KIAMBU COUNTY

PARTICIPATORY CLIMATE RISK ASSESSMENT REPORT

OCTOBER 2023

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DEFINITION OF TERMS

Climate Change" means a change in the climate system which is caused by significant changes in the concentration of greenhouse gases as a consequence of human activities and which is in addition to natural climate change that has been observed during a considerable period of time

Adaptation" means the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects in order to moderate harm or exploit beneficial opportunities

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

"**Adaptive Capacity**" means the ability of a system to adapt to the impacts, cope with the consequences, minimize potential damages, or take advantage of opportunities offered by climate change or climate variability

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

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

ABBREVIATIONS AND ACRONYMS

AR5:	Fifth Assessment Report
CCCAP	County Climate Change Action Plan
CDM	Clean Development Mechanisms
CMIP5:	Coupled Model Intercomparison Project 5
FLLoCA	Financing Locally Led Climate Action
GCM:	Global Climate Modelling
GHGs	Green House Gases
HIV	Human Immuno-Deficiency Virus
IPCC:	Intergovernmental Panel on Climate Change
JJA:	June-July-August
KARLO	Kenya Agricultural and Livestock Research Organization
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
KIST	Kiambu Institute of Science and Technology
KIWASCO	Kiambu Water and Sewerage Company
LTM:	Long Term Mean
MAM:	March-April-May
MAX:	Maximum
MIN:	Minimum
NAP	National Adaptation Plan
NCCAP	National Climate Change Action Plan
NCPD	National Cereals and Produce Board
OND:	October-November-December
PCRA	Participatory Climate Risk Assessment
PWD	Persons with Disability
RCM:	Regional Climate Model
RCP:	Representative Concentration Pathway
SDG	Sustainable Development Goals
SGR	Standard Gauge Railway
UNFCCC	United Nation Framework Convention on Climate Change
WEENR	Water, Environment, Energy and Natural Resources

FOREWORD

The United Nations Framework Convention on Climate Change (UNFCC), the Kyoto protocol, Paris Agreement, Constitution of Kenya 2010, the National Climate Change Action Plan 2018-2022, the Kenya Vision 2030 and the Kiambu County Climate Change Act 2021 forms the basis of the preparation of the Participatory Climate Risk Assessment Report.

The preparation of the Participatory Climate Risk Assessment Report is guided by the principles such as;

- Right to a clean and healthy environment in accordance with Article 42 of the Constitution.
- Respect for human rights, national values and principles of governance as spelt out in Article 10 of the Kenyan Constitution.
- The values and principles of public service as provided for under Article 232 of the Constitution.
- Commitment to the fulfillment of state obligations in respect to the environment as stipulated under Article 69 of the Constitution.
- Promotion of sustainable development.
- Ensuring participation of all stakeholders in planning and implementation of climate change responses.
- Enhancing access to information, sharing and knowledge management.
- Building partnerships and collaborations in climate change actions and responses.
- Promoting intra and inter-governmental cooperation and collaboration in climate change actions and responses.
- Ensuring equity and social inclusion.
- Mainstreaming gender, special needs and indigenous people in climate change actions and responses.
- Recognition, respect and integration of knowledge, perspectives and experiences of communities in climate change responses.
- Recognition of the role in research, innovation and application of technology in addressing challenges in climate change.
- Ensure integrity, accountability, transparency, community driven and bottom-up planning for response to climate change.

The PCRA report is a roadmap that will be undertaken to enhance climate resilience through development planning, management, implementation, regulation, monitoring of adaptation, mitigation measures and actions. Additionally, it has incorporated the Governors manifesto, the relevant aspirations of regional development frameworks, the 2030 Agenda and international obligations such as Sustainable Development Goals (SDGs), the Paris Agreement on climate change and the Sendai Framework, among others.

A consultative approach to the preparation of this report was adopted hence it is a demonstration of a shared commitment to undertaking climate action by involving everyone. This is the only approach that will lead to sustainable success and progress to minimize the County's carbon footprint and enhance the adaptive capacity of residents to cope with climate change. In that regard, concerted efforts will be taken to ensure that resources are mobilized and channeled towards the implementation of this report.

I call upon all relevant stakeholders, development partners and the people of Kiambu County to remain steadfast in playing their respective roles during Programme/project planning, implementation, monitoring and evaluation in order to bring about the envisaged results.

DAVID KURIA

CEC MEMBER WATER, ENVIRONMENT, ENERGY AND NATURAL RESOURCES

ACKNOWLEDGEMENT

The preparation of the Participatory Climate Risk Assessment Report was achieved through commitment, dedication, sacrifice and determination of the staff members of the County Government, citizens and other stakeholders who provided valuable inputs.

We wish to thank the Governor H.E. Dr. Paul Kimani Wamatangi, and the entire management team of Kiambu County Executive Committee Members and Chief Officers for their unwavering support. This process kicked off by a county management meeting whereby the Directorate of Climate Change presented their roadmap and work plan that was approved and supported.

We appreciate the immense contribution made by the Technical Cross-Sectoral Working Group who spearheaded the entire process from stakeholder mapping, engagement, data collection and analysis and the final report writing. This team that was drawn from various departments spent many hours and went beyond the call of duty to make this Participatory Climate Risk Assessment a success. The teamwork demonstrated reinforced the necessity of approaching climate issues in a multi-sectoral manner since it is cross cutting.

The County Assembly of Kiambu, through the coordination of the Departmental Sectoral Committee played a crucial role in budget allocation which ensured that all activities were implemented.

The department also wishes to extend sincere gratitude to the National Treasury and development partners for the coordination, financial support and technical support that ensured this program was successfully rolled out.

The county government lauds the members of the public and professionals who heeded to the call and offered valuable insights into the climate change scenario. Their contribution and recommendations forms the heart of this document.

JENNIFER MUSYOKI

CHIEF OFFICER WATER, ENVIRONMENT, ENERGY AND NATURAL RESOURCES

EXECUTIVE SUMMARY

Kiambu County is one of the 47 counties in the Republic of Kenya, located in the central region and covers a total area of 2,538.7 Km^2. It borders Nairobi and Kajiado Counties to the South; Machakos to the East; Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West. It lies between latitudes 00 25'and 10 20'South of the Equator and Longitude 360 31'and 370 15'East. The County has twelve constituencies (sub-counties) and sixty wards in number.

The Kiambu County Participatory Climate Risk Assessment Report presents an in-depth analysis of the climate change context, risks, vulnerabilities and proposed interventions. This report was one of the outputs under the Financing Locally Led Climate Action (FLLoCA) program.

The county experiences two rain seasons: the long rains season runs between March and May and is wetter than the short rains season experienced between October and December. Dry spells (periods with less than 20 mm rainfall) occur between July and September. This season is also cooler characterized with drizzles and frost in some parts of the County. April receives the highest rainfall, more than 200 mm. The annual average precipitation in the county is 600-1300 mm. The northern region receives an annual average precipitation of more than 1000 mm. Historical annual average rainfall and temperature records show a directional-spatial trend, with peak values generally appearing in the northern parts of the county for precipitation and western parts of the county for temperatures.

