COUNTY GOVERNMENT OF NYERI

Ndiambaga Na Igua

NYERI COUNTY

PARTICIPATORY CLIMATE RISK ASSESSMENT REPORT.

MAY, 2023

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FREDRICK KINYUA

CECM WATER, IRRIGATION, ENVIRONMENT & CLIMATE CHANGE

NYERI COUNTY

ACRONYMS

ASDSP: Agricultural Sector Development Support Programme

BAU: Business As usual

CFA: Community Forest Association

CCRI: County Climate Resilience Investment

CECM: County Executive Committee Member

CIS: Climate Information Systems

CSA: Climate Smart Agriculture

CMIP5: Coupled Model Intercomparison Project 5

CIDP: County Integrated Development Plan

CHV: Community Health Volunteers

EMCA: Environmental Management and Coordination Act

FLLoCA: Financing Locally-Led Climate Action

GCM: General Climate Model

KHIS: Kenya Health Information Systems

KIHBS: Kenya Integrated Household Budget Survey

KMD: Kenya Meteorological Department

MAM: March April May

NDMA: National Disaster Management Authority

OND: October November December

RCM: Regional Climate Model

RCP: Representative Concentration Pathways

TWG: Technical Working Group

PCRA: Participatory Climate Risk Assessment

WRUA: Water Resources Users Association

EXECUTIVE SUMMARY

The Nyeri County Participatory Climate Change Risk Assessment (PCRA) was carried out between April and May 2023. The objective of PCRA is to guide the county to identify climate risks and hazards with their associated impacts within Nyeri County in order to inform the climate change action planning. The PCRA report documents prevalent climate risks, sources of vulnerability, current resilience strategies and the prioritized adaptation response actions.

The process of developing the PCRA involved: Formation and training of the Technical Working Group, stakeholder's analysis and mapping, community engagements at ward level, multi-stakeholder workshop, data analysis and drafting of the report.

The assessment revealed that about most of the residents of Nyeri primarily depend on low-input rain fed agriculture. With the frequent changes in rainfall patterns, most households that depend on agriculture are exposed to the impacts of climate change. Furthermore, women are the highest portion of laborers in the agricultural sector (60% household and 40% hired) (ASDSP, 2014) which further makes them more vulnerable to the effects of climate change. Impacts of climate change are compounded by anthropogenic activities such as; untenable land use and unsustainable exploitation of natural resources.

The main climate hazards identified in the county are prolonged dry spells which lead to drought, erratic rainfall patterns, floods, emergence of pests and diseases, frost and mud/landslides. Mukurweini, Tetu, Mathira West and Othaya sub-counties are exposed to landslides due to steep slopes and human activities. Drought is more pronounced in Kieni East and Kieni West as they are semi-arid areas. Extreme temperatures were experienced in all parts of the county with frost being documented in Othaya, Kieni East and Kieni West causing destruction of crops and agricultural loss.

The impacts of climate hazards identified include; soil erosion, decimation in agricultural yields, water shortage, extreme temperatures, human natural resource use and wildlife conflicts, landslides, emergence of pest and diseases, invasive species, destruction of infrastructure, death and morbidity of crops and animals. In addition, the community reported non-climate risks attributed to climate change including; Disintegration of families, increased rural-urban migration, Lifestyle diseases, Mental health issues, Gender Based Violence among others.

Impacts of climate change in the key sectors were identified and response actions, human wildlife conflicts,

prioritized. Adaptation strategies included conservation and restoration of water catchment areas and wetlands, promotion of rain water harvesting, afforestation, improved drainage, promotion of climate smart agriculture, storm water control and conservation infrastructure, diversification of livelihoods, strengthening extension services, soil and water conservation and regulation of human activities in riparian areas and integrated pest and disease management among others

Prioritized response strategies for environmental conservation include: afforestation and reforestation, protection of fragile ecosystems, awareness creation and capacity building and improved storm water storage. County physical planning was proposed to be undertaken to guide settlements and land use for optimize returns on land resources, storm water control and conservation infrastructure, household flood proofing, improved waterways and drainage infrastructure was proposed as measures to control floods.

The Nyeri County Participatory Climate Risk Assessment has encompassed community-informed data on local level climate risks and hazards, their impacts, currently adopted resilience strategies, a thorough analysis of their efficacy to both present and future trends, and proposed strategies that the communities reported to ensure that they are able to cope effectively.

This report shall inform the Nyeri County Climate Change Action Plan, which is a 5-year plan for the County Integrated Development Plan (2023-2027), and the National Climate Change Action Plan.

DEFINITION OF TERMS

Adaptation to climate change: - The adjustment of communities and ecosystem to cope with the adverse effects of climate change (Managing the un-avoidable)

Adaptive Capacity: - The social and technical skills and strategies of and individual and group (communities) that can be directed towards responding to effects caused by climate change.

Carbon credit or offset is a financial unit of measurement that represents the removal of one ton of carbon dioxide equivalent from the atmosphere. Carbon credits are generated by projects that deliver measurable reductions in greenhouse gas emissions.

Climate: - Refers to the behavior of weather parameters for a relatively long period of time, classical period of 30 years and above, for a larger region.

Climate change: - Refers to a change in the state of the climate that persists for an extended period, typically a decade or longer. A permanent shift in the normal pattern of climate.

Climate Hazard: - It is a physical process or event that has a potential of harming human health, livelihoods or natural resources.

Climate Risks: - Physical damage and financial losses as a result of increasing exposure to climate hazards.

Climate Variability: - Refers to fluctuations in the mean state and other characteristics of climate.

Global warming refers to the observed or projected gradual increase in global surface temperature. It is one of the consequences of climate change.

Greenhouse gases (GHGs) are gases that absorb and emit radiant energy within the thermal infrared 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 trifluoride (NF3).

Mitigation: - Measures undertaken to reduce the climate change causing substances/activities (Avoiding the un-manageable)

Resilience: - The capacity for a socio-ecological system or community to absorb stresses and maintain function in the face of external stresses imposed upon by climate change.

Weather: - Refers to the behavior of the atmosphere on a day-to-day basis in a relatively small area.

Vulnerability: - The degree to which a system/community is exposed to, and is unable to cope with, adverse effect of climate change.

CHAPTER ONE: CONTEXT OF THE PARTICIPATORY CLIMATE RISK ASSESSMENT (PCRA)

1.1 Background

Climate change is one of the most pressing challenges facing our planet, with far-reaching impacts on ecosystems, economies, and societies. As the effects of climate change become increasingly evident, governments, organizations, and communities worldwide are recognizing the need to develop effective strategies to mitigate and adapt to these changes. One crucial aspect of climate change response is assessing and managing climate-related risks at various levels, including global, national, and local.

The Paris Agreement, established in 2015, has obligated ratified nations including Kenya to undertake concerted efforts in climate response through adaptation and mitigation. These efforts trickle down from the national level to county levels and subsequently down to local communities. Owing to the intricate nature of climate hazards and risks, there has been an escalating emphasis on participative approaches that engage multiple stakeholders, including governments, communities, experts, and vulnerable groups. This approach brings diverse perspectives and inclusion of vulnerable groups, culminating in more resilient and tailor-made climate action strategies.

Kenya has shown commitment to protect the climate system for the benefit of the present and future generations by supporting the United Nations Framework Convention on Climate Change (UNFCCC) process, ratifying the Kyoto Protocol in 2005, and contributing to continental and regional climate change initiatives. Further, the country's Constitution has set out a legal commitment to attain ecologically sustainable development; hence providing a firm basis to address the challenge of climate change while striving to attain the development goals set out in Kenya Vision 2030.

One important tool in this process is the Participatory Climate Risk Assessment (PCRA), which has gained prominence as an effective means of understanding and addressing climate risks at the grassroot level. Participatory climate change is a process that involves active involvement and collaboration of individuals and communities in climate change mitigation and adaptation efforts. The Participatory Climate Risk Assessment uses a collaborative and inclusive approach, engaging stakeholders, including policymakers, researchers, local communities, government agencies, Faith Based Organizations, NGOs, Civil Society Organizations, academia, and the private sector in the assessment and analysis of climate risks, vulnerabilities, and opportunities in their specific context. Participatory climate change empowers people to take ownership of climate change challenges and solutions by providing them with information, skills, and tools to make

informed decisions and take appropriate actions. This approach has gained traction in recent years as climate change impacts continue to threaten communities and ecosystems worldwide. It is a critical tool to build resilience, and promote sustainable development in the face of climate change.

The Participatory Climate Risk Assessment (PCRA) is built upon the solid foundation established at the national level through climate change policies, frameworks, and priorities. These legal policies and frameworks encompass the Climate Change Act of 2016, Kenya National Adaptation Plan 2015-2030 and the National Climate Change Policy of 2016. Within these frameworks, the Kenyan government formulated the National Climate Change Action Plan 2018-2022, which outlined specific targets to guide both climate change mitigation and adaptation endeavors. These national policies serve as the bedrock for disseminating climate action to the various counties.

In Nyeri County, the PCRA process entailed the establishment of a Technical Working Group responsible for spearheading the initiative. This group brought together experts from key departments such as Water, Agriculture, Environment, Health, the Kenya Meteorological Department, and the National Drought Management Authority, among others. The Technical Working Group collaborated closely with a broader consultative group to ensure a comprehensive approach. Furthermore, a stakeholder analysis and mapping were conducted to identify pivotal individuals involved in the process. These informants were engaged at multiple levels, including the ward, sub county, and county levels. Careful consideration was given to ensure the inclusion of diverse perspectives, including those of youths, women, and people living with disabilities. The engagement methods employed a combination of qualitative and quantitative approaches, including participatory resource mapping, focus group discussions, and the development of community seasonal timelines.

The qualitative and quantitative data collected during this process were thoroughly analyzed to capture the historical and current climate risks and hazards, traditional and existing adaptation strategies, as well as proposed adaptation priorities. The knowledge, experiences, and perspectives of local communities, vulnerable groups, and stakeholders were integral to the PCRA process. By incorporating their input, the accuracy and comprehensiveness of the PCRA were enhanced. Moreover, this involvement will empower local communities to take ownership of the developed adaptation and resilience strategies.

1.2 Policy Context

This section presents an analysis of the climate change legal and policy framework in three categories namely;

- Global and regional climate change policy and legal framework context
- National climate change policy and legal framework; and,
- Sub-national climate change policy and legal framework.

1.2.1 Global and regional

1.2.1.1 Kyoto Protocol

Adopted in 1997 and ratified by Kenya in 2005, under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol has its party countries commit not to emit greenhouse gases (including carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons) over the assigned amounts – emission reduction targets, imposing penalties on parties that have emitted greenhouse gases over their allocated amounts.

192 parties were part of the second commitment period that was between 2013 – 2020. Commitments were made towards energy efficiency, renewable energy, protection of natural resources, and phasing out fiscal incentives to industries that are heavy emitters of greenhouse gases.

1.2.1.2 Paris agreement

Adopted in 2016 and ratified by Kenya in the same year, during the 21st Conference of Parties (COP 21), parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future, with all nations committing to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so.

Under this agreement, nations endeavor to keep the rise in global temperatures well below 2 degrees Celsius, and actively pursues efforts to limit the temperature further to 1.5 degrees Celsius. To achieve this, individual countries are expected to communicate their intended actions, Nationally Determined Contributions (NDCs) to reduce GHG emissions in order to reach the goals of the Paris Agreement, as well as actions to build resilience to adapt to the impacts of climate change. A framework to support counties in need is provided for, on finances, technical and capacity building support.

The REDD+ Mechanism that is specific on sustainable conservation of forests and efforts to reduce emissions from forest deforestation and degradation, is provided for under the Paris Agreement. A framework

to support counties in need is provided for, on finances, technical and capacity building support.

1.2.1.3 The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework)

The Sendai Framework provides member states with concrete actions to protect development gains from the risk of disaster with its main goal being the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

Seeing that there is no country experiencing the drastic effects of climate change, the framework is an enabler in climate change adaptation and resilience building as it allows for early warning systems for all hazards including those arising from climate change, reducing disaster and losses arising from climate change. In its implementation, climate action strategies are incorporated and implemented by member states as they develop their disaster management strategies, thus reducing vulnerabilities arising from climate change.

1.2.1.4 Cancun Agreement

The agreement, reached in 2010 United Nations Climate Change Conference, has a set of significant decisions to address the long-term challenge of climate change collectively by nations and comprehensively over time, and to take concrete action immediately to speed up the global response to it. The main objectives cover mitigation, transparency of actions, technology, finance, adaptation, forests and capacity building.

1.2.1.5 Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) define global sustainable development priorities and aspirations for 2030 and seek to mobilize global efforts around a common set of seventeen goals
and targets. SDG 13 specifically addresses climate action with the targets including to: -

- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- Integrate climate change measures into national policies, strategies and planning
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
- Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund

through its capitalization as soon as possible

- Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities. Other SDGs that if met will assist in dealing with climate change include: -

SDG 1 – No poverty, whereby by 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

SDG 2 – Zero Hunger, by ensuring sustainable food production systems and implementing resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

SDG 3 – Good health and wellbeing, by reducing the number of deaths and illnesses and ending epidemics on diseases fueled by effects of climate change by 2030

SDG 5, 10 – Gender equality, and Reduced Inequalities respectively. Seeing that climate change continues to have a disproportionate effect on the various age groups. races and genders as well as other vulnerable groups, it is important to empower such groups to participate in ownership, control and decision making in climate change related matters.

SDG 6 - Clean Water and Sanitation. Interventions under this SDG help communities become more resilient in the face of climate change related water scarcity due to prolonged drought and high temperatures.

SDG 7 – Affordable and clean energy, by ensuring universal access to affordable, reliable and modern energy services and increasing substantially the share of renewable energy in the global energy mix, is an effective climate change mitigation strategy.

SDG 11 – Sustainable cities and communities. Implementation of strategies and targets set under this SDG mitigate against and allow communities, particularly the urban and pro- poor, to adapt to climate change.

1.2.1.6 New Urban Agenda

The New Urban Agenda, adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador in 2016, provides a roadmap for building cities that can serve as engines of prosperity, inclusion and centers of cultural and social wellbeing while protecting the environment. The agenda also provides guidance for achieving the SDGs and provides the underpinning for actions to address climate change, with one of its objectives being accelerating urban action for a carbon-free

world.

1.2.1.7 Agenda 2063: The Africa we want

Agenda 2063, is Africa's blueprint and master plan for transforming Africa with its aim being to deliver on its goal for inclusive and sustainable development. The plan seeks to create climate resilient communities and economies, acting with a sense of urgency, by prioritizing climate adaptation and mitigation in all its actions to ensure implementation of actions for the survival of the most vulnerable populations, including island states, and for sustainable development and shared prosperity. The plan outlines specific actions to be undertaken under climate action.

1.2.1.8 East African Community Climate Change Policy, 2010

The overall objective of the policy is to guide Partner States and other stakeholders on the preparation and implementation of collective measures to address Climate Change in the region, while ensuring sustainable social and economic development. The Policy prescribes statements and actions to guide Climate Change adaptation and mitigation to reduce the vulnerability of the region and enhance adaptive capacity and build socioeconomic resilience of vulnerable populations and ecosystems. Adaptation to Climate Change is of priority to the EAC region in view of the high vulnerability of the region to the impacts of Climate Change, with the emerging associated challenges, especially food security. To actualize this, the East African Community Climate Change Strategy, 2011- 2016 was developed.

1.2.1.9 East African Climate Change Master Plan, 2011- 2031

The Master Plan is a long-term vision and a basis for Partner States to operationalize a comprehensive framework for adapting to and mitigating climate change in line with the EAC Protocol on Environment and Natural Resources Management and with international climate change agreements. The plan's vision is to ensure that the People, the Economies and the Ecosystems of the EAC Partner States are climate resilient and adapt accordingly to Climate Change.

1.2.2 The National (Kenya) Climate Change Policy and Legal Framework

At the national level, the climate change policy and legal framework consists of policies, laws, strategies and plans as discussed in the following sections.

1.2.2.1 Constitution of Kenya, 2010

Article 10 of the Constitution lays down national values and principles of governance, such as sustainable development, that guide government action in implementing laws or policy. Article 42 guarantees the right to a clean and healthy environment and requires the environment to be protected for current and future

generations.

Article 66 (1) states that the state may regulate the use of any land or right over land in the interest of public safety, order, health or land use planning, and Article 69 provides for the sustainable use, management and conservation of natural resources to ensure equitable sharing of accruing benefits, including envisioning the achievement and maintenance of a tree cover of at least ten per cent of the land area of Kenya. Of notable significance is the creation of the Environment and Land Court (ELC) under Article 162. This specialized court has the status of a High Court in Kenya and deals with environmental protection matters. The court has powers to make, among others, preventive, cessation and compensatory orders.

1.2.2.2 The Environment and Management Co-ordination Act (EMCA) 1999

EMCA, the operative law on matters concerning the environment, lays out environmental quality standards and provides for the inspection, enforcement and punishment of environmental offenses. It complements other sectoral laws on water, land, forest, mining and wildlife, among others and brings harmony to the management of the country's environment.

1.2.2.3 The National Climate Change Response Strategy (NCCRS)

The NCCRS was the first national document on climate change formulated in 2010. The strategy focuses on ensuring that adaptation and mitigation measures are integrated in all government planning and development objectives. The objective of the strategy is to respond to climate change by: Enhancing the understanding of the global climate change negotiations process, international agreements, policies and processes and most importantly, the positions Kenya needs to take in order to maximize beneficial effects; assessing the evidence and impacts of climate change in Kenya; recommending robust adaptation and mitigation measures needed to minimize risks associated with climate change while maximizing opportunities; enhancing understanding of climate change and its impacts nationally and in local regions; recommending vulnerability assessment, impacts monitoring and capacity building framework needs; recommending research and technological needs and avenues for transferring existing technologies; providing a conducive and enabling policy, legal and institutional framework to combat climate change; and, providing concerted action plan, resource mobilization plan and robust monitoring and evaluation plan11.

The NCCRS laid the foundation for the establishment of the current climate change response policy and legislative framework in Kenya. The policies, plans and legislations emanating from the implementation of the strategy include: The National Climate Change Action Plans; the National Adaptation Plan; the National

Climate Change Framework Policy of 2016; and the National Climate Change Act.

1.2.2.4 National Climate Change Act 2016

The Climate Change Act came into force in 2016. The main objective of the Act is to govern the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya. The Act is to be applied to all sectors of the economy by both the national and county governments. Specifically, the Act is to be applied to ensure among other objectives: Mainstreaming of climate change responses into development planning, decision making and implementation; building resilience and enhancing adaptive capacity to the impacts of climate change; formulation of programmes and plans to enhance the resilience and adaptive capacity of human and ecological systems to the impacts of climate change; and, mainstreaming and reinforcing climate change disaster risk reduction into strategies and actions of public and private entities.

1.2.2.5 National Climate Change Framework Policy 2016

This Policy was developed to facilitate a coordinated, coherent and effective response to the local, national and global challenges and opportunities presented by climate change. An overarching mainstreaming approach has been adopted to ensure the integration of climate change considerations into development planning, budgeting and implementation in all sectors and at all levels of government. This Policy therefore aims to enhance adaptive capacity and build resilience to climate variability and change, while promoting a low carbon development pathway. As a policy statement on enhancing climate resilience and adaptive capacity, the Government commits to ensure integration of climate change risk and vulnerability assessment in environmental impact assessments and strategic environmental assessments. The policy further compels the Government to promote public and stakeholder consultation and participation, including with vulnerable groups, to enhance adaptive capacity and climate resilience.

1.2.2.6 The Nationally Determined Contributions

The Nationally Determined Contributions (NDCs) are commitments made by countries who are parties to the Paris Agreement to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement requires each party to prepare, communicate and maintain successive NDCs that it intends to achieve. Kenya first submitted its NDC on 28th December 2016. In the first NDC, (Government of Kenya, 2020) Kenya committed to reduce its emissions by 30 per cent by the year 2030 given the Business as Usual

(BAU) scenario of 143 MtCO2 eq. On 24th December 2020, Kenya submitted its updated NDC with a commitment to reduce its national emissions by 32 per cent by the year 2030 relative to the BAU scenario of 143 MtCO2 eq. In the updated NDCs Kenya committed to meet 13 per cent (USD 8.06 Billion) of the total required costs (USD 62 Billion) of implementing the mitigation and adaptation actions. The updated NDCs contain Kenya's mitigation and adaptation goals.

Mitigation goal: BAU scenario of 143 MtCOzeq; and in line with her to) the promotion and implementation of the sustainable development agenda. Subject to low carbon, climate resilient development pathway.

Adaptation goal: Kenya aims to ensure a climate resilient society. This is to be achieved through mainstreaming climate change adaptation into the Medium-Term Plans (MTPs) and County Integrated Development Plans (CIDPs) and implementing adaptation actions. Subject to national circumstances, Kenya intends to mobilize domestic resources to cater for 10 percent of the adaptation cost, while 90 per cent of the adaptation cost will require international support in the form of finance, technology development and transfer, and capacity building. The implementation mechanism for the NDC in Kenya is the five-year National Climate Change Action Plans.

1.2.2.7 Kenya Climate Smart Agriculture Strategy 2017-2026 (KCSAS)

The strategy recognizes climate change as an emerging issue for food and nutrition security and advocates for adaptation interventions that enhance farming communities' resilience to climate change induced effects. It also recognizes the role of mitigation in addressing climate change.

1.2.2.8 Climate smart agriculture implementation framework (CSA)

The Framework aims at supporting the implementation of the KCSAS 2017-2026.The objectives of the framework are to; enhance adaptive capacity and resilience of farmers, pastoralists and fisher-folk to the adverse impacts of climate change, develop mechanisms that minimize greenhouse gas emissions from agricultural production systems, create an enabling regulatory and institutional framework; and address cross cutting issues that adversely impact CSA.

1.2.2.9 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 level. Other relevant legal frameworks include; -Water Act 2016, Irrigation Act 2017 and The Public Participation (no. 2) Bill, 2019.

1.2.3 Sub-National Climate Change Policy and Legal Framework.

1.2.3.1 Nyeri County Integrated Development Plan (2023 - 2027)

The County Government of Nyeri has mainstreamed climate change in its CIDP. It addresses the impacts of Climate change through its planned development activities. In the CIDP, Nyeri County has prioritized mitigation and adaptation programs set to build climate resilience of the citizenry through cross -sectoral strategies. Carrying out the Nyeri climate change risk and vulnerability assessment will contribute to the realization of the CIPD's objectives of tackling climate change and inform the mainstreaming of climate actions.

1.2.3.2 Nyeri County Climate Change Act 2021

The Act puts in place the framework and mechanisms for mobilization and facilitation of the county government, communities and other stakeholders to respond effectively to climate change through appropriate adaptation and mitigation measures and actions for related purposes. Among the key frameworks established under the Act are the County Climate Change Action Plans, County Climate Change Fund and various climate change committees from the ward to the county level, Other relevant legal frameworks are; the Nyeri County Climate Change Policy, Nyeri County Forest conservation and management Act,2021, Nyeri County Environmental Management Act,2022, The Nyeri County Public Participation Act, 2015, Nyeri County Water and Sanitation Act 2023 (Draft) , Nyeri County Water and Sanitation Policy 2023 (Draft).

1.3 The Purpose of PCRA report

Participatory climate risk assessment aimed at understanding climate change threats at the local level and, ultimately documenting them. Its core objective is to empower communities to articulate their unique vulnerabilities and priorities. By involving local voices, this approach accurately identifies climate-related hazards, enabling the development of tailored and responsive strategies in the county. It fosters resilience within communities, equipping them to confront the evolving challenges of climate change effectively.

1.4 The Nyeri County PCRA Process

As described in the PCRA guidelines, the PCRA was implemented through 8 main steps. These are: Formation of the technical working group; training of the technical working group; mapping of stakeholders; preparation for community engagements; conducting participatory risk assessment at ward level; preparation of ward level

risk assessment reports; data analysis and preparation for county level multi-stakeholder workshop; multi-stakeholder climate change risk assessment workshop and final report writing as detailed in the section below:

Step 1: Creation of the Technical Working Group

The technical working group was constituted in April 2023 through appointment by the County Executive Committee Member in Charge of Climate Change. Considerations for appointment to the technical working group were: representation of climate change relevant sectors such as environment, water, agriculture, economic planning, physical planning, National Drought Management Authority (NDMA), Kenya Meteorological Department (KMD), trade and cooperatives, Geographical Information Systems (GIS), civic education and social services; Those appointed to the group were technical officers from the above sectors.

Step 2: Training of the Technical Working Group

The Technical Working Group was trained for two days on the PCRA process. The training involved understanding of the process, its relevance in development planning and implementation and how each step of the PCRA process should be conducted as described in the PCRA guidance templates under the FLLoCA program. The importance of the PCRA document was also heightened during the training. The training was coordinated by the CCU.

Step 3: Stakeholder Identification and Analysis

The key objective of carrying out this step was to identify all key stakeholders at county, sub- county and ward levels who can contribute and should participate in the PCRA process, including representatives of groups traditionally marginalized and vulnerable to the impacts of climate change; and develop a stakeholder engagement strategy/process for the key stakeholders.

The initial process was carried out by the Technical Working Group who met and identified, mapped and analyzed, all the stakeholders that are impacted by climate change, responsible for climate change actions and responses to the impacts and resilience strategies and knowledge / expertise relevant to matters relating to climate change, as well as those interested in climate change matters.

