Coordinating Team
CDF	Constituency Development Fund
CDP	County Development Profile/ Plan
CEC	County Executive Committee
CFAs	Community Forest Associations
CHMT	County Health Management Team
CHW	Community Health Worker
CIDP	County Integrated Development Plan
CIGs	Common Interest Groups
CIP	Community Implementation Plan
CMEC	County monitoring and evaluation committee
CMT	County Management Team
CO_2	Carbon Dioxide
CTC	County Technical Committee
DRR	Disaster Risk Reduction
ECLOF	Ecumenical Loan Fund
EDE	Ending Draught Emergencies
EIA	Environmental Impact Assessment
EMCA	Environmental Management & Coordination Act
EMR-Electronic	Medical Record
EPWH	Environment Protection, Water & Housing

ESP	Economic Stimulus Programme
FBO	Faith-Based Organization
FIF	Facility Improvement Funds
FP	Family Planning
GDI	Gender Development Index
GDP	Gross Domestic Product
GECLA	General Economic, Commercial & Labour Affairs
GHGs	Green House Gases
GIZ	German International Development Agency
GJLOS	Governance, Justice Law & Order Sector
GOK	Government of Kenya
HDI	Human Development Index
HH	Household
HMT	Health Management Team
HPI	Human Poverty Index
HQS	Headquarters
ICT	Information Communication Technology
IDPs	Internally Displaced Persons
IEBC	Independent Electoral & Boundaries Commission
IEC	Information Education Communication
IMIS	Integrated Management Information Systems
IMR	Infant Mortality Rate
ITNs	Insecticide Treated Mosquito Nets
KCB	Kenya Commercial Bank
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forest Research Institute
KEMSA	Kenya Medical Supplies Agency
KENAS	Kenya National Accreditation Services
KENHA	Kenya National Highway Authority
KeRRA	Kenya Rural Roads Authorities

KFS	Kenya Forest Services
KIRD	Kenya Institute of Research & Development
KNBS	Kenya National Bureau of Statistics
KPC	Kenya Power Company
KURA	Kenya Urban Roads Authority
KWFT	Kenya Women Trust Fund
KWS	Kenya Wildlife Services
LSK	Law Society of Kenya
MCH	Mother & Child Health
MDGs	Millennium Development Goals
MGCSS	Ministry of Gender, Culture & Social Services
MOHEST	Ministry of Higher Education, Science & Technology
MOLD	Ministry of Livestock Development
MOLD	Ministry of Livestock Developments
MOPHS	Ministry of Public Health & Sanitation
MOPW	Ministry of Public Works
MOR	Ministry of Roads
MOTI	Ministry of Trade & Industry
MOU	Memorandum Of Understanding
MOWI	Ministry of Water & Irrigation
MOYA	Ministry of Youth Affairs
MSMEs	Micro- Small & Medium Enterprise
MSPND & V2030	Ministry of Planning and National Development
MTEF	Medium Term Expenditure Framework
MTP	Medium Term Plan
MTP II	Medium Term Plan II
NAAIP	National Accelerated Agricultural Inputs Access Programme
NACC	National Aids Control Council
NAP	National Adaptation Plan
NDMA	National Draught Management Authority

NARIGP	National Agriculture Rural Inclusive Growth Project
NCPD	National Cereals & Produce Board
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NHIF	National Health Information Fund
NIMES	National Integrated Monitoring & Evaluation System
NMK	Njaa Marufuku Kenya
NNMR	Neo Natal Mortality Rate
NSEC	National Socio-Economic Council
OVCs	Orphans & vulnerable Children
PAIR	Public Administration & international Relations
PC	Project Committee
PLWHAs	People Living With HIV/AIDS
PM&E	Participatory Monitoring and Evaluation
PMC	Project Management Committee
PPPs	Public Private Partnerships
PSDA	Private Sector Development In agriculture
RPD	Rural Planning Directorate
SCCU	Sub- County coordinating Unit
SCCU	Sub- County Coordinating Unit
SCDPO	Sub County Development Planning Officer
SCEC	Sub- County Environment Committee
SHEP UP	Small Holder, Horticulture Empowerment Promotion Unit Project
SMASSE	Strengthening Mathematics and Science in Secondary Education
SMEP DTM	Small and Micro Enterprises Programme Deposit Taking Microfinance
SMEs	Small & Medium Enterprise
SP	Sector Programme
SPCR	Social Protection, Culture & Recreation
Spp	Species

SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis
UNDP	United Nations Development Programme
UNFCCC	United Nation Framework Convention on Climate Change
WARMA	Water Resource Management Authority
WEDF	Women Enterprise Development Fund
WRA	Women of Reproductive Age-18-49.1
WRUA	Water Resource Users Association
YARD	Youth Action for Rural Development
YDI	Youth Development Index
YEC	Youth Empowerment Centre
YEDF	Youth Enterprise Development Fund
YP	Youth Polytechnics

Definition of terms

Climate change: refers to a 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: means adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Greenhouse gases (GHGs): are gases that absorb and emit radiant energy within the thermal infra-red range. The main GHGs measured in a GHG inventory are, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), Sulphur hexafluoride (SF6) and nitrogen trif-luoride (NF3). Mitigation refers to human interventions to prevent or slow down atmospheric GHG concentrations by limiting current or future missions, and/or enhancing potential sinks for greenhouse gases.

Programme: A grouping of similar projects and/or services performed by a Ministry or Department to achieve a specific objective; The Programmes must be mapped to strategic objectives.

Project: A project is a set of coordinated activities implemented to meet specific objectives within defined time, cost and performance parameters. Projects aimed at achieving a common goal form a programme

Resilience: refers to the capacity of social, economic and environmental systems to cope with a hazardous event, trend, or disturbance. It is manifested through responding or reorganizing in ways that assert the essential function, identity, and structure of the system, while also maintaining the capacity for adaptation, learning and transformation.

Target: A target refers to planned level of an indicator achievement

Vulnerability: refers to the propensity or predisposition to be adversely affected. It encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm, and lack of capacity to cope and adapt.

1.0. Chapter 1 Context of the Participatory Climate Risk Assessment (PCRA)

1.1 Background/ Introduction

Murang'a County is in the center of the Republic of Kenya. It borders Kiambu County to the south, Nyeri County to the north, Nyandarua County to the west and Embu, and Machakos and Kirinyaga counties to the east. Murang'a County occupies a total area of 2,559 km² (Murang'a County Government, 2018). The county's altitude ranges from 914 meters above sea level in the east to 3353 meters above sea level in the west. The highest parts of the county border the Aberdares mountains, which catch rain and are the source of the county'srivers (Murang'a County Government, 2018). Murang'a County's annual temperature ranges between 10 and 25°C. Most of the county experiences an annual average temperature of more than 20°C. The county receives between 750 and 1700 mm of precipitation annually. The eastern part of the county receives an average of less than 750 mm of rainfall annually. The months of March, April, and May are very rainy in Murang'a County, with April historically recording the highest amount of rainfall. The short rainy season usually occurs during the months of October, November, and December. The County has three climatic regions: the western region, is characterized by upper highland humid(UHH) and upper highland per humid (UHP) agro ecological zones and covers the upper Parts of Mathioya, Kangema, Gatanga, and higher Kigumo and Kandara sub-counties (Figure 3). The County is characterized by a diverse agro-ecological landscape, ranging from highland areas to lower-lying regions. The need for a Participatory Climate Risk Assessment (PCRA) in Murang'a County arises from the growing recognition of the escalating impacts of climate change on the county's socio-economic and environmental systems.

The central region is characterized by lower highland humid LHH), upper midland sub humidand humid (UM1& UM2) agro ecological zones covering, lower Kigumo, and Lower Gatanga sub-counties. The eastern region is characterized by lower midland semi humid LM3, LM4), transitional and semi-arid agro ecological zones. This region covers the lower parts of the Kandara, Kiharu and Maragua sub-counties (Murang'a County Government, 2018).

Climate change is becoming one of Kenya's most serious challenges. The country is susceptible to climate-related events, and projections indicate that climate-related eventswill continue to affect Kenya in the future. In many areas, extreme weather is now the norm. Rainfall is irregular and unpredictable; some regions experience frequent droughts during the long rainy season or severe floods during the short rainy season. Arid and semi-arid areas are particularly vulnerable to these extreme changes, putting the lives and socio-economic activities of millions of households at risk.

The PCRA process is essential as it engages local communities, government agencies, and experts to assess current vulnerabilities, climate-related risks, and resilience strategies. It involves mapping out key climatic stressors, identifying critical sectors at risk, and developing adaptive measures to mitigate these threats. In Murang'a County, this approach is particularly relevant due to the necessity of understanding how climate change affects water availability, crop yields, and livestock health, as well as the potential for increased conflict over scarce resources.

1.2 Policy Context

Climate change is a complex and multifaceted global issue that requires a coordinated policy approach at international, national, and local levels. As of my last knowledge update in September 2021, here are some key policy contexts regarding climate change:

International Agreements:

1.2.1 Kyoto Protocol:

The Kyoto Protocol, adopted in 1997 as an extension of the United Nations Framework Convention on Climate Change (UNFCCC), set legally binding emission reduction targets for developed countries (Annex I countries) during the first commitment period (2008-2012). It introduced mechanisms like emissions trading and the Clean Development Mechanism (CDM) to help countries meet their targets.

1.2.2 REDD+ (Reducing Emissions from Deforestation and Forest Degradation):

REDD+ is an initiative under the UNFCCC that aims to reduce greenhouse gas emissions from deforestation and forest degradation in developing countries. It also includes the conservation and sustainable management of forests, as well as the enhancement of forest carbon stocks.

1.2.3. UNFCCC (United Nations Framework Convention on Climate Change):

The UNFCCC, established in 1992, is the foundational international treaty for addressing climate change. Its primary objective is to stabilize greenhouse gas concentrations in the atmosphere to prevent dangerous human-induced interference with the climate system. The annual Conference of the Parties (COP) meetings serve as a platform for negotiation and decision-making on climate-related issues.

1.2.4 Paris Agreement:

While not included in your initial list, the Paris Agreement is a crucial international climate accord adopted in 2015. It builds upon the UNFCCC and aims to limit global warming well below 2 degrees Celsius above pre-industrial levels, with an aspirational goal of limiting it to 1.5 degrees Celsius. The agreement includes commitments from countries to reduce emissions, enhance climate resilience, and provide financial support to developing nations.

1.2.5. Montreal Protocol:

While primarily focused on ozone-depleting substances, the Montreal Protocol is often cited as an example of a successful international environmental treaty. It has indirectly contributed to climate change mitigation by phasing out substances like chlorofluorocarbons (CFCs), which are potent greenhouse gases

1.2.6 Constitution of Kenya (2010)

A robust framework of policies, plans, and institutions is being progressively establishedat the National and County levels in Kenya to address climate change. The foundation of the institutional and legal framework for climate change action is the Constitution of Kenya (2010). Article 10 sets out national

values and principles of governance, such as sustainable development, devolution of government, and public participation, which aremandatory when making or implementing any law or public policy decisions, including those relating to climate change.
Article 42 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 present andfuture generations through legislative and other measures.
County Governments have a key delivery role in implementing the Climate Change Act,

2016, having jurisdiction, as set out in the Fourth Schedule (Part 2) of the Constitution,

over sectors relevant to climate change action, such as agriculture, soil and water

conservation, forestry, water and sanitation, tourism, and health.

1.2.7 National Climate Change Response Strategy (NCCRS) 2010

This recognizes the impact of climate change on the country's development. This was followed by the 2012 National Climate Change Action Plan (NCCAP), which provided a means for implementing response strategies and highlighted the country's priorities.

These two initiatives are focused on the national level, but the response to climate change also needs to be integrated into county-level policies, programs, and development plans. Initiatives need to be locally relevant and actively involve local stakeholders.

1.2.8. Kenya Vision 2030 and its Medium-Term Plans

Kenya Vision 2030, the country's development blueprint, recognized climate change as

a risk that could slow the country's development. Climate change actions were identified

in the **Second Medium Term Plan (MTP) (2013-2017)**. The **Third Medium Term Plan**

(2018-2022) and **(2025-2030)** recognized climate change as a crosscutting thematic area, and

mainstreamed climate change actions in sector plans.

1.2.9. National Climate Change Action Plan (2018-2022)

Kenya's National Climate Change Action Plan, 2018-2022 is a five-year

plan that seek to further Kenya's development goals in a low carbon climate resilient

manner. The plan has set out adaptation, mitigation, and enabling actions.

1.2.10. National Adaptation Plan (NAP) (2015-2030)

Kenya's National Adaptation Plan 2015-2030 (NAP) was submitted to the UNFCCC in 2017. NAP provides a climate hazard and vulnerability assessment, and sets out priority adaptation actions in the 21planning sectors in MTP II.

1.2.11. Nationally Determined Contribution (NDC) (2016)

Kenya's NDC under the Paris Agreement of the UNFCCC includes mitigation and adaptation contributions. In regard to adaptation, "Kenya will ensure enhanced resilience to climate change towards the attainment of Vision 2030, by mainstreaming climate change into Medium Term Plans (MTPs), and implementing adaptation actions. The mitigation contribution "seeks to abate Kenya's GHG emissions by 30% by 2030." Achievement of Kenya's NDC is subject to international support in the form of finance, investment, technology development and transfer, and capacity development.