The annual average temperature for the county is 15-23°C. The western areas of the county including the upper midland and the lower highland agro ecological zones experience annual average temperatures greater than 20°C. Lowest temperatures are recorded in the months of June to August whereas highest temperatures are recorded in the months of January to March. The county's average relative humidity ranges from 65 percent in February which is generally a hot month and 84 percent in the wet months of April and May.

The process of developing this PCRA report was highly interactive at all levels of the county. Stakeholders were engaged from the County, Sub County and Ward Levels. The process kicked off with a county management meeting comprising of H.E the Governor, his CECs and Chief Officers and officers from climate change directorate. The entire process was spearheaded by a Technical Working Group which comprised of 34 officers drawn from

different county departments.

Other stakeholders were engaged at the county, sub county and ward level. The participants were drawn from diverse sectors and social demographics. The stakeholders were invited based from the stakeholder identification that had been done. They included academia, government departments, producer groups, farmers, Matatu welfare, youths, PWDs, herbalists, CBOs and FBOs.

The exposure and vulnerability of key interest groups and their livelihood systems a far as climate hazards and trends are concerned in Kiambu County shows that different hazards impact differently on livelihoods. The agricultural sector is shown to be highly vulnerable to many hazards while other sectors are impacted differently.

Kiambu has existing reliance strategies in place. These strategies are in the agriculture, roads, public health, lands, housing, trade and other sectors. The successes vary and there is capacity for more interventions.

CHAPTER ONE: AN OVERVIEW OF KIAMBU COUNTY

1.1 Background Information

1.1.1 Location and Size

Kiambu County is one of the 47 counties in the Republic of Kenya, located in the central region and covers a total area of 2,538.7 Km^2. It borders Nairobi and Kajiado Counties to the South, Machakos to the East, Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West. It lies between latitudes 00 25'and 10 20'South of the Equator and longitudes 360 31'and 370 15'East.
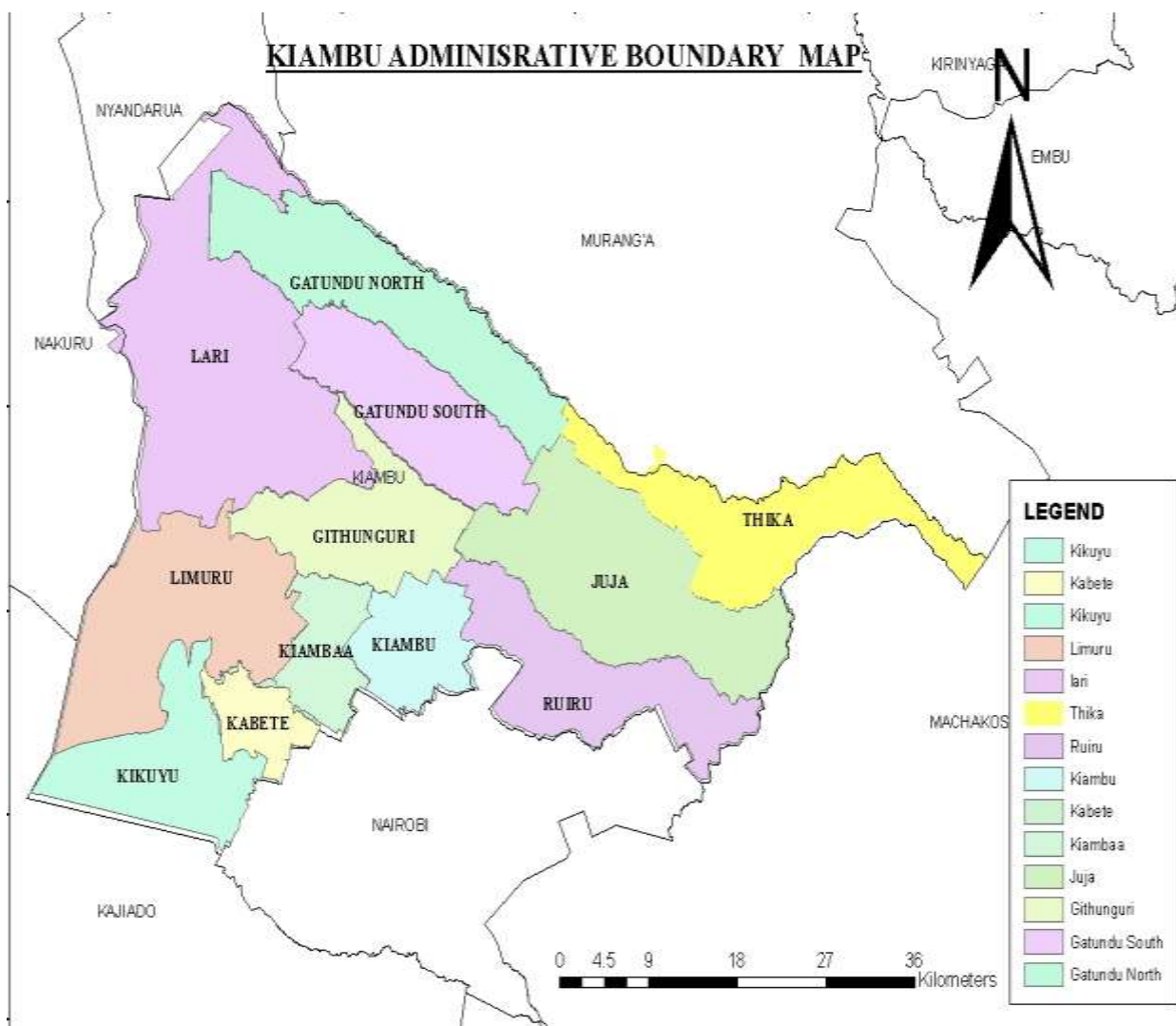
Figure 1 : Map of Kiambu County

1.1.2 Administrative Boundaries

The County has twelve constituencies and sixty wards as shown in the table below.

Table 1: County's Administrative and Political Units and County Wards by Constituency

Constituency / Sub County	No. of wards	Electoral Wards
Gatundu North	4	Gituamba, Githobokoni, Chania, Mang'u
Gatundu South	4	Kiamwangi, Kiganjo, Ndarugo, Ngenda
Githunguri	5	Githunguri, Githiga, Ikinu, Ngewa, Komothai
Juja	5	Murera, Theta, Juja, Witeithie, Kalimoni
Kabete	5	Gitaru, Muguga, Nyathuna, Kabete, Uthiru
Kiambaa	5	Cianda, Karuri, Ndenderu, Muchatha, Kihara
Kiambu	4	Ting'ang'a, Ndumberi, Riabai, Township
Kikuyu	5	Karai, Nachu, Sigona, Kikuyu, Kinoo
Lari	5	Kinale, Kijabe, Nyanduma, Kamburu, Lari/Kirenga
Limuru	5	Bibirioni, Limuru Central, Ndeiya, Limuru East, Ngecha/Tigoni
Ruiru	8	Gitothua, Biashara, Gatongora, Kahawa/Sukari, Kahawa Wendani, Kiuu, Mwiki, Mwihoko
Thika Town	5	Township, Kamenu, Hospital, Gatuanyaga, Ngoliba
Total	**60**	

1.1.3 Physical and Topographic Features

Kiambu County is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zones. The Upper Highland Zone is found in Lari sub-county and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 meters above sea level. It is dominated by highly dissected ranges and it is very wet, steep and an important water catchment area. The major forests in the County are also found

in this zone, which are Kieni and Kinale with an acreage of 13,723.6 and 10, 504.87 hectares respectively.