The following key stakeholders were put into consideration during the mapping process: The Ward Climate Change Planning Committees (WCCPCs), Community Based Organizations(CBOs, Civil Society Organization's (CSOs), grass roots organizations, Faith Based Organizations FBOs , Non- Governmental Organizations (NGOs), customary/traditional institutions, local producer groups, Academia and Research Organizations, business community, community leaders and representatives , youth groups, women groups,

representatives of people living with disabilities vulnerable groups and other umbrella organizations. Scientific and statistical data providers such as Kenya Meteorological Department were very critical in the PCRA process.

During the mapping process the Technical Working Group ensured that there was 50% presentation of the women, youth, elderly and People Living with Disabilities (PWDs) in stakeholder list. After the TWG identified all the stakeholders, the developed a strategy which was going to be used to relay information following the definitions set out in the County Public Participation Guidelines, 2016 on the different modes of passing information. Communication was made to the relevant personnels within a period of 7 working day. Invitations were sent out using various mediums such as letters, emails, advertisements using different dialects, social media posters and Short Message Service (SMS) stating clearly that a response was expected from them within the seven days as per the PCRA guidelines.

High Influence, Low Interest	High Influence, High Interest
State Department of Youth and Gender KNCCI NEMA Research and Academic Institutions e.g., Dedan Kimathi University of Technology, Karatina University Community Forest Association (CFA)/ Forester Social Officers (National Level/County Level) Faith Based Organization's /Groups (NCCK, SUPKEM) Commercial Banks (KCB) Ministry of Interior – (Chief/Asst. Chief).	Department of Agriculture (crop/ livestock/fisheries/veterinary) Water Service Provider's /CBOs/ NGOs/CSOs Department of health Research institution's Kenya Forest Service Kenya Meteorological Department National Drought Management Authority Nyeri Municipal Board Member of County Assembly (MCA) Representative
Low influence, Low Interest	**Low Influence, High Interest**
Media	WCCPC Business community GBV champions Environment officers Sub County Water Officers Farmer Groups

Table 1: Stakeholder Analysis Matrix

Step 4: Preparation for ward level engagements

The Climate Change Unit and the technical working group sensitized the sub county technical teams on participatory climate change risk assessment exercise at ward level. Stakeholders ward mapping was carried

out to identify relevant community representatives and CBO's. Participants mobilized from the wards included representatives of; WCCPC, PWD, farmers groups, cooperatives, CFA, WRUAs, women, youth and relevant ward/sub county technical officers. Programs, engagement tools and other materials relevant to the community engagements were prepared in advance. These materials included: the program, digitized hazards and resource maps, community guiding questions and the note takers feedback forms. Training of the relevant technical sub county /ward officers was also carried out. Officers selected to spearhead the engagement were drawn from; Social Welfare and Development, Environment, Agriculture, Public Health and Water.

Step 5: Engagement of Communities at Ward Level on PCRA

On average, 15-20 community representatives participated at the ward level engagement forums. In the first session of the community forums, all the wards clustered were jointly taken through an introduction session on PCRA processes and its application in the county planning and development cycle. The participants were then segregated into their respective wards where members of the technical team and a note taker was assigned.

The community engagement meeting started by climate hazard and community resource mapping. Thereafter, the climate change risk assessment tools were administered to determine the main hazards, prioritize them, identify vulnerabilities, local response actions and propose adaptation strategies. The output of this process was that the community identifies key climate change risks and hazards and prioritizes response measures.

Step 6: Data Analysis

The information collected at the ward level, was analyzed by the technical working group to identify key hazards, historical & current climate patterns, and the main issues related to climate risks in each ward. The data analysis phase involved synthesizing and interpreting the qualitative information obtained from the entire stakeholder engagement process at the ward, sub-county, and county levels.

The process helped in identifying historical climate patterns, current climate patterns, key hazards and risks, and the potential impacts of these risks on different sectors such as agriculture, health, water resources, and livelihoods. Furthermore, this phase identified existing climate change adaptation measures and their effectiveness in curbing the climate change menace.

Step 7: Multi Stakeholder workshop

A multi stakeholder workshop was held at the county level. The main goal of the workshop was to bring together representatives from different stakeholder groups, including government officials, Community-Based Organizations (CBOs), community members, NGOs, Faith-Based Organizations (FBOs), Civil Society Organizations (CSOs) and business community. The workshop served as a platform for sharing the findings of the ward engagements and fostering discussions among stakeholders. It allowed for the identification of

key hazards and risks, potential adaptation measures, and the prioritization of adaptation options. Through focus group discussions, the workshop also helped in building consensus among stakeholders regarding the most appropriate and effective adaptation strategies in Nyeri County.

Step 8: Drafting of Participatory Climate Change Risk Assessment

The final step involved the drafting of this participatory climate risk assessment report. Based on all stakeholders' inputs and secondary data, a PCRA report was prepared. The report outlined the identified climate risks, their potential impacts, and recommended adaptation strategies as well as prioritized areas.

CHAPTER TWO: NYERI COUNTY CLIMATE HAZARD PROFILE

2.0 Introduction

The chapter delves into the comprehensive climate hazards profile of Nyeri county, aiming to provide a detailed understanding of the various climatic hazards that the county faces. It explores the geographical location of the county, social economic activities, climatic conditions and, historical context of climate change in the region, examining the trends, patterns, and impacts observed over recent decades. Furthermore, the chapter explores the historical climate data and trends, shedding light on precipitation patterns, temperature changes and extreme weather events that have occurred in the past. Moreover, the chapter discusses current climate hazards, vulnerability, and adaptative capacity in relations to these hazards.

2.1 Overview of Nyeri County

Nyeri County is one of the 47 counties in Kenya and is located in the central region of the country. It covers an area of 3,337.2 Km2 and is situated between longitudes $36^{0}38$" east and $37^{0}20$" east and between the equator and latitude $0^{0}38$" south. It borders Laikipia County to the north, Kirinyaga County to the east, Murang'a County to the south, Nyandarua County to the west and Meru County to the northeast.

Nyeri County has a population of 759,164 (male - 49% and female - 51%), according to the projections by KNBS, 2018. Majority of the people living in Nyeri County are from the Kikuyu Community most of whom are predominantly farmers growing tea and coffee as cash crops alongside food crops such as maize, beans, assorted vegetables and sweet potatoes. Nyeri County plays host to all Kenyan communities who are mostly engaged in own businesses or employed by the government.

The county is divided into eight administrative sub counties namely; Kieni East, Kieni West, Mathira East, Mathira West, Nyeri Central, Mukurweini, Tetu and Nyeri South. The county is further subdivided into 30 wards, 69 locations and 256 sub-locations.

Agriculture is an important sector in Nyeri County. It employs approximately 66% of the labor force and contributes about 57% to household incomes (Gok, 2013). Productivity in the sector is low, as it faces several challenges such as poor agricultural credit access, land degradation, poor access to agricultural inputs, crop livestock diseases and most importantly climate hazards. Problematic climatic challenges in the county are drought, extreme temperatures, frost and floods.

Kieni East and West are the most prone to floods; Kieni West, East Mukurweini, Mathira West and Tetu Sub-County to drought and Mukurweini, Tetu, Nyeri South, Mathira East and West sub counties more prone to

landslides. These hazards affect agricultural production negatively. For instance, 2013 resulted in a 15% decrease in crop areas in Kiamathaga and Munyu locations, and an equal reduction in maize yields. Drought incidences are foreseen to increase following a decrease in rainfall amounts after every 3-4 years.

Despite the high adoption rates of adaptation strategies (72%), 74%, 68%, and 60% for the male-, female- and youth-headed households, hitherto, the youth and female are the most vulnerable due to factors such as limited resource (for example land) control. These adaptations are heavily embedded in the farmers' local knowledge which is based on experience of their local environment and resources.

Adaptation strategies for crop farmers include improved seed varieties, changing the cropping calendar, use of indigenous information in controlling diseases, irrigation, water harvesting, soil and water conservation, drought tolerant crops and use of greenhouse, use of indigenous information in controlling diseases, irrigation, and use of greenhouses. Strategies for livestock farmers include fodder conservation, rearing improved breeds, feed supplementation, livestock intensification (zero grazing), and planting drought- tolerant fodder crops. There is need to promote strategies such as tree planting, rehabilitation and conservation of water sheds and value addition for both livestock keepers and crop producers.

2.2 Climatic conditions

The county experiences equatorial rainfall due to its location within the highland zone of Kenya. The long rains occur from March to May while the short rains are experienced in October to December, but occasionally this pattern is disrupted by abrupt and adverse changes in climatic conditions. The annual rainfall ranges between 1,200mm-1,600mm during the long rains and 500mm-1,500mm during the short rains. In terms of altitude, the county lies between 3,076 meters and 5,199 meters above sea level and registers monthly mean temperature ranging from 12.8ºC to 20.8ºC.

2.3 Current and Historical Climate Hazards and Trends

2.3.1 Historical climate hazards trends

The rainfall time series (1981 to 2018) and temperature time series (1981 to 2018) reconstructed from KMD station observations, remote sensing and other proxies were analyzed and plotted.

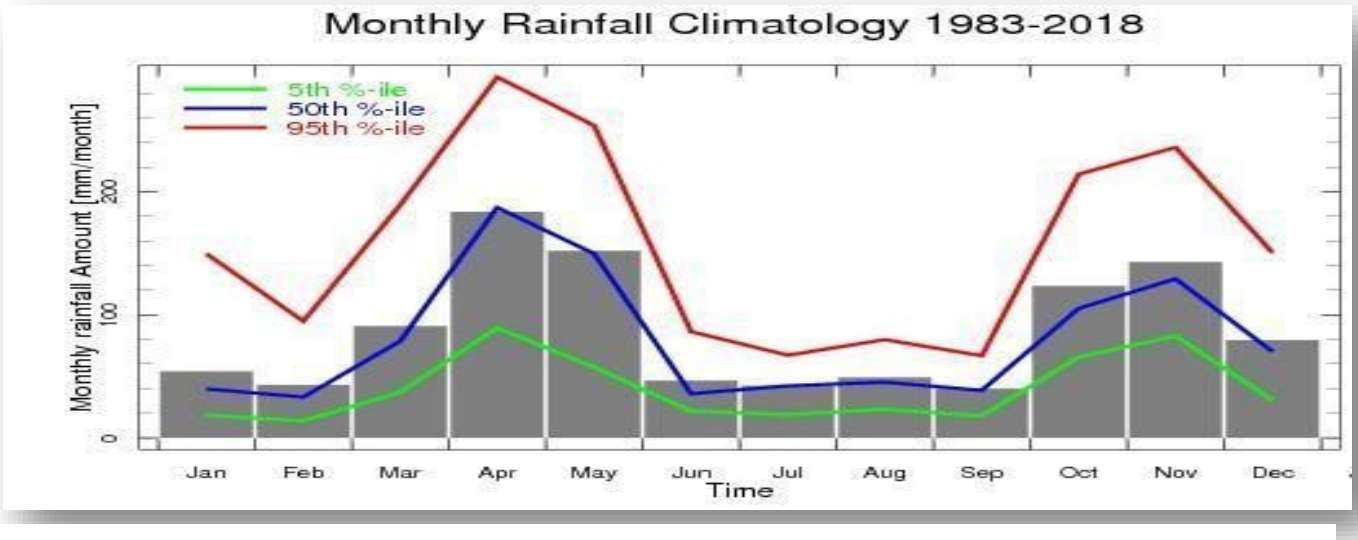

Figure 1: Monthly rainfall climatology 1983-2018

The Monthly Rainfall Climatology shows mean monthly rainfall for the county. The county experiences bi-modal rainfall pattern with peaks from March to May and October to December as shown in figure 1. The other months experiences dry and hot climate but a cold period is experienced from June to August. The highest rainfall is experienced in the month of April (being the peak of MAM season) and November (being the peak of OND season) while the lowest monthly rainfall is experienced in the month of February. The county receives the highest monthly rainfall of about 200 mm in April while the lowest monthly rainfall is about 40 mm in February. This has been illustrated in the figure 1 above.

The yearly Seasonal Rainfall Anomaly in figure 2 shows a uniform departure from the mean in the negative direction. However, there was a sudden positive departure in 1997 when the El Nino occurred which was experienced nationally and beyond.

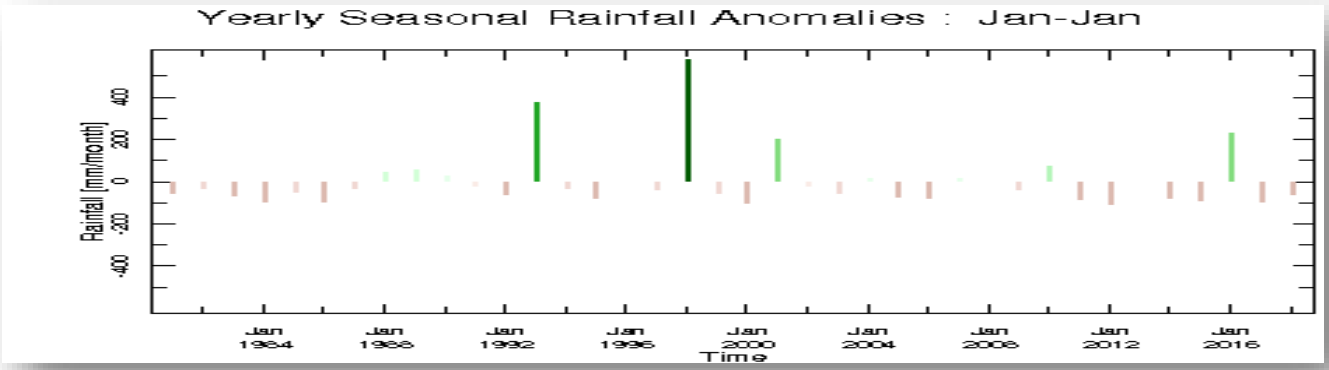

Figure 2: Yearly seasonal rainfall anomalies Jan-Jan

The highest Maximum Temperature is normally observed in the month of February while the lowest maximum temperature is normally observed in the month of July. The maximum temperature ranges from 15°c to 24°c annually. The yearly Seasonal Maximum Temperature Anomaly shows a varying departure from the mean yearly by +/-2°c. This has been described in the figure 3 and 4 below.

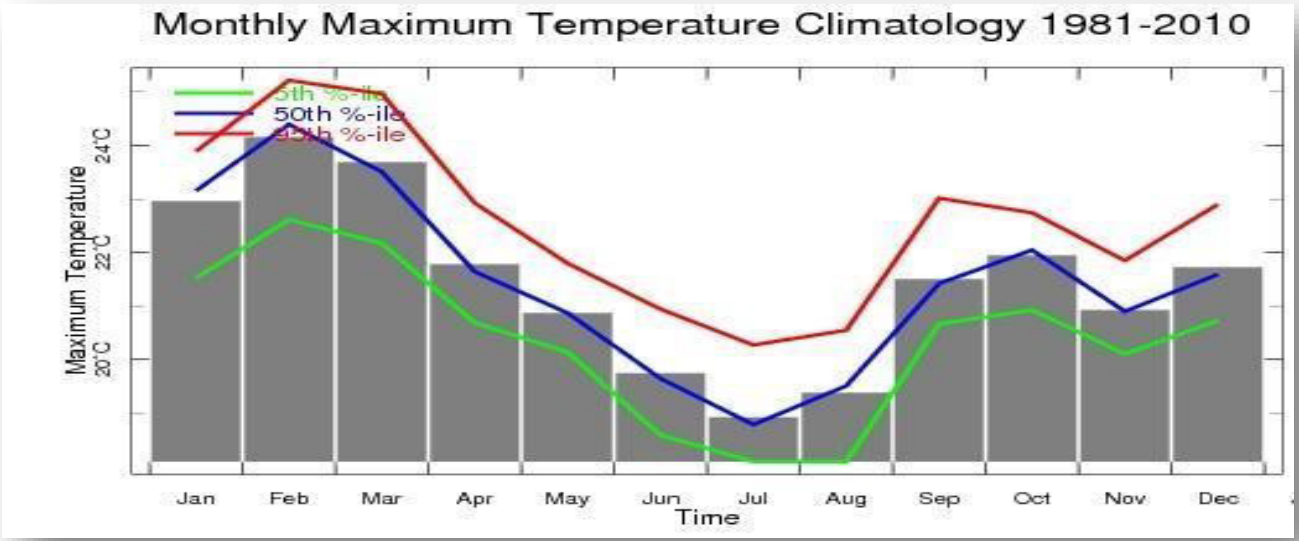

Figure 3: Yearly seasonal rainfall anomalies Jan-Jan

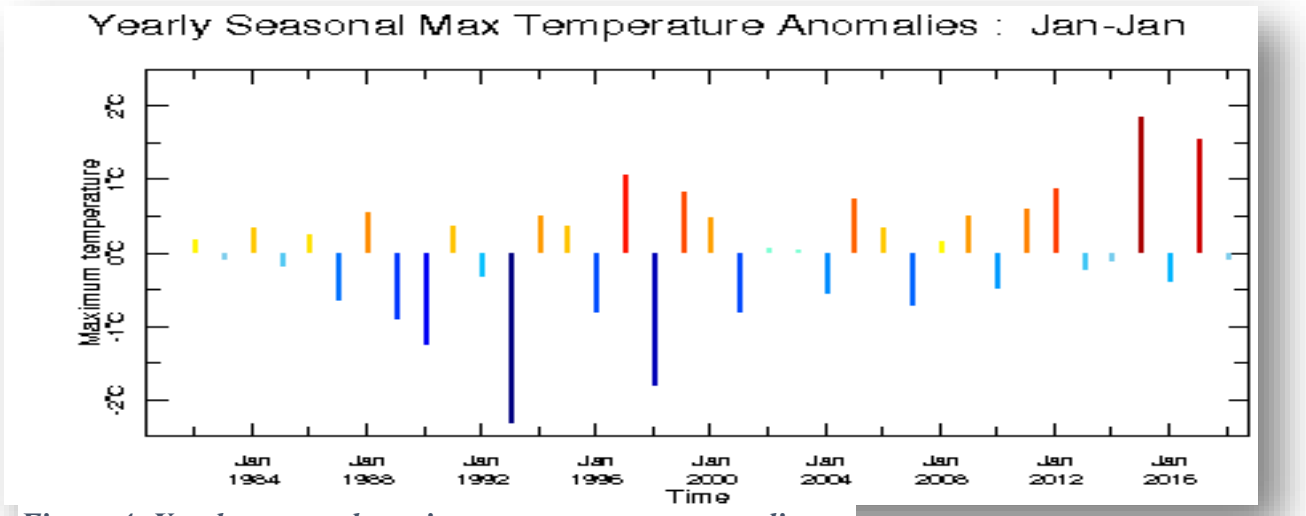

Figure 4: Yearly seasonal maximum temperature anomalies Jan -Jan

The highest Minimum Temperature is normally observed in the month of May while the lowest minimum temperature is normally observed in the month of July. The minimum temperature ranges from 9°c to 11°c annually. The yearly Seasonal Minimum Temperature Anomaly shows (figure 5 and 6) a varying departure from the mean yearly by +/-2°c.

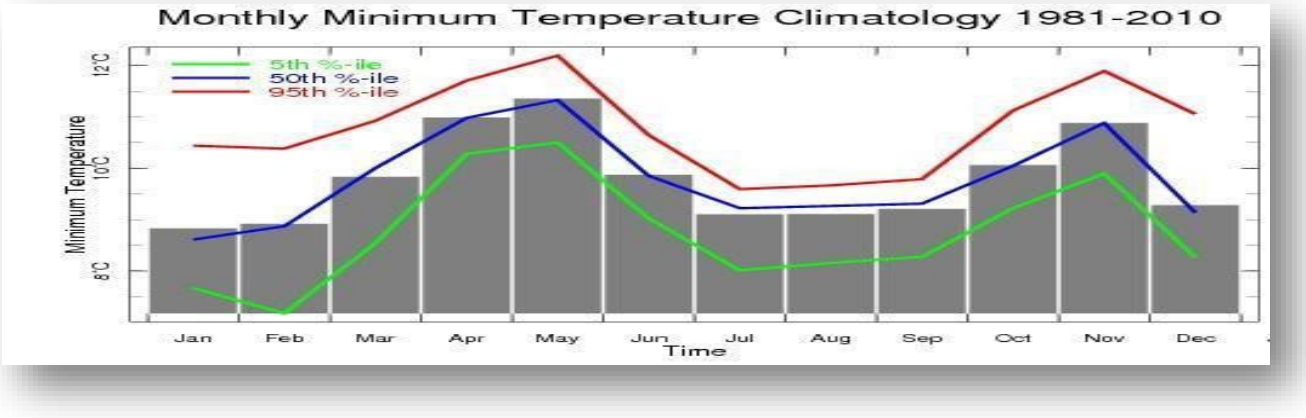

Figure 5:Monthly Minimum temperature climatology 1981-2010

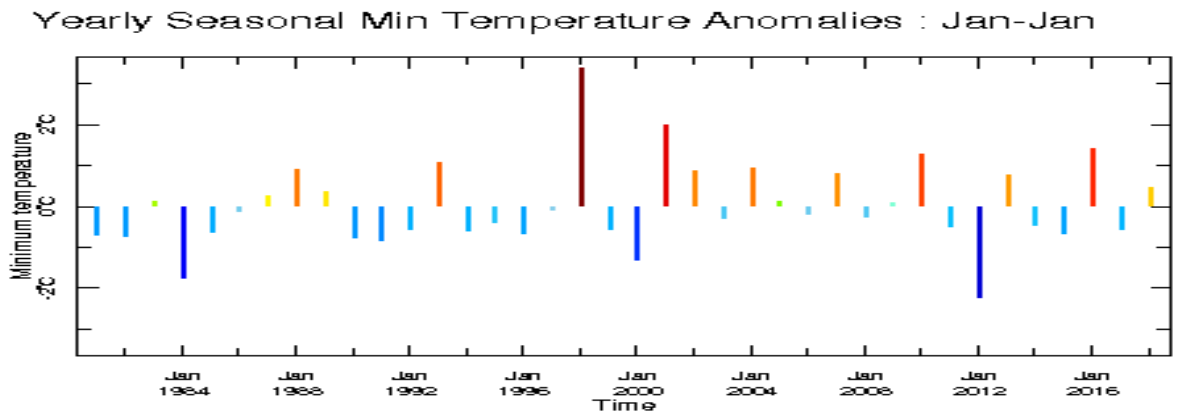

Figure 6:Yearly seasonal min temperature anomalies Jan-Jan

The Annual Rainfall trend shows a decreasing trend in the annual rainfall from 1981 to 2018. The highest Annual rainfall attained during the period was in 1997 of about 1500 mm. The rainfall was associated with the El Nino phenomenon while the lowest Annual rainfall attained was in 2008/2009 of about 200 mm. Figure 7 and 8 shows varying departure from the mean of the annual rainfall within the county. The highest departure was observed in 1997 in the positive direction and in 2008/2009 in the negative direction. The probability of exceedance shows that the highest rainfall attained within the county is about 1400 mm as shown in figure 7.