1.2.12. Climate Change Act (No. 11 of 2016)

The Climate Change Act (No. 11 of 2016) is the first comprehensive legal framework for climate change governance in Kenya. The objective of the Act is to "Enhance climate change resilience and low carbon development for sustainable development of Kenya. "The Act establishes the National Climate Change Council (Section 5), Climate Change Directorate (Section 9), and Climate Change Fund (Section 25).

1.2.13. Kenya Climate Smart Agriculture Strategy (KCSAS) (2017-2026)

The objective of the Kenya Climate Smart Agriculture Strategy (KCSAS) is to adapt to climate change and build the resilience of agricultural systems, while minimizing GHG emissions. Planned actions will lead to enhanced food and nutritional security, and improved livelihoods.

1.2.14. Climate Risk Management Framework (2017)

The Climate Risk Management Framework for Kenya integrates disaster risk reduction, climate change adaptation, and sustainable development, so that they are pursued as mutually supportive rather than stand-alone goals. It promotes an integrated climate risk management approach as a central part of policy and planning at National and County levels.

1.2.15 National Climate Change Framework Policy (2018)

The National Climate Change Framework Policy aims at ensuring the integration of climate change considerations into planning, budgeting, implementation, and decision-making at the National and County levels, and across all sectors.

1.2.16 National Climate Finance Policy (2018)

The National Climate Finance Policy promotes the establishment of legal, institutional, and reporting frameworks for access to, and management of climate finance. The goal of the policy is to further Kenya's national development goals through enhanced mobilization of climate finance that contributes to low carbon climate resilient development goals.

1.2.17 Murang'a County Integrated Development Plan (2018 - 2022)

Murang'a County Government has mainstreamed climate change in its CIDP. It addresses the impacts of Climate change through their development activities.

Finally, Through the Ministry of Agriculture, Livestock, Fisheries, and Cooperatives, the Government of Kenya (GoK) is implementing the National Agricultural and Rural Inclusive Growth Project **(NARIGP),** with support from the World Bank. This project aims to increase the agricultural productivity and profitability of targeted rural communities in selected counties. To address the climate change risks and vulnerabilities that negatively impact agricultural production, the Alliance of Biodiversity International and the International Center for Tropical Agriculture (CIAT) completed a climate risk assessment in 14 counties supported by NARIGP.

1.2.18 Murang'a County Solid waste management policy 2021

Social lifestyles, waste management practices and production determine how we dispose of our waste. Accumulation of waste has stagnated development of some societies due to their inadequate waste management

leading to degradation of environment, proliferation of diseases and ultimately impact on livelihoods. Further, improper waste management poses a threat to climate change and eventually in the achievement of sustainable development. Waste being one of the contributors of greenhouse gases, affects climate change and it is for this reason that as a county, we should develop sustainable waste management technologies and initiatives to curb this growing county challenge.

1.2.19. Murang'a County Climate Change Fund Act, 2021

To facilitate and coordinate financing of Climate Change Adaptation and Mitigation activities, the County Assembly enacted the Murang'a Climate Change Fund Act, 2021 for the establishment of a Climate Change Fund. It mandates the Murang'a County Government to set aside 2% of its annual development budget for climate change action

1.3. Purpose of the PCRA Report

The purpose of a Participatory Climate Risk Assessment (PCRA) report is to engage stakeholders and communities in a collaborative process to comprehensively understand and address climate-related risks. It aims to facilitate informed decision-making and adaptive strategies in the face of climate change. PCRA reports gather local knowledge, scientific data, and community perspectives to assess vulnerabilities, impacts, and adaptation options. By involving diverse stakeholders such as government agencies, NGOs, scientists, and local residents, these reports foster a sense of ownership and shared responsibility in mitigating climate risks. The PCRA report informs the County Climate Change Action Plan (CCCAP). The report aims to achieve the following specific objectives:

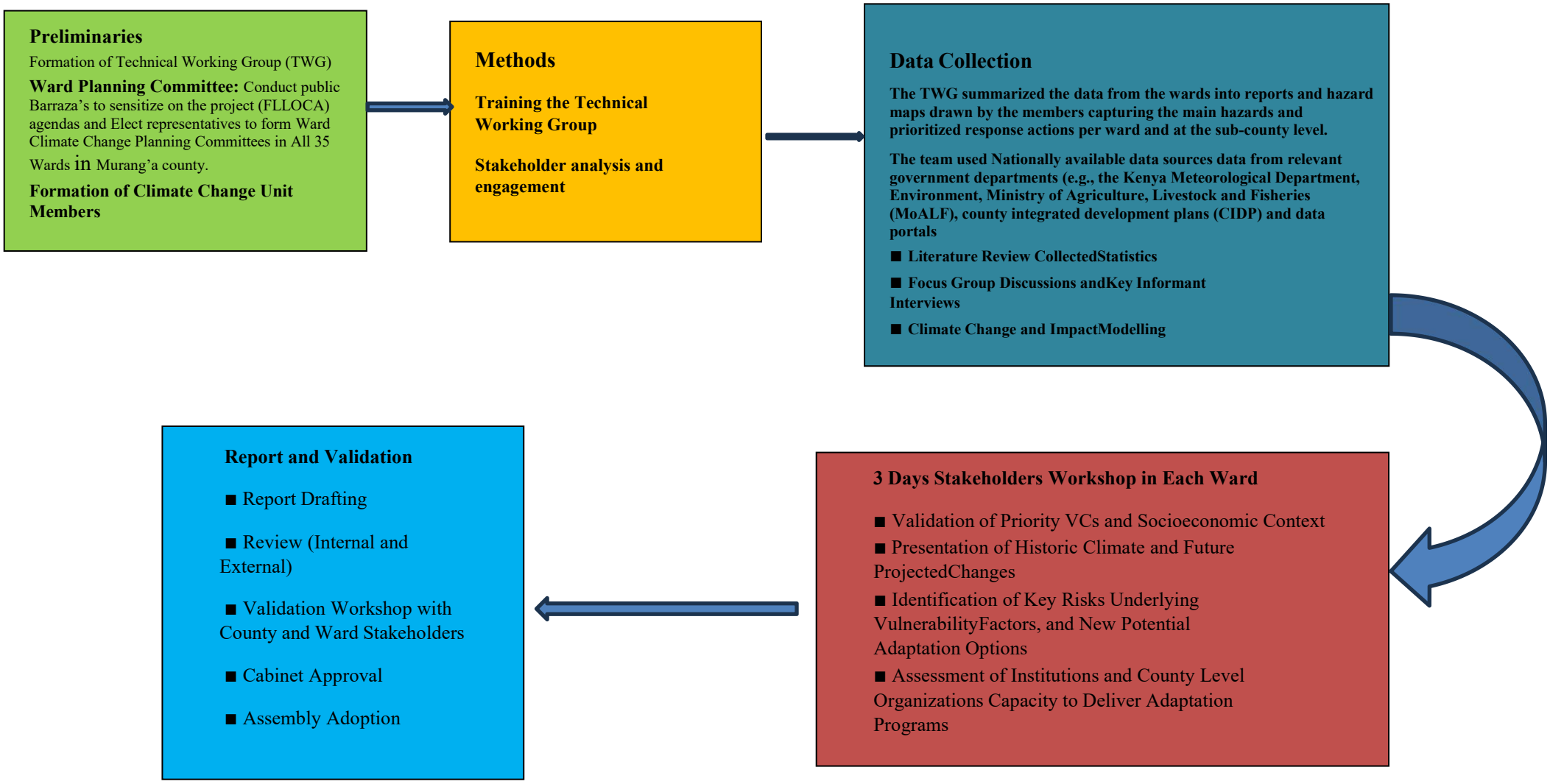
- To provide information about the current climate and possible future climate scenarios,
- To pinpoint climate-related vulnerabilities and risks for major agricultural value chains and specific groups of people involved in agriculture,
- To identify adaptation options that address climate risks and vulnerabilities, and
- To assess the institutional capacity to deliver adaptation programs. This assessment aims to educate governments and stakeholders on climate change-related risks and opportunities.
- This report will help governments and stakeholders integrate climate change perspectives into their development plans.

1.4 Key steps in the county's PCRA process

The FLLoCA County Technical Working Group (CTWG) implemented the (PCRA) assessment through a set of interrelated stages (Figure 2). It first initiated a desk review of the conceptual and analytical context of climate change risks at national and county levels. Efforts were made to involve a wide range of institutions that have past and ongoing work on climate change at national and regional levels. The team used Nationally available data

sources as well as collected data from relevant government departments (e.g., the Kenya Meteorological Department, Environment, Ministry of Agriculture, Livestock and Fisheries (MoALF), county integrated development plans (CIDP) and data portals (e.g., Kenya Population and Housing Census Report, 2019). Data was also collected through focus group discussions, interviews with key informants, climate modelling and three-day-long, Ward Climate Change Planning Committee (WCCPC) and other stakeholder workshops. The final reports were then presented to and validated by County - and Ward-level stakeholders.

Figure 2: Key steps in the county's PCRA process



Find attached link for the attachments of community members among other documents used during PCRA Process in the Annexes

2.0. Murang'a County Climate Hazard Profile

2.1. Current and Historical Climate Hazards and Trends

Murang'a County, located in Kenya, has experienced distinct historical and current climatic trends. Historically, the region has had a tropical highland climate, characterized by mild temperatures and well-distributed rainfall. However, over the past few decades, there have been noticeable shifts in climate patterns. Trends in climate (past, present and future) always need to be understood in the context of the naturally occurring variability. Historical Trends. Murang'a County has two rainy seasons – the long rains and short rains - and experiences a dry season with less than 50 mm of rainfall between December and February. The months of April andMay, which are the long rains, experience the most rainfall, with more than 200 mm per month. Rainfall peaks in the upper highlands and upper midland agro ecological zones. Hazards are mostlyassociated with Direct or indirect effects as a result of changes in either of the following weather conditions over a period of time;

Historical Trends

Table 1 Historical Time lines

YEAR	EVENT	Wards
1944	Drought of Mianga	
1984	Drought of Gathirikari	
1992	Drought	
1998	El-Nino led to Flooding of many River within the County	
2011-2012	Foot and Mouth pandemic and Rift valley fever	
2018	Heavy Rainfall that lead to Flooding of many River in the County	
2020-2022	Prolonged dry periods (Drought)	
2022-2023	Cholera outbreak	

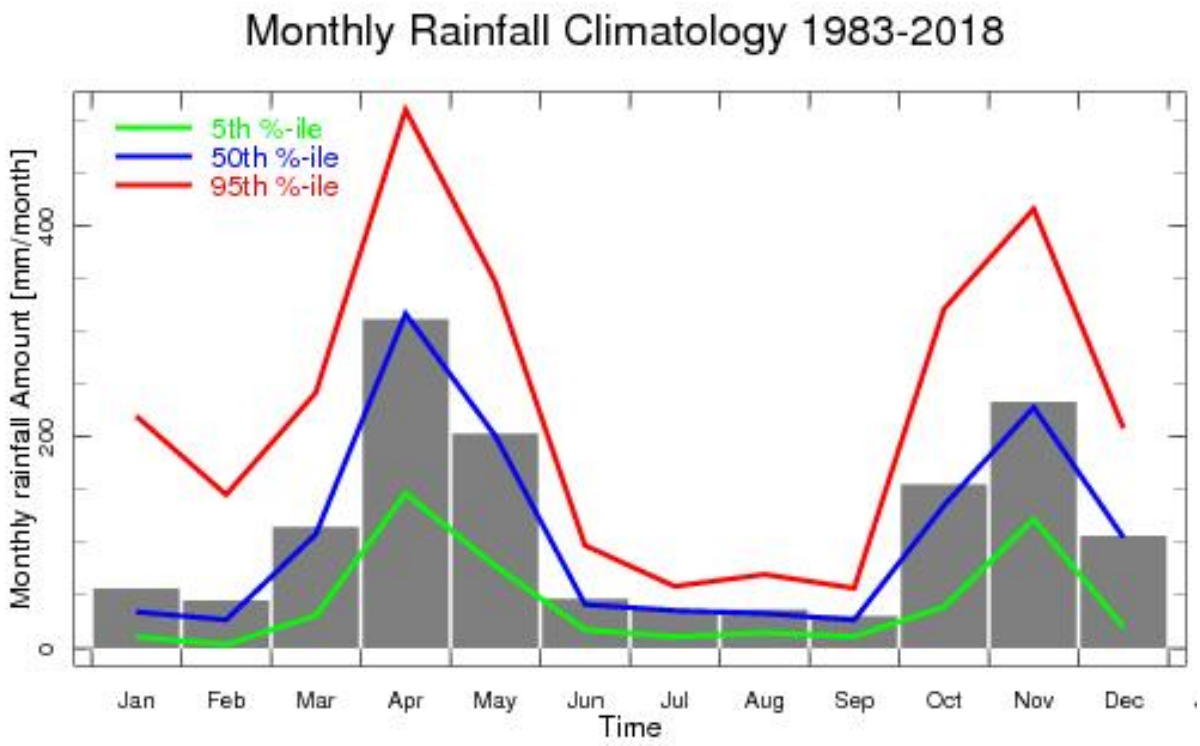


Figure 3: Historical time trend for distribution of rainfall in time from 1983 – 2018

Explanation: From the above historical time series presentations, it is evidenced that rainfall fluctuation has been the norm. Rainfall was high during the long rain seasons (March, April and May). Months of June to September experiencing below normal. Short rain seasons starts from October to December