The lower highland zone is mostly found in Limuru and some parts of Gatundu North, Gatundu South, Githunguri and Kabete sub counties. The area is characterized by hills, plateaus, and high-elevation plains. The area lies between 1,500-1,800 meters above sea level and is generally a tea and dairy zone, though some activities like subsistence and sheep farming are also practiced. The upper midland zone lies between 1,300-1,500 meters above sea level and it covers mostly parts of Juja and other sub counties with the exception of Lari. The landscape comprises of volcanic middle level uplands. The lower midland zone partly covers Thika, Limuru and Kikuyu sub counties. The area lies between 1,200-1,360 meters above sea level. The soils in the midland zone are dissected and are easily eroded. Other physical features include steep slopes and valleys, which are unsuitable for cultivation. Some parts are also covered by forests.

1.1.4 Geology and Soils

The county is covered by three broad categories of soils which are; high level upland soils, plateau soils and volcanic footbridges soils. These types are of varying fertility levels. Soils from high-level uplands are from volcanic rocks and very fertile, conducive for livestock keeping and growth of various crops such as tea, coffee, horticultural products, pyrethrum, vegetables, maize, beans, peas and potatoes among others. These soils are mostly found in Gatundu South, Gatundu North, Githunguri, Kiambu, Kiambaa, Lari, Kikuyu, Kabete and Limuru sub counties.

Low fertility soils are mainly found in the middle zone and the eastern part of the county which form part of the semi-arid areas. The soils are sandy or clay and can support drought resistant crops such as soya beans and sunflower as well as ranching. These soils are mostly found in parts of Juja, Thika Town, Ruiru, Kikuyu, Limuru, Gatundu North and Gatundu South sub counties.

Most parts of the county are covered by soils from volcanic footbridges. These are well drained with moderate fertility. They are red to dark brown friable clays, which are suited for cash crops like coffee, tea and pyrethrum. However, parts of Thika Town, Ruiru and Juja sub counties are covered by shallow soils, which are poorly drained, and these areas are characterized by low rainfall, which severely limits agricultural development. However, these areas are suitable for ranching and growth of drought resistant crops.
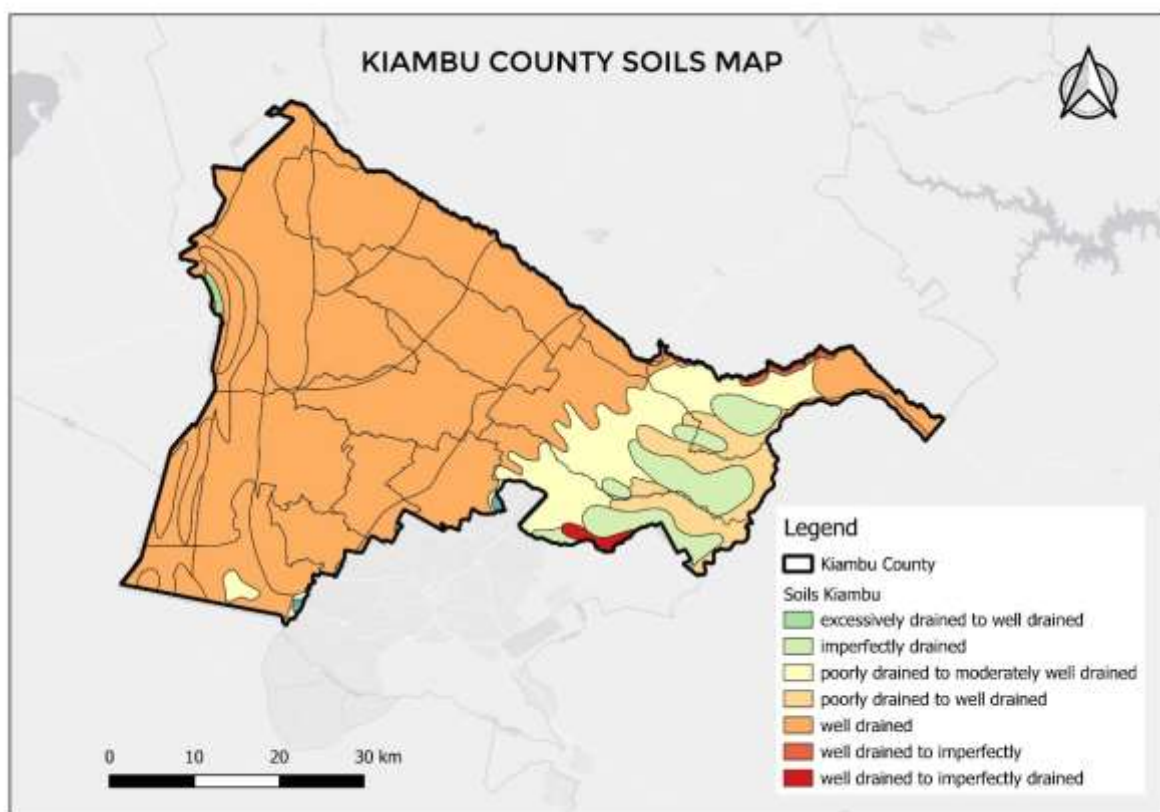
Figure 2: Soil Types in Kiambu

1.1.5 Climatic Conditions

The county experiences two rain seasons: the long rains season runs between March and May and is wetter than the short rains season experienced between October and December. Dry spells (periods with less than 20 mm rainfall) occur between July and September. This season is also cooler characterized with drizzles and frost in some parts of the County. April receives the highest rainfall, more than 200 mm. The annual average precipitation in the county is 600-1300 mm. The northern region receives an annual average precipitation of more than 1000 mm. Historical annual average rainfall and temperature records show a directional-spatial trend, with peak values generally appearing in the northern parts of the county for precipitation and western parts of the county for temperatures.

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1.1.6 Ecological Conditions

Kiambu County covers a wide range of agro ecological zones based on the climatic characteristics. These are upper highland humid and semi humid; lower highland humid, semi humid and sub humid; upper midland humid, semi humid and sub humid; lower midland humid, semi humid and sub humid; lower midland transitional and upper midland transitional, among others.

The upper highland humid agro ecological zone covers the upper parts of Kiambaa and Limuru; Kikuyu sub county falls in the lower highland semi humid zone; Gatundu North and Gatundu South sub-counties found in the upper midland sub humid agro ecological zone. Small land holdings as well as small scale farming are mostly found in these areas. The large land holdings are especially found in Juja sub-county which is in the upper midland transitional agro ecological zone and the upper highlands in Limuru and Lari sub-counties in the upper highland humid zone.

1.1.7 Water Resources

The County has both surface and ground water resources. The county is divided into several sub-catchments areas. The first one is Nairobi River Sub-catchment which occupies the southern part of the county with the major rivers being Nairobi, Gitaru, Gitathuru, Karura, RuiRwaka, and Gatharaini. The second one is Kamiti and Ruiru Rivers Sub-catchment which is located to the north of the Nairobi River sub-catchment. It has eight permanent rivers which include Riara, Kiu, Kamiti, Makuyu, Ruiru, Bathi, Gatamaiyu and Komothai.