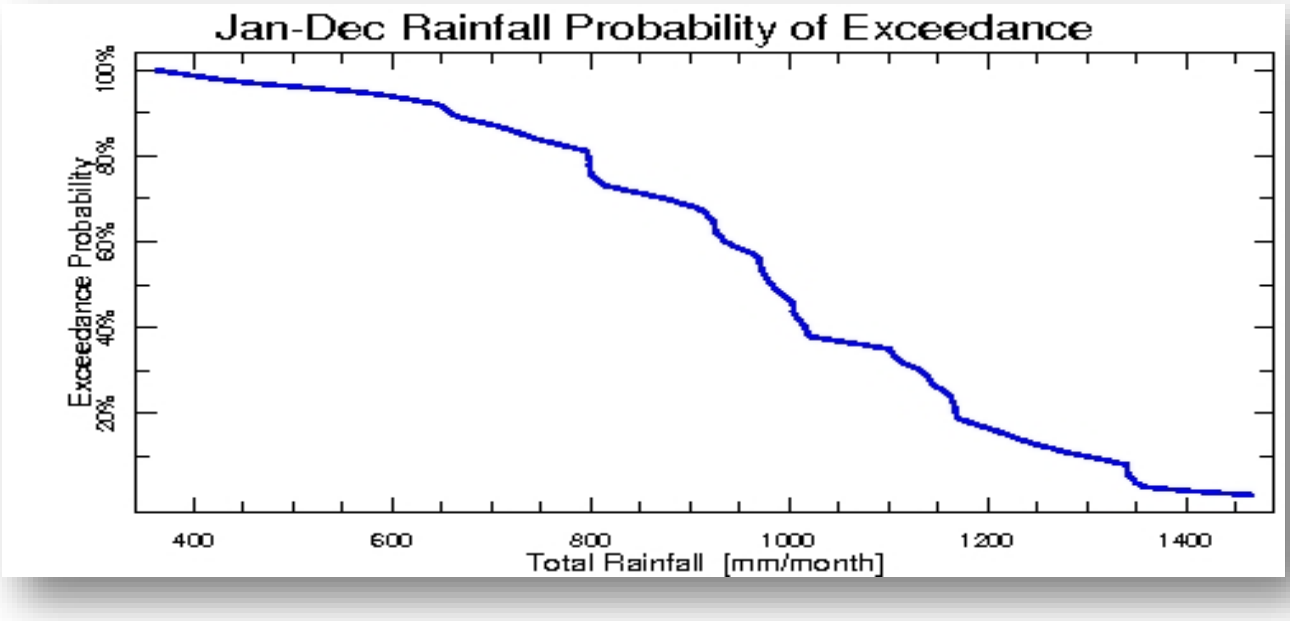

Figure 7: Annual Rainfall probability of exceedance

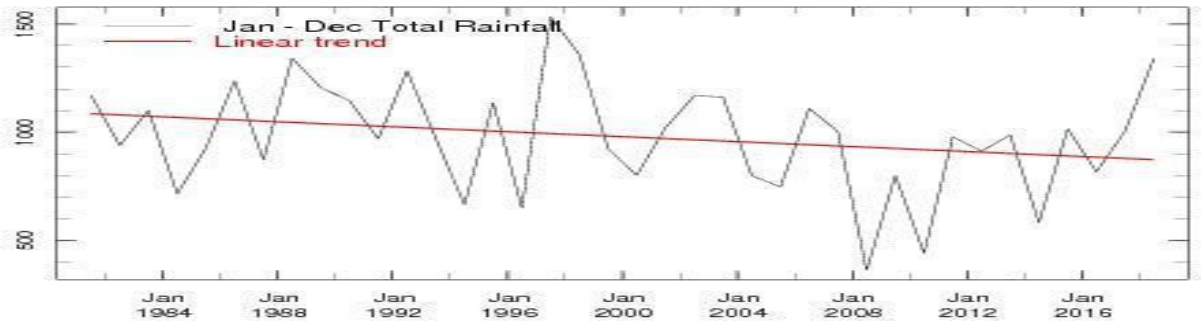

Figure 8:Rainfall trends Jan-dec

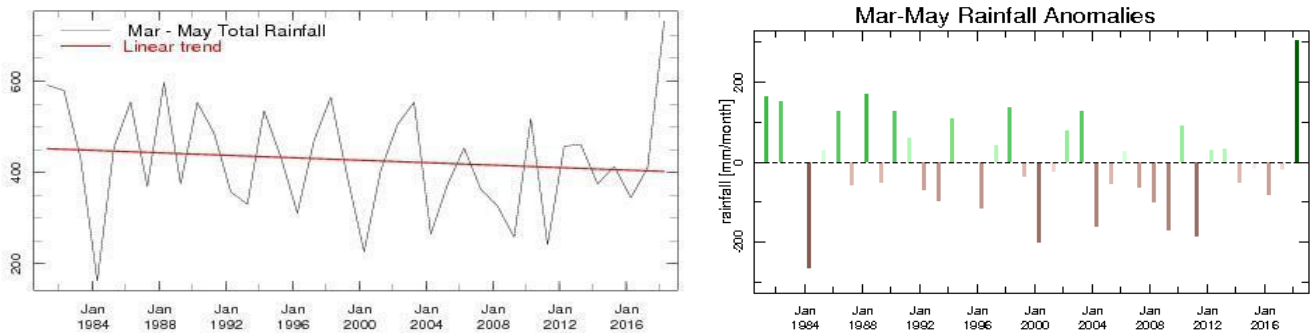

Figure 9: MAM seasonal rainfall from 1981 to 2018

The MAM Seasonal Rainfall trend shows a decreasing trend in the MAM seasonal rainfall from 1981 to 2018 as shown in figure 9. The highest MAM seasonal rainfall of about 750mm was received in 2018 while the lowest MAM seasonal rainfall of about 200mm was received in 1984.There has been a varying departure from the mean of the MAM seasonal rainfall within the county. The highest departure was observed in 2018 in the positive direction and in 1984 in the negative direction. The probability of exceedance shows that the highest rainfall attained within the county in MAM season was about 600 mm as shown in figure 10.

Figure 9: MAM trends from 1984-2016

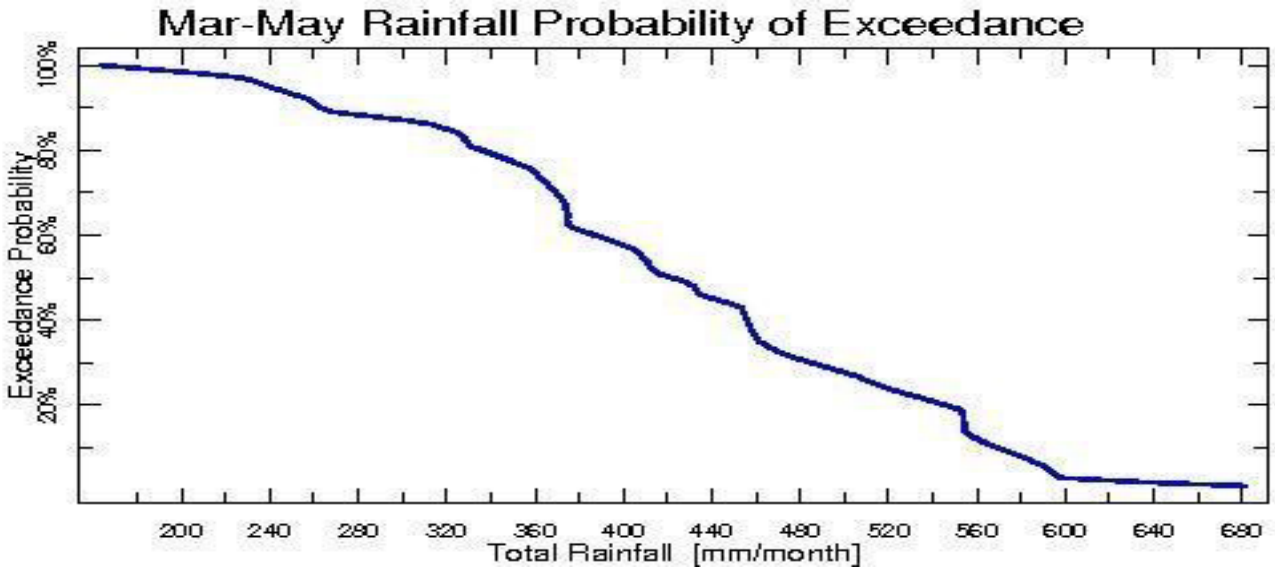

Figure 10:March -May rainfall probability of exceedance

The OND Seasonal Rainfall trend shows a decreasing trend in the OND seasonal rainfall from 1981 to 2018. The highest OND seasonal rainfall received during the period was in 1998 of about 800 mm. The rainfall was associated with the El Nino phenomenon while the lowest OND seasonal rainfall attained was in 2005 of about 200 mm. Figure 1 shows varying departure from the mean of the OND seasonal rainfall within the county. The highest departure was observed in 1998 in the positive direction. The probability of exceedance shows that the highest rainfall attained within the county in OND season was about 450 mm.

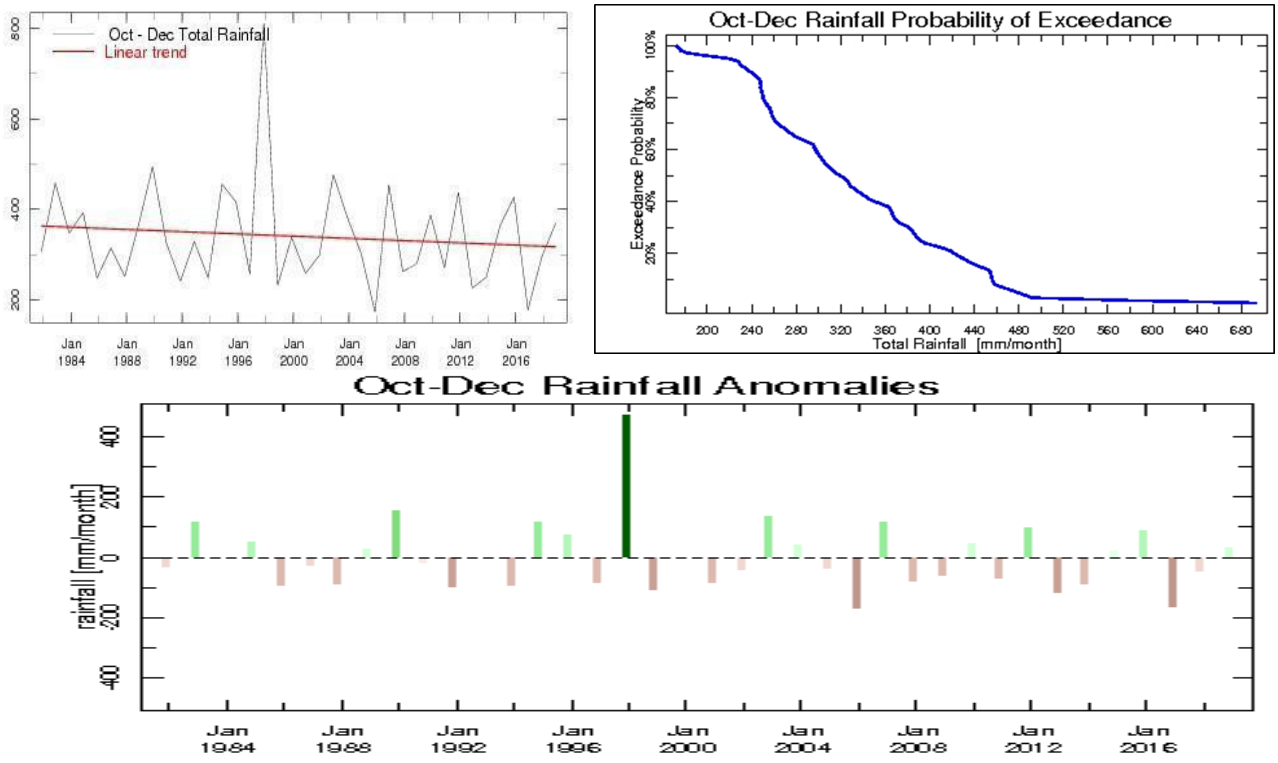

Figure 11: OND trends, rainfall anomalies and probability of exceedance

The figure 11 above indicate that rainfall has been decreasing since 1964 to 2016. There have been instances of very high rainfall and low rainfalls which resulted in floods and droughts respectively. The two hazards were identified during the community and multi stakeholders' engagement as a common past hazard whose impact affects almost all sectors of sustainable development.

2.3.2 Current Climate Hazards

Severe droughts occur approximately every ten years, and moderate droughts or floods every three to four years. As reported during the ward engagements the community identified drought as the major current hazard. Repeating patterns of floods and droughts in the county have had large socio- economic impacts and high economic costs. Crops and livestock loss were identified by the community as the major impacts of drought. From 1983 to 2023 drought appears to be increasing in frequency.

The wards in Kieni East, Kieni West and Mukurweini sub counties are some of the county's most disaster-prone areas and have required significant disaster risk investment. Vulnerability from these hazards poses major challenges for economic stability and fiscal sustainability and have had adverse social and fiscal consequences. Indeed, lower-income populations reside in more hazard prone locations, with high potential for significantly increased exposure of already vulnerable populations.

Communities also identified landslides as an emerging climate hazard that has affected some parts of Mukurweini, Tetu, Othaya and Mathira. Most of the landslide prone areas are near major rivers such as Gura, Sagana.

Figure 12: Community Members Anchoring a pipeline exposed by a landslide

Figure 13: Water gullies formed in Mukurwe-ini Sub County as a result of flash floods leading to exposed water systems

Figure 14: A Recent flash flood when heavy rains pounded in the areas of Gakawa

Frost has also occurred in some areas of Kieni that are near Aberdare and Mt Kenya. It has been reported to have devastating effects on crops. The area has a low tree cover hence making it more prone to frost.

Emergence of pests and diseases was also cited during the community engagements. Tropical diseases in animals and humans such as malaria have been on the rise in recent years.

During the community engagements several hazards were identified aligned to different current and historic timelines as tabulated below.

Timeline	Hazards /Risks	Specific Areas
1983-1992	1984 Drought	**All wards**
	Pest & diseases e.g., army worm & locusts	**All wards**
1993-2002	Flooding (El Nino)	**All wards**
	Drought (la Nina)	**All wards**
	Soil erosion	
	Pest & diseases	
2003-2012	Drought (2009 and 2011)	**All wards**
	Loss of biodiversity e.g., ants	
	Partial flooding	
	Forest fires	
2013-2023	Pest infestation 2020(Desert locust) 2022(Army worm)	
	Extreme temperatures	**All wards**
	Ecological imbalances	
	Frost	**some parts of Kieni**
	Drought frequencies intensified	**All wards**

Table 2: Summary of current and Historic hazards/Risks experienced as reported during community engagement

2.4 Exposure and vulnerability profiles of the county

2.4.1. Vulnerability Indicators

To aid in planning and decision making the following vulnerabilities indicators are used to identify how prone a community or an individual is to climate change impacts; -Poverty statistics, Food security/ Food aid and geographical location

1. **Poverty statistics**

The poverty rate in the county is 27.3% while absolute poverty is 19.3%. (KNBS 2019). The higher the poverty index the higher the vulnerability of a community or a household. During the community engagement communities identified poor households and one of the vulnerable groups. Most of the poor households in Nyeri County are located in slums and colonial villages.

2. **Food security**

In recent years, increased drought occurrence has led to decreased availability of food and forage in the county. Climate hazards and risks have led to reduced income especially to those who heavily rely on agriculture as the main source of income. Consequently, this leads to reduced economic access to food and forage. To cope with food insecurity, most communities highlighted a change in feeding habits and reduction of meal times. Food poverty index for the county is 15.5% (Economic survey 2023). Since 2011, frequent & prolonged drought have hit some parts of the county. In the first half of the financial year 2022/2023, approximately 2760 people received food aid in Kieni East, Kieni West, Mathira West, Nyeri Central and Tetu sub-counties.

Child undernutrition in Nyeri County remains a public health challenge with current statistics placing stunting at 15.1%, wasting at 2.4 % and underweight at 2.1% (KHIS, 2021/2022). This is well reflected in the suboptimal growth of undernourished children. Undernutrition has both short- and long-term ramifications for the health of children, and adversely affects their educational performance and cognitive abilities. In adulthood, it leads to poor economic productivity (NCNAP - Nyeri County Nutrition Action Plan, 2020). Further, KHIS data shows that 1617 children between 0 - 5 years were severely underweight, 936 were severely stunted and 968 had malnutrition. The trend will worsen with increased frequency, severity, and duration of extreme climatic events such as droughts.

3. Geographical location

Nyeri County has different agro ecological zones hence different climatic conditions. In recent years there has been a change in weather patterns hence change in climate hazards affecting the different agro ecological zones. Some parts of Kieni and Mukurweini have been facing acute drought than other areas in the county. Also, communities living along steep areas in Tetu, Othaya, Nyeri Central & Mukurweini have been facing landslides in recent years. This is a clear indicator that communities are prone to different climate hazards depending on their geographical location.

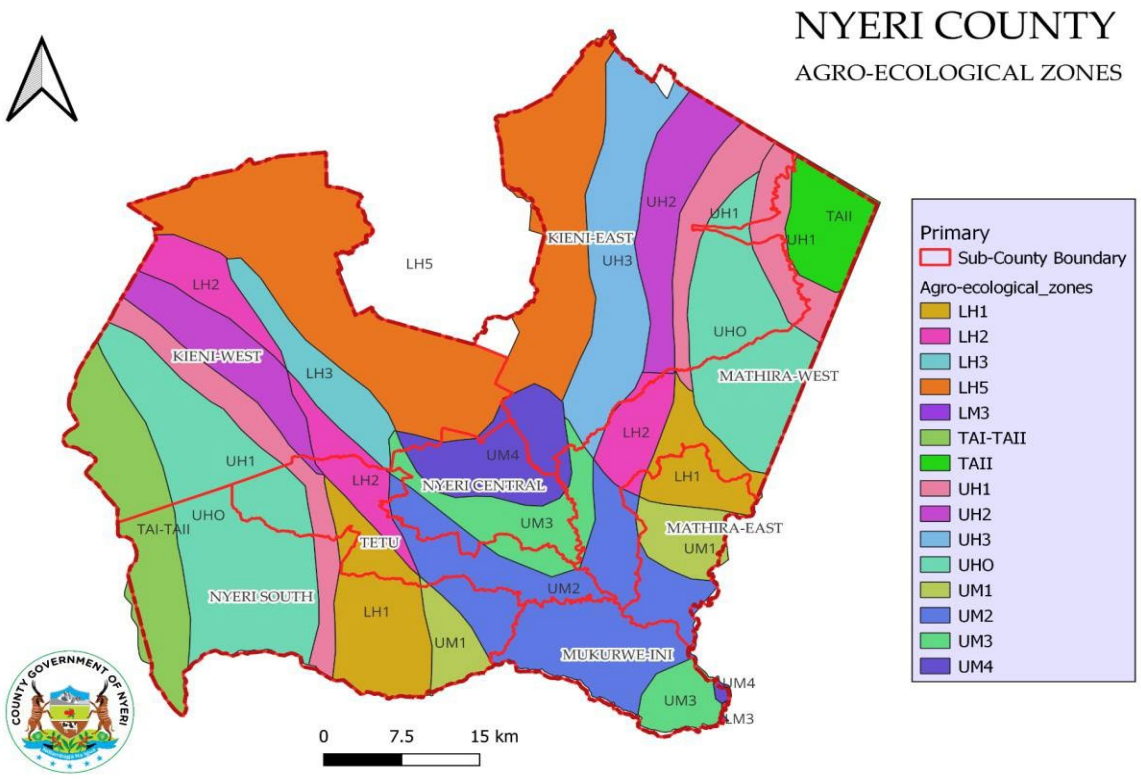

Figure 15: Agro ecological zones in the county¬¬ (Data Source-Climate Risk Profile Nyeri County)

Description

UH1, also known as the Sheep and Dairy Zone, receives about 1080 - 2000 mm of mean annual rainfall and lies at an altitude of 2070-2400 m is found in Othaya, Tetu, Kieni and Mathira sub counties. UH2, also known as the Pyrethrum - Wheat Zone (though crops such as onions, cabbage, carrot and kales are also produced in the zone), receives about 2130-2380 mm of mean annual rainfall and lies between 2130 and 2380 m above sea level Kieni East and Kieni West Sub counties.

UH3, also known as the Upper Wheat-Barley Zone, receives 900-1050 mm of mean annual rainfall and lies between 2130 and 2200 meters above sea level (Kieni and a bit of Mathira). UH0, also known as the Forest Zone, is under Forest Reserve (Othaya, Tetu, Kieni, and Mathira). LH1, also known as the Tea-Dairy Zone, receives 1400-1800 mm of mean annual rainfall and lies at an altitude of 1950-2070 meters (Tetu Othaya and Mathira).

LH2, also known as the Wheat/Maize-Pyrethrum Zone, receives about 950-1050 mm of mean annual rainfall and lies between 1830 and 2100 meters (Kieni, Tetu, and a small section of Mathira). LH3, also known as the Wheat (Maize)-Barley Zone, receives 850-1000 mm of mean annual rainfall and lies at an altitude of 1980-2130 meters. LH5, also known as the lower Highland Ranching Zone, receives about 650-850 mm of mean annual rainfall and is 1890-1950 meters above sea level (Kieni).

UM1, also known as the Coffee-Tea Zone, receives 1100-1600 mm of mean annual rainfall and is 1710 -1780 meters above sea level (Othaya and Mathira). UM2, also known as the Main Coffee Zone, receives about 950-1500 mm of mean annual rainfall and is 1460 -1710 meters above sea level (Mukurweini, Mathira, Othaya, and Tetu). UM3, also known as the Marginal Coffee Zone, receives about 870-1000 mm of mean annual rainfall and lies at an altitude of 1220-1780 meters.

UM4, also known as the Sunflower-Maize Zone, receives 850-900 mm of mean annual rainfall and is at an altitude of 150-1780 meters (Kieni and Nyeri Town). TAII, which is also under National Park (Mt. Kenya; Mathira and Kieni).

4. Non-Communicable Diseases

The rapid rise in incidences of Non-Communicable Diseases (NCDs) in Nyeri County presents a growing burden with an enormous social-economic impact at the household level. Close to half of deaths in the county are caused by NCDs, and about 700 new cancer cases are reported annually (MoH, 2020). For the year 2021/2022, hypertension cases stood at 16,466, while diabetes was 10,477. Cardiac Related Complications were the second leading cause of mortality after pneumonia. Cancer came at position 4, as Diabetes Mellitus

and Hypertension occupied positions 8 and 9 respectively.

Climate-driven changes will upset agricultural systems and lead to diminished crop yields, reduced food availability, and altered nutritional content of food. These changes will contribute to malnutrition and raise risk factors for NCDs.

2.4.2. Social Vulnerability

Social Vulnerability refers to the potential negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters, or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss in the event of a climate change hazard occurring. The main focus was laid on culturally disadvantaged groups in the population. The communities identified women, children, poor households and Persons Living with Disabilities.

1. **Women**

Women in Nyeri are more vulnerable to hazards and risks of climate change because they depend more on, yet have less access to, natural resources. Most of the women in Nyeri County have limited rights to land ownership and control, hence they cannot utilize the land or the proceeds of the 'land' for their own benefit. This makes it difficult to adopt strategies that help them adapt to climate change impacts. Agriculture is the most important employment sector for women in low- and lower-middle income in Nyeri County. Most women in Nyeri County are casual laborers in farms, especially coffee and tea farms. During periods of drought and erratic rainfall, women, as agricultural workers, work harder to secure income and resources for their families. In many parts of the county, women bear a disproportionate responsibility for securing food, water, livestock forage and fuel. During the drought periods women suffer a lot in search of water, food, forage and jobs especially those working on farms.

2. **Youth**

Article 260 of Kenya's Constitution defines a youth as a person aged between eighteen (18) years and thirty-four (34) years. youth comprise 31.16% of the total population in the county as per the 2019 census. Being the majority in the county they are vulnerable to climate change impacts. Most of the youth face unemployment as the biggest challenge, hence limited resources to adjust to climate change risks and hazards.

3. **Children**

Children are more predisposed to climate change risks and hazards because they need more food and water per unit of their body weight, are less able to survive extreme weather events, and are more susceptible to temperature changes and diseases. In the event of a drought, many children in the county suffer from malnutrition, child abuse, early pregnancies and marriages, and mental illnesses, among others. Varying rainfall

patterns and protracted droughts due to climate changes will result in water scarcity. Access to clean water will become a challenge. These conditions will compound incidences of water-washed diseases such as skin, eye and helminth infections leading to poor learning outcomes. Flooding, poor waste management and other climate-driven effects contribute to the rise in vector-borne diseases such as malaria.

Subcounty	Kieni East	Kieni West	Mathira East	Mathira West	Mukurweini	Nyeri Central	Othaya	Tetu	Total
Data Name									
Severely underweight 0-<6 months	32	25	179	0	17	169	92	43	**557**
Severely underweight 24-59 months	4	2	49	2	6	31	13	8	**115**
Severely underweight 6-23 months	58	33	330	8	34	331	89	62	**945**
Underweight 0-<6 months	359	300	833	46	138	889	253	443	**3261**
Underweight 24-59 Months	139	44	124	10	23	139	42	103	**624**
Underweight 6-23 months	741	318	1516	71	258	1245	617	1044	**5810**
0-<6 months Stunted	248	127	97	36	61	896	257	346	**2068**

24-59 months Stunted	135	7	62	6	14	92	40	35	**391**
6-23 months Stunted	468	148	37	20	177	1148	453	715	**3166**
0-<6 months Severely Stunted	20	10	1	6	12	225	20	27	**321**
24-59 months Severely Stunted	29		8	3	16	12	31	3	**102**
6-23 months Severely Stunted	64	21		6	33	221	61	107	**513**
Malnutrition	**17**	**13**	**142**	**31**	**7**	**723**	**31**	**4**	**968**

Table 3: Table showing Underweight and Stunting statistics in Nyeri county (KHIS, 2021/2022)

4. **Elderly or aged**

Our bodies capacity to counteract the impacts of some environmental stresses decreases with age. According to the 2019 census persons aged 60 years and above form 10.8% of the total population in the county with a projection of 11.9% by 2026. Most of the elderly people in the county are more vulnerable to climate risks and hazards.

The elderly population face complex medical conditions impacting physical, sensory, and cognitive abilities to care for oneself and respond to climate disasters. This makes them not to effectively adjust to climate change impacts unlike the other population. Most of them Depend on caregivers and intact medical delivery systems, which can be fragmented during climate disasters. In recent past climate change, rural urban migration has left most of them with no one to look after them. Also, cognitive impairments ranging from minimal to severe dementias impairing the ability to assess risks, plan responses, and execute protective behaviors hence difficulty in adapting to climate change impacts.

5. Poor Households

Most of the poor income earners in rural areas count on natural resources such as forests, rivers, land among others for their livelihoods. When climate change affects these resources, there's overexploitation of these natural resources. In recent years there has been an increase in deforestation in county forests and farmlands as a result of increased drought, hence alternative sources of livelihood. Also, most of the poor households in the county depend on river sources for both domestic water and subsistence irrigation farming. Most of these water sources have dried up hence greatly affecting them. Most of these poor households depend on agriculture as their main source of livelihood and it's hard for them to adopt climate change smart agriculture technologies to build their climate resilience. In the event of climate change impacts occurring, the poor household face difficulties in adjusting due to the limited resources.