2.1.1 Current Trends

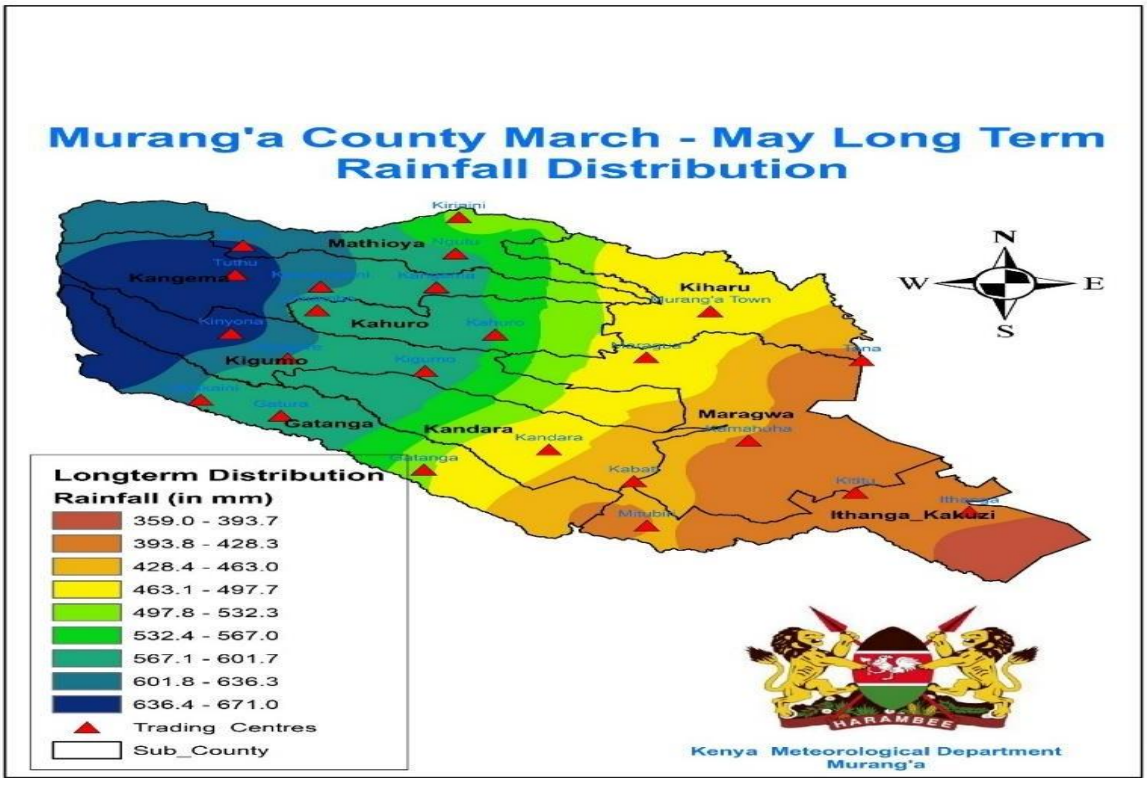


Figure 4: Long-term distribution rainfall in mm

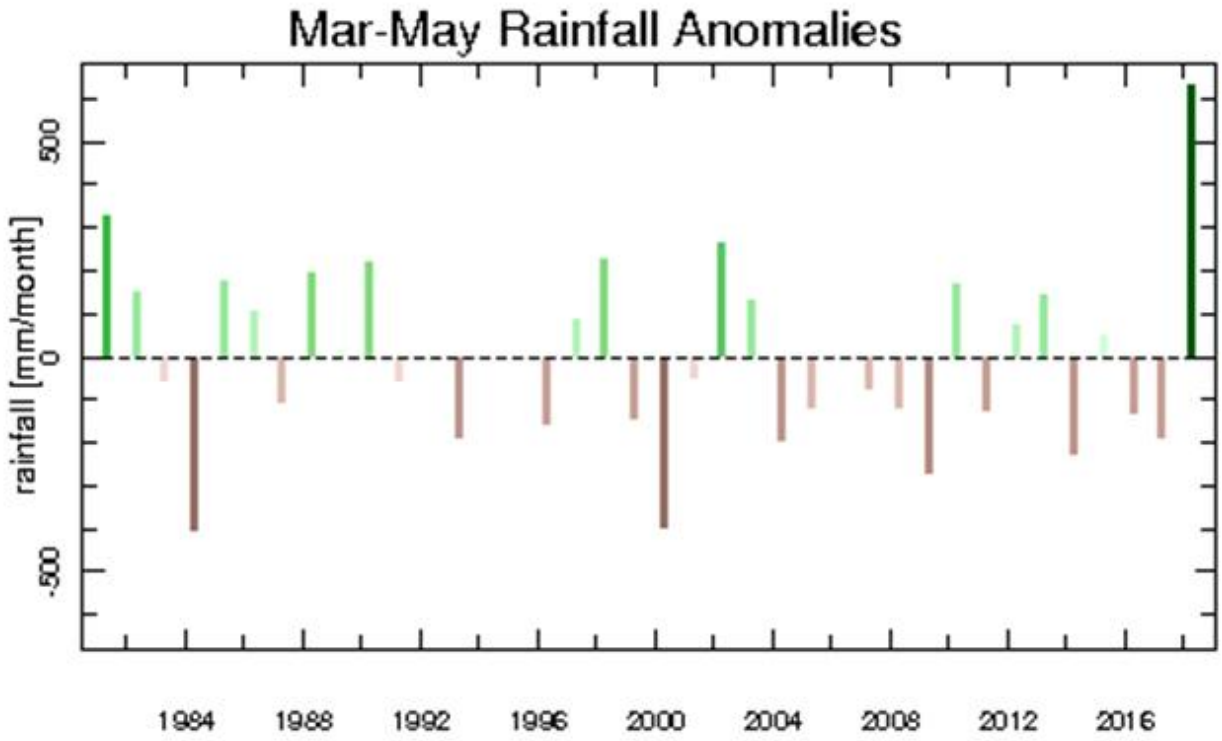


Figure 5: March, April and May Rainfall Anomalies

2.1.2 Future Trends

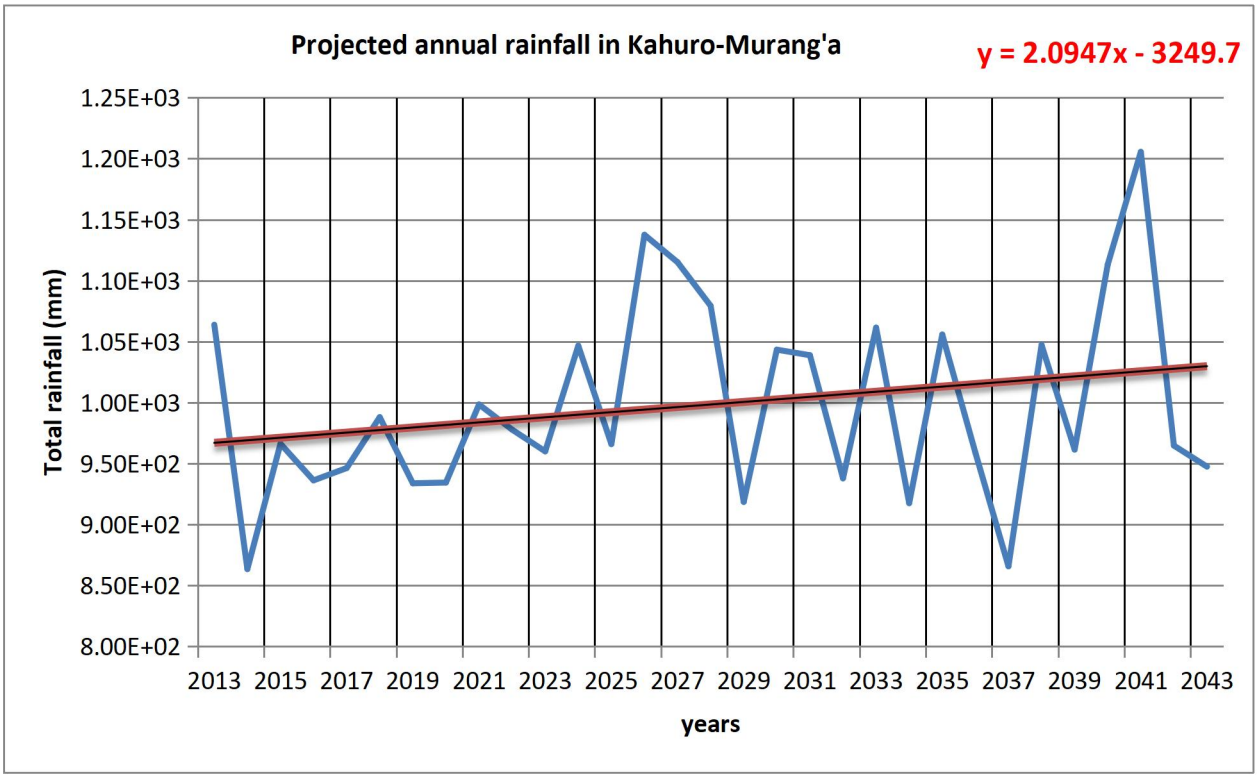


Figure 6: Projected future trends of rainfall in Murang'a County

CLIMATE CHANGE: A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties persisting extended period, typically decades or longer.

2.1.3. Summary

Variability in seasons for Long Rain seasons (May, April and May and October, November and December) depicts inconsistency and interrupted community systems in terms of preparing and planning for the seasons. In view of the historical, current and future trends, the County faces eminent challenges in rainfall distribution and intensity, thus placing the County on the red side of failed rainfall and drought trajectory. The future scenario shall exacerbate other climate hazards and risks such as land and soil degradation, diminishing water levels, heat stress, human/wildlife conflict among others

2.2. Exposure and vulnerability profiles for the county

2.2.1 Risks and Vulnerabilities

In generating this profile, we assessed past trends and future projections of precipitation- and temperature related hazards, such as extreme hydrological events (including flash floods), drought,moisture stress, heat stress, and the start and length of the growing seasons. The growing season was defined as follows: the first season (long rains) is the 100-day wettest period from January to June, while the second season (short rains) is the 100-day wettest period from July to December (KMD, 2020).

We used Representative Concentration Pathway (RCP) 8.5, one of the four-greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. Future climate projections were generated based on an ensemble of multiple CMIP5 models(Taylor et al., 2012), using RCP 8.5 for two future periods: 2030 and 2050.To assess drought and dry spells, we focused on the maximum number of consecutive dry days(CDD) taken as days with rainfall less than 1mm/day (precipitation < 1 mm day-1).

Heat stress was determined by measuring the total number of days with maximum temperatures greater or equal to 35°C (NT35).The start of the growing season was determined by 5 consecutive growing days,while the length of the growing period (LGP) was determined as the total number of growing days. Growing days are those days during a season when average temperatures are greater than or equalto 5°C and precipitation exceeds half the potential evapotranspiration.

For each season, heavy precipitation events were captured with a 5-day running average of rainfall (P5D), indicative of floods, and the 95th percentile of daily precipitation, indicative of extremely high rainfall over a short period of time that can lead to events like flash floods. The 95th percentile of daily precipitation distribution based on the 100 wettest daysper season per year was calculated for each pixel.

To assess the degree to which rainfall and soil moisture levels meet the potential water requirements for agriculture, focus was placed on drought stress, represented by the number of consecutive days in each season where the ratio of actual to potential evapotranspiration (Eta / ETp) is below 0.5. This was calculated for each pixel per season peryear by evaluating soil's water capacity and evapotranspiration to define the number of days that could undergo a level of stress.

EXPOSURE AND VULNERABILITY PRIORITIES OF THE COUNTY

Hazard	Drought		
Sector	Risks	Stressors	Adaptation strategies
Water	✓ Water scarcity ✓ Reduced water levels ✓ Reduced agricultural land	✓ Deforestation and degradation of water catchment areas ✓ Sand harvesting	✓ Capacity building on water harvesting and utilization ✓ Early warning system on drought occurrences
Environment	✓ Biodiversity loss ✓ Reduced forest cover	✓ Little and delayed rainfall ✓ Degradation of forest lands	✓ Early warning systems ✓ Increased the percentage forest cover
Agriculture	✓ Reduced crop yield ✓ Death of livestock	✓ Delayed onset of rainfall ✓ Invasion of pest and diseases ✓ Human wildlife conflicts	✓ Promote adaptation drought tolerant crops ✓ Promoting smart agriculture
Hazard	Flooding		
Sector	Risks	Stressors	Adaptation strategies
Water	✓ Water pollution ✓ Blockage of drainage tunnels	✓ Poor management of solid waste ✓ Degraded water catchment areas	✓ Building gabions ✓ Improve and protect water catchment areas.
Environment	✓ Soil erosion ✓ Land degradation	✓ Reduced on farm forest cover ✓ Deforestation	✓ Increased on farm forest cover. ✓ Rehabilitation of degraded sites
Agriculture	✓ Crop and livestock loss ✓ Post-harvest losses	✓ Land degradation ✓ Poor farming methods	✓ Afforestation and rehabilitation of degraded forest land. ✓ Promotion of smart agriculture
Hazard	Landslide		
Sector	Risks	Stressors	Adaptation strategies
Water	✓ Siltation of water sources ✓ Destruction of infrastructure	✓ Encroachment of riparian land ✓ Reduced on farm forest cover	✓ Rehabilitation of degraded riparian areas. ✓ Water harvesting
Environment	✓ Destruction of properties ✓	✓ Reduced forest cover ✓ Land degradation	✓ Planting trees in areas prone to landslide
Agriculture	✓ Degradation of agricultural	✓ Reduced vegetation cover in the farms	✓ Improving irrigation technology such as use of solar

	land ✓ Reduced crop yield	✓ Deforestation	✓ Capacity building conservation agriculture
Hazard	Irregular seasons		
Sector	Risks	Stressors	Adaptation strategies
Water	✓ Water scarcity ✓ Over extraction of water source	✓ Degradation of riparian land ✓ Poor water management strategies	✓ Rehabilitation of degraded riparian lands ✓ Training farmers on on-farm water harvesting and conservation
Environment	✓ Loss of biodiversity ✓ Reduced forest cover	✓ Deforestation ✓ Delayed onset of rain season	✓ Rehabilitation of degraded forest areas ✓
Agriculture	✓ Low crop yield ✓ Death of livestock	✓ Reduced forest cover ✓ Low adoption of technology	✓ Capacity building of the farmers on fodder conservation during the plenty seasons
Hazard	Strong wind		
Sector	Risks	Stressors	Adaptation strategies
Water	✓		
Environment	✓ Destruction of properties ✓	✓ Reduced forest cover	✓ Enhancing agro-forestry
Agriculture	✓ Destruction of crops and properties ✓ Low crop yield	✓ Reduced on farm forest cover ✓	✓ Capacity building on agro-forestry ✓ Encouraging mixed farming