The third one is the Aberdare plateau that contributes to the availability of two sub-catchments areas comprising of Thiririka and Ndarugu Rivers. The main streams found in the two areas include Mugutha, Theta, Thiririka, Ruabora, Ndarugu and Komu. They flow from Nairobi, Kamiti, Ruiru, Thiririka, and Ndarugu sub-catchments to form Athi River sub-catchment. The fourth is the Chania River and its tributaries comprising of Thika and Karimenu Rivers which rise from the slopes of Mt. Kinangop in the Aberdare ranges. The last one is Ewaso Kedong sub catchment which runs in the North-South direction and occupies the western part of the County. It has several streams that normally form swamps such as Ondiri and Nyakumu swamps in Kikuyu subcounty.

The eastern part of the county that includes Thika, Gatundu, Ruiru and Juja is well endowed with surface water from Chania, Thika, Karimenu, Ruabora, Ndarugu, Thiririka, Theta, Mukuyu, Ruiru rivers. The western part of the county that includes Limuru, Kikuyu, Kiambu,

Karuri, Lari and Githunguri areas has limited surface sources, hence rely on underground water sources mainly boreholes.

1.1.8 Social- Economic Activities

The County is predominantly an agricultural County with a high proportion of the population depending on agriculture for their livelihood. The county is also highly dependent on its natural base, making it one of the counties that are highly vulnerable to the impacts of climate change.

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

2.1 Background to the Participatory Climate Risk Assessment Process

Climate change has increasingly become a concern globally and its effects are now being felt at the lowest level of our communities. Kiambu County has not been spared of the negative impacts and therefore there is need to put measures in place to mitigate and adapt effectively. The communities need to be equipped with the necessary information, technology and finances to combat climate change. The resilience measures undertaken should in a special way assist the most vulnerable residents cope and adapt to the climate changes.

To supplement the global and national efforts to address climate change a Risk Assessment was undertaken to take stock of the risks and hazards as well as the proposed interventions. This Assessment will be a useful tool for climate action at the county level.

2.2 Policy Context

2.2.1 INTERNATIONAL LEGAL AND POLICY FRAMEWORKS

Globally, Climate change is a challenge which demands a global solution, and Kenya is a party to the United Nation Framework Convention on Climate Change (UNFCCC), the Kyoto protocol and Paris Agreement, which are international efforts designed to strengthen the global response to the threat of climate change, in the context of sustainable development. Kenya became a party to the UNFCCC on June 23, 1994. The **UNFCCC** is an international environmental treaty aimed at addressing climate change and its impacts. It provides a framework for countries to cooperate on reducing greenhouse gas emissions and adapting to the impacts of climate change. Kenya ratified the **Kyoto Protocol** on November 12, 2005.The Kyoto protocol is an international treaty linked to the UNFCCC that sets binding targets for industrialized countries to reduce their greenhouse emissions. Kenya, as a developing country, has also been involved in Clean Development Mechanism (CDM) that promotes sustainable development. Kenya signed the Paris Agreement on April 22, 2016, and ratified it on May, 2016. The **Paris Agreement** is a landmark international climate agreement that aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius. It sets out a framework for countries to regularly report on their emission reduction efforts and enhance their climate actions over time. Kenya is actively working towards achieving the **Sustainable Development Goals**

(SDG), especially SDG 13 "take urgent action to combat climate change and its impacts.

Constitution of Kenya, 2010

The Constitution of Kenya (2010) lays a foundation for the formulation of adaptation and mitigation legislation, policies, strategies and plans. In Article 11 under Culture, the Constitution recognizes the roles of science and indigenous technologies in development. Further, it provides that legislation will be enacted to recognize and protect ownership of indigenous seeds and plant varieties and use by communities. In Chapter 4, article 42 it guarantees the right to a clean and healthy environment. It provides that every Kenyan has a right to a clean and healthy environment. In Article 43 on Economic and Social rights, the constitutions states that "every person has a right to be free from hunger, and to have adequate food of acceptable quality". In chapter 5 on Land and Environment, article 69 provides for obligations in respect of the environment while Article 72 requires Parliament to pass legislation relating to the environment.

a) Climate Change Act, 2016

The objective of the Climate Change Act 2016 is to provide mechanisms and measures to improve resilience to climate change and promote low carbon development and provide a regulatory framework for an enhanced response to climate change. The Climate Change Act adopts a mainstreaming approach, provides a legal basis for climate change activities through the NCCAP, and establishes the National Climate Change Council and the Climate Fund.

With this enactment, Kenya joins the league of nations that have taken concrete steps to domesticate the Paris Accord on Climate Change. The main objective of the Climate Change Act is to be applied in the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya.

b) Energy Act, 2019

The Energy Act provides a useful supporting framework for the transition to a green economy with likely gains in environmental protection and climate change. The Act mandates the government to promote and encourage the development and use of renewable energy, including biodiesel, bioethanol, biomass, solar, wind and hydropower.

c) Forest Conservation and Management Act, 2016

The act protects existing forests and promotes reforestation and afforestation efforts towards increasing carbon storage capacity and reducing greenhouse gas emissions. The act also emphasizes on sustainable forest management practices, which help prevent deforestation, and ensure long-term viability of forest ecosystems. The act also emphasizes the involvement of local communities and indigenous people in forest conservation and management to foster a sense of ownership and stewardship, leading to more effective forest management and conservation. The Act establishes mechanisms for monitoring and enforcement to help address issues such as illegal encroachment, and unsustainable practices that contribute to deforestation and forest degradation. The act further promotes collaboration between government agencies, local communities, civil society organizations, and other stakeholders involved in forest conservation to foster knowledge and exchange best practices that aim at protecting and conserving the forests.

d) Community Land Act, 2016

Community Land Act (2016) gives rural and indigenous communities the legal right to own the land they live in and use for their livelihoods, culture, and homes. The Community Land Act provides a clear process which communities should follow to be able to register and govern their lands. This toolkit does not seek to replace the traditional/customary climate change resilience practices the communities have adopted over time, but rather to build on and strengthen them.

e) The Environmental Management and Coordination Act, 1999 (Amendment, 2015)

The Environment and Management Co-ordination Act (EMCA) 1999 is the operative law on matters concerning the environment. It is Kenya's first framework environmental law. It sets out general principles, creates administrative bodies, lays out environmental quality standards and provides for the inspection, enforcement and punishment of environmental offences The Environment and Management Co-ordination Bill 2022, seeks to repeal EMCA 1999. Importantly, the Bill introduces a proposal for the National Environment Management Authority (NEMA) to develop guidelines for integrating climate risk and vulnerability assessments as part of the environmental assessment study process.

Section 49 promotes the use of renewable energy and the planting of trees. Further Section 57 grants the relevant ministry the possibility to allow fiscal incentives under the form of tax rebates for private entities "that invest in plants, equipment and machinery for pollution control,

re-cycling of wastes, water harvesting and conservation, prevention of floods and for using other energy resources as substitutes for hydrocarbons".