6. Persons Living with Disability

People with disabilities are more likely to have social and economic risk factors, such as poverty and unemployment, that put them at greater risk to climate change impacts. During the community engagements most of them reported that the decision makers have not fully considered them during
planning in the county programs and projects hence they feel neglected. This has limited their access to donations, education and awareness, health care, social amenities and natural resources. Most of them may also face challenges in adapting to climate change due to limited resources.

2.5 Differentiated Impacts of Climate Trends and Risks

2.5.1 Sector Impacts

2.5.1.1 Crop Production

There is a general reduction in production for the major crops across the County as rainfall becomes erratic, as shown in the table below. This has a negative impact on food and nutrition security in the county. The farming community is faced with a situation of a meal a day or hunger pangs. Extreme temperatures such as frost, drought, floods, pests and disease have decreased subsistence and cash crop production, which remain a critical source of livelihoods and the main economic activity across the county.

YEAR	RAINFALL (MM)	NO. OF DAYS	MAIZE PRODUCTION (BAGS)	BEANS (BAGS)	IRISH POTATO (TONS)
2019- 2020	650	143	114000	68400	**644000**
2020- 2021	522	139	0	1200	**387600**
2021- 2022	316.2	78	1200	1800	**3200**

Table 4; Data from Crops annual reports and Nyeri County Horticultural Crops data 2020 excel sheet

Small- scale farms account for up to 90 percent of crop production across the county and the main source of employment for the county especially rural residents, women and the elderly. The most dominant crops include subsistence crops e.g., Irish potatoes, onions, beans, carrots and cabbages and cash crops e.g., coffee and tea. Low yields resulting from low-input rainfed production with limited processing, storage, and transportation infrastructure make the vast majority of crop production highly vulnerable to changes in temperature and rainfall. Water sources which facilitate irrigation-fed agriculture have reduced. Loss of soil moisture and loss of soil fertility also contributes to the low yields. The County is faced with a situation of budgeting for famine relief for the hunger-stricken households. It is both expensive and unsustainable. This calls for intervention measures to combat drought conditions which have become frequent especially in Kieni; which covers 52% of the County in land mass; and across the whole County in general.

Figure 16:Fall armyworm attack in Maize left and African army infestation

Table 5: A table showing impacts of climate hazards on crops

Climate Stressors and Climate Risks	
Rising temperatures	**Crop failure/loss, reduced yields and quality**
Increased heat stress on crops	**Changes in crop suitability due to shifting agro-ecological zones**
Shifting seasonal rainfall patterns	**Increased incidence of pest and diseases (e.g., Fall armyworm, maize stalk borer, coffee berry borer)**

2.5.1.2 Livestock

Drought, pests and diseases, increased heavy rainfall events and Extreme temperatures are the most significant stressors facing the county's main livestock species: cattle, sheep, goats, and poultry. In Nyeri County small-scale livestock rearing is done as a livelihood activity. This is an integral part of food security and livelihoods and contributes to the economy of the county. Livestock are susceptible to heat stress that reduces feed intake, reproduction rates, milk production, and longevity. Additionally, rising temperatures and flooding increase the incidence of diseases and expands the range of ticks carrying. Increased seasonal and drought-related water stress, alongside warming trends, have already impacted pastures, fodder crops, and water availability in some wards. This has adversely affected dairy milk value addition industries in the county.

Climate Stressors and Climate Risks	
Livestock	
Stressors	**Risks**
Increased Temperatures	Reduced livestock reproduction, growth rate, and milk production due to heat stress
Shifting Seasonal rainfall patterns	Increased milk spoilage due to warmer temperatures & reduced production of milk

Increased frequency and intensity of heavy rainfall	Reduced feeding options due to rangeland degradation and diminished fodder crops
	Early drying or loss of seasonal water sources
	Altered pastoral mobility and increased conflict over scarce resources
	Increased occurrence and outbreaks of livestock diseases

Table 6: A table showing effects climate change on livestock

2.5.1.3 Human Health

Climate change poses various health risks to the people of Nyeri. One of these risks is the potential increase in vector-borne diseases. Changes in climatic conditions can affect the distribution and abundance of disease-carrying vectors like mosquitoes and ticks. This may result in a higher

prevalence of diseases such as malaria, dengue fever, and tick-borne illnesses in Nyeri, posing a significant threat to the health of its population, particularly vulnerable groups who may struggle to access adequate healthcare. It is important to note that the country is facing a fresh threat from a new species of mosquito, *Anopheles stephensi,* which is invasive and can spread very fast to new areas with or without the known malaria mosquitoes (KEMRI, 2023). It is adaptive and can adapt to different climatic and environmental conditions.

Another health concern linked to climate change in Nyeri is waterborne diseases. Changes in precipitation patterns and extreme weather events can impact water availability, quality, and sanitation systems. This, in turn, increases the risk of waterborne diseases such as diarrhea, cholera, and dysentery, affecting the overall health of the community.

Agricultural productivity, crucial for food security and nutrition, is also at risk due to climate change. Changes in climate patterns can adversely affect crop yields and livestock health, potentially leading to malnutrition, especially among vulnerable groups such as children and pregnant women.

Furthermore, climate change can worsen air quality, which can have implications for respiratory health. Increased levels of air pollution, exacerbated by climate change, can contribute to respiratory illnesses such as asthma and chronic obstructive pulmonary disease (COPD) among the population of Nyeri.

The mental health impacts of climate change are also noteworthy. Extreme weather events, droughts, and floods can lead to displacement, loss of livelihoods, and social disruption. These factors can contribute to heightened stress, anxiety, and other mental health issues within the community.

Addressing these challenges requires concerted efforts to mitigate and adapt to climate change. Measures such

as reducing greenhouse gas emissions, enhancing healthcare infrastructure, improving water management and sanitation systems, promoting sustainable agriculture, and fostering community resilience are crucial for minimizing the adverse health effects of climate change on vulnerable groups in Nyeri and similar regions worldwide.

Climate Risks & Stressors Human Health	
Increased temperature	Increased mortality related to health stress
Shifting seasonal rainfall patterns	Increased drowning and displacement of people and flooding Water scarcity and crop failures, potentially affect nutrition and health. Waterborne illnesses, such as cholera, can be exacerbated by changes in rainfall patterns. Expansion or shifting of habitats for disease-carrying insects, driven by altered rainfall patterns, can increase the transmission of vector-borne diseases like malaria
Increased frequency and intensity of rainfall	Increased poverty, food insecurity, and undernutrition caused by crop loss/decreased yields, livestock loss, or rising food prices

Table 7:: Effects of climate change on health

2.5.1.4 Trade

The trade sector relies heavily on the products and services generated by other sectors within the economy. Consequently, any detrimental effects of climate change on these sectors will inevitably have an impact on trade. Notably, the agriculture and manufacturing sectors, which play crucial roles in both domestic and international trade, are particularly susceptible to climate variability and extreme weather conditions. In order to ensure a thriving trade sector, it becomes imperative to foster resilience throughout the entire economy of the county.

In Nyeri County, a significant number of traders primarily rely on agricultural products, which have been severely affected by various climate-related challenges. These include prolonged periods of drought resulting in water scarcity, the proliferation of pests and diseases, and even the occurrence of frost. Such adverse

conditions have significantly hampered the productivity and reliability of agricultural outputs. Consequently, traders in the region have faced numerous challenges, including reduced availability and quality of agricultural goods for trade.

2.5.1.5 Tourism

Tourism is also significantly impacted by climate change, which in turn affects biodiversity and wildlife. This is a matter of concern for Nyeri County's tourism industry as it is expected to result in the alteration of wildlife species' habitats in Aberdare and Mount Kenya ecosystems, the decline in population sizes of various species, and even the extinction of certain species.

2.5.1.6 Cooperatives

The cooperative sector, particularly in agriculture, has suffered negative consequences due to climate change. The frequency and intensity of droughts and floods have significantly reduced farm production especially in dairy, coffee and tea industries, making it increasingly challenging for people to engage in farming activities. Consequently, this has hindered the growth and progress of cooperatives within the county. Furthermore, interventions aimed at value addition have also been affected by these circumstances.

2.5.1.7 Infrastructure

Infrastructure and energy systems are susceptible to the impacts of climate change, especially with more frequent and intense heavy rainfall events. These events can lead to floods and landslides, causing damage to infrastructure and disrupting essential services such as energy, water, and transportation. As a result, social amenities suffer, and the most vulnerable members of the community bear the brunt of these consequences. Additionally, the reliance on firewood, particularly among women who heavily depend on this resource, exacerbates the situation.

While increasing temperatures may reduce heating demands, they also heighten the overall demand for cooling. This increased demand, especially during peak periods, strains transmission and distribution systems. Furthermore, small hydroelectric systems that support agricultural cooperatives and industries, such as tea production, are at risk due to river siltation caused by soil erosion and the heightened demand for water during drought periods. Lastly, flooding events can also inflict damage on the infrastructure of these systems.

Hydrological climate parameter	Select Energy Uses
Rainfall	Hydrogeneration potential and efficiency, biomass production demand, demand simulation /modelling
Wind speed/direction	Wind generation potential and efficiency, demand, simulation/modeling
River flow	Hydro-generation and potential, hydro-generation modeling (including dam control), power station cooling water demands
Flood statistics	Raw material production and delivery, infrastructure protection and design, cooling water demands
Drought statistics	Hydro-generation output, demand
Storm statistics	Infrastructure protection and design, demand surges

Climate Stressors and Climate Risks Infrastructure and Energy	
Stressors	**Risks**
Increased temperature and Heat	Increased flood and landslide damage to buildings, bridges, roads,
Increased frequency and intensity of heavy Rainfall	Buildings overheat and road surfaces are compromised by high temperatures
	Reduced river flows hamper hydropower production
	Increased siltation of reservoirs and water pans

Table 8: Effects of climate change on infrastructure

2.5.1.8 Ecosystems

The intricate interplay between various factors influencing ecosystem structure, composition, and function makes it challenging to predict the impacts of climate change. However, it is anticipated that rising temperatures and shifting rainfall patterns will exacerbate the strain on the rich biodiversity of Nyeri County, which is already under pressure from human activities such as deforestation, pollution, human-wildlife conflicts, expanding settlements, and conversion of agricultural land.

The county has already experienced a loss of biodiversity, primarily attributed to hazards like droughts and floods. The projected increase in heavy rainfall events and more intense droughts is expected to intensify land degradation and diminish vegetative cover in the county's diverse ecosystems. These ecosystems are essential for providing crucial products and ecosystem services, including forestry, fishery, pastoralism, tourism-related livelihoods, as well as fuel and food supplies, and water regulation through filtration and groundwater recharge.

Additionally, rising temperatures, storms, and floods pose heightened threats to ecosystems through direct damage, altered distributions of native and invasive species (e.g., Tumutumu Forest), elevated physiological stress, and increased risk of wildfires. Forest fires have already impacted Nyeri County.

2.5.1.9 Water Sector

Over the past three decades, the water resources in Nyeri County have been facing continuous depletion due to the hazards associated with climate change. This depletion has resulted in water scarcity, particularly in sub-counties like Kieni East, Kieni West, and Mukurweini. Some notable changes in the water resources over this period include the depletion of water pans and springs due to encroachment by human activities such as crop and livestock farming. This encroachment has diminished the effectiveness of these water bodies as vital carbon sinks and important water sources.

The water table levels have significantly dropped due to high water demand, limited water recharge caused by excessive runoff resulting from inadequate water storage infrastructure, and the effects of deforestation. As a consequence, borehole drilling costs have risen due to deeper water table/aquifer levels below ground, and there is insufficient water available for domestic use and irrigation purposes. Unpredictable river flow levels have led to water usage restrictions and rationing for farmers engaged in irrigated agriculture. The rivers have become more seasonal and intermittent.

Moreover, there has been an increase in flash floods, particularly during the long rainy seasons, which have caused crop damage and destruction of animal pastures. Therefore, there is an urgent need for extensive extension services and training on modern methods of water conservation and harvesting, as well as infrastructural development to ensure sustainable water availability.

Climate Stressors and Water Sector Climate Risks Water Sector	
Stressors	**Risks**
Deforestation	Poor underground water recharge leading to lower water table levels. This has caused rise in borehole drilling costs and depletion of shallow wells. Reduced spring water sources and dried wetlands
Unpredictable river flow levels	This has led to restricted/rationed water usage for farmers engaging in irrigated agriculture hence limiting crop production and pasture growth.
Rising Temperatures	High evaporation and wetlands' encroachment rates leading to depletion of open wetlands. This has also led to an increased water demand, depletion of water pans and springs therefore causing a significant ineffectiveness of these water bodies as carbon sinks and as major sources of water.

Table 9: Effects of climate change on water sector

2.5.1.10 SOCIAL-ECONOMIC IMPACTS

1. **Disintegration of families:** Communities cited an increase in family breakage in the county as a result of many factors which are related to climate change hazards and risks, such as unemployment and migration in search of alternative livelihoods.
2. **Increased rural-urban migration:** In many parts of the county the majority of the youth who form the biggest proportion of active workforce have migrated to the urban areas hence reduced workforce

in the rural areas.

3. **Lifestyle diseases:** Nyeri County has been ranked 2nd leading in overweight and obesity in Kenya, one of the risk factors for Non-Communicable Diseases (NCDs). Child undernutrition is also still a major public health problem with stunting levels being at 15.1%, wasting at 2.4% while underweight at 2.1%. These unacceptable high levels of malnutrition, over-nutrition and micronutrient deficiency have remained a public health concern and a hindrance to achieving the county's developmental agenda.
4. **Mental health issues:** The community highlighted mental health as a main social economic risk which partly can be attributed to the climate change risks and hazards.
5. **Gender Based Violence as a result of imbalance in providing for the family:** The community cited an increase in GBV as a result of economic imbalances in the families. GBV is affecting both women and men in the county.
6. **Drug and substance abuse:** There has been an increase in drug and substance abuse in the county, among the youth and older persons, with men being the most affected. This has led to family breakage, reduced workforce and increased insecurity.
7. **High cost of living:** Increased inflation has led to high cost of living which has also led to increased environmental degradation as people look for alternative sources of living to supplement their income such as charcoal burning.
8. **Increased conflicts over natural resources**: Increased drying up of rivers and other water sources due to drought has led to increased conflicts as communities scramble for the little water available.

2.6 Spatial distribution of risks

The agricultural sector is the mainstay of the economy of Nyeri County. Agriculture comprises mainly cultivation of cash and food crops, and rearing of livestock and fish. It employs approximately 66% of the labor force and contributes roughly 57% to household incomes (Gok, 2013). The major cash crops grown in the county include tea, mostly grown in Mathira, Othaya and Tetu, coffee is mostly grown all over the county except in Kieni, and horticultural crops (carrots and kales) mostly in Kieni. The major food crops grown in the county include maize, Irish potatoes, beans, and vegetables whereas the major livestock kept include dairy cattle, poultry, goats, pigs, sheep and donkey.

Climate variability is a reality in Nyeri that has manifested itself in many forms as community members and the stakeholders engaged. The variability has manifested through prolonged dry seasons, frost, extremely rainy

seasons which are associated with floods and landslides/mudslides. Landslides have greatly affected Mukurweini and Othaya sub counties whereas drought and frost affect (more severely) Kieni East and Kieni West. Floods have affected all sub counties with parts of Nyeri Central and Othaya experiencing urban floods.

The intensity and frequency of effects/impacts that are drought related have increased over time, all the sub counties are now affected. The agro-ecological zoning and geographical zoning of this wards plays a big role in differentiating the hazards impacts felt e.g., landslides affect the very steeply sloped wards than others. Frost has been experienced in several parts of the county especially parts on Kieni East, and Kieni West. Physical distribution of the hazards in all the eight sub counties (30 wards) is shown in hazard maps (figures 17-25).

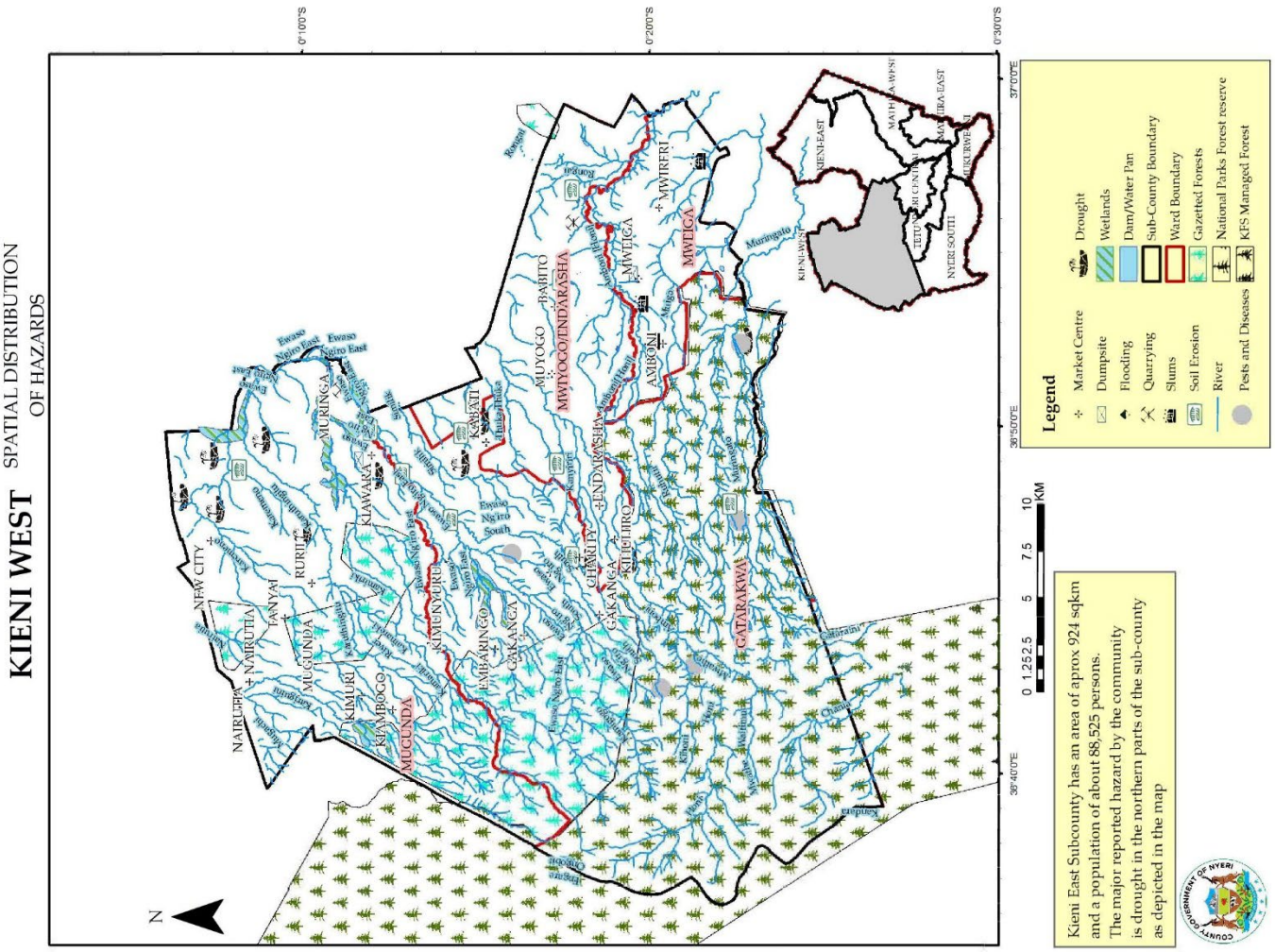

Figure 17: A map showing spatial distribution of Hazards in Kieni West Sub- County

As shown in figure 17 above, Kieni West Subcounty comprises four distinct Wards: Mwiyogo-Endarasha, Mweiga, Gatarakwa, and Mugunda. Within this region, several significant hazards were identified, including floods, droughts, landslides, and soil erosion. Furthermore, the area faces the added challenge of pest infestations and diseases due to the evolving climatic conditions. Mugunda Ward stood out as the most severely affected by drought, underscoring the pressing need for proactive measures and community resilience strategies to mitigate the impact of these environmental threats.

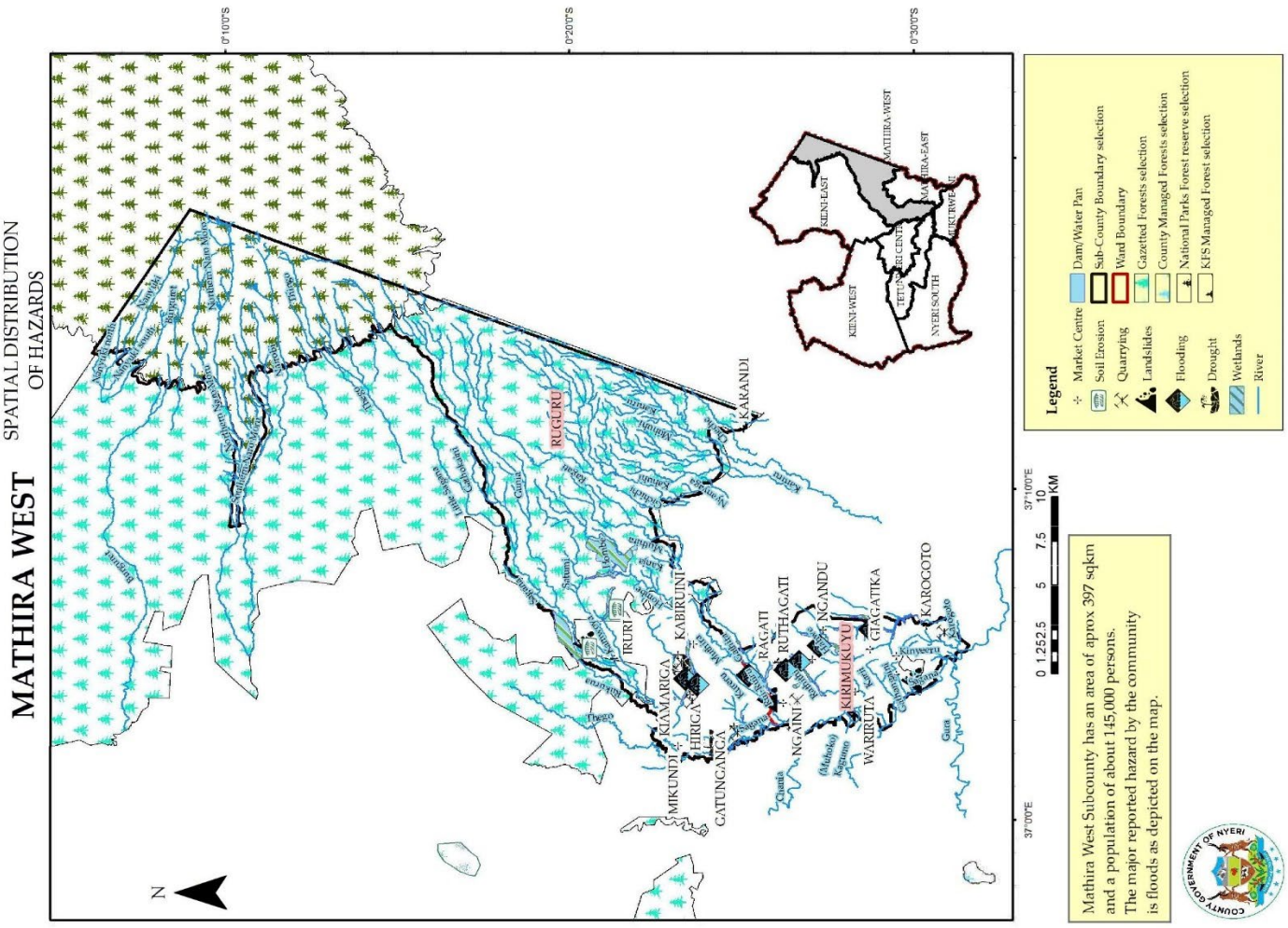

Figure 18: Hazard Map Mathira West

Figure 18, depicted above, highlights the various hazards prevalent in Mathira West Subcounty, Nyeri County. It is made up of 2 wards; Kirimukuyu & Ruguru wards. The predominant hazards are landslides, which was particularly in Kirimukuyu ward, floods, drought, and the impending threat of soil erosion exacerbated by prolonged drought conditions. Notably, the region boasts gazette forests, national parks, dams, and water pans. However, these invaluable resources face rapid depletion due to the effects of climate change.