ASSETS	HAZARDS				
	Flooding	Landslide	Drought	Irregular seasons	Strong wind
Agricultural Land	3	3	3	1	2
Crops (cash and Food crops)	3	3	3	3	3
Livestock (Dairy Cow, Goats, Poultry)	2	2	3	3	3
Infrastructure (roads, bridges, electricity lines, Buildings)	2	2	1	1	1
Human Labour (Men, Women and Youth)	3	2	3	3	2
Professional workers	3	2	3	3	2
Transport and communication	2	1	1	1	1

Table 2 Vulnerability Matrix
(where: 3=Very Vulnerable, 2= Vulnerable, 1= Least Vulnerable)

Vulnerability matrix is used to prepare a risk or vulnerability statement which is then used to prepare the action plan. When floods occur both critical facilities and productive assets are affected.
When droughts occurs it results to livestock deaths and low crop yield causing a huge loss to farmers. The water pans and dams dries up as a results of prolonged drought resulting to water sacristy in the county.
Landslides results in destructions of infrastructure and properties which may some times results to death of livestock and human beings.

2.3 Differentiated impacts of climate trends and risks

Table 3; Impacts of climate trends and Risks

Hazard	Direct Impacts	Indirect Impacts
Flooding	Crop and livestock loss	Reduced Family income,
		Hunger and Malnutrition
	Water pollution	Outbreak of water borne diseases-Cholera
		Salinity of underground water sources-Boreholes and wells

	Heavy/Plentiful yields when combined with high temperatures	Post-harvest losses
		Poor market prices, reduced Family income
	Blockages of Drainage tunnels	Destruction of infrastructure- Bridges, Roads
		Soil Erosion
		Spillages of sewerages in major towns
Landslide/Mudslides	Crops and livestock loss	Decreased income
		hunger
	Soil degradation	Decreased crop production
		High Cost of Production
	Destruction of Infrastructure and properties	Degradation of agricultural land, destruction of infrastructure such as power transmission lines and water supplies, causing economic and social disruptions, displacement of families
Drought (Prolonged Dry spells)	Reduced Agricultural Land/Soil productivity due to reduced moisture	Decreased Crops and Livestock Production
		High cost of food
		Hunger
		Reduced Fodder / dying of Pasture
		Reduced Forests cover

	Reduced Water Levels	Women walk long distance in search of Water (domestic)
		Drying-up of Water (livestock) sources
		Dying up of Wetlands
		Water borne diseases or death of livestock
High Temperatures	Mutation of Pest and Diseases causing vectors	Prevalence of common and new pests and diseases, High cost of Control, Reduced family income,
	Increased Crop production when combined with Heavy rainfall	Post-harvest losses
		Poor market prices of Agricultural commodities
	Reduced Crop and Livestock Production	Hunger
		High cost of food
		Reduced family income
	Reduced labour productivity	Reduced income
Irregular seasons	Untimely planting	Loss of income
Over Quarrying	Landslides and mudslides	Loss of properties, crops and livestock, Death

2.4. Spatial Distribution of Risks

Table 4: Spatial Distribution of Risks

Ecological Zones	Wards	Risks/ Hazards
Upper	**Kiru, Kanyenyaini, Rwathia, Kinyona, Kangari, Ruchu, Kigumo, Kariara,**	**Erratic rains, soil erosion, landslides, Deforestation Extreme cold Reduced Crop and Livestock production, Long Cold seasons**
Middle	**Kamahuha, Gaturi, Mbiri, Township, Wangu, Muguru, Mugoiri, Murarandia, Gitugi, Kamacharia, Muthithi, Kahumbu, Ichagaki, Nginda, ithiru, Gatanga, Kahumbu-ini, Ichagaki, Gaichanjiru, Muruka, Ngararia, Mugumoini**	**Crop pest and diseases Livestock diseases, Flooding, salinity of underground water sources, Human-wildlife conflicts, High temperatures, irregular seasons, Reduced Crops and livestock production,**
Lower	**Ithanga, Kakuzi-Mitumbiri, Kimorori-wempa, Kambiti, Makuyu,**	**Drought, flooding, Human wildlife conflict Crop pest and diseases, high temperatures, Irregular seasons, Reduced Crops and livestock production and Famine**

Refer to the Annex for detailed Table

In focus group discussions, Murang'a County farmers reported intensifying climate change effects;

2.4.1 Reduced crop and livestock production.

The different agro ecological zones of Murang'a County tend to experience different effects. Farmers in the lower midland agro ecological zone, confirm that there is reduced yields due to erratic rainfall patterns and unpredictable planting seasons.

2.4.2. Increased post-harvest pests and diseases

There is increased post-harvest pests and diseases and farmers store their maize and other cereals produced in improvised storage bags to reduce post-harvest losses.

2.4.3. Unpredictable rains

In 2019, they replanted their crops thrice due to unpredictable rains. Traditionally, the long rainy season would start on March 15th and the short rainy season would start on October 15th. In 2019, however, the rainy seasons were delayed. This affected planting calendars and food security.

2.4.4. Invasion Pests and Diseases

Farmers confirm that the resurgence of invasive pests and diseases can be attributed to climate change, especially in the lower midland agro ecological zones.

2.4.5. Water Scarcity and Famine

The farmers also attest that during the peak dry season, between December and February, water scarcity affects their farms and leads to the premature death of some animals. In extreme cases, water scarcity leads to famine. These communities end up depending on relief food during these months.

2.4.6. High Rainfall

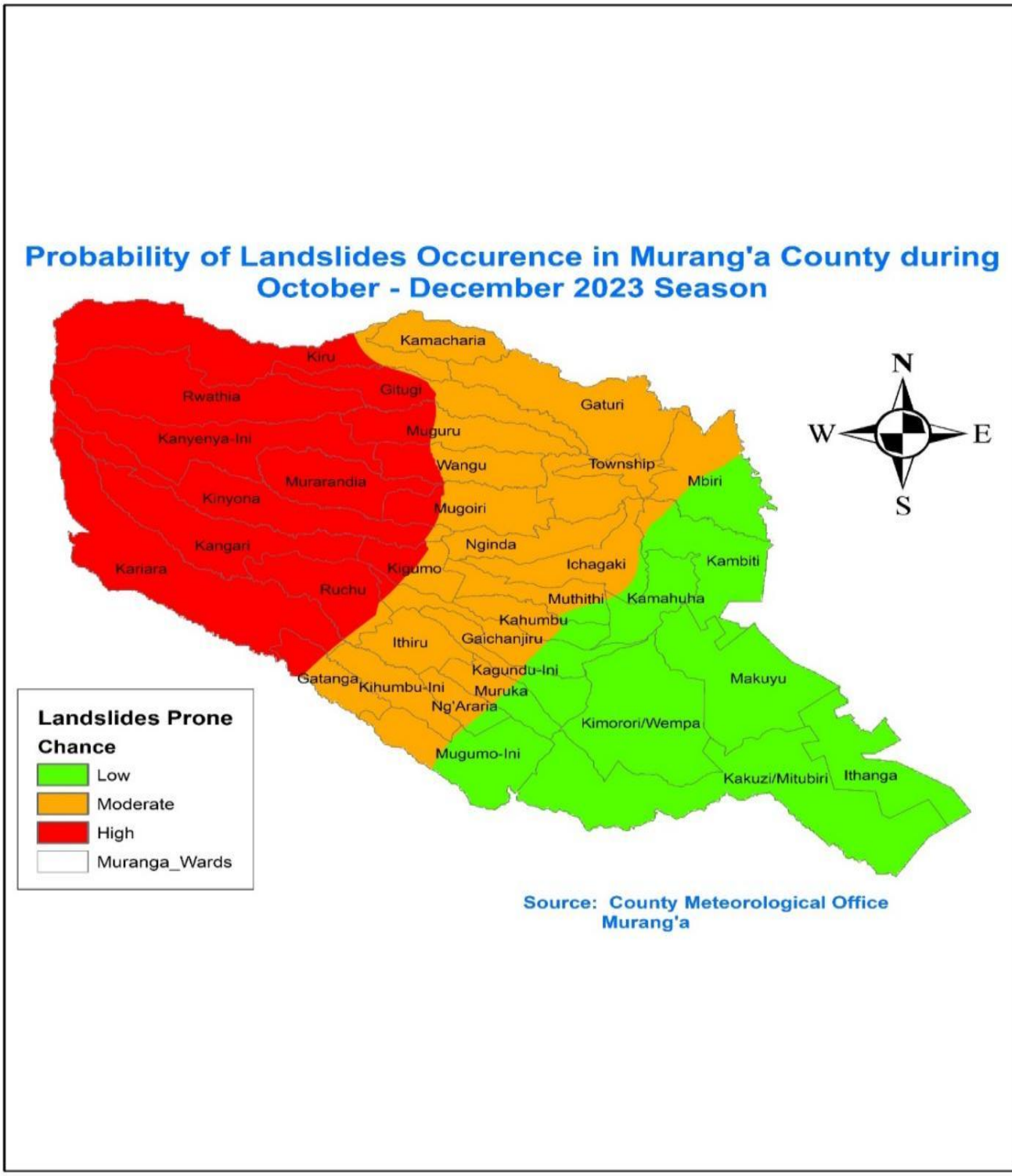
Extreme rainfall is a significant risk for Murang'a county. High rainfall leads to swelling of the rivers Sagana, Mathioya, Saba Saba, Githanja, Mbaro and Maragua. The rainy season has lengthened from 2-3to 4-5 months, which affects the planting calendar.

a) **Landslides** and **Mudslides** are also very common in the upper highlands agro ecological zones.
b) **Farmers have also identified frost** as a main climatic hazard especially in the upper highland agro ecological zones. Frost mostly affects the tea value chain.

Other hazards that the farmers identified include lightning and strong winds in the upper highland and midland agro ecological zones. These hazards mostly affect the banana value chain.

Amazing lady's Cooperative society comprising women involved in the chicken value chain identifies reduced/ low temperatures as a key climatic hazard affecting this value chain. They have therefore incorporated indigenous knowledge to adapt to the climatic hazards. They use jiko to increase the temperature for the chicks' survival and develop housing units using improvised materials such as sacks to ensure that the chicks are warm. Climatic conditions in the upper highlands agro ecologies affect farmers who live in the lower midland agro ecological zones. For instance, excessive rains in the upper highland leads to run-off affecting water bodies (rivers, dams) quality in the lower AEZs. This is a result of sediment load and water pollution. In one instance, the water of Ndakaini dam was polluted. This led to disruption in the city of Nairobi's water supply.

Figure 7: Probability of landslide risks occurrence in Murang'a County.



3.0. Future Climate Scenarios for the county

3.1 National Downscaled Climate Change Projections

3.1.1 Temperature

While temperatures vary across Kenya, a distinct warming trend is evident, particularly since 1960s with inland areas registering larger increase in minimum and maximum temperatures.In Kenya, air temperature is projected to rise by 1.2 to 3.2 degrees Celsius very likely range by 2080 relative to year 1876, depending on the future Green House Gas (GHG) emissions scenario. Compared to pre-industrial levels, median climate model temperature increases over Kenya amount to approximately 1.4 degree Celsius in 2030 and 1.7 degree Celsius in both 2050 and 2080 under the low emissions scenario. Representative Concentration Pathway (RCP) - RCP2.6. under the medium/ high emissions scenario RCP6.0, median climate model temperature increases amount to 1.3 degree Celsius in 2030,1.6 degrees Celsius in 2050 and 2.2 degree Celsius in 2080.