Section 50 sets the legal framework to ensure the conservation of biological diversity, and charges the relevant agency to "measure the value of unexploited natural resources in terms of watershed protection, influences on climate, cultural and aesthetic value, as well as actual and potential genetic value thereof." The document also contains a number of dispositions to protect forests.

f) Sustainable Waste Management Act 2022

Sustainable Waste Management Act, 2022 is developed to ensure material resources are used efficiently as prioritized by waste hierarchy, circular economy and clean production in order to reduce the amount of waste that is generated, deposited or discarded in the environment including the management of materials that would otherwise have been dumped or wasted in a way that contributes to environmental, social and economic goals of sustainable development.

g) The Environmental Management and Coordination (Air Quality, Regulations, 2013

The Environmental Management and Coordination (Air Quality) Regulations set emissions standards for air pollution including greenhouse gas emissions. Under Section 14, occupiers and operators of certain types of facility are required to apply for emissions licenses and prohibited from emissions exceeding the levels set out in Schedule 3 of the Act. Greenhouse gases are listed as priority air pollutants in Schedule 2 of the Act.

h) Public Health Act CAP 242

This Act concerns the protection of public health in Kenya and lays down rules relative to, among other things, food hygiene and protection of foodstuffs, the keeping of animals, protection of public water supplies from pollution, the prevention and destruction of mosquitos and the abatement of nuisances including nuisances arising from sewerage. The Act establishes the Central Board of Health and a district health management board in each district.

i) Kenya Vision 2030 and Its Medium-Term Plans (MTPs)

Kenya Vision 2030, is the country's development blueprint. Its objective is to help transform Kenya into a "newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment" The Vision 2030 particularly recognizes that Agriculture will continue to play a crucial role towards the achievement of a sustained GDP growth rate of 10% annually. The Vision is based on three pillars: economic,

social and political. The vision recognizes climate change as a risk that could slow the country's development. However, it did not identify actions to address climate change in its original form. Climate change actions were identified in the Second Medium Term Plan (MTP) (2013-2017). The Third Medium Term Plan (2018-2022) recognized climate change as a crosscutting thematic area, and mainstreamed climate change actions in sector plans.

j) National Climate Change Action Plan (NCCAP) 2018-2022

The NCCAP provides mechanisms to realize low carbon climate resilient development. It emphasizes sustainability, while prioritizing adaptation and enhanced climate resilience for vulnerable groups. NCCAP 2018-2022 has identified seven priority areas, including: Disaster Risk Management; Food and Nutrition Security; Water and the Blue Economy; Forestry; Wildlife, and Tourism; Health, Sanitation, and Human Settlements; Manufacturing; and Energy and Transport.

NCAAP aligns with the Government's Big Four Agenda, and the Sustainable Development Goals (SDGs). NCCAP 2018-2022 seeks to increase the number of households and entities benefiting from devolved adaptive services; improve the ability of people to cope with drought and floods; improve the coordination and delivery of disaster management response; improve crop productivity through roll out of actions in the Kenya Climate Smart Agriculture (KCSA), 2017-2026; improve crop productivity by increasing the acreage under irrigation; increase productivity in the livestock and fisheries sectors through implementation of relevant actions in KCSA; and diversify livelihoods to adjust to the changing climate.

k) National Climate Change Response Strategy (NCSRS), 2010

The National Climate Change Response Strategy is a strategic document with a multi-sectoral approach whose vision is for a prosperous and climate change resilient Kenya. The objective is to strengthen and focus nationwide actions towards climate change adaptation and Global Greenhouse Gas emission mitigation. In summary, the objective of the NCCRS is to respond to climate change by, among other aspects:

- Enhancing 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.

The NCCRS recognizes the link between climate change and food security: climate change affects the four components of food security, namely food availability, food accessibility, food utilization and food system stability. The strategy aims to help eliminate hunger, food insecurity and malnutrition. With a view to making agriculture more sustainable, sectoral adaptation and mitigation interventions are set out under Chapter 4. Adaptation measures include the prevention, tolerance or sharing of losses, changes in land use or activities, changes of location, and restoration.

The strategy also aims to reduce poverty, not only in urban but also in rural areas. Focus is given to increasing the resilience of livelihoods to disasters. Regarding governance, it is proposed that Ministry of Environment and Mineral Resources establishes a National Climate Change Steering Committee to help it gather and collate input and advice from key climate change stakeholders for its use in the coordination of Kenya's climate change activities. Also, the National Climate Change Activities Coordinating Committee (NCCACC) will continue to serve in its current advisory capacity.

l)   National Adaptation Plan (NAP), 2015-2030

The aim of NAP is to consolidate the country's vision on adaptation supported by macro-level adaptation actions that relate with the economic sectors and county level vulnerabilities to enhance long term resilience and adaptive capacity. This NAP presents adaptation actions that cover the timeframe 2015-2030. NAP is aligned to MTP II in which climate change adaptation is represented in the drought risk management and ending drought emergencies, environment, water, energy, agriculture, livestock, and fisheries sectors. The NAP proposes macro-level adaptation actions and sub-actions in 20 planning sectors, categorizing them into short-, medium- and long-term time frames. The objectives of the NAP include:

- Highlight the importance of adaptation and resilience building actions in development
- Integrate climate change adaptation into national and county level
- Development planning and budgeting processes
- Enhance the resilience of public and private sector investment in the national transformation, economic and social pillars of Vision 2030 to climate shocks.

- Enhance synergies between adaptation and mitigation actions in order to attain a low carbon climate resilient economy
- Enhance resilience of vulnerable populations to climate shocks through adaptation and disaster risk reduction strategies.

m) National Climate Finance Policy, 2018

NCFP, 2018 outlines the role that climate financing could play in each of Kenya's most important economic sectors (agriculture, forestry, energy, transport, trade, tourism, manufacturing, water and sanitation, disaster risk management, and research and innovation). It describes the policy interventions the Kenyan government intends to make with respect to climate financing, including to establish a national Climate Change Fund, identify climate financing sources and create a national system for tracking them, enhancing Kenya's carbon trading system, and exploring the possibility of green bonds. It describes the current legal and policy framework for climate financing that is relevant for Kenya, focusing on both domestic and international sources.

n) Sessional Paper No.1 of 2017 on National Land Use Policy

The overall goal of the national land use policy is to provide legal, administrative, institutional and technological framework for optimal utilization and productivity of land related resources in a sustainable and desirable manner at national, county and community levels. The Policy is cognizant of numerous factors that affect land use in Kenya which include geographic and ecological features, population distribution, social, historical, cultural and economic factors. Other key factors are administrative, institutional and policy instruments, investment, urbanization and land tenure. So as to ensure efficient, productive and sustainable use of land, key measures shall be taken by the government (both national and county) and all land users. These include: sound land use practices, conservation and enhancement of the quality of land and land-based resources and the proper management of demographic and health parameters. The Government shall institute mechanisms designed to induce land owners to put their land to productive use and encourage the application of efficient technology for the intensification of land use. Urban land use will be improved through measures such as establishing transparent, accountable, sustainable, comprehensive and participatory governance structures and decision-making processes.

o) National Climate Change Framework Policy, 2008

The National Climate Change Policy Framework (NCCPF) sets out the Government's

commitments and responsibilities to address climate change. This policy framework will guide the development of adaptation and energy security measures, prepare to manage current climate variability and future climate projections.