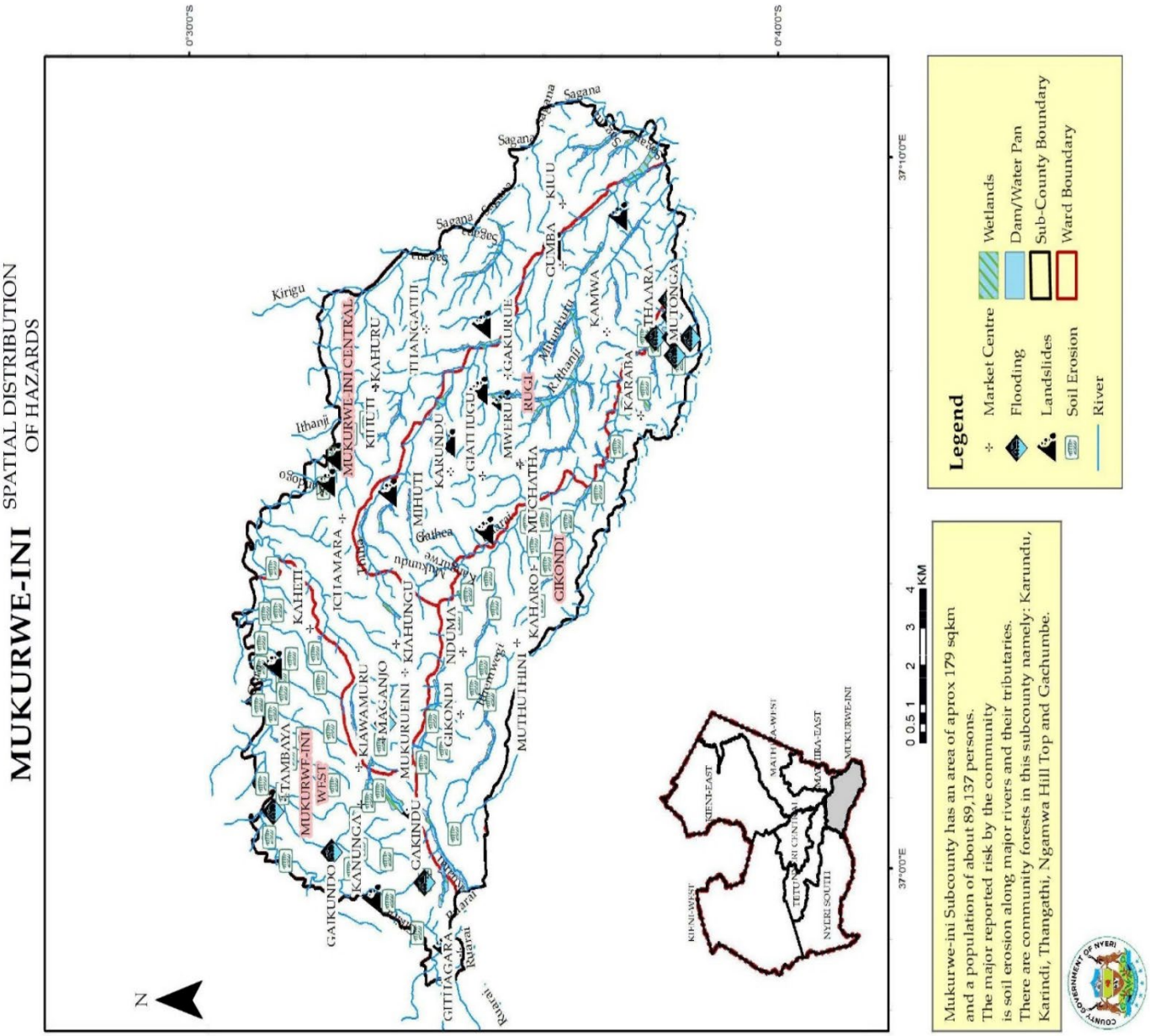

Figure 19: A Map showing hazards distribution in the four wards of Mukurwe-ini

The figure above illustrates that Mukurweini Ward comprises four distinct wards: Mukurwe-ini West, Mukurwe-ini Central, Rugi, and Gikondi. The primary hazard identified in this region was landslides, posing a consistent threat across all wards. Additionally, the area is prone to floods, especially during the rainy season, exacerbating the risk of soil erosion. Notably, Rugi ward faces the additional challenge of drought.

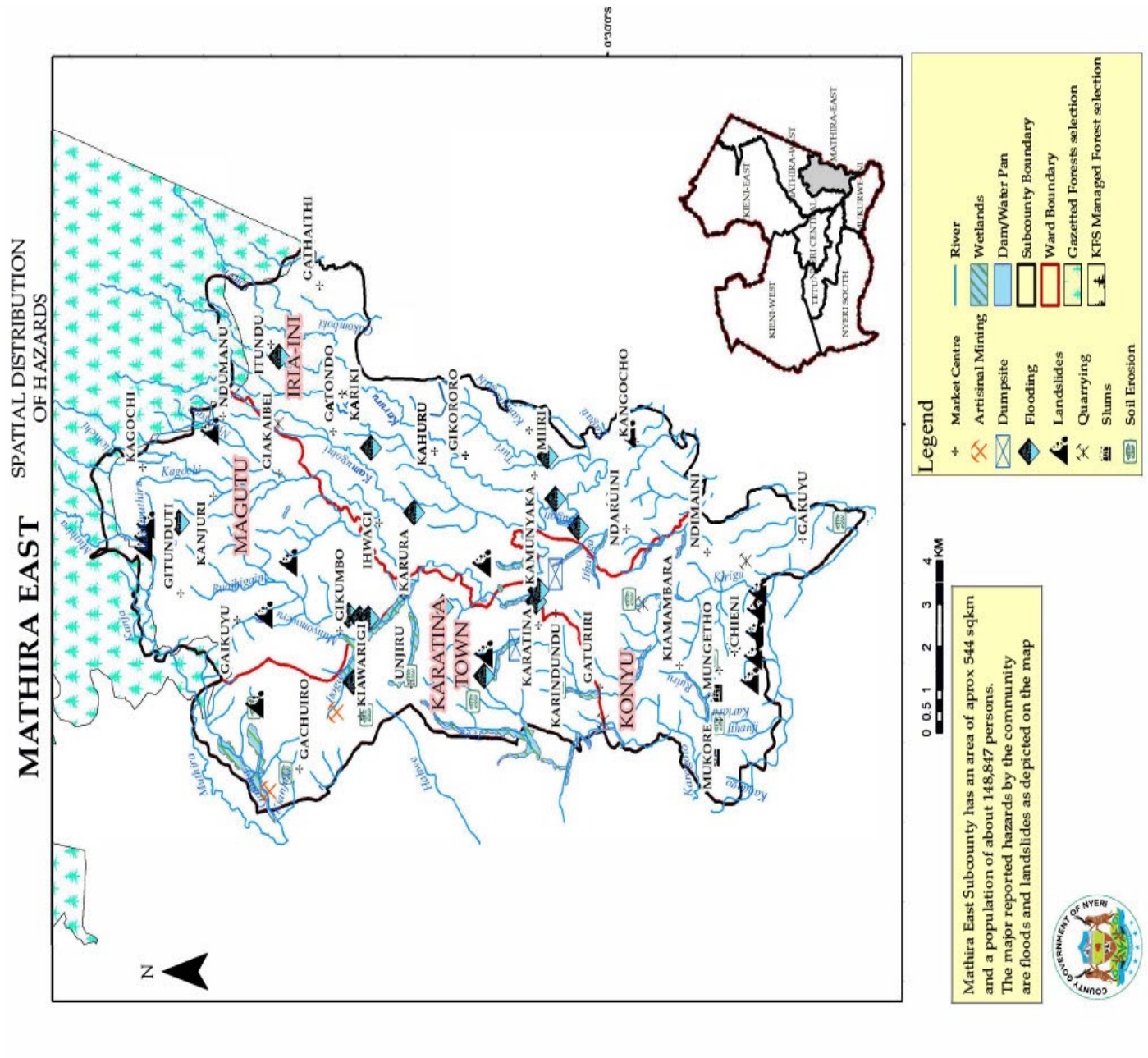

Figure 18: Map showing hazards distribution in the four wards of Mathira East

Mathira East subcounty spans approximately 544 square kilometers and comprises four distinct wards: Magutu, Karatina, Konyu, and Iria-ini. This region boasts a diverse array of resources, encompassing quarries, rivers, wetlands, forests, slums, and dumpsites. However, it faces significant challenges, primarily in the form of frequent floods and landslides, with Chieni area being particularly susceptible to landslides. Additionally, soil erosion is another noteworthy concern in the area.

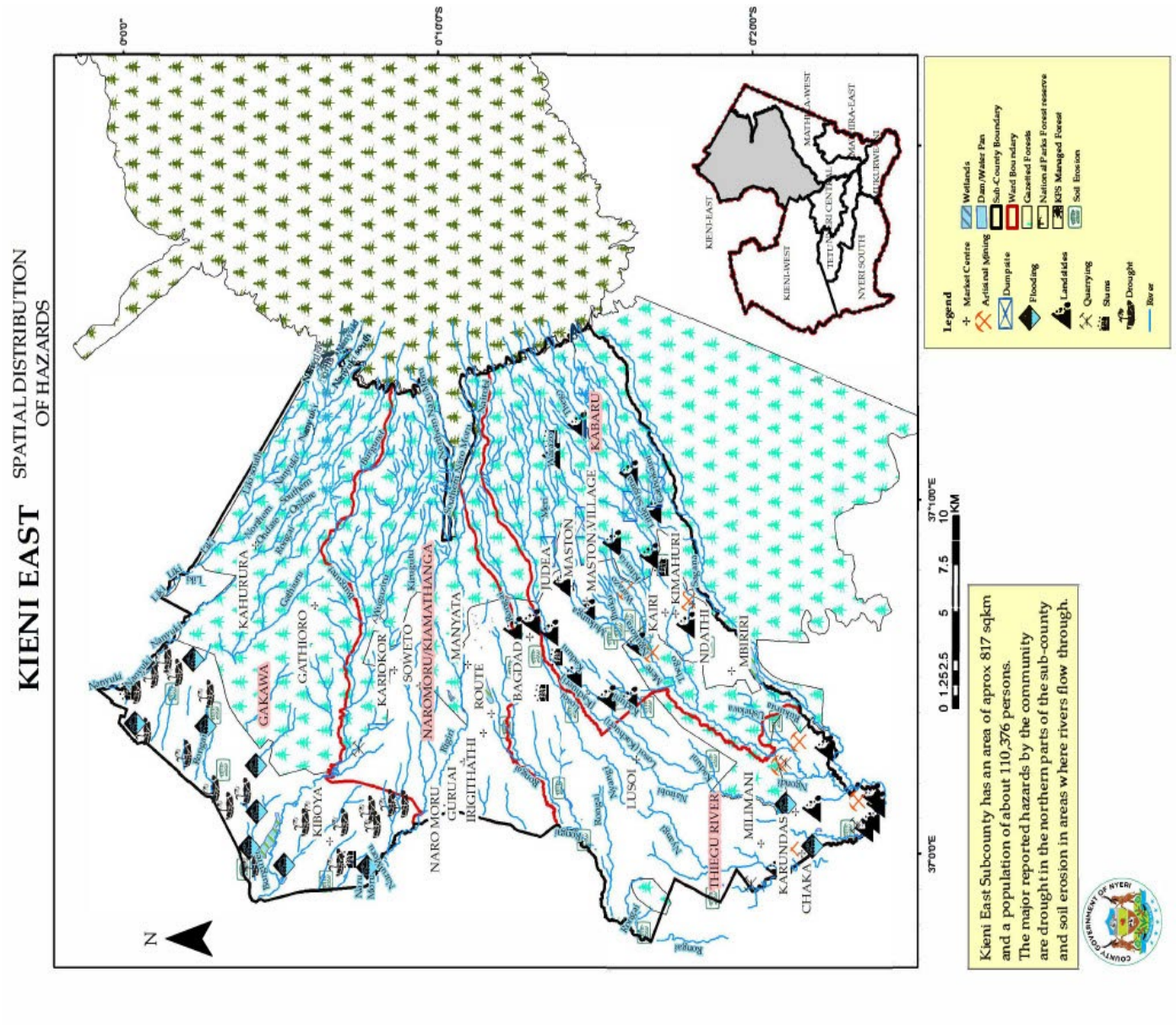

Figure 21: Map showing hazards distribution in the four wards of Kieni East

Kieni East Subcounty encompasses an expansive 817 square kilometers, primarily characterized by a semi-arid landscape with minimal annual rainfall. Its geographical composition comprises of Thegu River, Narumoru-Kiamathaga, Chaka, and Kabaru Wards, each contributing unique resources. Notably, subcounty hosts forests, rivers, artisanal mines, and wetlands. The main hazards were drought, particularly in the northern part of the subcounty, which results in acute water shortages.

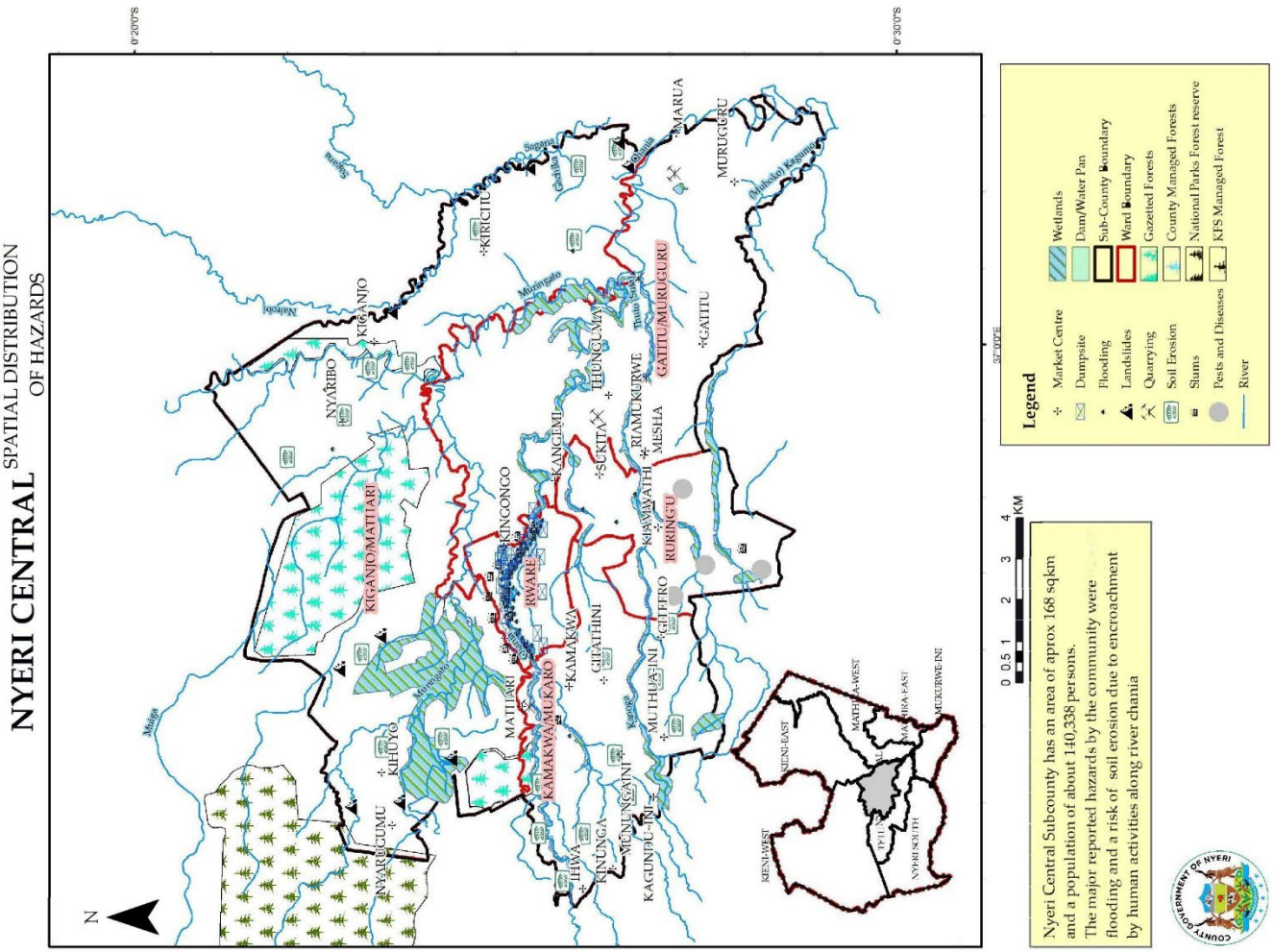

Figure 19: Map showing hazards distribution in the five wards of Nyeri Central

Nyeri Central Sub-County comprises five distinct wards: Rware, Kiganjo-Mathari, Kamakwa-Mukaro, Gatitu-Muruguru, and Rurin'gu. This sub-county boasts a blend of urban and rural landscapes, including Nyeri town within its boundaries, encompassing an expansive 168 square kilometers. Its rich natural resources encompass wetlands, forests, rivers, and quarries, contributing to its ecological diversity. The major hazards identified were frequent flooding, especially along the Chania River, as well as the looming threat of soil erosion. Farmers in the area also voiced concerns over escalating pest and diseases.

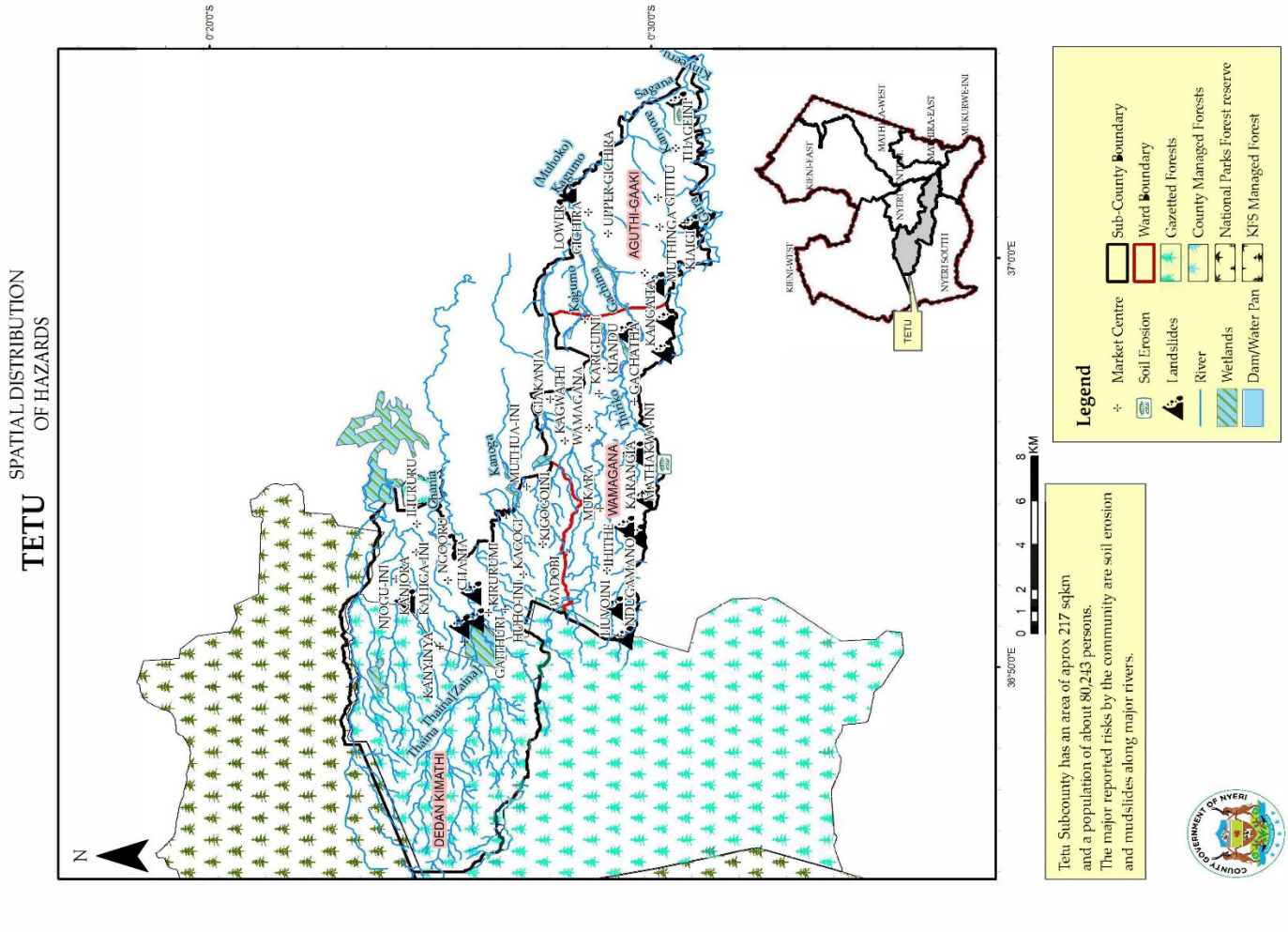

Figure 20: Map showing hazards distribution in the three wards of Tetu

Tetu Subcounty has an area of approximately 217 square kilometers and comprises three wards: Dedan Kimathi, Wamagana, and Aguthi-Gaaki. The region boasts abundant natural resources, including forests, rivers, wetlands, and dams. However, it faces significant challenges, with landslides emerging as a major hazard. Furthermore, soil erosion is a pressing concern as highlighted in the assessment.

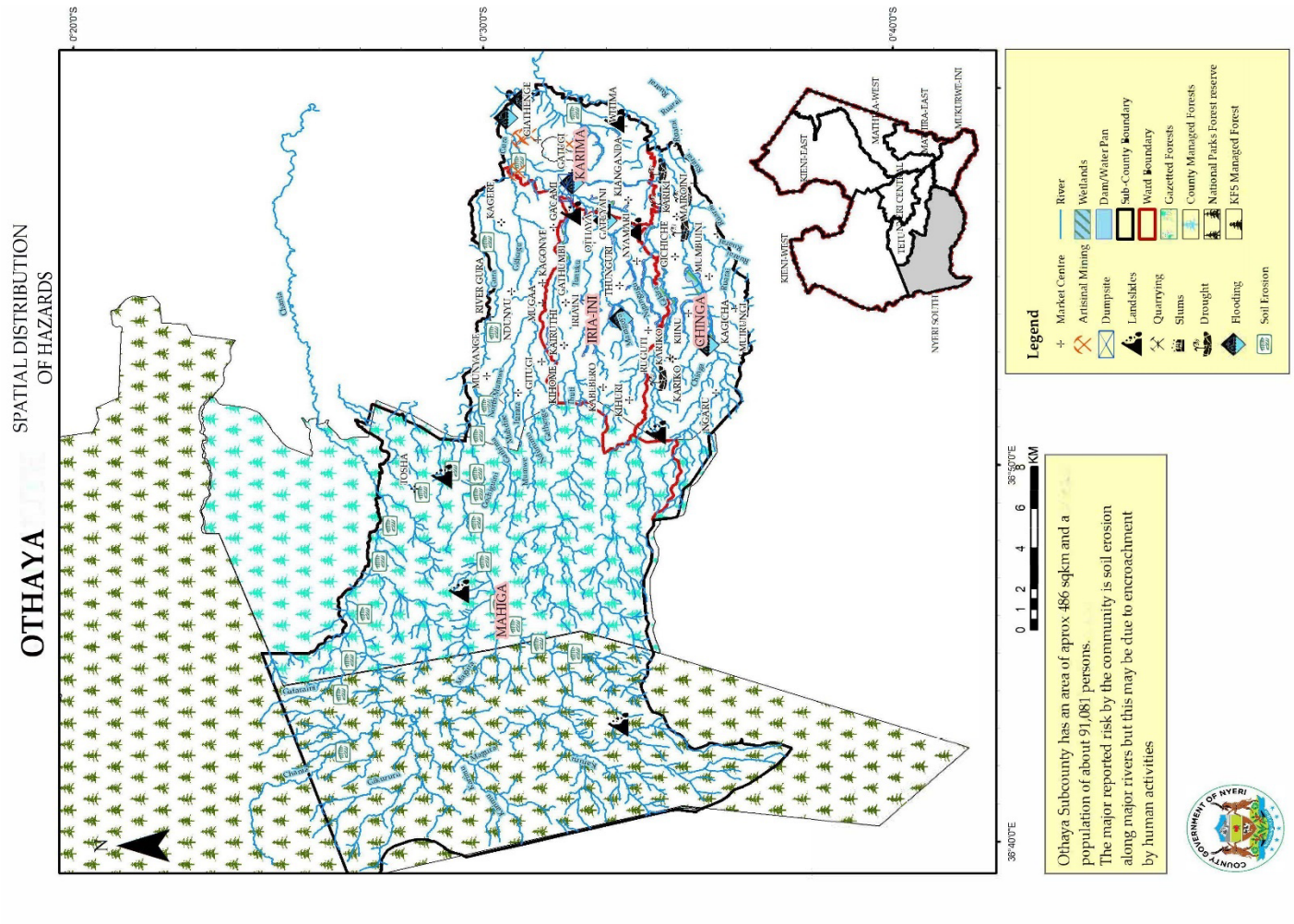

Figure 21: Hazard map for Othaya

Othaya sub-county has an area spanning approximately 486 square kilometers. Its economic backbone primarily relies on agriculture, livestock husbandry, and mining. This region is blessed with abundant natural resources, featuring rivers, wetlands, quarries, and artisanal mines. However, it faces several significant hazards, notably seasonal flooding, drought, exacerbating water shortages, landslides causing displacement, and soil erosion that detrimentally impacts soil fertility.

CHAPTER THREE: FUTURE CLIMATE SCENARIOS FOR THE COUNTY

3.0 Introduction

This chapter presents the future climate scenario of the national level and county level. It presents the findings based on the best-case scenario and the worst-case scenarios. The projections are made based on complex mathematical simulations in response to increasing Green House Gases, associated to human activities. Furthermore, the chapter comprehensively analyzes and explains national and county climate change projections.

3.1 Climate Change Projections under RCP 4.5 and RCP 8.5 Scenarios

Future climate projections are produced by complex mathematical simulations of the physical processes of the atmosphere and ocean to model the response of the global climate to increasing concentrations of greenhouse gases, aerosols, and other atmospheric constituents that affect the planet's radiative balance. There is considerable uncertainty associated with these projections, particularly at lower scales; this is in part because the models are large scale approximations to complex physical systems, but also because future emissions pathways are not yet known.