Figure 8: Global IPCC Representative Concentration Pathways for Global and Kenya

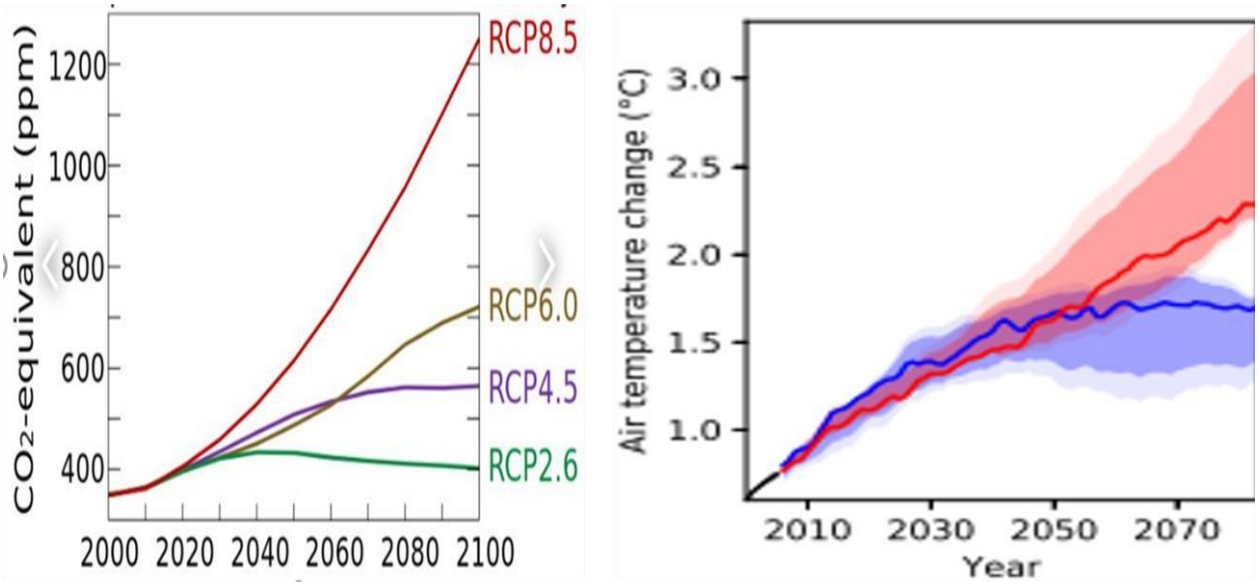
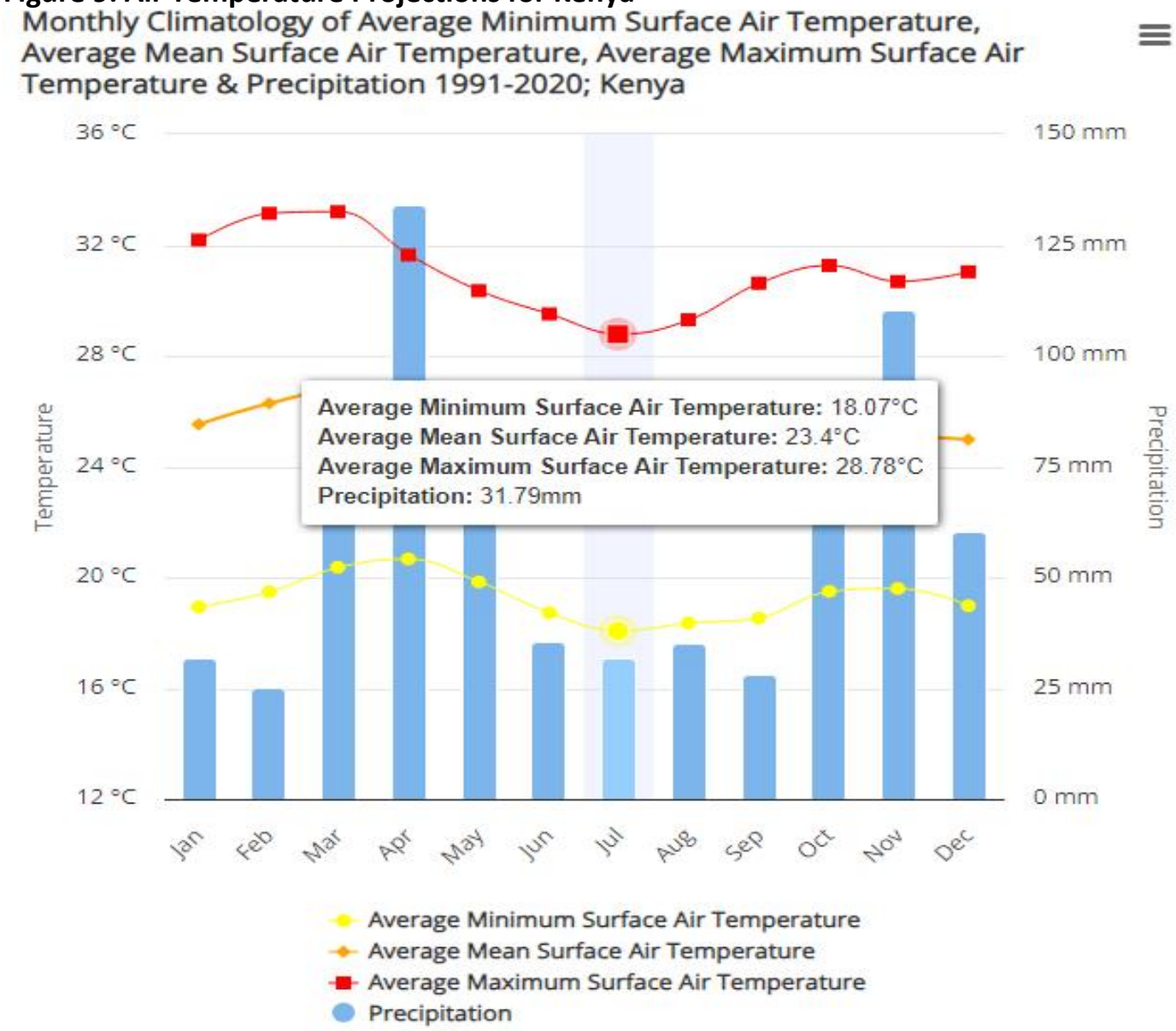


Figure 9: Air Temperature Projections for Kenya



3.1.2 Precipitation

Precipitation trends for Kenya are highly variable, however there is significant geographical diversity in observed rainfall trends. Northern areas have become wetter and southern areas have become drier since 1960s although this has had a high degree of variability. Extreme rainfall events are occurring with greater frequency and intensity. Increased aridity and droughts have also been observed, with moderate drought events recorded on average every three to four years and major droughts every ten years. Since 2000, prolonged droughts have become more common in Kenya.

The future projections of precipitations are less certain than projections of temperature change due to

high natural year-to year variability. There are 3 climate models analysed, one model project no change to a slight decrease in mean annual precipitation over Kenya under RCP6.0, the other two models project an increase under the same scenario. Under RCP2.6, median model projections indicate a slight increase towards the year 2030 but an overall decrease towards the end of the century. Under RCP6.0, the projected precipitation increase is likely to intensify after 2050, reaching 53mm per year at the end of the century compared to year 2000. Higher concentration pathways suggest an overall wetter future for Kenya.

FIGURE 10 AVARAGE PRECIPITATION IN KENYA

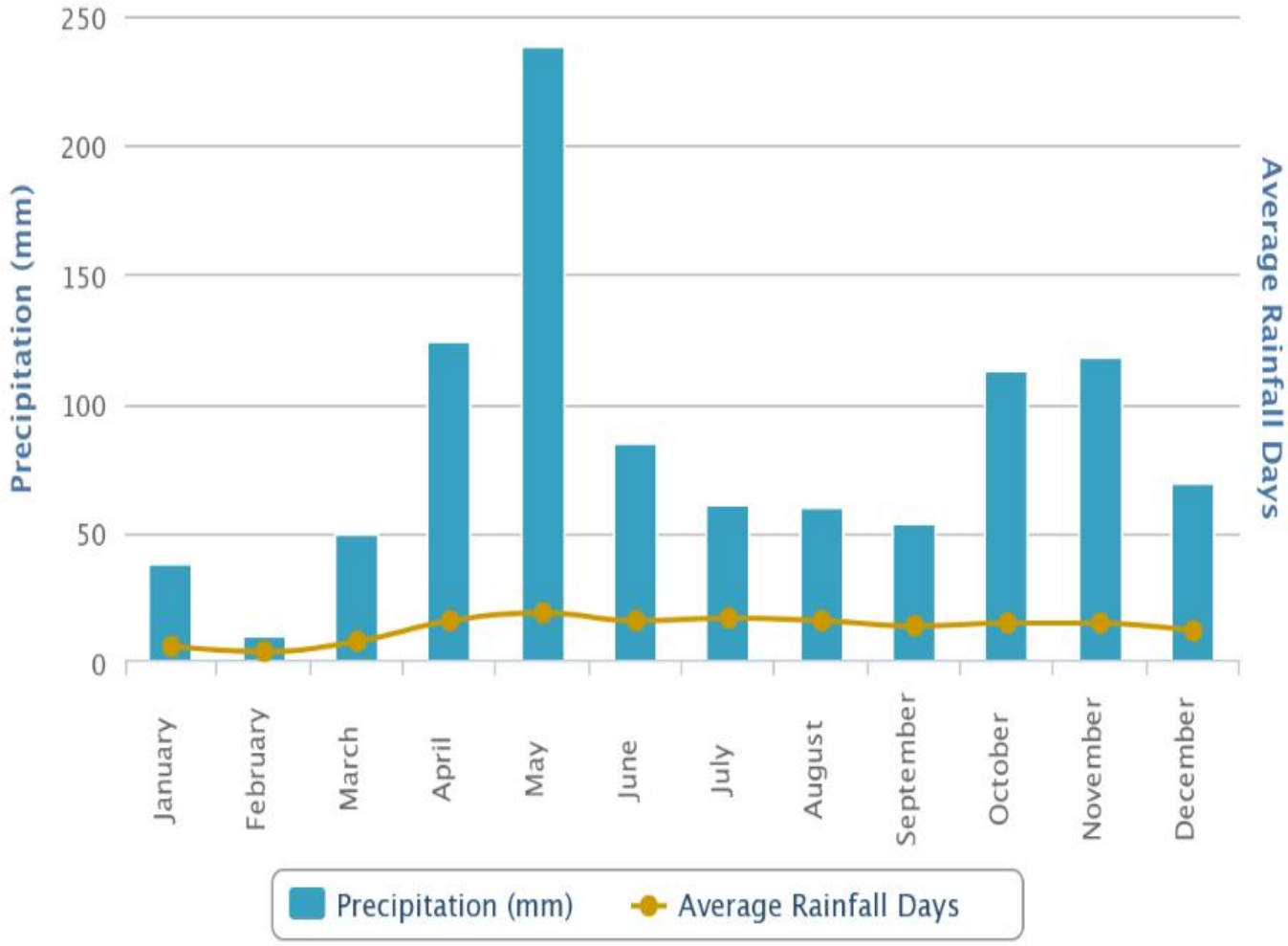
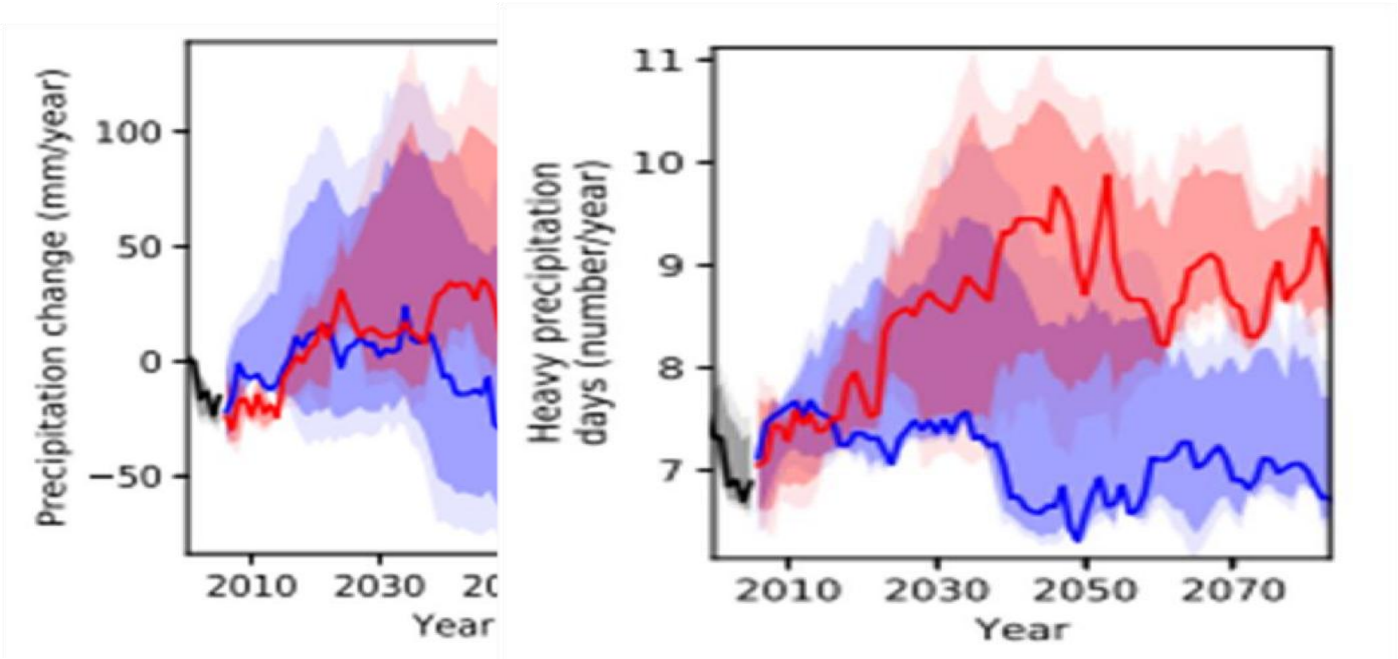


Figure 10: Precipitation Projections for Kenya



3.2 County future climate scenarios

3.2.1 Murang'a County Climate Future Scenarios

The climate risk assessment workshop conducted in Murang'a County unveiled a range of future climate scenarios crucial for understanding regional climate vulnerabilities. Drawing on climate modelling and local expertise, two key scenarios emerged.First, a trajectory of rising temperatures was highlighted, with average annual increases projected at 1.5 to 2.5 degrees Celsius by mid-century. This warming trend poses significant risks to agriculture and water resources.Second, increased variability in rainfall patterns was anticipated, with a higher likelihood of prolonged droughts and more intense rainfall events.