The document sets five priority goals:

- Strengthen the Enabling Environment for Climate Change Adaptation and Mitigation, including Sustainable Financing.
- Adaptation and Reducing Risks for a Climate Resilient Future.
- Energy Security and Low-Carbon Future
- Disaster Preparedness, Response and Recovery
- Building Education and Awareness, Community Mobilization, whilst being mindful of Culture, Gender and Youth.

The National Climate Change Committee (NCCC) will further oversee the development of a Climate Change and Disaster Risk Management National Action Plan. This action plan will identify priority actions needed under each strategic goal, and align these with actions already identified under the National Action Plan for Disaster Risk Management 2008-2018.

p) Climate Risk Management Framework, 2017

The Climate Risk Management Framework for Kenya outlines how the government intends to harmonize its climate change and disaster risk policies. According to the framework, there are ten priority areas that overlap between climate change and disaster risk policies, which can be areas for government intervention. Specifically, the government intends to:

- Create an enabling policy and legal framework for integrated climate risk management (policy framework);
- Build capacity at national and county level for integrated climate risk management (capacity building);
- Analyze the level of exposure, vulnerability to disasters, and capacity at the local scale (exposure, vulnerability, and capacity);
- Involve communities at risk, and consider gender and marginalized groups (gender mainstreaming);
- Mobilize financial resources for climate risk management (resource mobilization);
- Mainstream climate risk management into sector programmes, plans and activities (mainstreaming climate risk management);

- Design and implement pilot projects for climate risk management at county and national level (pilot projects);
- Enhance research and dissemination of information about climate risk management (training, research, and outreach);
- Create platforms for sharing lessons and good practices on integrated climate risk management (learning).

q) National Energy Policy, 2018

The policy promotes use of renewable energy sources to reduce reliance on fossil fuels and reduce greenhouse gas emissions. It also highlights the importance of adopting energy-efficiency sources to reduce energy consumption and associated carbon emissions. It facilitates the transition to a low-carbon economy by encouraging sustainable practices such as cleaner cooking solutions. The policy also promotes sustainable land use practices to minimize vulnerability to climate-related risks and encourages research and development initiatives in clean energy technologies, climate change mitigation, and adaptation strategies. Further it aids international collaboration, partnerships, technology transfer and financial support from various organizations, and development partners to help achieve Kenya's climate goals.

2.2.3. COUNTY LEGAL AND POLICY CONTEXT

a) Kiambu County Climate Change Act, 2021

The Act provides for a framework and mechanism for mobilization and facilitation of county government and its stakeholders to respond effectively to climate change through appropriate adaptation and mitigation measures and actions.

b) Kiambu County Water and Sanitation Services Act, 2015

The Act, Part IV-V, ensure that water conservation areas are demarcated, conserved and protected for the purpose of conserving water, initiate programs that promote soil conservation and sustainable management of wetlands as well as flood flow management. It also provides necessary sanitation services in the urban areas for sustainable Wastewater/effluent management.

c) Kiambu County Sustainable Forest Management and Tree Growing Policy, 2023 (Draft)

The Act, facilitate legal and regulatory reforms that promote sustainability of the environment and forest resources, facilitate transition to green growth and chart ways of mitigating and

adapting to climate change. It also enhances climate change resilience, water aquifer recharge and low emission development pathway in all economic sectors for sustainable development and posterity.

d) **Kiambu County Citizen Petition and Participation Act, 2016**.

The Act, establish modalities and a platform for citizen petition in the governance of the County and for connected purposes. It provides clear guidelines on citizen petition and participation on all matters affecting them including climate change related issues.

e) **Kiambu County Food Safety Bill, 2021 (Draft)**

The Act, make provision for protection of the public against health hazards in production, handling, processing, distribution, storage and sale of food and feeds.

f) **Public Finance Management (Kiambu County Climate Change Fund Regulations, 2021) (Draft).**

The Act define the procedures for resource mobilization, administration, management, operations, and winding up of the Climate Change Fund. This Fund will provide funding for climate change activities identified in the County Integrated Development Plan (CIDP), County Climate Change Action Plan and County Climate Finance Framework and for connected purposes.

2.3 Purpose of the Participatory Climate Risk Assessment (PCRA) Report

This Participatory Climate Risk Assessment (PCRA) report will identify the key climate risks and hazards that are in Kiambu County as well as the strategic areas of investment. The key stakeholders are identified and the actions for different actors that are involved in climate action also presented. The PCRA will promote climate resilience and empower communities at the lowest level to tackle climate related challenges in a timely and sustainable manner. The report will specifically help to:

a) Identify climate stressors in various sectors that facing the community

b) Ascertain vulnerability and risks that various sectors and livelihoods and groups

c) Identify location of hazards in the county

d) Identify factors that contribute to vulnerability of groups and resources

e) Examine existing coping mechanisms and their effectiveness

f) Prioritize adaptation actions

2.4 Key Steps in the County's Participatory Climate Risk Assessment Process

The process of the developed PCRA report was highly interactive at all levels of the county. Stakeholders were engaged from the County, Sub County and Ward Levels. The process kicked off with a county management meeting comprising of H.E the Governor, his CECs and Chief Officers and officers from climate change directorate. The management team gave utmost level of support to the process.

The PCRA entire process was spearheaded by a Technical Working Group which comprised of 34 officers drawn from different county departments. The technical Working group met for three days during which they were sensitized on the PCRA and CCAP process. The team also undertook stakeholder mapping and stakeholder engagement.

Figure 3: Training of Technical Cross sectoral Working Group

The county level stakeholder engagement was held at Kiambu County Headquarters. The participants were drawn from diverse sectors and social demographics. The stakeholders were invited based from the stakeholder identification that was earlier carried out. They included

academia, government departments, producer groups, farmers, matatu welfare, youth, PWDs, herbalists, CBOs and FBOs.

The Climate Risk Assessment was undertaken in all wards in the county. The participants were briefed on the purpose of the activity and subsequently guided to provide the required data. Different stakeholders for each ward were represented to give their contributions for their respective areas.

Figure 4: Community members mapping resources in Kiganjo Ward, Gatundu South
Technical Working Group met severally as the various steps of the PCRA process progressed, analyzed data and prepared a draft report which was validated by a multi stakeholder climate risk assessment workshop.