3.2 National and downscaled climate change projections

Future projected changes in rainfall over Kenya were assessed for near- (2011-2040), mid- (2041- 2070), and far- (2071-2100) future climates relative to the current climate (1976-2005) using CORDEX-Africa regional climate model (RCM) runs forced by GCM simulations under three emission scenarios (RCP2.6, 4.5, 8.5). Based on assessment of the performance of 24 model runs from five CORDEX-EA simulations, Ogega et al (2020) identified four RCM runs that outperform the all-model or individual model ensemble means in describing the spatial-temporal characteristics of precipitation over Eastern Africa. All four models' data were used for the present assessment of projected precipitation changes over Kenya under RCP 8.5 scenario, but only three of the models were available to assess projected changes under the RCP 4.5 scenario.

Figures 25 and 26 show the projected decadal MAM seasonal rainfall changes (mm/day) over Kenya based on the ensemble means of the best four model runs under RCP 4.5 and RCP 8.5 scenarios. Although there is spatial variability over the 8 future decades, there is generally a reduction in projected seasonal rainfall over northern Kenya and increase over southern regions for both RCP4.5 (Fig 25) and RCP 8.5 (Fig. 26) scenarios

compared to the 1981-2005 present climate simulations of best-model ensemble mean. Except for MAM 2081-2090 decadal rainfall change, the projected reduction appears to intensify and expand southwards under the RCP 8.5 scenario

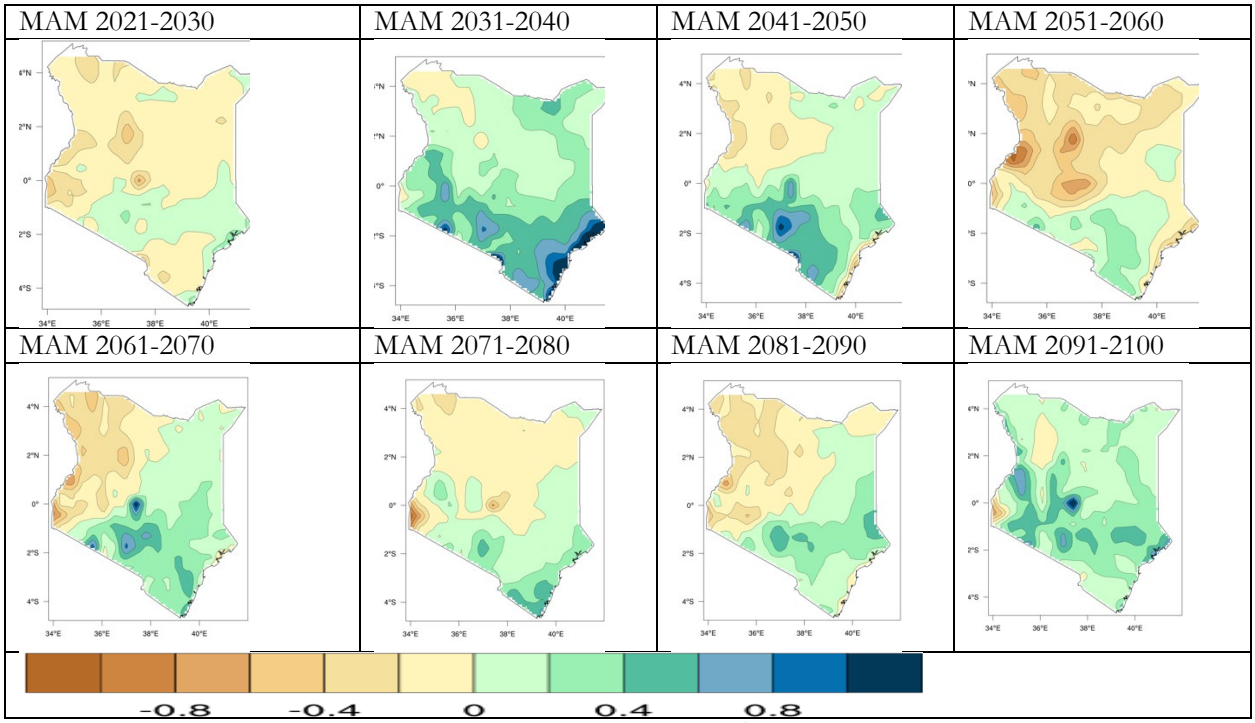

Figure 22: March-May seasonal rainfall changes (mm/day) over Kenya obtained from ensemble under the RCP4.5 scenario

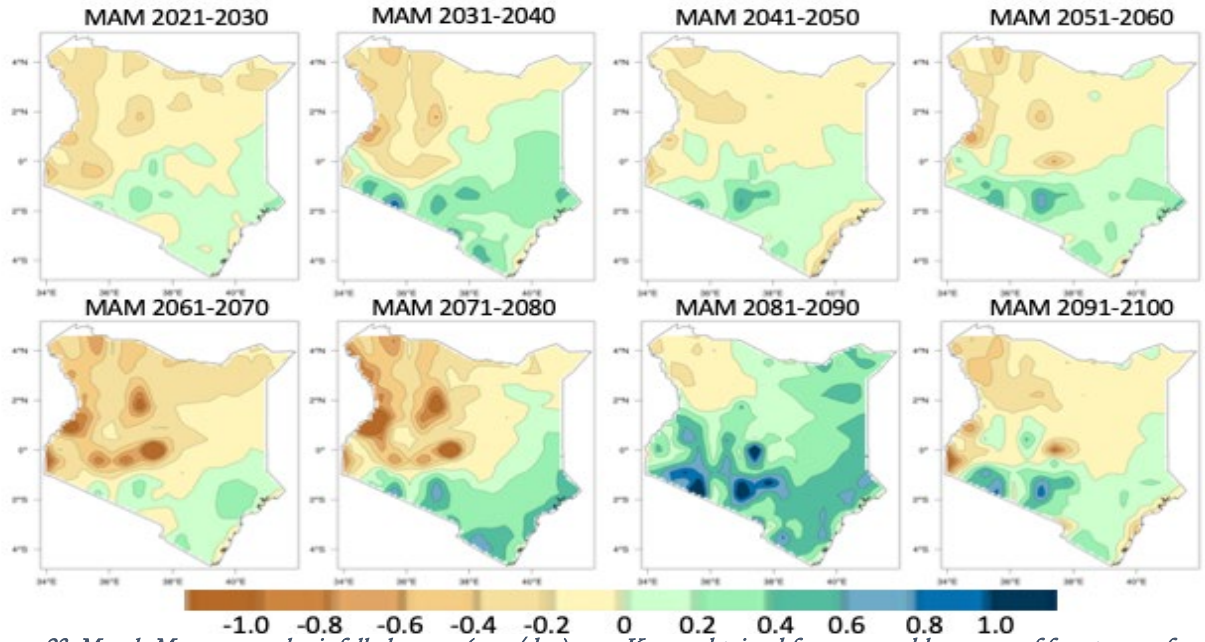

Figure 23: March-May seasonal rainfall changes (mm/day) over Kenya obtained from ensemble means of four top performing RCMs under the RCP8.5 scenario for future ten-year periods from 2021 relative to historical simulations for the period 1981–2005

Projected OND seasonal rainfall changes are shown in Figures 27 and 28. The projected decadal OND seasonal rainfall changes (mm/day) over Kenya based on the ensemble means of the best four model runs under RCP 4.5 and RCP 8.5 scenarios. Although there is spatial variability over the 8 future decades, there is generally an increase in projected seasonal rainfall over Kenya for both RCP4.5 (Fig. 24) and RCP 8.5 (Fig. 25) scenarios compared to the 1981-2005 present climate simulations of best-model ensemble mean. The OND 2081-2090 decadal rainfall change shows the highest increase in future rainfall under the RCP 8.5 scenario.

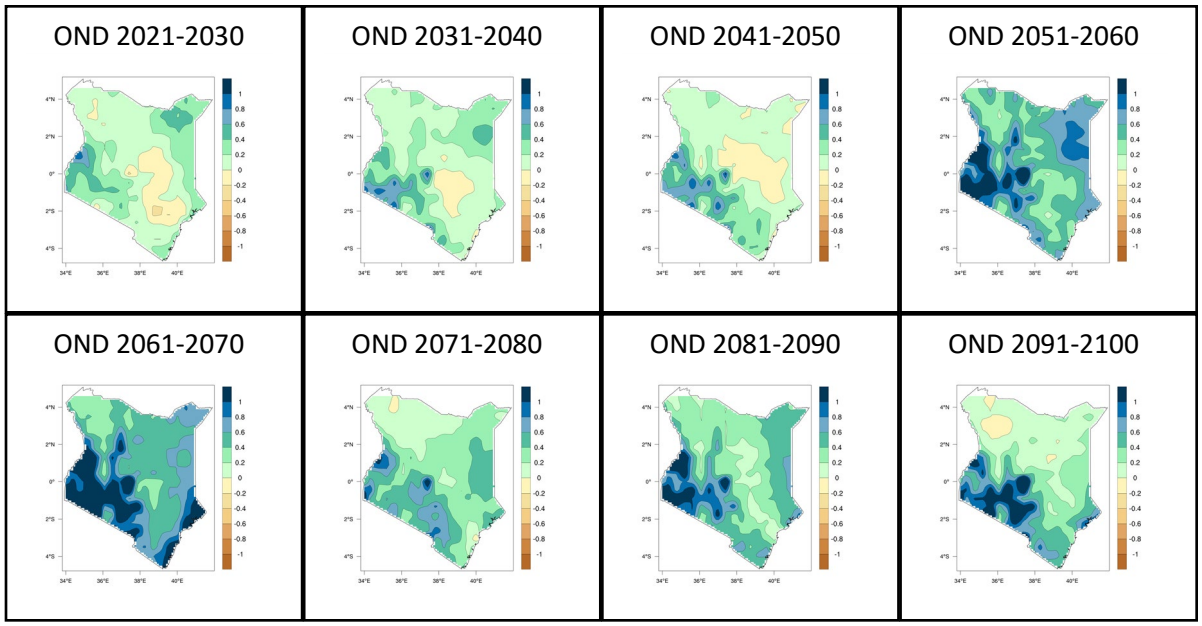

Figure 24: October-December seasonal rainfall changes (mm/day) over Kenya obtained from ensemble means of four top performing RCMs under the RCP4.5 scenario for future ten-year periods from 2021 relative to historical simulations for the period 1961–2005

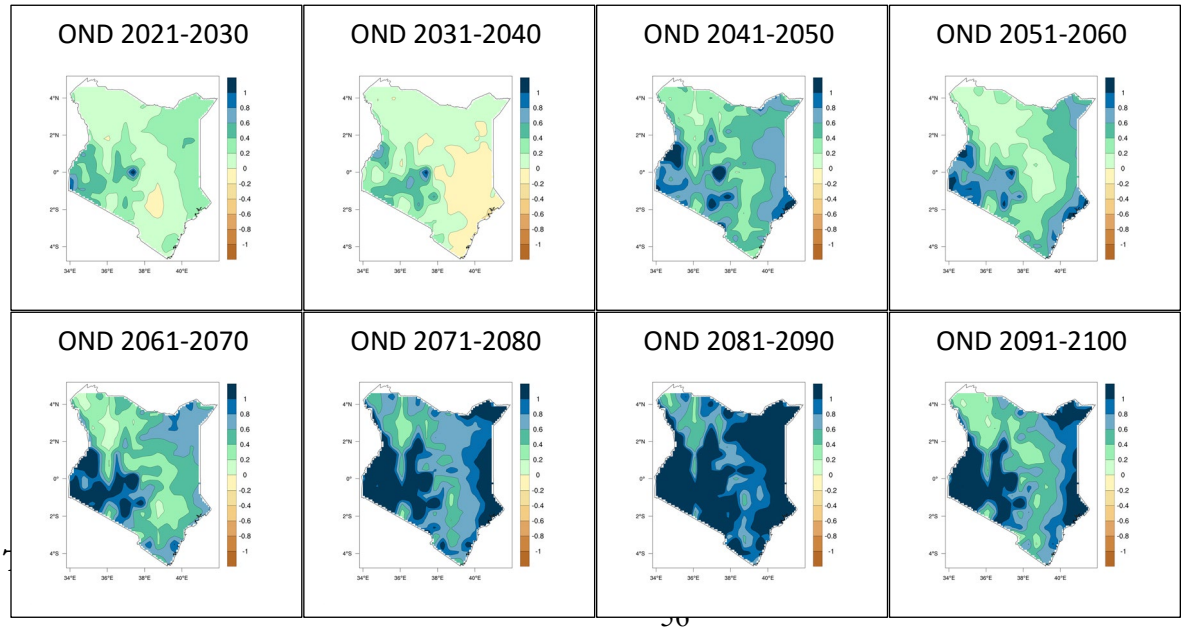

Figure 25: October-December seasonal rainfall changes (mm/day) over Kenya obtained from ensemble means of four top performing RCMs under the RCP8.5 scenario for future ten-year periods from 2021 relative to historical simulations for the period 1961–2000.

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

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

Rainfall

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

3.3 County future climate scenarios

3.3.1 Climate Change Projections under RCP 4.5 and RCP 8.5 Scenarios over Nyeri County

Future projected changes in rainfall over Nyeri were assessed for near- (2011-2035), mid- (2036- 2070), and far- (2071-2100) future climates relative to the historical climate (1981-2005) using CMIP5 model simulations under two emission scenarios (RCP 4.5 and RCP 8.5).

The projected Annual MAM and OND rainfall changes are shown in Figure 29. The projected rainfall changes (mm/day) expressed in percentage over Nyeri County based on the CMIP5 model runs under RCP 4.5 and RCP 8.5 scenarios were analyzed. Although there were spatial and temporal variability over the future projections i.e., near future (2011-2035), mid future (2036-2070) and far future (2071-2100), there is a general increase in projected annual rainfall over Nyeri County for both RCP 4.5 and RCP 8.5 (Fig. 29) scenarios compared to the 1981-2005 present climate simulations of best-model ensemble mean.

The MAM and OND projected seasonal trends show highly variable trends of increasing and decreasing rainfall for both RCP 4.5 and RCP 8.5 scenarios. Fig. 30 shows the future trends of rainfall for MAM season

under scenario RCP 4.5 and RCP 8.5. There is an increase of rainfall in the near future (2011-2035) for RCP 4.5 followed by a decrease of rainfall in the mid future (2036- 2070) under the same scenario. However, there is a general decrease of rainfall in the MAM rainfall season for both near future (2011-2035) and mid future (2036-2070) under the RCP 8.5 scenario.

Figure. 31 shows the future trends of rainfall for the OND season under RCP 4.5 and RCP 8.5 scenarios. There is an increase of rainfall in the near future (2011-2035) for RCP 4.5 followed by a decrease of rainfall in the mid future (2036-2070) under the same scenario. However, there is a general decrease of rainfall in the OND rainfall season for both near future (2011-2035) and mid future (2036-2070) under the RCP 8.5 scenario. The seasonal rainfall change shows the highest decrease in future rainfall under the RCP 8.5 scenario.

Further, climate change effects have caused the distribution, onset and cessation of rainfall within the county to vary significantly. The overall annual increase of rainfall within the county and the significant decrease of both MAM and OND seasons is attributed by shift of season from the current main rain season to either January, February (JF) or June, July, August and September (JJAS).

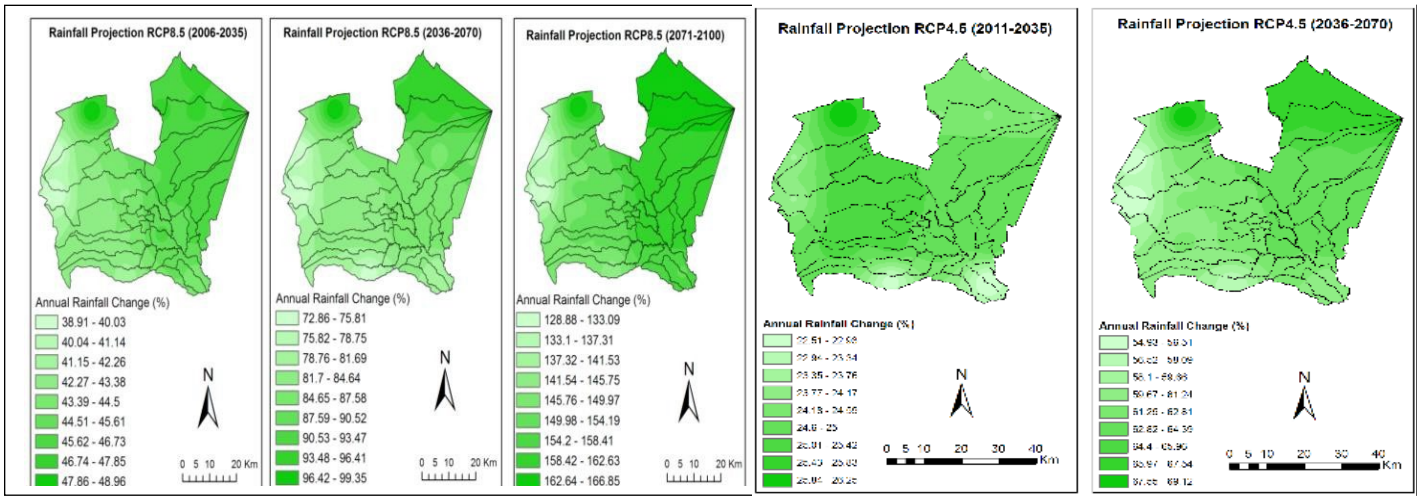

Figure 26: Annual rainfall changes (mm/day) over Nyeri expressed in percentage obtained from CIMP5 model under the RCP4.5 and RCP8.5 scenarios for future

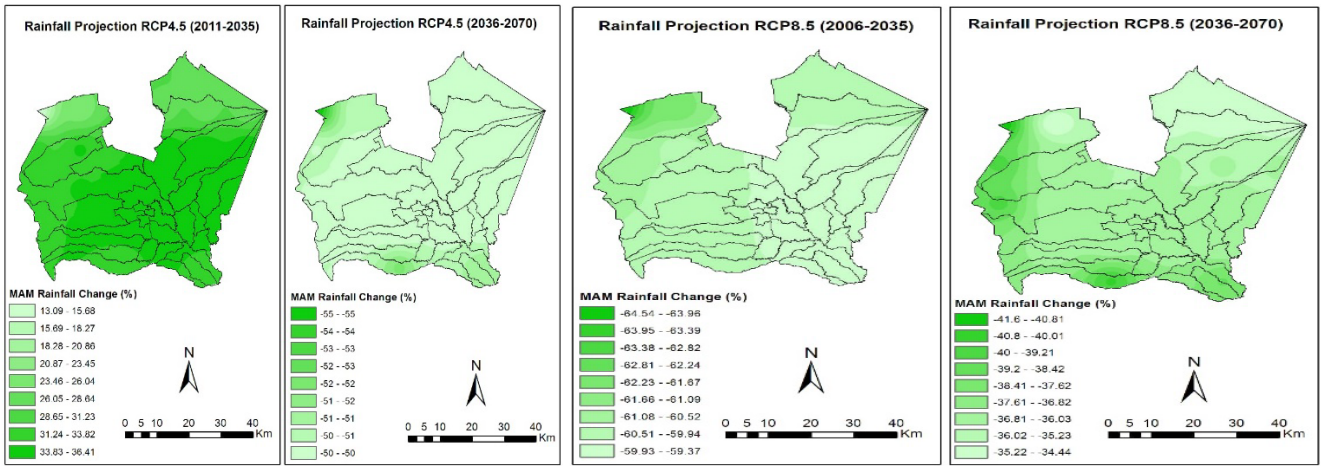

Figure 27: March-May (MAM) Seasonal rainfall changes (mm/day) over Nyeri expressed in percentage obtained from CIMP5 model under the RCP4.5 and RCP8.5 scenarios for future

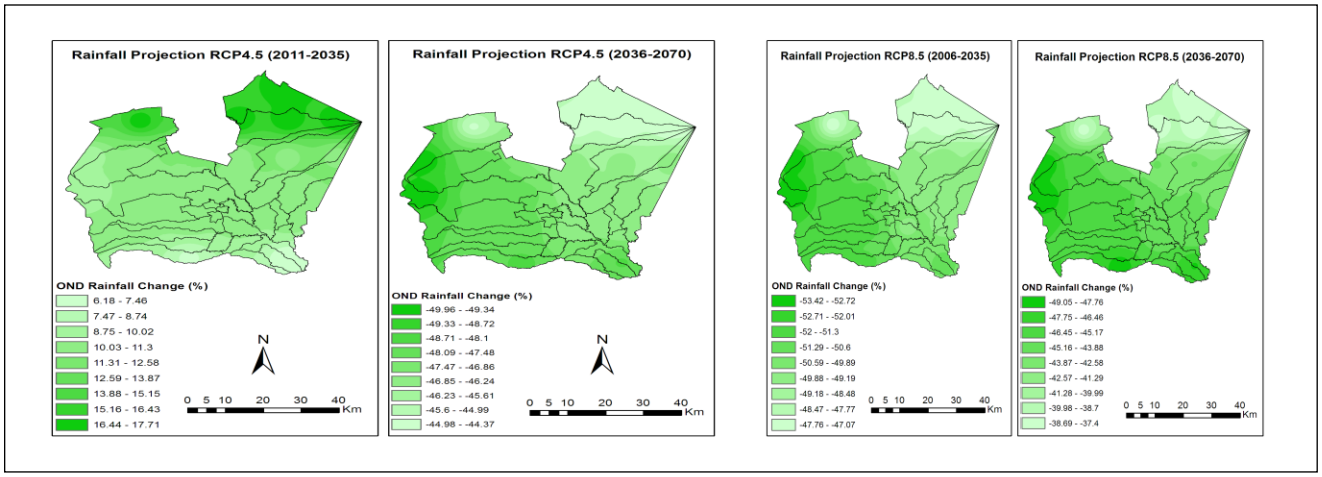

Figure 28: October-December (OND) Seasonal rainfall changes (mm/day) over Nyeri expressed in percentage obtained from CIMP5 model under the RCP4.5 and RCP8.5 scenarios for future

3.3.2 Temperature Projections under RCP 4.5 and RCP 8.5 Scenarios over Nyeri

The observed and future Maximum and Minimum temperature over Nyeri were assessed for observed (1980-2006), mid (2006-2020) and future (2020-2050) using CMIP5 model simulations under two emission scenarios (RCP 4.5 and RCP 8.5). The observation was as per the figure 1 and figure 2 below.

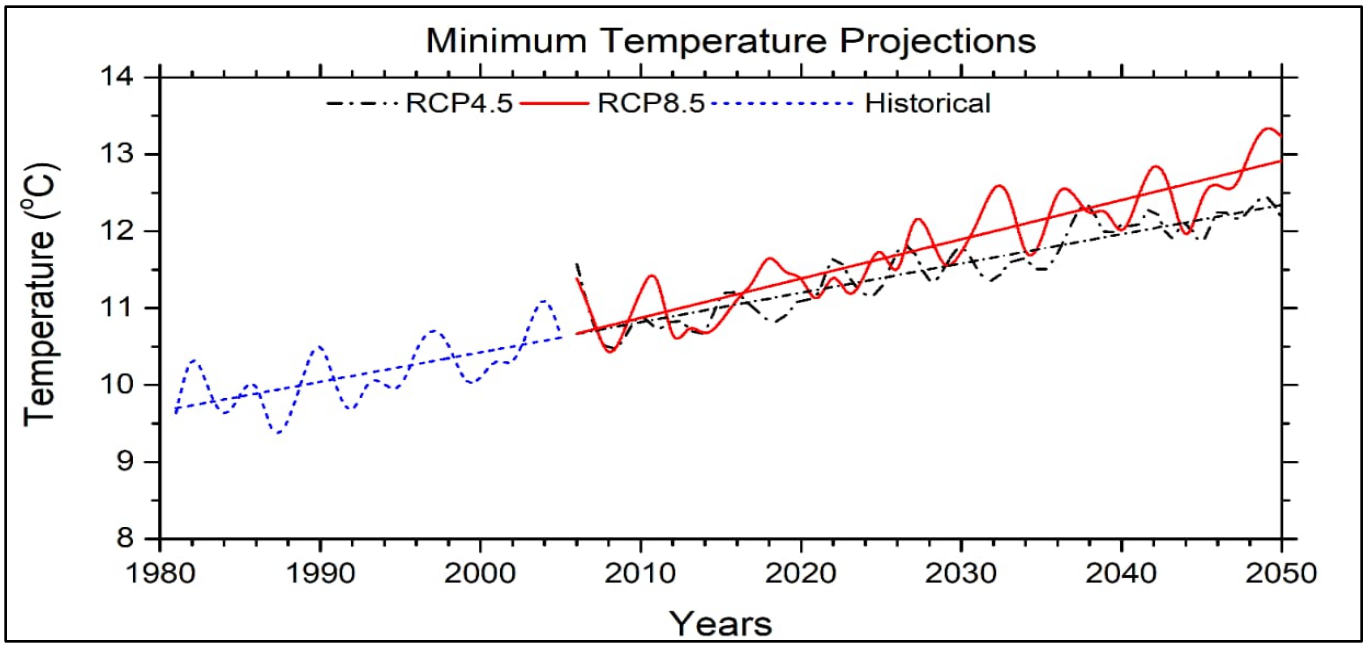

Figure 29: Observed minimum temperature from 1980 to 2006 and future minimum temperature projection from 2006 to 2050 obtained from CMIP5 model under the RCP4.5 and RCP8.5 scenarios.