This presents challenges for water management, food security, and flood risk. These scenarios provide a crucial foundation for Murang'a County's climate adaptation and mitigation strategies, enabling proactive planning and resilience-building to safeguard communities and ecosystems against the impending climate challenges.

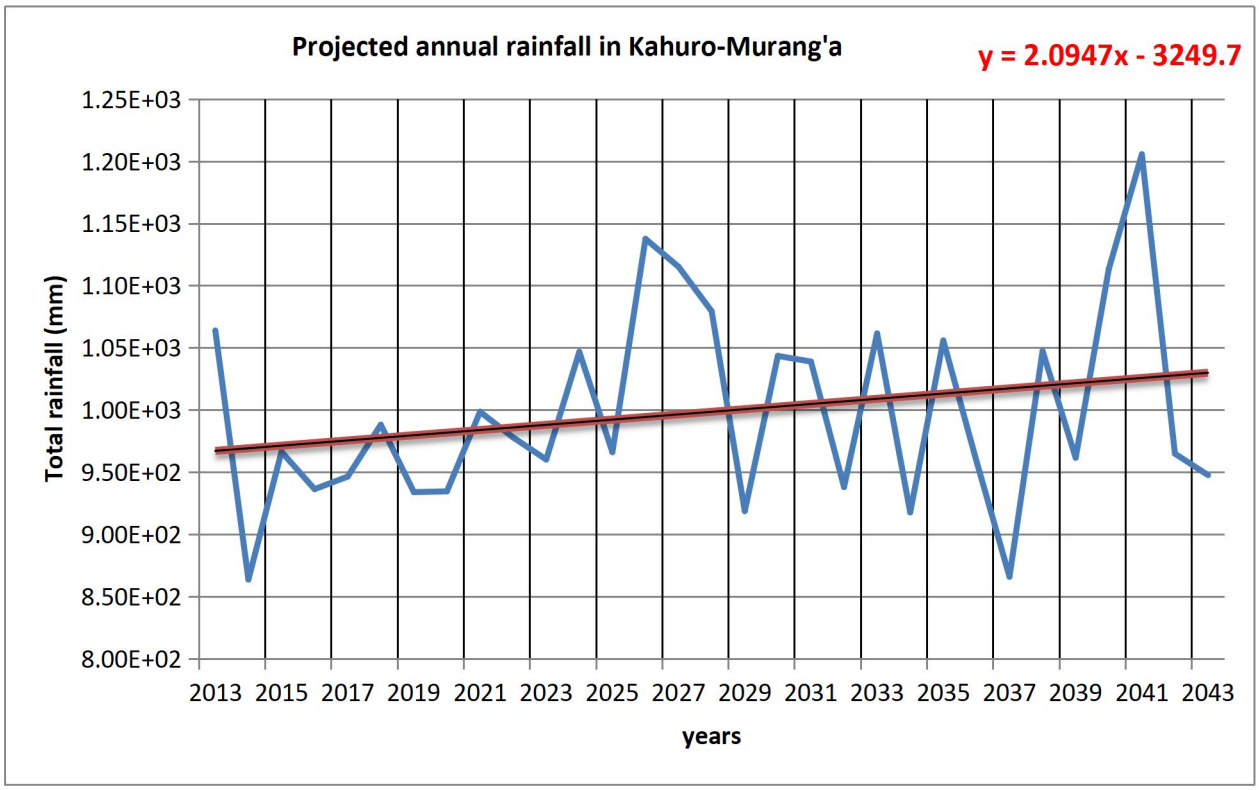


Figure 11: Projected time trend for rainfall distribution in time from 2013 – 2043

county future climate scenarios

Table 6: Murang'a County Climate Future Scenarios

Future Climate Scenario	**Impacts**	**Vulnerable Groups**
Heavy rainfall/ Flooding	Reduced Family income,	Horticultural alongriver valleys
	Hunger and Malnutrition	Rural community
	Outbreak of water borne diseases-Cholera	Urban community
	Salinity of underground water sources-Boreholes and wells	Lower Midland people
	Post-harvest losses	Upper Midland people
	Poor market prices of Agricultural commodities, reduced Family income	Producers
	Destruction of infrastructure-Bridges, Roads	School going children, business community
	Soil Erosion	Farmers

	Spillages of sewerages in major towns	Urban Community
Landslides/Mudslides	Decreased income due to crops and livestock loss	Farmers
	Decreased crop production as a result of soil degradation	Farmers
	High Cost of Production caused by Degradation of agricultural land-soil erosion	Farmers
	Destruction of infrastructure such as power transmission lines and water supplies, causing economic and social disruptions, displacement of families	Upper Midland communities
Drought	Decreased Crops and Livestock Production	Farming Community
	High cost of food	All Categories
	Reduced Fodder / dying of Pasture	Livestock
	Reduced Forests cover	General community
	Women walk long distance in search of Water (domestic)	Women
	Drying-up of Water (livestock) sources	Livestock
	Dying up of Wetlands	General community
	Water borne diseases or death of livestock	Livestock
High Temperatures	Prevalence of common and new pests and diseases, High cost of Control, Reduced family income,	Farmers
	Post-harvest losses	farmers
	Poor market prices of Agricultural commodities	Farmers
	Hunger	All
	High cost of food	General community
	Reduced family income	Farmers
Irregular seasons	Loss of income leading to multiple planting	Farmers
Strong winds	Loss of properties, crops and livestock, Death	General community

4.0. Analysis of Existing Resilience/Adaptation Strategies to Current and Future Climate Risks

During the participatory climate risk assessment in Murang'a County, it was noted that majority of the residents have little/ no knowledge on the effects of climate change. Since there is no improved technologies to help the community adapt to climate change in the county the high potential of the county is yet to be achieved in the agricultural sector and in other sectors. There is need for community capacity building on adaptive measures to climate change.

4.1. Overview of existing adaptation/resilience strategies and their effectiveness to current climate risks

Murang'a County, located in Kenya, faces a range of climate risks, including prolonged droughts, erratic rainfall patterns, and increased temperatures. To address these challenges, various adaptations and resilience strategies have been implemented, albeit with varying degrees of effectiveness.

1. **Rainwater Harvesting:** Many farmers in Murang'a have embraced rainwater harvesting techniques, such as installing rooftop water tanks and constructing earth dams. These initiatives have helped to store water during the rainy season for use during dry spells, improving agricultural resilience.
2. **Crop Diversification:** Traditional crops like maize and beans have been supplemented with drought-resistant crops like sorghum and millet. This diversification enhances food security and reduces vulnerability to climate-induced crop failures.
3. **Agro-forestry:** The county has promoted agro-forestry, encouraging farmers to plant trees alongside their crops. Trees provide shade, reduce soil erosion, and enhance carbon sequestration, contributing to climate adaptation and mitigation.
4. **Irrigation Systems:** Modern irrigation methods, including drip and sprinkler systems, have been introduced to reduce dependency on rain fed agriculture. However, the high cost and limited access to these technologies remain challenges for small-scale farmers.
5. **Community-Based Adaptation:** Local communities have organized themselves into self-help groups and cooperatives to pool resources and knowledge. They engage in collective farming and climate-smart practices, which have proven effective in improving resilience.
6. **Early Warning Systems:** The county has improved its climate forecasting and early warning systems to help farmers anticipate extreme weather events. Timely information allows for better preparation and reduces the impact of disasters. Murang'a has a radio station based in Kangema Town under the department of Kenya Meteorological Department (KMD).

While these adaptations and resilience strategies have made positive contributions to climate risk management in Murang'a County, challenges like limited access to resources, inadequate infrastructure, and capacity constraints continue to hinder their full effectiveness. Additionally, ongoing monitoring and evaluation are crucial to refine and scale up successful initiatives in the face of evolving climate risks. Collaboration between government agencies, NGOs, and local communities is essential to build a more climate-resilient Murang'a County.

4.2. Effectiveness of adaptation/resilience strategies to future climate risks in the County

Table 7: Adaptation/resilience Strategies

S/NO	HAZARDS	LIVELIHOOD/ ECONOMIC SYSTEMS	CLIMATE RESILIENCE STRATEGIES	STAKEHOLDER GROUP APPLYING THE STRATEGY	GENDER AND SOCIAL INCLUSION INFORMATION
1	Drought	farming livestock keeping Apiculture Traders Health	• Water harvesting and storage at household, community and institution level as well and on farms through water and soil conservation structures • Conservation of water catchment areas • Reforestation and afforestation of degraded lands	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs
2	Unpredictable Rainfall	Farmers infrastructure	• Livelihood diversification • Adoption of innovative farming techniques • Strengthen early warning systems and access and use • of Climate Information Services • Use of appropriate certified seeds	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs
3	Low water volumes (rivers, streams, springs and boreholes)	farms domestic chores livestock and wildlife trade Health	• Water harvesting and storage at household, community and institution level as well and on farms through water and soil conservation structures • Conservation of water catchment areas. • Reforestation and	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs

			afforestation of degraded lands		
4	Deforestation and low vegetation cover	farmers livestock and wildlife water quality and quantity	• Reforestation and afforestation of degraded lands • Surveying and gazzetment of county hills • Extension services on forestry programs • Promotion of wood lot or farm forestry • Promotion of energy efficiency programs like energy saving jikos	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs
5	Flooding and Flash floods	farmers trade infrastructure livestock water supply/ availability	• Storm water management structures and improvement of urban drainage systems. • Protection of water banks • Construction of water harvesting infrastructure such as pans	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs
6	Pests, diseases and invasive species	farmers livestock health landscape	• Adoption of disease resistant crop and livestock varieties • Integrated pest management practices	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs
7	Land degradation (ball pits, landslides, gullies among other	farming trade infrastructure water supply or availability	• Sustainable Land Management practices (terracing, construction of gabions), • catchment conservation reforestation and afforestation of degraded lands; and support conservation of communal forest resources • Adoption of Climate Smart Agriculture (CSA) specifically early maturing and drought tolerant crops • Capacity building of the	Community members County and National government CBOs FBOs NGOs	Targets both men, youth, women and PLWDs

			community members on soil • erosion conservation mechanisms		
8	Over- abstraction of water resources	Downstream domestic, livestock and wildlife consumers	• water regulation • community sensitization and awareness creation on sustainable water efficiency • construction of common intakes	Community members County and National government	Targets both men, youth, women and PLWDs

5.0. Murang'a County Climate Strategic Adaptation Investment/Action Priorities

This chapter provides an overview of the County Spatial Development Framework and it outlines key County development priorities, strategies, programmes and projects as identified and prioritized during the public participation Workshops. The chapter further assesses natural resources endowment within the county and analyses County's competitive edge with an aim of strengthening Climate Change Adoptive and Mitigation Strategies. It further provides a summary of the development priorities identified in the sectors from the sectoral plans, the programmes are linked to the Kenya Vision 2030, MTP and National government 'Big Four Agenda', County Transformative Agenda, as well as the Governor's manifesto. The programmes are further formulated to attain the provisions of Article 56 of the Constitution of Kenya 2010 in addition to achieving the aspirations of Sustainable Development Goals (SDGs), African Union Agenda 2063, CAADP and Malabo declaration among others. The implementation of the programmes envisage a green economy that shall be achieved through mainstreaming of cross-cutting issues such as gender, youth and PWDs, disaster risk management, HIV/AIDs as well as climate change and environment degradation

Table 8: County Spatial Development Strategies

Thematic Area	Overview/ Current Status	Policy Strategy	Potential Geographical Areas	Lead Agencies/ Departments
Industrialization	County produces adequate quantities of milk, avocado, Banana, mangoes, horticulture, coffee and tea	Establish a multi-processing unit for milk, avocado, banana, mango and French beans with supporting infrastructures (water, electricity, road network…)	Lower part of Murang'a	Trade, commerce industry and Investment
Infrastructure	The infrastructure development in the county is not adequate to support the current potential capacity of the county production	Establish integrated, efficient, reliable, adequate, accessible, safe, sustainable and environmentally-friendly systems of infrastructure (roads; transport; energy;, training facilities; health; ICT; sewer; sports)	County Wide	Transport; Public Works; Infrastructure
Modernizing Agriculture	The county has rich fertile soil suitable for large scale agricultural activities.	Establish integrated irrigation system in the lower parts of Murang'a	Lower parts of Murang'a	Agriculture; Irrigation
		Establish value addition industry for horticulture crops, milk, bananas (Grading sheds, milk coolers, dispensers)	County Wide	Trade, Industry and Investment; Agriculture; Marketing; Agribusiness

		Agribusiness specialized farm unit at Mariira	Mariira in Kigumo Sub County	Agribusiness Marketing; Trade, Industry and Investment; Agriculture
Tourism	The County has historical sites suitable for tourism attractions. However, the great potential is highly underutilized	Develop strategies for offering diverse tourist products for the respective tourism circuits (Mukurwe Wa Nyagathanga)	Mukurwe Wa Nyagathanga in Kiharu Sub County	Tourism, Forestry, KWS, Marketing,
		Motor vehicle racing at Ndakaini	Ndakaini in Gatanga Sub County	
		Dating clubs and parks	County Wide	
		Beautify major towns to attract visitation (Murang'a, Kenol		
Transportation network	The county has underdeveloped transport network system that hinders free trade activities within and outside the county	Establish an integrated sustainable transport system through enhanced links and connectivity.	County Wide	Roads; Lands; Environment

Table 9: Assessment of natural Resources

Name of Natural Resource	Dependent Sectors	Status, Level of Utilization & Scenarios for future	Opportunities for optimal utilization	Constraints to optimal utilization	Sustainable Management strategies
Murang'a county has several rivers. the major ones are: River Maragua River Mathioya River kayahwe River Irati River chania	Fisheries Tourism Irrigation Agriculture Disaster management Water sector Energy (Wanjii - Mengen) Mining (sand)	The rivers are mainly used for domestic water and rarely for irrigation. There is a lot of pollution emanating from farming, industrialization among others. Deforestation indigenous trees, afforestation of exotic trees in catchment areas for instance blue gum. Lack of conservation of water Forestry activities around the catchment areas Declining water levels – expected to further decline with expansion of horticulture sector Water quality expected to decline due to increased farming activities	Best practices in waste water management and wetland conservation in some farms Construction of dams. Establishment of irrigated farming. Recreational activities.	Water levels declined Water quality deteriorated from horticulture (affecting quality of fish, and quality of tourism). Pollution Deforestation of water catchment areas.	Monitoring of water levels and quality Regulate waste water and effluents from farms Extension services to cover waste water treatment management Nutrient enrichment Conservation of water catchment areas
Quarrying	Housing Roads	Quarry stones for housing and road constructions Quarrying usually leads to land degradation During the rainy seasons they usually experience landslides and consequently deaths. .	Mapping of the quarry sites in the county. Adopting new technologies of mining. E.g. use of modern technology and machines. Making quarry sites accessible.	Environmental degradation. Poor technology. Land ownership.	Rehabilitation of quarry sites. They can be rehabilitated and used as water pans, farming, fish-ponds, touristattraction sites. Formulation of policy to regulate quarrying.