Figure 5: PCRA Workshop Preparation Meeting

CHAPTER THREE: KIAMBU COUNTY CLIMATE HAZARD PROFILE

The chapter will focus on climate hazard profile of Kiambu County to gain an in-depth understanding. It will examine the climatic conditions, social economic activities, current and historical hazards and trends. The vulnerability of various groups will also be explored to understand how they are impacted. Finally the adaptive capacity for each of the hazards will be provided.
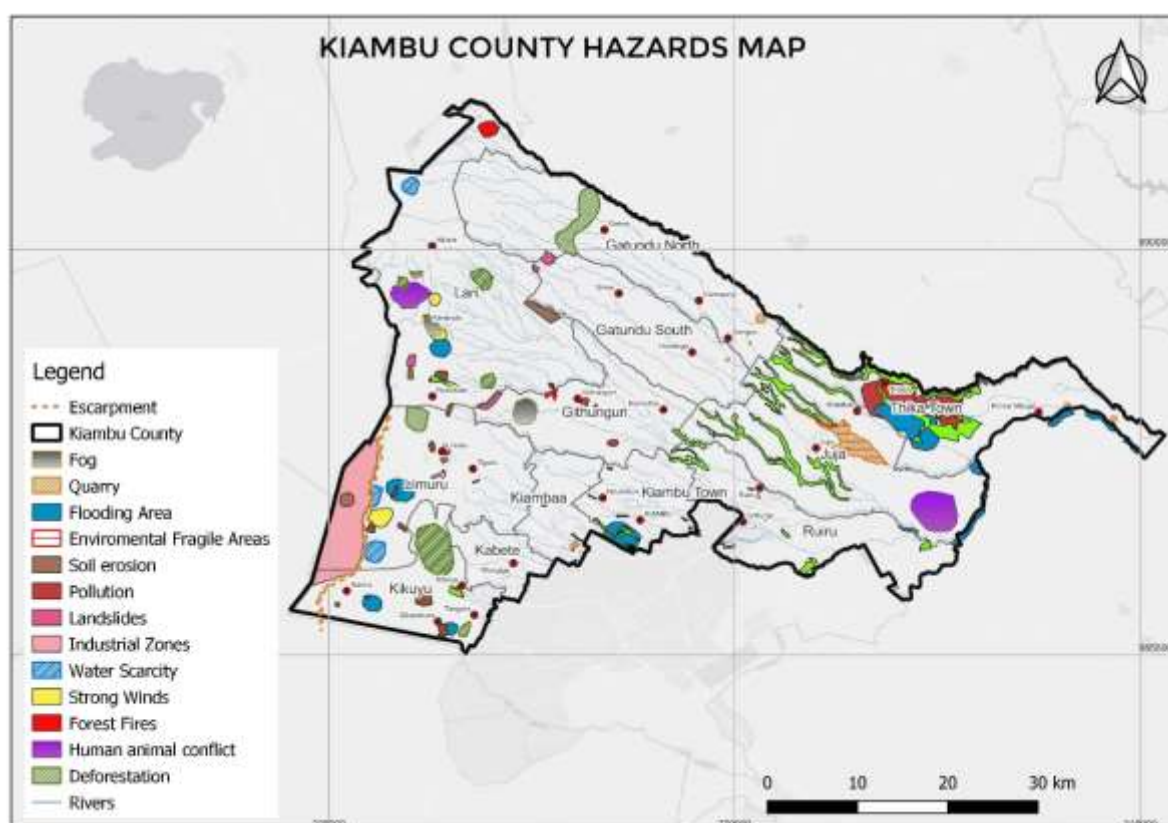
Figure 6: Kiambu County Hazards Map

3.1 Current and Historical Climate Hazards and Trends

An overview of the average climate conditions in Kiambu County across the years indicates two rain seasons March - April – May (Long rain), October – November – December (Short rains) rainfall and average temperature (both maximum and minimum values). This analysis is based on Climatological data of the period between years 1981 and 2022.
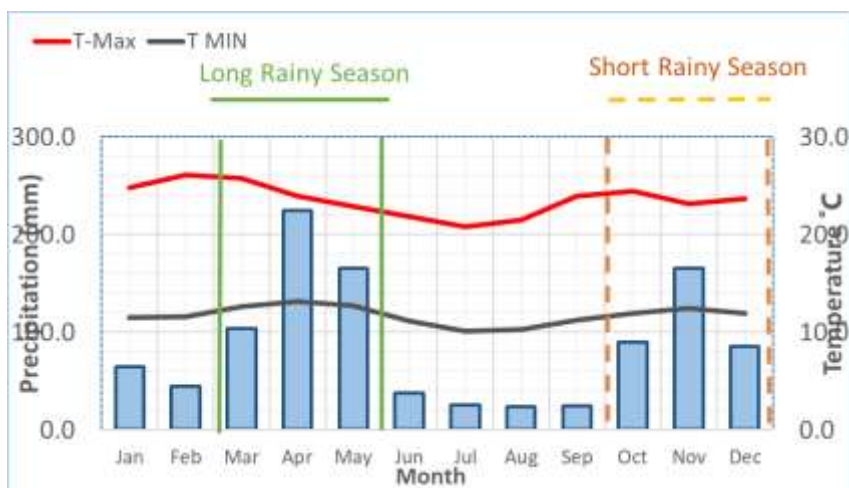
Figure 7: Average climate conditions in Kiambu County across the year

Figure 8 below shows Long Term historical seasonal rainfall trends for March-April-May (MAM) and October-November-December-(OND) seasons for a period of 41 years from 1981 to 2022. The El Nino years highest OND rainfall attained during the period was in 1997 of about 800mm resulting in exceptionally heavy rainfall and floods. The consequent El Nino in 2015 resulted to lower rainfall amounts of about 320mm causing less significant effects. During MAM season in 1984 the County experienced lowest rainfall amount of about 25mm which was inadequate for crop production hence causing drought. A number of climate variations (fluctuations) take place without affecting the overall average. For example, in a place, we may have a wetter than normal year followed by a drier than normal year but the average stays nearly the same hence the slightly increasing trend.
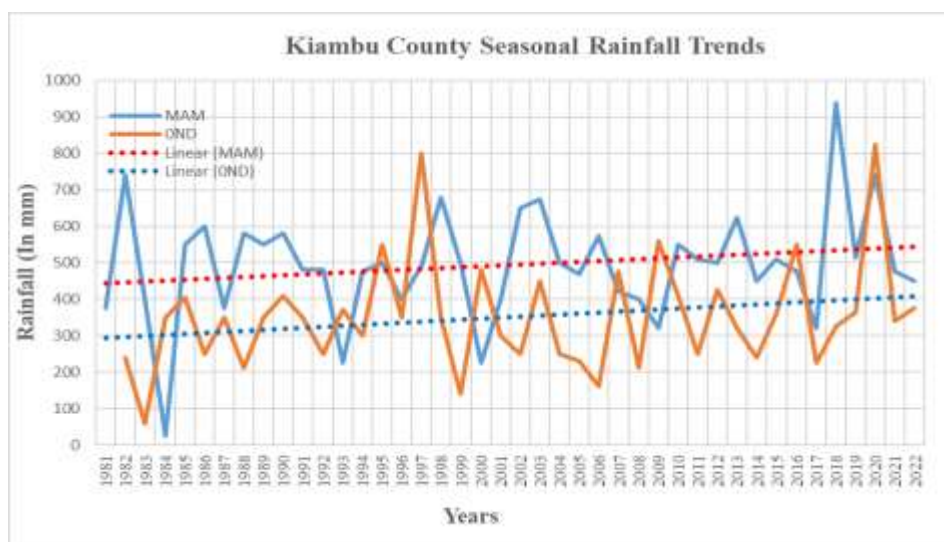
Figure 8: Long Term historical seasonal rainfall in Kiambu County

Figure 9 below explains how Kiambu Rainfall seasons have been behaving in the recent past
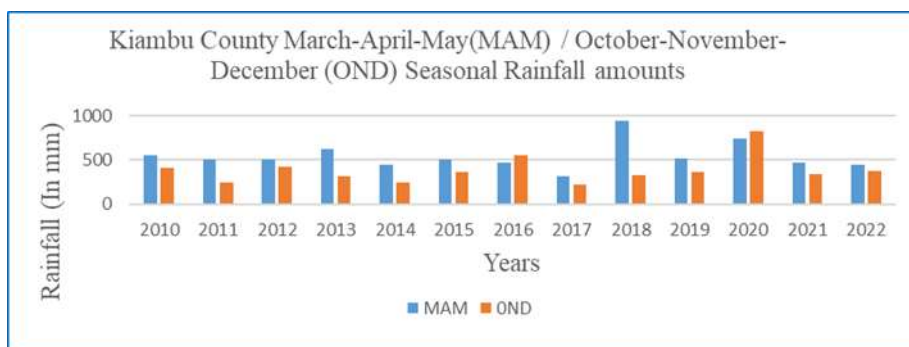
Figure 9: Kiambu County March-April-May (MAM)/October-November-December (OND) Seasonal Rainfall amounts.