The observed minimum temperature shows an increasing trend from 1980 to the year 2006. The base year 1980 had a minimum temperature of about 9.7^{O} C. The increase for the period was between 0.5^{O} C - 1^{O} C. The future minimum temperature projection shows an increasing trend for both RCP 4.5 and RCP 8.5 scenario though the rate of increase were different. The increase in RCP 8.5 was higher than that of RCP 4.5 scenario. The minimum temperature in the year 2050 is projected to be at approximately 12^{O} C.

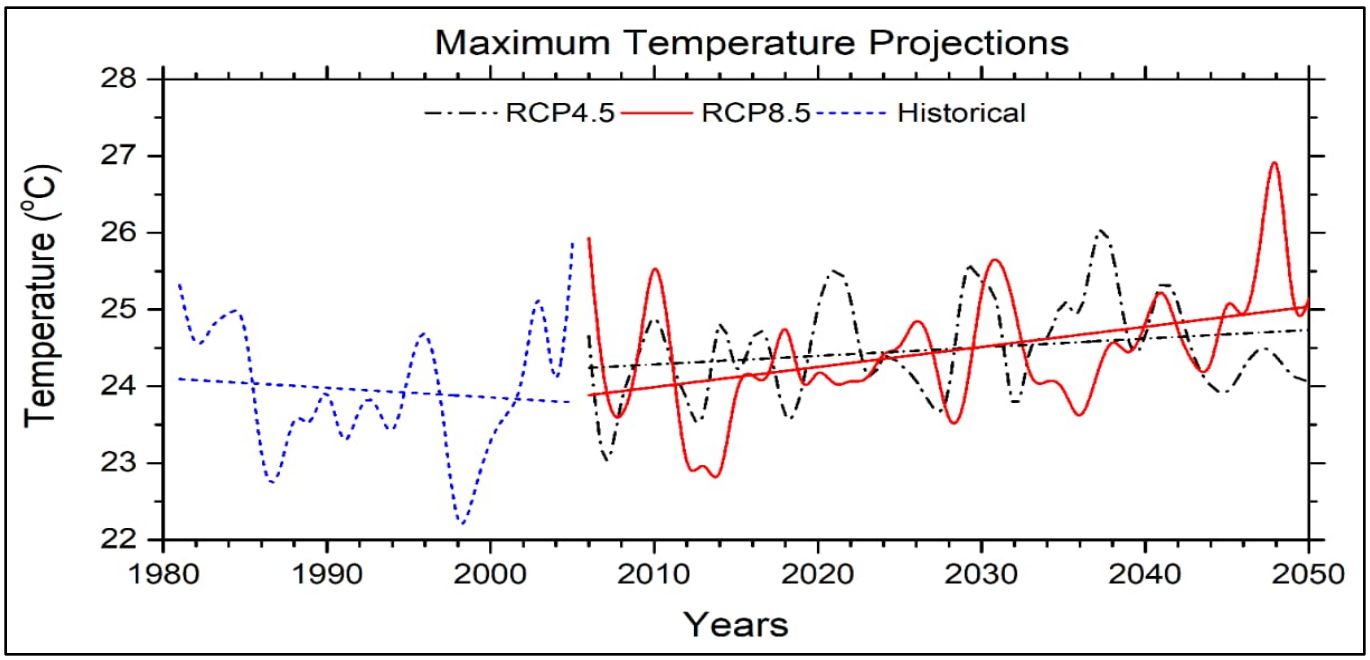

Figure 30: Observed maximum temperature from 1980 to 2006 and future maximum temperature projection from 2006 to 2050 obtained from CMIP5 model under the RCP4.5 and RCP8.5 scenarios.

The observed maximum temperature shows a slight decreasing trend from 1980 to the year 2006. The base year 1980 had a maximum temperature of about 24.2^{O} C. The decrease for the period was between 0.4^{O} C – 0.6^{O} C. The future maximum temperature projection shows an increasing trend for both RCP 4.5 and RCP 8.5 scenario though the rate of increase were different. The increase in RCP 8.5 was higher than that of RCP 4.5 scenario. The maximum temperature in the year 2050 is projected to be at approximately 25^{O} C. The increase of both maximum and minimum temperatures is due to emission of greenhouse gases into the atmosphere that subsequence causes climate change.

3.3.3 Projected Impacts of Climate Change in Nyeri County

Climate change poses a great challenge to the sustainable growth of the global economy Nyeri included. Most of the communities in the county are vulnerable to the impacts of climate change. It affects several sectors of the economy, which are critical to the livelihood of the communities. Increase in extreme climatic events and climate change has been attributed to several impacts on agriculture, water resource, health and even in the energy sector.

Climate change has been blamed to the erratic seasonal rainfall leading to change of seasons. It has been established that MAM rainfall has been on the decline and is projected to decrease in future, while that of OND is projected to increase. The changes are not uniform from one region to another. Future changes that are expected to occur are different from one climatological zone to another. Future rainfall variability is also expected to increase; therefore, climate extremes of drought and floods are expected to increase its frequency

and intensity toward the end of 21st Century. And these will result in economic losses to communities because of over dependency on rainfed agriculture. Temperature is also anticipated to increase, which might cause frequent heat wave especially in the low-lying areas and also increase evapotranspiration and thus affecting agriculture. Crop production and livestock keeping will be greatly negatively impacted by decrease in the rangeland for livestock keeping these will lead to lose of livelihood for many households and will lead to over reliance on government relief food and increase conflict over resources. It was established high heat stress will increase heat related health risks more especially to the vulnerable communities. Due to projected increase in temperature and the rapid expansion of urban areas, Urban heat island will affect the urban dweller, where night time temperature will generally increase.

3.3.4 Future changes/impacts related to the projected scenarios

a) Ecosystems and their services in the water, along river lines, on land and in freshwater

1. Risks of harmful impacts on ecosystems and human systems increase with the rates and magnitudes of warming, water bodies acidification, and other dimensions of climate change. Future risk is indicated to be high by the observation that natural global climate change at rates lower than current anthropogenic climate change caused significant ecosystem shifts and species extinctions during the past millions of years on land.
2. A large fraction of terrestrial, freshwater and marine species faces increased extinction risk due to climate change during and beyond the 21st century, especially as climate change interacts with other stressors.
3. Carbon stored in the terrestrial biosphere is susceptible to loss to the atmosphere as a result of climate change, deforestation and ecosystem degradation. The aspects of climate change with direct effects on stored terrestrial carbon include high temperatures, drought and windstorms; indirect effects include increased risk of fires, pest and disease outbreaks. Increased tree mortality and associated forest dieback is projected posing risks for carbon storage, biodiversity, wood production, water quality, amenities and economic activity.

(b) Water, food and urban systems, human health, security and livelihoods

1. Climate change over the 21st century is projected to reduce renewable surface water and groundwater resources in most dry subtropical regions, intensifying competition for water among sectors. In presently dry regions, the frequency of droughts will *likely* increase by the end of the 21st century under RCP8.5.

2. All aspects of food security are potentially affected by climate change, including food production, access, use and price stability. For wheat and maize in crops growing areas climate change without adaptation is projected to negatively impact production
3. Throughout the 21st century, climate change is expected to lead to increases in ill-health in many counties and especially with low income, as compared to a baseline without climate change.
4. Risks from vector-borne diseases are projected to generally increase with warming, due to the extension of the infection area and season, despite reductions in some areas that become too hot for disease vectors
5. In urban areas, climate change is projected to increase risks for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, flooding, landslides, air pollution, drought, water scarcity. These risks will be amplified for those lacking essential infrastructure and services or living in exposed areas.
6. Rural areas are expected to experience major impacts on water availability and supply, food security, infrastructure and agricultural incomes, including shifts in the production areas of food and non-food crops.
7. These impacts will disproportionately affect the welfare of the poor in rural areas, such as female-headed households and those with limited access to land, modern agricultural inputs, infrastructure and education.
8. More severe and/ or frequent weather hazards are projected to increase disaster-related losses and loss variability, posing challenges for affordable insurance.
9. From a poverty perspective, climate change impacts are projected to slow down economic growth, make poverty reduction more difficult, further erode food security and prolong existing poverty traps and create new ones, the latter particularly in urban areas and emerging hotspots of hunger.

CHAPTER FOUR: OVERVIEW OF EXISTING ADAPTATION/RESILIENCE STRATEGIES AND THEIR EFFECTIVENESS TO FUTURE CLIMATE RISKS

4.0 Introduction

The chapter describes the existing adaptation strategies that the local community has been utilizing to deal with the dire impacts of climate change. Furthermore, the chapter outlines the effectiveness of adaptation strategies in enhancing resilience at the grassroots. It has captured the vitality of inclusiveness in community consultations.

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

4.1.1. Drought

To counter the adverse effects of drought which has an impact chain of water scarcity, low yields and famine, the community has embraced innovative practices such as rainwater harvesting both roof and surface runoff and drilling boreholes to ensure water security during dry season for domestic and livestock use. In the agricultural sector, farmers have adopted drought-tolerant crops such as sweet potatoes, beans, cassava, millet, hay and sorghum and irrigation farming. Additionally, farmers have diversified their livelihoods and embraced CSA practices such as intercropping, use of certified seeds and early maturing, use of conservation agriculture, pasture conservation, production of aquaculture under greenhouse as well as irrigation projects crops to counter the effects of erratic rainfall.

Famine is being alleviated through the provision of relief food by the government, non- governmental organizations, and philanthropists. Furthermore, the community has tapped into indigenous knowledge and traditional weather forecasting techniques to predict weather patterns and plan their agricultural activities accordingly. Residents of semi-arid areas of Nyeri traditionally predict weather and climate variation through the observation of diverse bio-physical entities including livestock, insects, birds, trees and wildlife.

4.1.2 Floods

Floods occurrences in different wards of the county, have led to destruction /loss of biodiversity, pollution of water bodies and spread of water and vector borne diseases. The communities have adopted planting of cover crops, construction of drainage systems and gabions, terracing, establishment of cut off drains in the farms to reduce the impacts of the floods. Use of early warning systems through the Red Cross and the National Disaster Management Authority are also used. The communities also incorporate de- silting of

intakes and dams/pans to improve carrying capacity, water storage and water quality, which was found to be effective. To implement some of these initiatives the community has been funded through both National and County Governments' initiatives and in some cases NGOs.

4.1.3 Mud and Landslides

Landslides are prominent in Mukurweini, Othaya, Mathira and Tetu Sub Counties. This has resulted in destruction of properties, infrastructure and displacement of households. In some parts of the county landslides have caused the destruction and disruption of the water distribution system resulting in erosion. Landslides have also greatly impacted the production system which includes loss of livestock, destruction of livestock housing and reduction of fodder farm yield.

The community has adopted different measures for landslide risk reduction, including, afforestation, agroforestry, terracing, storm water management, and relocating people from high- risk areas. Furthermore, Early warning systems from the National Disaster Management Authority have assisted in dealing with landslides in the county.

4.1.4 Environmental degradation

Environmental degradation has been witnessed in various forms in different parts of the county such as land/mudslides, soil erosion, deforestation, destruction of water sources and reduced levels of groundwater that have affected agricultural activities, health, trade and the transport sector.

The community has implemented measures to counter these forms of degradation such as Sustainable Land Management practices (terracing, construction of gabions), catchment conservation, reforestation and afforestation of degraded land, rehabilitation of riparian land, such as wetlands restoration, and support conservation of communal forest resources.

The strategies applied have partly been effective and can be made more effective if farmers are trained and have access to information, improved infrastructure and technology e.g., irrigation systems; financial support and incentives as well as strengthened environmental organizations.

4.1.5 Human- Wildlife Conflict

Destruction of wildlife habitats and degradation of natural resources has led to human wildlife conflict due to competition of available resources such as invasion in to farmlands in search of food. In areas near forests and adjacent to wildlife conservancies, the community has devised ways to mitigate human-wildlife conflict, such as community sensitizations, erecting physical barriers, thorny fences and electric fences, provision of water and food to animals in dry seasons and enlisting the services of wildlife rangers to monitor and manage

animal populations. There are also compensation schemes initiated by the government to cushion community members from the loss of crops, livestock and property.

Livelihood diversification by the communities adjacent to forests, early warning systems and rapid response teams, conservation friendly land use planning such as wildlife corridors and buffer zones, collaborations and partnerships as well as strengthening law enforcement and deterrent measures will be key in making these strategies highly effective.

4.1.6 Frost

Frost was identified as an emerging climate hazard in Nyeri County, imposing severe risks on the local environment, water, and agriculture. Its detrimental effects encompass the destruction of crops and vegetation, leading to a stark reduction in crop yields. Communities in Nyeri County resorted to a range of adaptation strategies to contend with this formidable challenge. Notably, the utilization of windbreaks serves as an effective defense mechanism, shielding vulnerable crops from the ravages of frost. Additionally, implementing greenhouses emerged as a vital measure to safeguard plants by creating a controlled microclimate that counters the adverse effects of frost.

4.2 Effectiveness of adaptation/resilience strategies to future climate risks

As elaborated and discussed above, a wide array of adaptation and resilience strategies are employed in addressing the identified climate risks and hazards. These strategies have a varying level of effectiveness as assessed during this process. The section below presents the climate related hazards, affected livelihood and economic systems, ranked adaptation strategies and the community segment applying the strategy as well as Gender and Social Inclusion information. The ranking was done in order of effectiveness as reported by the communities. This was done from community consultation at the ward level; county multi-stakeholder climate risk assessment and further review and input by technical working group (TWG) at the county level. In order to make the adaptation strategies more effective, there is need for improved access and use of climate information; capacity building through strengthened extension services and sensitization strategies; better coordination between all actors for optimal outcomes.

NYERI COUNTY PARTICIPATORY RISK ASSESSMENT

Risk/Hazard	Livelihood/Economic System	Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Drought				
	Agriculture	Early-warning systems	MDAs, Farmers, community	The strategy should target Men, Women, Youth and PWDs
		Intensification of Irrigation	Farmers	Both men and Women will benefit from an increase in agricultural produce.
		Planting of Drought tolerant crops	Farmers	The strategy is gender inclusive.
		Proper food preservation and storage (e.g., Post harvest management)	Farmers/women	The whole community but Women will benefit more
		Diversification of livelihoods	Farmers/traders/consumers	The strategy is gender inclusive in the whole community

		Agroforestry	Farmers	The Strategy should incorporate Men, Women and Youth.
		Drought tolerant livestock	Livestock keepers/consumers	The strategy is all gender inclusive.
		Drought tolerant fodder crops	Livestock keepers/ consumers	Involve all community members to ensure everyone is reached.
		Cattle Breeding	Livestock keepers/ consumers	The strategy would be applied by both Men and Women, with men benefiting more from better breeds and increased herds.
		Soil fertility management (soil testing, low-cost composting)	Farmers	The strategy is all gender inclusive for increased agricultural produce.
		Incorporation of fast-growing crops	Farmers	The strategy is all gender inclusive.
		Value addition of products	Farmers,	Both Men and Women would benefit from the strategy.

		Early planting, upland planting, crop rotation and adoption of early maturing plants	Farmers	Involvement of all community members to ensure everyone is reached.
		Petty trading and selling of asset such as livestock	Farmers	Both Men and Women would benefit with Men benefiting more since they are asset owners.
	Water	Water harvesting technologies e.g., Rain water harvesting, construction of dams, and water pans. Provision of storage tanks both masonry and portable plastic tanks	Farmers, water resource users	Both men and Women will benefit but Women will benefit more from water harvesting.
		Alternative water sources e.g., Drilling of boreholes,	Farmers, water resource users	Inclusivity of all community members
		Afforestation and reafforestation	Farmers, water resource users	The strategy is all gender inclusive.
		Water treatment and	Farmers, water	The strategy is all

		recycling	resource users	gender inclusive.
		Desilting of existing dams and rivers intakes	Farmers, water resource users	Both men and women will benefit from an increase in irrigation water.
		Modification fishing and fish farming techniques	Fish farmers	The strategy is all gender inclusive.
	Forestry	Reafforestation/affo restation	Foresters, farmers, community	Involvement of all community members to ensure everyone is reached.
		Growing of drought tolerant species e.g., *Fraxinus berlandieriana*	Farmers	The strategy is all gender inclusive
		Diversification of livelihoods	Farmers, sawmillers community	Involvement of all community members to ensure everyone is reached.
	Health	Improvement of health care services	Government	The strategy is all gender inclusive.
		Food diversification, preservation and storage to curb malnutrition	Farmers, consumers	Involvement of all community members to ensure everyone is reached.
		Alternative water	Community, water	Involvement of all

		sources e.g., Drilling of boreholes; Provision of storage tanks to curb water wash diseases e.g.,	resource users	community members to ensure everyone is reached.
	Trade	Diversification of Livelihoods	Traders, consumers	The strategy is all gender inclusive.
		Value chains improvements	Industries. farmers	Both men and women will benefit but women will benefit more.
	Domestic/ household	Water-harvesting strategies (storage water tanks, roof-water harvesting)	Households	Both men and women will benefit but women will benefit more from water harvesting.
		Food diversification, preservation and storage	Households	The strategy is all gender inclusive.
		Diversification of livelihoods for breadwinners	Households	Both men and women will benefit with men benefiting more.
		Government/ NGO interventions to facilitate relocation of drought victims	Government, NGO	Inclusion of all community members to ensure everyone is reached.

Floods				
	Agriculture	Early-warning systems	MDAs, Farmers, community	this strategy is all inclusive
		Sensitization of farmers on flood-proofing measures such as terraces	MDAs, agriculture officers, TOTs	this strategy is all inclusive
		Soil fertility management- cover crops planting	Farmers	The strategy should target Men, Women, Youth and PWDs
		Early planting, upland planting, crop rotation and adoption of early maturing plants	Farmers	The strategy should target Men, Women, Youth and PWDs
		Petty trading and selling of asset such as livestock	Farmers, traders	The strategy should target Men, Women, Youth and PWDs
		Cross-breeding of livestock	Livestock keepers	The strategy should target Men, Women, Youth and PWDs
		Upland structures for livestock	Livestock keepers	The strategy should target Men, Women, Youth and

				PWDs
	Water	Flood water harvesting technologies - Rain water harvesting, construction of dams, and water pans, provision of storage tanks at household and learning institutional level	Government, water resource users, Learning institutions.	The strategy should target Men, Women, Youth and PWDs
		Construction of modern drainage systems for managing water flow and preventing soil saturation. and erosion	Government	The strategy should target Men, Women, Youth and PWDs
	Health	Water- treatment systems to curb water-borne diseases	WSPs, community	The strategy should target Men, Women, Youth and PWDs
		Fumigation to eradicate breeding grounds for disease-causing organisms such as mosquitoes	CHVs, community	The strategy should target Men, Women, Youth and PWDs
		Improvement of	Government	The strategy should target Men,

		health care services		Women, Youth and PWDs
		Food diversification	Farmers, community	
	Infrastructure	Climate-proofing of the built environment – culverts, roads, bridges etc.	Government	The strategy should target Men, Women, Youth and PWDs
		Installation of flood-protective systems	Government	The strategy should target Men, Women, Youth and PWDs
		Establishment of urban green spaces	Government	The strategy should target Men, Women, Youth and PWDs
	Trade	Diversification of livelihoods	Traders, consumers	The strategy should target Men, Women, Youth and PWDs
		Climate-proofing of built environment – culverts, roads, bridges etc. to facilitate transport of market products	Government	The strategy should target Men, Women, Youth and PWDs
	Domestic/	Government/ NGO interventions to	Government, NGOs	The strategy should target Men,

	household	facilitate relocation of flood victims		Women, Youth and PWDs
		Water-harvesting strategies (storage water tanks, roof-water harvesting)	Households	The strategy should target Men, Women, Youth and PWDs
		Food diversification, preservation and storage	Households	The strategy should target Men, Women, Youth and PWDs
		Diversification of livelihoods for breadwinners	Households	The strategy should target Men, Women, Youth and PWDs
Mud and Landslides				
	Infrastructure	Early warning systems	Government	The strategy should target Men, Women, Youth and PWDs
		Geo-hazard mapping	Government, GIS experts	this strategy is inclusive
		Regulation of development	Government	this strategy is all inclusive, targeting everyone
	Water	De-siltation of dams and rivers intakes.	Government	

		Harvesting of storm-water to manage run-off	Community	
		Construction, maintenance and repair of water distribution systems	Government, community	
	Agriculture	Cover crops to facilitate soil stabilization	Farmers	
		Agroforestry	Farmers, Community	this target is all inclusive to
		Terracing	Farmers, Community	The strategy should target Men, Women, Youth and PWDs
	Trade	Diversification of livelihoods	Traders, consumers	The strategy should target Men, Women, Youth and PWDs
		Climate-proofing of built environment – culverts, roads, bridges etc. to facilitate transport of market products	Government	The strategy should target Men, Women, Youth and PWDs

		Early warning systems to know about landslide prone areas	Government	The strategy should target Men, Women, Youth and PWDs
		Diversify supply chain e.g., through finding alternative routes or alternative suppliers	Traders, farmers	The strategy should target Men, Women, Youth and PWDs
	Domestic/households	Utilize information from early warning systems	Households	The strategy should target Men, Women, Youth and PWDs
		Resettlement of victims of landslides	Government, NGOs	The strategy should target Men, Women, Youth and PWDs
		Planting trees, shrubs, and ground cover can help stabilize the soil and reduce erosion.	Community	this target is all inclusive
		Constructing retaining walls, installing erosion control measures, or implementing slope reinforcement techniques.	Households	The strategy should target Men, Women, Youth and PWDs

FROST				
	Agriculture	Use of green houses	Farmers	The strategy should target Men, Women, Youth and PWDs
		Growing crops tolerant/ resistant to cold temperatures and frost	Farmers	The strategy should target Men, Women, Youth and PWDs
		Breeding of livestock tolerant to cold.	Livestock keepers	The strategy should target Men, Women, Youth and PWDs
		Flexible planting seasons i.e. By planting crops earlier or later in the season, they can minimize the risk of frost damage	Farmers	The strategy should target Men, Women, Youth and PWDs
		Undertaking irrigation through use of sprinklers during freezing conditions, to raise temperature around the crops and prevent frost damage.	Farmers	The strategy should target Men, Women, Youth and PWDs

		Use of wind breakers e.g., trees and shrubs around farms to reduce the impact of cold winds on plants	Farmers	
	Water	Proper installation and covering of underground water pipelines	Government	
		Insulating of infrastructure vulnerable to frost such as pipes, storage tanks, valves etc.	Government	
		Prompt repair of leakages to prevent freezing of water	Government, community	The strategy should target Men, Women, Youth and PWDs
	Health	Improve health care systems to deal with severe cases of frost related illnesses	Government	The strategy should target Men, Women, Youth and PWDs
		Establish emergency preparedness procedures	Government, NGOs	this strategy is all inclusive
		Establish community outreach and educational	Government	The strategy should target Men, Women, Youth and

		campaigns to raise awareness about frost-related health risks and preventive measures.		PWDs
		Proper tracking and analyzing data related to cold-related injuries, respiratory conditions, and other frost-related illnesses	Government	The strategy should target Men, Women, Youth and PWDs
	Trade	Invest in technology and undertake research and development for frost resilience.	Government, NGOs	The strategy should target Men, Women, Youth and PWDs
		Diversification of livelihoods	Traders	The strategy should target Men, Women, Youth and PWDs

Table 10: A table showing existing climate resilience adaption strategies

The afore-mentioned adaptation strategies are crucial in addressing the impacts of global warming and ensuring community resilience and ecosystems. Most adaptation strategies were seen to be effective in addressing future scenarios, while others varied at medium effectiveness. Strategies that were found to be highly effective in addressing future climate scenarios include:

Climate smart agriculture, intensification of irrigation, adoption of drought-resistant crops and livestock, application of water harvesting technologies, afforestation and reafforestation programmes, food diversification, preservation and storage to address prolonged droughts; Early planting, upland planting, crop rotation and adoption of early maturing plants, soil fertility management, sensitization of farmers on flood-

proofing measures such as terraces, expansion of current water sources, relocation of water facilities to higher elevations, climate-proofing of built environment (culverts, roads, bridges etc.) to address more frequent/ intense floods; Geo-hazard mapping, regulation of developments, de-siltation of dams and rivers, agroforestry, resettlement of victims of landslides to address more intense mud/landslides; Integrated pest management, preservation of traditional seedbanks, organic production, livestock vaccination, pest monitoring and surveillance to address wide-spread pests and diseases; and, use of green houses, use of wind breakers, overhead irrigation, community outreach and educational campaigns to address frost.

Early warning systems, diversification of livelihoods, and community awareness were found to be the most effective adaptation/ resilience strategies in addressing future scenarios in the county.

There were resources and/or actions that were identified to be crucial in enhancing effectiveness of current strategies in addressing future scenarios. These include: funding, strengthening of institutional capacity, research and innovations, value-addition, trade restrictions and embargoes to prevent invasive pests, improvement of market systems, simplified early warning systems that are accessible to vulnerable groups, utilization of media for widespread community awareness, exploration of alternative practices, development and implementation of regulatory frameworks.