Name of Natural Resource	Dependent Sectors	Status, Level of Utilization & Scenarios for future	Opportunities for optimal utilization	Constraints to optimal utilization	Sustainable Management strategies
Forests (Aberdare forest)	Kenya forest service Agriculture Tourism Wildlife Water Environment Lands	In Murang'a county forests are mainly found in the upper parts of the county. There have been deforestation due to encroachment of forest areas, illegal logging, use of firewood by tea factories ,forest fires.	Formulation and enforcement of policy to safeguard the forests. Establish of man-made forests for logging e.g. Tim sales forestin Nakuru.	Deforestation. Illegal felling of trees, Forest fires.	Formulate policy to curb illegal felling of trees. Establishment of man-made forests. Deployment of more forest wardens. Procurement of fire fighting helicopters. Planting exotic trees to minimize logging of indigenous trees.
Water Springs	Water Environment Kenya forest service	In the county there are a number of springs which can be protected to provide water for domestic and irrigated farming to the surrounding households. Most of them are in dilapidated state.	Springs protection programme county wide. Mapping of all water springs in the county.	Deforestation which leads to drying of springs. Pollution from farming residues	Springs protection. Formulation of policy on springs management.
Wildlife (snakes, monkeys, elephants, velvet monkey	Tourism Kenya wildlife service Agriculture	In Murang'a county they are found in Aberdare range. We usually experience human wildlife conflict.	Establishment of game reserves to enhance tourism local and international.	Destruction of agricultural crops Some pose health hazards to humans.	Construction and maintenance of electrical fence/barriers. Formulation of policy to allow conservation of wildlife. Designating land for wildlife conservation.

Table 10: Development Priorities per department

Environment and Climate Change		
Development needs	**Priorities**	**Strategies**
Environment managementand protection	Proper waste managementmechanisms Prevention of noise and airpollution	Lease/procure waste collection vehicles Mounting of litter bins Construction of refuse chambers Improvement of waste disposal sites Provision of waste collection tools Acquisition of noise meters Development of solid waste laws
Natural Resources Conservation And Management	To increase farm forest cover To rehabilitate degraded sites	Establishment of tree nurseries Procure and distribute tree seedlings Rehabilitation of degraded quarries Water catchment areas protection
Climate change resilience building	Promotion of clean energy Integrate climate change Measures into county policies strategies and planning	Promotion of energy saving jikos Development of climate change laws
environmental education and awareness	Capacity building on environmental issues	Sensitization of the public on environmental issues
Department of Agriculture, Livestock and Fisheries		
Development needs	**Priorities**	**Strategies**
Markets sheds and collection centres	Market developments	Construct markets and grading sheds in all the wards
Basic amenities in markets	Construction of sanitationblocks	Construction of sanitation blocks in all the markets
Roads infrastructure	Grading of all roads leading to the market areas	Upgrade all feeder roads leading to markets
Efficient markets	Easy access to markets	Open up roads in the rural areas
Agro processing, manufacturing and value addition	Agro-processing, manufacturing of farm produce	Establishment of multi product processing units.

Inclusion of youth and womenin agribusiness	Social inclusion	Develop youth and women friendly technologies –e.g. Value addition
Inadequate and unreliable rainfall for crop and fodder production.	Capacity building Water harvesting and Utilization Crops and livestock insurance	Promote drought tolerant/ resistant crops andfodder varieties. Promote crop insurance. Conserve fodder during plenty season
Low soil fertility for crop and fodder production	Soil fertility and aciditymanagement	Promote soil testing and fertility management
Crops and livestock diseaseand pests	Emerging and existing zoonotic diseases of anthrax, rabies and rift valley fever Emerging crop pests and diseases	Adopt the county one health strategy in control of zoonosis Adopt the national rabies eradication strategy Adopt common approach of providing resources for prevention, early detection and response to zoonotic disease Establishment strategic pest and disease control unit
Inadequate pre and post harvest management and value addition investments.	Low adoption of newtechnologies Inadequate information Youth involvement	Promote and support of value addition initiatives. Promote on-farm and off farm storage and transport facilities Create awareness on pre and post-harvest losses and management. Promote Cottage industries
Water and irrigation		
Development needs	**Priorities**	**Strategies**
Inadequate and unreliable rainfall for crop and fodder production.	Irrigation infrastructure Capacity building Water harvesting	Invest in irrigation schemes/infrastructure Train farmers on on-farm water harvesting and efficient utilization technologies.

Increased access to irrigation water Flood control Building farmers capacity on water use and management Establish water user'sassociation Enhancing compliance with Environmental, statutory and legal requirement To improve irrigation technology Climate change mitigation	- Feasibility studies to determine the technical andsocio-economic viability of projects. - Project planning anddesign. - Implementation, operationalization and management of irrigationschemes.	- Development of water harvesting and storage infrastructure for irrigation. - Infield irrigation water management. - Rehabilitating and upgrading existing under-utilized irrigation systems. - Enhancing farmer education and awareness, and improving communication and information flow. - Mitigating effects of climate change by harnessing agricultural water resources and storage infrastructure to reduce flood and drought disasters, and environmental damage arising from climatic variations. - Establishment and Legalization of Irrigation Water Users' Associations (IWUAs) - Improving irrigation technology such as the use of solar energy and other renewable energy in pumping. - Enhancing Public-Private Partnerships by encouraging private sector players to invest and participate in irrigation. - Strengthening stakeholder participation in all irrigation projects and initiatives. - Enhancing compliance with environmental, statutory and legal requirements - Gender equity and involvement of youth in irrigation development and management.
Water, security and sanitation	Avail piped clean and safewater in the market Centres, lighting	Connect all markets with clean water.
Education, Youth, Sports, Culture, and Social Services		
Development needs	**Priorities**	**Strategies**
Promotion of sports among youths	Infrastructure Development	Rehabilitation and Construction of Sports Stadia

ECD lunch programme	Nutritional improvement	Improve and develop 4K-Clubs in schools- multi-storey kitchen gardens
Health		
Development needs	**Priorities**	**Strategies**
Incidence and re-emergence of diseases	Strengthen preventive and promote health services through; malaria control; expanded programs on immunization; integrated management of childhood illness; control and prevention of environmenttally related communicable diseases and encouraging improved nutrition	Implement preventive, curative and rehabilitative services through partners and MCG. • enhance school health program • Pests and vector control • Eradicate OD • Provision of mosquito nets • Encourage health education-through campaigns • Hold world health days • Buildings inspection and certification • Examination and licensing of food handlers • Surveillance of diseases targeted for eradication and elimination. • Treatment of water at household level • Protection of minor water sources • Mainstreaming gender, Disability equity and inclusion
Cooperative development sub sector		
Development needs	**Priorities**	**Strategies**
Cooperative societies	Access to markets-milk, coffee, tea, avocados, French beans, mangoes, bananas	Strengthening existing cooperatives, governance, formation of business model, reviving coffee societies to provide value added products
Land, Housing and Urban Development		
Development needs	**Priorities**	**Strategies**

Solid waste management clean and conducive environment Inadequate sanitation facilities e.g. public toilets, waste receptors, waste disposal sites Liquid waste management Poor and/or non-existent Drainage system	Sustainable solid and liquid waste disposal mechanism Storm water drainage in major towns and market centres	Establishment of designated landfills and dump sites and disposal sites Establish solid waste collection and segregation mechanism Designate waste collection sites Construct public pay toilets Establishment of funding and building liquid waste treatment plants. Mapping of drainage system Design and construct open drainage systems
Lack of recreational facilities and other open spaces/aesthetics	Zoning of parks, open spaces and play fields Establish urban parks Beautification of open spaces	Design and maintenance of urban parks Maintenance of all public facilities and make them self-sustaining
Substandard dilapidated housing structures for poor population (10,000 households)	Rural Housing program	Introduce use of ABT and support Housing construction
Roads, Transport, Energy, and Public Works		
Development needs	**Priorities**	**Strategies**
Impassable roads.	Upgrading of Impassable roads	Opening of access roads. Grading of access of roads. Gravelling of access roads. Tarmacking of access roads.
Inadequate Security.	Rehabilitation of existing and installation of new security lights	Installation of Floodlights. Installation of Street lighting.
Low Electricity Connectivity	Increase connectivity.	Supply & Installation of Transformers. Lowering of connectivity cost.
Poor road Connectivity	Improve Connectivity	Construction & Rehabilitation of footbridges & bridges.

Poor Drainage of roads & urban areas.	Improve drainage	Excavation of Drains De silting of drains & Culverts Storm water management in urban areas
Poor Road safety.	Improve of roads safety	Construction of N.M.T facility. Installation of road bumps. Zebra crossings. Construction of bus parks. Training of road users on road safety i.e. Boda-boda operators

Table 11: County Climate Strategic Adaptation Action Priorities

No	Projects/Programs Description	Area Of Coverage	Estimated Cost Ksh.
Water, Irrigation, Environment and Natural Resources			
1.	Purchase of office equipment, inter-sectoral management meeting, reporting, Conferencing and other official activities	Administration Services Improved service delivery	10,000,000
2.	Capacity building and provision of inputs for tree nursery establishment and management to self-help groups, irrigation CBOs and CFA's	Countywide	4,800,000
3.	Agro-forestry and wood lot establishment at house hold level (capacity building and distribution of tree seedlings (Mukau-Melia Volkensii)	Countywide	3,000,000

4.	Clean energy adoption (training and financial support to local fabricators/artisans) for mass energy jikos fabrication and distribution	Countywide	10,000,000
5.	Sand harvesting control (check dams construction, river bank protection and capacity building)	Lower Murang'a	35,000,000
6.	Climate information services enhancement –participatory scenario planning at ward level and county level for the two seasons (OND and MAM)	Countywide	2,000,000
7.	Excavation of new earth dams and installation on of solar pumping and piping system	Middle and lower Murang'a	70,000,000
8.	desilting and rehabilitation of existing earth dams and installation of solar pumping and piping system	Desilting existing dams in Lower Murang'a Wards; Ithanga, Kakuzi-mitumbiri, Kimorori-wempa	350,000,000
9.	Conduct water supply and demand analysis under various hydrologic conditions and estimate scenarios		5,000,000
10.	Review and modify, as appropriate, management processes of existing water supply systems and users to consider potential impacts of climate change.	Countywide	3,500,000
11.	Implement water harvesting technologies	Countywide	20,000,000
12.	Implement the Clean Water Act and the County Septate and Sewerage program (Enhancing compliance with environmental, statutory and legal requirements)	Policy Formulation	3,000,000
13.	Improve sanitation infrastructures.-public utilities	Murang'a County Town centres	5,000,000
14.	Increase safe water coverage in waterless Wards Centres. (Rehabilitating and upgrading existing under-utilized irrigation systems)	Lower Murang'a	35,000,000
15.	Implement time-limited groundwater abstraction licenses to provide flexibility to respond to extreme climate conditions. (Drilling boreholes for use in dry seasons)	Countywide	350,000,000