CHAPTER FIVE: NYERI COUNTY CLIMATE STRATEGIC ADAPTATION INVESTMENT/ACTION PRIORITIES

5.1 Participatory risk assessment priority actions

This section focuses on the summary of priority actions as per the major climate hazards and risks which includes, Drought, Floods, Mudslides/landslides, Frost and pest and diseases that were identified during community engagement in all wards and multi-stakeholder workshop. The priority actions cover the wide range of strategies, including strengthening local livelihoods, economic systems as well as physical infrastructure investments. The process integrated the needs of vulnerable groups including: women, children, elderly, poor resource households, youths and people with disability.

S/No.	Risk/Hazard	Livelihood/Economic System/Infrastructure / Natural Resources	Specific Priority Area of Investment	Gender And Social Inclusion Information
1.	Drought	**Agriculture, livestock and aquaculture** (To increase agricultural production, productivity, food and nutrition security)	**Climate smart Agriculture Technologies** -Undertaking agricultural extension services -Provision of quality farm input (certified seeds) -Promotion of crop and livestock diversification -Soil conservation, and water management -Soil fertility management -Agro-forestry -Bio-Energy systems, -Value addition and post-harvest structures -Pest and disease control -Expansion of irrigated agriculture -Enhance mechanization -Enhance aggregation for marketing of produce -Enhance quality assurance standards -Promotion of heathy nutrition	**Poor resource household, Women and children, farmers**

			-Enhance lobbying for the sector -Enhance public private partnership -Federation of farmers into common interest groups and producer organization -Encourage value chain-based financing -Encourage community contribution in project implementation -Incentivize community towards the sector development ownership -Leverage on opportunities in carbon credit	
		(Water)To increase access to water for domestic and Agriculture	-**Water Harvesting technologies** – Construction of water pans, dams, roof water harvesting facilities and storage tanks **- Groundwater Exploration** -Drilling and Equipping of boreholes Rehabilitation of existing boreholes -Establishment of irrigation water projects	**Women and farmers**
		Environment	-Wetland /Riparian /River Catchments Protection	**Women, youths, farmers**
		Forestry (Promotion of Forestry activities	Reafforestation/afforestation and Growing of drought tolerant species e.g., Fraxinus berlandieriana	**Women youth**

		Health	-Creation of awareness on prevention of waterborne diseases, water washed diseases and malnutrition -Integrated Diseases Surveillance -Promotion of Water, Sanitation and Hygiene (WASH)	**Children, Elderly, PWD**
		Energy	-Investing on Low carbon/clean technologies e.g., Biogas, energy efficient cook stoves, Solar Street energy, harnessing on wind energy.	**Women and Children**
		Trade	-Diversification of Livelihoods	**Women, men, children, youths**
2	**FLOODS**	Agriculture	- Early warning systems Sensitization of farmers on flood proofing methods	**Farmers and women**
		water	Flood water harvesting technologies -Rain water harvesting, construction of dams, digging of water pans, -provision of storage tank	**All**
		Infrastructure	-Construction and maintenance of infrastructure (Bridges, Culverts and drainages) -Capacity building to community to Improve the ability of people to cope with floods	**Women, poor resource household**

			-Proper /improved drainage system	
		Health	-Fumigation of mosquito breeding grounds -Supply of long-lasting insecticidal nets -Establishment of Urban Green spaces	**Elderly, Children**
		Trade and cooperative	Building of climate resilient markets -Capacity building to farmers to farmers on production systems (e.g., coffee, tea)	**Women, Poor resource farmers groups**
3	**Landslides/Mudslides**	Agriculture	Early warning systems -Resettlement programs -Rehabilitation of affected areas	**Women and Poor resource farmer**
		Water	-Investing in water harvesting technologies e.g., Dams	**Women**
		Infrastructure	-Construction and improvement of water cut off drains and drainage systems -Construction of artificial water ways -Construction of gabions -Compensation of the victims as a result of properties destruction	

		Environment	-Geo-hazard mapping	**Women and poor resource farmer**
4	**Frost**	Agriculture	-Agro forestry -Adoption of sustainable Irrigation methods e.g., sprinklers irrigation -Use of Green house -Adoption of adaptive species -Research -Community sensitization on use of cold tolerant crops -Awareness creation to the community	**Farmer, Poor resource household**
		Water	-Ensuring laying of pipes at the required ground level	**Farmers**
		Health	-Improve health care systems to deal with severe cases of frost related illnesses -Establish community outreach and educational campaigns to raise awareness about frost-related health risks and preventive measures.	**Children and Elderly**

CHAPTER SIX: CONCLUSION & RECOMMENDATIONS

6.1 Conclusion

The participatory climate risk assessment (PCRA) is a valuable approach for understanding and addressing climate risks at the local level. It recognizes the importance of engaging communities, stakeholders, and experts in the assessment process, allowing for a more comprehensive and inclusive understanding of climate risks and their impacts. PCRA goes beyond traditional top-down assessments by empowering local communities to contribute their knowledge, experiences, and priorities, leading to more context-specific and actionable results.

Through the implementation of PCRA, several key findings have emerged. Firstly, PCRA has shown that local communities possess valuable knowledge and insights about climate risks that are often overlooked in traditional assessments. Their lived experiences provide a unique perspective that can enhance the accuracy and relevance of risk assessments. Secondly, the participatory nature of PCRA fosters collaboration and builds trust among stakeholders, leading to better decision-making and more effective risk management strategies. The process of engaging diverse stakeholders ensures that the voices and concerns of marginalized groups are heard, promoting social equity and justice in climate action.

Moreover, PCRA has the potential to enhance resilience and adaptive capacity at the local level. By involving communities in the assessment process, they develop a deeper understanding of climate risks and are more likely to take ownership of adaptation and mitigation measures. The participatory approach empowers communities to identify their own vulnerabilities and develop locally appropriate strategies to address them. This bottom-up approach not only improves the effectiveness of climate interventions but also builds resilience from within the community.

6.2 Recommendations

Based on the findings this Participatory Climate Risk Assessment, several recommendations can be made to promote its wider adoption and effective implementation.

1. **Integration of local and scientific knowledge for enhanced resilience**

The integration of local and scientific knowledge is essential for strengthening resilience in the face of climate change. Bridging these two forms of expertise allows clear understanding of climate change impacts within communities. Through use of local knowledge, we can enhance the accuracy and relevance of this climate risk climate assessment. The synergy between local wisdom and scientific insights empowers communities to craft adaptive solutions that are not only effective but also respectful of their unique cultural and environmental contexts.

2. **Capacity Building**

Invest in capacity building initiatives to enhance the knowledge and skills of local communities, stakeholders, and facilitators in PCRA methodologies. This can include training programs, workshops, and resource materials that help participants understand climate risks, data collection techniques, and analysis methods.

3. **Institutional Support**

Governments and organizations should provide institutional support and resources for PCRA initiatives. This includes financial resources, technical assistance, and policy frameworks that enable the integration of PCRA into decision-making processes. Institutionalizing PCRA within existing governance structures ensures its sustainability and long-term impact.

4. **Collaborative Partnerships:**

Foster collaborative partnerships between researchers, policymakers, NGOs, and community-based organizations to promote knowledge exchange and mutual learning. Such partnerships can facilitate the co-production of knowledge and the development of innovative solutions to address climate risks.

5. **Integration with Existing Processes**

Integrate PCRA with existing development planning processes and policies at different levels. This ensures that climate risk assessment becomes an integral part of decision-making, leading to more coherent and effective adaptation and mitigation strategies.

6. **Data Accessibility and Visualization**

Develop user-friendly tools and platforms that make climate risk data accessible and understandable to a wide range of stakeholders. Visualization techniques, such as maps, infographics, and interactive dashboards, can help communicate complex information and support evidence-based decision-making.

7. **Knowledge Sharing and Learning**

Encourage knowledge sharing and learning among practitioners and researchers involved in PCRA. Establish networks, platforms, and communities of practice to facilitate the exchange of experiences, methodologies, and best practices. This will contribute to the continuous improvement and refinement of PCRA approaches.

8. **Social Inclusion**

Following the arising issue of men being particularly vulnerable in Nyeri County as a result of societal pressures and climate hazards, recommendation is made for research to be done on the same to ensure that men, especially the youth are included in the vulnerable and marginalized population so that their needs ca be met in an appropriate manner.

In conclusion, participatory climate risk assessment holds immense potential for enhancing our understanding

of climate risks and promoting climate resilience at the local level. By involving communities and stakeholders in the assessment process, we can develop context-specific and inclusive strategies to address climate challenges effectively. By implementing the recommended actions, we can ensure the widespread adoption and successful implementation of PCRA, ultimately contributing to more sustainable and resilient communities in the face of a changing climate.

ANNEXES

Appendix 1: prioritized adaptation strategies done during community engagements

NYERI CENTRAL SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Drought	• Farming • Grazing • Education. • Marriages	1. Modernization of water infrastructure through construction of dams, boreholes and establishment of irrigation schemes. 2. Investment in conservation of Aberdare and Mt. Kenya catchment areas to protect our water sources. 3. Investment in water harvesting infrastructure and storage tanks. 4. Investment in drought resilient plants and animals. 5. Adoption of modern techniques of farming such as climate smart agriculture. 6. Training of agriculture and livestock extension officers to advise farmers accordingly.	• Farmers • Pastoralists. • Community based organizations • Self-help groups.	Programs targets both men, youth, women and PWDs
Floods	• Farming • Transport. • Settlement	1. Investment in community water harvesting projects like construction of water pans.	• Farmers • Community based Organization	strategy is all gender inclusive

		2. Construction of drainage systems, artificial waterways and installation of culverts on our roads. 3. Conservation of river bank and riparian areas by planting bamboo seedlings.	• Pastoralists	
Pests and diseases	• Farming • Grazing	1. Adoption of disease resistant crop and livestock varieties 2. Surveillance and scouting. 3. Spraying with ago chemicals 4. Integrated pest management practices. 5. Employment of extension officers. 6. Investing in more research on pest and diseases control	• Farmers • County government • Pastoralists	strategy is all gender inclusive
Landslides and Soil Erosion	• Farming • Electrical power sector • Transport sector • Water sector.	1. Planting of cover crops like Napier grass on sloped lands. 2. Mapping areas prone to landslides for early warning systems. 3. Soil and water conservation practices. 4. Contour farming and use of terraces on sloppy landscapes. 5. Reforestation and afforestation of degraded lands. 6. Construction of gabions on landslide prone areas. 7. Planting of indigenous trees	• Farmers • Women groups • County Government of Nyeri • CBOs • SHP	• Both men and women will be able to increase agricultural yields

NYERI COUNTY PARTICIPATORY RISK ASSESSMENT

TETU SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Landslides	• Farming • Electrical power sector • Transport sector • Water sector. •	1. Planting of cover crops like Napier grass on sloped lands. 2. Mapping areas prone to landslides for early warning systems. 3. Soil and water conservation practices. 4. Contour farming and use of terraces on sloppy landscapes. 5. Reforestation and afforestation of degraded lands. 6. Construction of gabions on landslide prone areas. 7.Planting of indigenous trees	• Farmers • Women groups • County Government of Nyeri • CBOs • SHP	• Both men and women will be able to increase agricultural yields
Extreme Temperatures.	/Farming /Small scale traders Grazing	1. Strengthen climate information services and early warning systems 2. Increase investment in modern farming techniques 3. Capacity build the community members on Livelihood diversification	• Farmers	Involvement of all community members will help to ensure that everyone is reached.

Drought	Crop and livestock Farming Drug abuse. School dropout. Early marriages. Divorces.	1. Investment in water storage and conservation of catchment areas 2. Promotion of small-scale irrigation projects. 3. Investment in modern farming techniques such as greenhouses	• Farmers • Community based Organizations • County government	Irrigation will benefit all genders; women benefit more from rainwater harvesting
Floods	• Crop farming • Transport systems • Traders	1. Investment in community water harvesting projects like construction of water pans. 2. Construction of drainage systems and installation of culverts on our roads. 3. Conservation of river bank and riparian areas by planting bamboo seedlings.	Farmers Pastoralists. Business people. The whole community.	This will benefit both men and women since it will reduce soil erosion and enhance food production

OTHAYA SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Pests and diseases	● Farming ● Grazing	1. Adoption of disease resistant crop and livestock varieties 2. Spraying with agro chemicals 3. Integrated pest management practices. 4. Employment of extension	● Farmers ● County government ● Pastoralists	strategy is all gender inclusive

		officers. 5.Investing in more research on pest and diseases control		
Drought	Crop and livestock Farming Drug abuse. School dropout. Early marriages. Divorces.	1.Investment in water storage and conservation of catchment areas 2.Promotion of small-scale irrigation projects 3.Investment in modern farming techniques such as greenhouses	• Farmers • Community based Organizations • County government	Irrigation will benefit all genders; women will benefit more from rainwater harvesting as water for domestic use will be available.
Floods	• Crop farming • Transport systems • Traders	1. Investment in community water harvesting projects like construction of water pans. 2. Construction of drainage systems and installation of culverts on our roads. 3. Conservation of river bank and riparian areas by planting bamboo seedlings.	Farmers Pastoralists. Business people. The whole community.	This will benefit both men and women since it will reduce soil erosion and enhance food production

MUKURWEINI SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information

Extreme Temperatures.	/Farming /Small scale traders Grazing	1.Strengthen climate information services and early warning systems 2.Increase investment in modern farming techniques 3.Capacity build the community members on Livelihood diversification	• Farmers • Pastoralists	Involvement of all community members will help to ensure that everyone is reached.
Drought	• Farming • Grazing • Education. • Marriages	1. Modernization of water infrastructure through construction of dams, boreholes and establishment of irrigation schemes. 2. Investment in conservation of Aberdare and Mt. Kenya catchment areas to protect water sources. 3. Investment in water harvesting infrastructure and storage tanks. 4. Investment in drought resilient plants and animals. 5. Adoption of modern techniques of farming such as climate smart agriculture. 6. Training of agriculture and livestock extension officers to advise farmers accordingly. 7. Reforestation of degraded land.	• Farmers • Pastoralists. • Community based organizations • Self-help groups.	Programs targets both men, youth, women and PWDs

Floods	• Farming • Transport. • Settlement	1. Investment in community water harvesting projects like construction of water pans. 2. Construction of drainage systems and installation of culverts on our roads. 3. Conservation of river bank and riparian areas by planting bamboo seedlings.	• Farmers • Community based Organization • Pastoralists	strategy is all gender inclusive
Pests and diseases	• Farming • Grazing	1.Adoption of disease resistant crop and livestock varieties 2. Spraying with agro chemicals 3. Integrated pest management practices. 4. Employment of extension officers. 5.Investing in more research on pest and diseases control	• Farmers • County government • Pastoralists	strategy is all gender inclusive
Landslides and Soil Erosion	• Farming • Electrical power sector • Transport sector • Water sector.	1. Planting of cover crops like Napier grass on sloped lands. 2. Mapping areas prone to landslides for early warning systems. 3. Soil and water conservation practices.	• Farmers • Women groups • County Government of Nyeri • CBOs • SHP	• Both men and women will be able to increase agricultural yields

		4. Contour farming and use of terraces on sloppy landscapes. 5. Reforestation and afforestation of degraded lands. 6. Construction of gabions on landslide prone areas. 7.Planting of indigenous trees		

KIENI WEST SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Drought	• Farming • Trade	4. Water harvesting and storage at household, community and institution level as well and on farms through trenches, water pans and construction of dams 5. Conservation of water catchment areas 6. Reforestation and afforestation of degraded land 7. Provision of relief food	• Government • Non-government organizations • Civil societies • Community members	Strategy is gender inclusive; women stand to benefit more from conserved water sources

Floods	-Farming -Transport -trade	1. Improving and maintenance of Infrastructure, including dams, bridges and culverts. 2. Desilting and rehabilitation of rivers and dams 3. Strengthen early warning systems and; access and use of Climate Information Services (CIS) 4. Sensitization of individual flood proofing measures	-National and county Government of Nyeri -Community members	Programs targets both men, youth, women and PWDs
Human-wildlife conflict	-Farming -trade -Transport	1. Installation of electric fences in areas near the forest 2. Provision of water and fodder to wild animals during the dry periods	-Government -Community members	Programs targets men, youth, women, PWDs and children
Environmental degradation such as erosion, gulley's, mudslides and destruction of water sources	• Farming • Trade • Transport	7. Sustainable Land Management practices (terracing, improved irrigation methods such as drip, construction of gabions), catchment conservation reforestation and afforestation of degraded lands, rehabilitation of riparian land; and support conservation and protection of communal forest resources 8. Adoption of Climate Smart Agriculture specifically early	• County Government of Nyeri • Civil Society Organizations • Non-governmental organizations • Community Members	Programs targets both men, youth, women and PWDs

		maturing and drought tolerant crops 9. Capacity building of the community members on soil erosion conservation mechanisms		
Erratic rainfall patterns	• Farming • Small scale traders	1. Livelihood diversification 2. Adoption of modern farming techniques 3. Use of appropriate certified seeds and 4. Strengthen early warning systems and; access and use of Climate Information Services (CIS)	• Farmers/community members • Kenya Meteorological Department • (KMD)	strategy is gender inclusive
Prolonged dry season	• Farming • Sand harvesting	• Water harvesting and storage at household, community and institution level as well and on farms through trenches • Conservation of water catchment areas • Reforestation and afforestation of degraded lands	• Farmers • Community based Organizations	women stand to benefit more from conserved water sources
Emerging pests, diseases and noxious weeds	• Farming	• Adoption of disease resistant crop and livestock varieties • Spraying with agro chemicals • Integrated pest management practices	• Farmers • County government	strategy is all gender inclusive

		• Access to basic health services with vaccination and immunization programs		

KIENI EAST SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Ranked Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Reduced quality and quantity of water in catchment areas; water catchment areas degradation and farmland and infrastructure destruction	• Farming • Trade • The transport sectors • Water supply	1. Implementation of Sustainable Land Management practices (terracing, construction of gabions) 2. Promote adoption of Climate Smart Agricultural practices (CSA) such early maturing and drought resistant crops,	• Farmers • Women groups • Youths' groups • County government • CSOs	• Both men and women will be able to increase agricultural yields and address food insecurity
Erratic rainfall patterns	/Farming /Trade	4. Strengthen climate information services and early warning systems 5. Increase investment in modern farming techniques 6. Capacity building the community on Livelihood diversification	• Farmers	Involvement of all community members will help to ensure that everyone is reached.

Drought	-Crop and livestock Farming	4. Investment in water storage and conservation of catchment areas; construction of dams, pans and installation of dam liners boreholes drilling and equipping. 5. Investment in modern farming techniques such as greenhouses; modern irrigation methods	• Farmers • Community based Organizations • County government	Irrigation will benefit all genders; women benefit more from rainwater harvesting. This strategy is inclusive of everyone in society
Floods	• Crop farming • Transport systems • Traders	1. Increase, improving and maintenance of Infrastructure, including dams, bridges and culverts. 2. Desilting, rehabilitation and protection of rivers catchment, dams and river banks 3. Strengthen early warning systems and; access and use of Climate Information Services (CIS) 4. Construction of water harvesting infrastructure such as pans and dams.	-community -County government - non-government organizations	This will benefit both men and women since it will reduce soil erosion, increase water availability and enhance food production. This strategy is all inclusive
Human-wildlife conflict	-Agriculture -Transport -Trade	1. Installation of electric fences in areas near the forest 2. Provision of water and fodder to wild animals during the dry periods 3. Sensitization of the subject	-County and national government -Kenya Wildlife Service (KWS)	This strategy is all inclusive. Women will benefit as they mostly fetch firewood in forest and take cattle for grazing

High temperature and frost	-Agriculture -community	1. Capacity building on Integrated Crop-Livestock-Forestry Systems; agroforestry, 2. Rehabilitate Degraded land and Pastures 3. Strengthen early warning systems and; access and use of Climate Information Services (CIS)	-Kenya Meteorological Department (KMD) -County Government	This strategy is all inclusive as men, women, youth, children and PWD will all benefit
Environmental degradation such as erosion, gulley's, mudslides and destruction of water sources	• Farming • Trade • Transport	1. Sustainable Land Management practices (terracing, improved irrigation methods such as drip, construction of gabions), catchment conservation reforestation and afforestation of degraded lands, rehabilitation of riparian land; and support conservation and protection of communal forest resources 2. Adoption of Climate Smart Agriculture specifically early maturing and drought tolerant crops 3. Capacity building of the community members on soil erosion conservation mechanisms	• County Government of Nyeri • Civil Society Organizations • Non-governmental organizations • Community Members	Programs targets men, youth, women and PWDs

MATHIRA WEST SUB COUNTY

Risk/Hazard	Livelihood/Economic System Affected	Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information

Unpredictable rainfall patterns	• Farming • Small scale trading	1. Promotion of livelihood diversification practices such as bee keeping and other nature-based enterprises 2. Capacity build farmers on modern farming techniques 3. Strengthen Climate information services and early warning	County government Farmers -KMD	All the genders to benefit from the strategies
Drought	• Farming • Trade	1. Construction of water reservoirs and water protection infrastructures 2. Promote, capacity build and sensitize cultivation of certified drought resistant crops 3. Promotion of smallholder irrigation and encourage alternative sources of income 4. Promotion of modern farming techniques	• Farmers • Community based Organizations	This will ensure that women spend less time in search for water and invest more time in other productive activities
Floods	• Farming • Transport systems • Traders	1. Soil and water conservation structures such as terraces, trenches 2. Construction of water pans 3. Improved, drainage system	County government -Kenya Rural Roads Authority	Strategies cuts across all genders
Pest and Diseases	• Farming • Trade	1.Investment in soil and Land Management practices 2.Integrated crop pests and disease management. 3.Increase investment in Pest and	-County Government •	This will enhance food security thus enhancing the economic status of both

		disease control measures		genders, children and PWDs
Landslides	-Households -Agriculture	1. Capacity build and sensitization to plant trees and cover-crops through agroforestry 2. Improvement and maintenance of storm water drainage systems	• Farmers • The county and national government -CSOs -Non-governmental Organizations	This strategy is all inclusive. Women, men, children and PWDs are all targeted

MATHIRA EAST SUB COUNTY

Risk/Hazard	Livelihood/ Economic System Affected	Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Environmental degradation	• Crop and Livestock Farming • Traders • The transport sector	1. Adoption of Climate Smart Agriculture (CSA) such as green houses, promotion of early maturing and drought tolerant crops, 2. Investment in Sustainable Land Management practices (terracing, construction of gabions) 3. Promotion of Soil conservation strategies	• Farmers • Women groups • County Govern ment	• Both men and women will be able to increase agricultural yields and address food insecurity.

Erratic rainfall patterns	• Farming • Small scale trading	1. Promotion of livelihood diversification practices such as bee keeping and other nature-based enterprises 2. Capacity build farmers on modern farming techniques 3. Strengthen Climate information services and early warning	Farmers	All the genders to benefit from the strategies
Drought	• Farming	1. Construction of water reservoirs and water storage infrastructure 2. Promotion of smallholder irrigation 3. Promotion of modern farming techniques	• Farmers • Community based Organizations	This will ensure that women spend less time in search for water and invest more time in other productive activities
Pest and Diseases	• Farming • Trade	1.Investment in soil and Land Management practices 2.Integrated crop pests and disease management. 3.Increase investment in Pest and disease control measures	-County Government •	This will enhance food security thus enhancing the economic status of both genders, children and PWDs

SUMMARY OF THE ADAPTATION STRATEGIES

Risk/Hazard	Livelihood/ Economic System Affected	Climate Resilience Strategies	Stakeholder Group Applying the Strategy	Gender and Social Inclusion information
Drought	• Crop and Livestock Agriculture and value addition • Marketing and Trading • Forestry • Health • Transport	1. Adoption of improved agricultural practices through irrigation, drought resistant crops, early maturing crops, as well as improved food storage and value addition 2. Enhanced water supply at household and farm levels through water harvesting and storage technologies egg roof water harvesting, construction, rehabilitation of dams, construction of lined water pans and boreholes construction 3. Rehabilitation of degraded forest land and riparian land through reforestation, agroforestry and afforestation 4. Adoption of Climate Smart Agriculture (CSA) such as green houses, promotion of early maturing and drought tolerant crops,	• Farmers • Women groups • County Government	• Both men and women will be able to increase agricultural yields and address food insecurity.

		5. Investment in Sustainable Land Management practices (terracing, construction of gabions) 6. Promotion of Soil conservation strategies		
Erratic rainfall patterns	• Farming • Small scale trading	4. Promotion of livelihood diversification practices such as bee keeping and other nature-based enterprises 5. Capacity build farmers on modern farming techniques 6. Strengthen Climate information services and early warning	Farmers	All the genders to benefit from the strategies
Prolonged dry season	• Farming	4. Construction of water reservoirs and water protection infrastructures 5. Promotion of smallholder irrigation 6. Promotion of modern farming techniques	• Farmers • Community based Organizations	This will ensure that women spend less time in search for water and invest more time in other productive activities
Pest and Diseases	• Farming • Trade	1.Investment in soil and Land Management practices 2.Integrated crop pests and disease management. 3.Increase investment in Pest and disease control measures	-County Government	This will enhance food security thus enhancing the economic status of both genders, children and PWDs

Appendix 1: Photos of Stakeholders Engagements


eMobilis


AJIRA

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