16.	Conduct water supply and demand analysis under various hydrologic conditions and estimate scenarios	Countywide	7,000,000
17.	Review and modify, as appropriate, management processes of existing water supply systems and users to consider potential impacts of climate change.	Countywide	2,000,000
Agriculture, Livestock, and Fisheries			
18.	Promote adaptation of drought tolerantcrops and fodder varieties.	Lower Murang'a – Ithanga, Kimorori-wempa, Kakuzi-Mitumbiri, Kambiti, Makuyu, kahumbu, Kihumbu-ini, Nginda, Ichagaki, Mugoiri, Wangu, Mbiri and Muguru, Njumbi	35,000,000
19.	Capacity building Water harvesting and Utilization		10,000,000
20.	Promote Crops and livestock insurance	Countywide	1,000,000
21.	Capacity building fodder Conservation during plenty season	Capacity building, procurement and installation of	17,500,000
22.	Train farmers on on-farm water harvesting and efficient utilization technologies. And Domos		17,500,000
23.	Establish 10 Fish pond units Combined with Local chickens	UM 3&4 zones	70,000,000
24.	Establish field schools to demonstrate best adaptation practices in agriculture, Livestock and fisheries,	Capacity building and Demonstrations	3,500,000
25.	Integrate CC in formal and non-formal or customized training programs on agriculture and fisheries		5,000,000
26.	Conduct training on adaptation and disaster risk reduction for farming communities;		3,500,000
27.	Integrate and harmonize in County Agriculture, Livestock and fisheries policies and plans, including the CIDP		35,000,000
28.	Scale up implementation of best practices-eg. Conservation Agriculture Demos,		35,000,000
29.	Monitor and evaluate implementation of CCAP in Agriculture		3,500,000

30.	Build the capacity of farming and fishing communities on adaptation and DRR		1,000,000
31.	Integrate CCA and DRR in agriculture and fishery curricula and training program		2,000,000
Public Health and Sanitation			
32.	**Implement community based public health surveillance system for CC-sensitive diseases.**	Countywide	**3,500,000**
33.	**Improve system for health emergency preparedness and response for climate and disaster risks.**	Countywide	**17,500,000**
34.	**Improve system for post-disaster health management**	Countywide	**3,500,000**
35.	**Implement preventive, curative and rehabilitative services through partners and MCG**	Countywide	**5,000,000**
36.	**enhance school health Program-Sanitation**	Countywide	**3,500,000**
37.	**Pests and vector control**	Countywide	**700,000**
38.	**Hold world health days**	Countywide	**700,000**
39.	**Surveillance of diseases targeted for eradiation and elimination**	Countywide	**350,000**
40.	**Promote water treatment at household level**	Countywide	**350,000**
41.	**Protection of major water sources**	Countywide	**350,000**
42.	**Promote Mainstreaming gender, Disability equity and inclusion**	Countywide	**700,000**
Education, youth, Gender, culture, and Social Services			
43.	**Establish network on CC resources in all regions**	Countywide	**7,000,000**
44.	**Develop and implement gendered and accessible CC adaptation and mitigation special or customized technical training programs (Inter-Sectoral)**	Countywide	**3,500,000**
45.	**Improve and develop 4K-Clubs in schools-multi-storey kitchen gardens for ECD**	Countywide	**3,500,000**
46.	**Capacity Build teachers, learners and parents on kitchen gardening**	Countywide	**7,000,000**
47.	**Procurement of Demo Materials**	Countywide	**5,000,000**
Co-operative development			

48.	Strengthening existing cooperatives, capacity build in leadership, governance, and formation of business models.	Countywide	7,,000,000
49.	Formation of one ward one marketing co-operative for the best performing Value Chains. (enterprises)	Countywide	3,500,000
Lands Housing and Urban development			
50.	**Establishment of County Stakeholders Forum** to address (solid waste collection and segregation mechanism, Designate waste collection sites, Construct public pay toilets)	Murang'a town Centres	**10,000,000**
51.	**Mapping of drainage system, Design and excavate and construct open drainage Tunnels**	Murang'a town Centres	**17,500,000**
Roads Transport, and public Works			
52.	Opening of access roads. Grading of access of roads. Gravelling of access roads.	Countywide	**10,000,000**
53.	Construction & Rehabilitation of footbridges & bridges.	Countywide	**15,000,000**
54.	Excavation of Drains Desilting of drains & Culverts Storm water management in urban areas	Countywide	**7,000,000**

6.0. Conclusion

The participatory climate risk assessment report for Murang'a County underscores the critical importance of local engagement and collaboration in understanding and addressing climate-related challenges. Through an inclusive and community-driven approach, we have gained valuable insights into the unique vulnerabilities and adaptation opportunities within the county.

Our findings reveal that Murang'a County faces multifaceted climate risks, including erratic rainfall patterns, prolonged droughts, and increased temperatures, all of which pose substantial threats to agriculture, water resources, and overall livelihoods. However, the participatory process has also illuminated the resilience, resourcefulness, and collective spirit of the local communities in Murang'a, who are actively seeking solutions to these challenges.

To mitigate these risks and capitalize on adaptation strategies, it is imperative that stakeholders at all levels, from local government to international organizations, prioritize sustainable land management, water resource conservation, climate-resilient agriculture, and community-based early warning systems. Additionally, empowering local communities with the knowledge and resources needed to implement adaptive measures is paramount.

In the face of climate change, this report serves as a call to action for concerted efforts to safeguard the well-being of Murang'a County's residents and its ecosystems. Collaboration, innovation, and a commitment to community-led solutions will be key in building a more resilient and sustainable future for this region

References

1. Climate Change Act (2016)

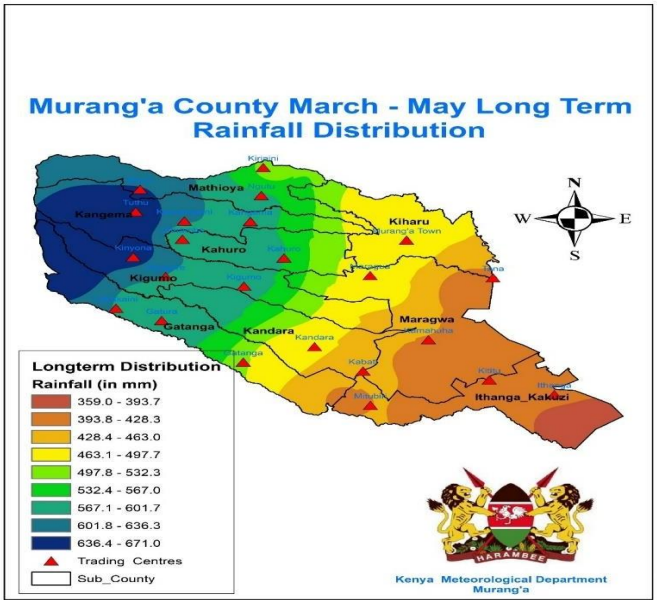
2. Kenya's Nationally Determined Contribution (2016)

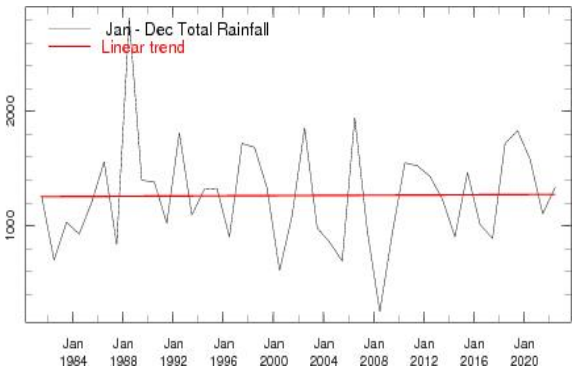
3. National Adaptation Plan (NAP) 2015-2030

4. National Climate Change Action Plan (NCCAP 2013). 6. Second National Climate Change ActionPlan (NCCAP 2018-2022)

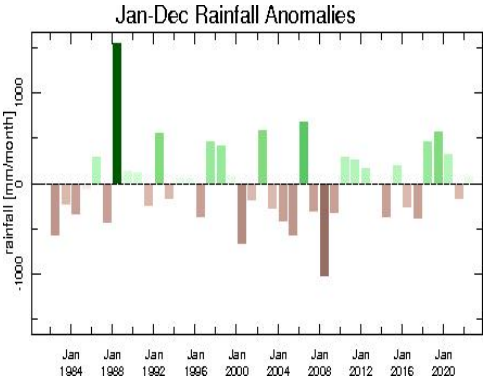
5. Kenya's Updated National Determined Contribution (2020)

Annexes





Annual Distribution Gaichanjiru ward and



Annual rainfall anomalies Gaichanjiru Ward

A link with PCRA Process photos

https://drive.google.com/drive/u/1/folders/1SWc8YQyNAUYYPVsV5sWvmDawLxGSIgZu

HAZARDS IN MURANG'A COUNTY AS PER WARDS		
HAZARD	RISKS	WARD
Flooding	✓ Land degradation ✓ Low harvests ✓ Water-borne diseases	1. RWATHIA
Prolonged Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	2. Kanyenya-ini
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation ✓ Displacement of people	3. Mbiri
Droughts	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Land slides	✓ Land degradation ✓ Low crop yield	4. Gaturi
Droughts	✓ Human wildlife conflicts ✓ Water scarcity ✓ Death of livestock ✓ Low income	

Flooding	✓ Displacement of people ✓ Pest and diseases ✓ Low crop yield	
Drought	✓ Human wildlife conflicts ✓ Crops failure ✓ Low income to the business community	5. Township
Landslides	✓ Displacement of people ✓ Destruction of properties	
Flooding	✓ Displacement of people ✓ Pest and diseases ✓ Low crop yield	6. Kiru
Prolonged drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Landslides	✓ Destruction of properties ✓ Land degradation	7. Kamacharia
Soil erosion	✓ Land degradation ✓ Low crop yield	
Quarry activities	✓ Land degradation ✓ Reduced forest cover	
Land slides	✓ Land degradation ✓ Destruction of properties	8. Gitugi
Soil erosion	✓ Land degradation ✓ Low crop yield	
quarry activities	✓ Land degradation ✓ Reduced forest cover	
Flooding	✓ Displacement of people ✓ Pest and diseases ✓ Low crop yield	9. Kihumbu-ini

Land slides	✓ Land degradation ✓ Low crop yield	
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Drought	✓ Pest and diseases ✓ Low crop yield ✓ Scarcity of water	10. Mugumo-ini
Flooding	✓ Displacement of people ✓ Land degradation ✓ Soil erosion	
Flooding	✓ Displacement of people ✓ Land degradation ✓ Soil erosion	11. Kariara
Drought	✓ Resource based conflicts ✓ Low crop yield ✓ Famine	
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	12. Gatanga
Soil erosion	✓ Land degradation ✓ Low crop yield	
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation ✓ Displacement of people	13. Kambiti
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
quarry activities	✓ Land degradation ✓ Reduced forest cover	14. Kimorori
Droughts	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	

Flooding	✓ Destruction of properties ✓ Human wildlife conflict	15. Kakuzi
Soil infection	✓ Land degradation ✓ Low crop yield	
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Drought	✓ Destruction of properties ✓ Human wildlife conflict	16. Ithanga
Soil degradation	✓ Land degradation ✓ Low crop yield	
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	17. Kangari
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Prolonged Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings	18. Kigumo

	✓ Low crop yield	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	
Landslides	✓ Land degradation ✓ Destruction of properties ✓ Low crop yield	19. Muthithi
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation	
Flooding	✓ Human wildlife conflicts ✓ Pest and diseases	20. Kinyona
Landslide	✓ Land degradation ✓ Low Crop yield	
Flooding	✓ Soil erosion ✓ Reduced water quality ✓ Human and wildlife conflicts ✓ Disease outbreaks	21. Kahumbu
Poor drainage	✓ Soil erosion ✓ Land degradation ✓ Diseases both for human beings and livestock	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	22. Murarandia
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Flooding	✓ Land degradation ✓ Low harvests ✓ Water-borne diseases	23. Wangu

Prolonged Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Land slides	✓ Reduced forest cover ✓ Land degradation	24. Mugoiri
Soil erosion	✓ Land degradation ✓ Low crop yield ✓ Reduced forest cover	
Flooding	✓ Land degradation ✓ Low crop yield ✓ Displacement of people	25. Kagundu-ini
Pest and diseases	✓ Reduced income ✓ Low crop yield ✓ Famine	
Prolonged Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	26. Ithiru
Land slides	✓ Reduced forest cover ✓ Land degradation	
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	27. Gaichanjiru
Drought	✓ Reduced forest cover ✓ Low crop yield	
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation	
Soil erosion	✓ Land degradation ✓ Low crop yield	28. Ngararia

Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation ✓ Displacement of people	
Drought	✓ Low crop yield ✓ Water scarcity ✓ Human wildlife conflict	
Land slides	✓ Reduced forest cover ✓ Land degradation	29. Muruka
Soil erosion	✓ Land degradation ✓ Low crop yield ✓ Reduced forest cover	
Landslides	✓ Destruction of properties ✓ Land degradation	30. Ruchu
Soil erosion	✓ Land degradation ✓ Low crop yield	
Flooding	✓ Pest and diseases ✓ Land degradation ✓ Reduced crop yield	31. Makuyu
Drought	✓ Loss of pastures ✓ Crop failure ✓ Human wildlife conflict ✓ Drying up of rivers ✓	
Drought	✓ Reduced forest cover ✓ Low crop yield	32. Kamahuha
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation	
Soil erosion	✓ Land degradation ✓ Low crop yield	
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation	33. Ichagaki

Landslides	✓ Destruction of properties ✓ Land degradation	
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Landslides	✓ Destruction of properties ✓ Land degradation	34. Nginda
Drought	✓ Human wildlife conflicts ✓ Pest and diseases invasion both for animal and human beings ✓ Low crop yield	
Flooding	✓ Pest and diseases both for human being and livestock ✓ Land degradation ✓ Displacement of people	35. Muguru
Landslide	✓ Destruction of properties ✓ Low crop yield ✓ Diseases ✓ Low income	