Historical Climate

Rainfall time series (1983 to 2018) and temperature time series (1981 to 2010) reconstructed from KMD station observations, remote sensing and other proxies were analyzed and plotted. **Figure 10** shows the County experiences bi-modal rainfall pattern with March-April-May (MAM) and October-November-December (OND). Other months experiences dry and hot climate but a cold period is experienced in the month of 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. From the figure, it shows that the observations are at about 50% (percentile) of the normal compared to threshold of where 95% (percentile) of the observations were at that level. The figure also shows if the lowest threshold was observed then that is where it would be at 5th % (percentile). The graph also indicates a more predictable June-July-August (JJA) season and low predictable long rains and short rains season.
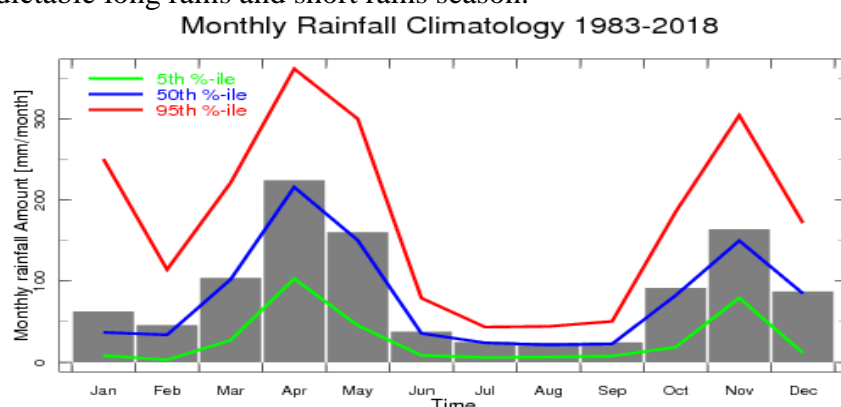
Figure 10: Kiambu County Monthly Rainfall Climatology 1983-2018

Figure 11 and Figure 12 shows the Monthly Maximum Temperature Climatology (1981 to 2010) and Monthly Minimum Temperature Climatology (1981 to 2010) respectively.

The highest Maximum Temperature is normally observed in the month of February while the

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lowest maximum temperature is normally observed in the month of July. The highest Minimum Temperature is normally observed in the month of April while the lowest minimum temperature is normally observed in the month of July. From the figure, it shows that the observations are at about 50% (percentile) of the normal compared to threshold of where 95% (percentile) of the observations were at that level. The figure also shows if the lowest threshold was observed then that is where it would be at 5th % (percentile). The graph also indicates a more predictable Maximum Temperatures during June-July-August (JJA) season and low predictable Maximum Temperatures during March- April –May (MAM) long rains season and October – November –December (OND) short rains season. Consequently, high predictable Minimum Temperatures are evident during the two rainy seasons (MAM and OND) and low predictable Minimum Temperatures are evident during JJA season
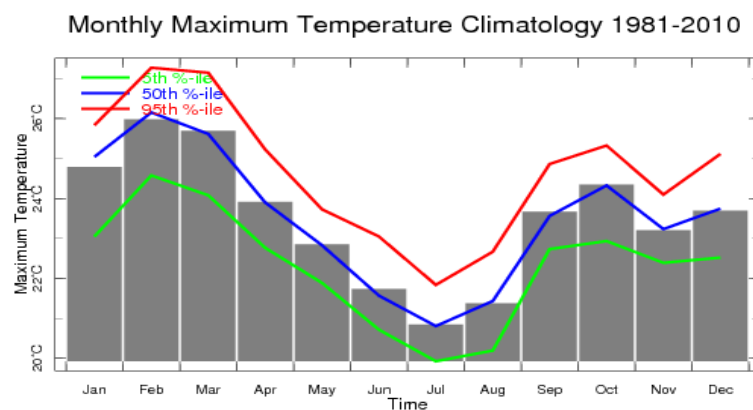
Figure 11: Kiambu Maximum Temperature Climatology
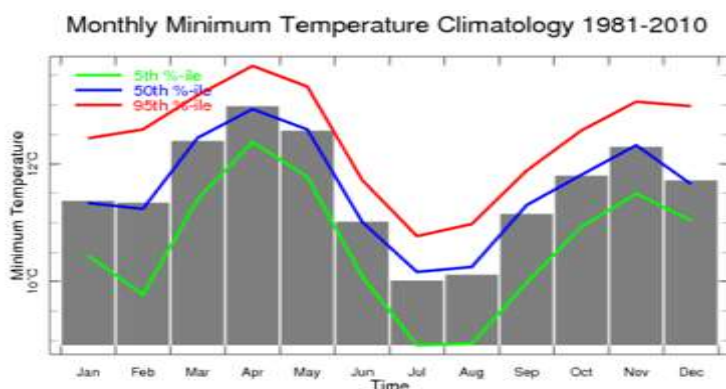
Figure 12: Kiambu Minimum Temperature Climatology 1981-2010

Figure **13** shows a slight increasing trend. In as much as the graphs show a general increase in annual rainfall in the period covering 1981 to 2022, increased variability is evidently. As shown in the analysis on **Figure 14**, it is notable that the more variability extremes are on the negative compared to those on the positive.
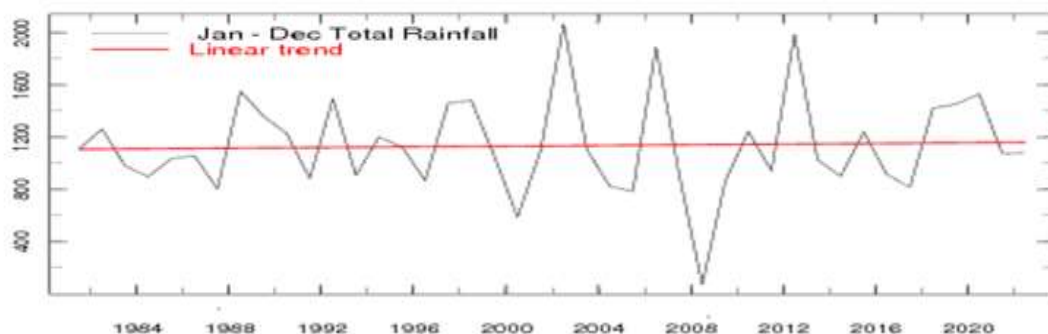
Figure 13: County Monthly Mean Rainfall

Figure 14 below shows varying departure from the mean of the annual rainfall within the County. The highest departure was observed in 2002 in the positive direction and in 2008 in the negative direction an indication of Drought.
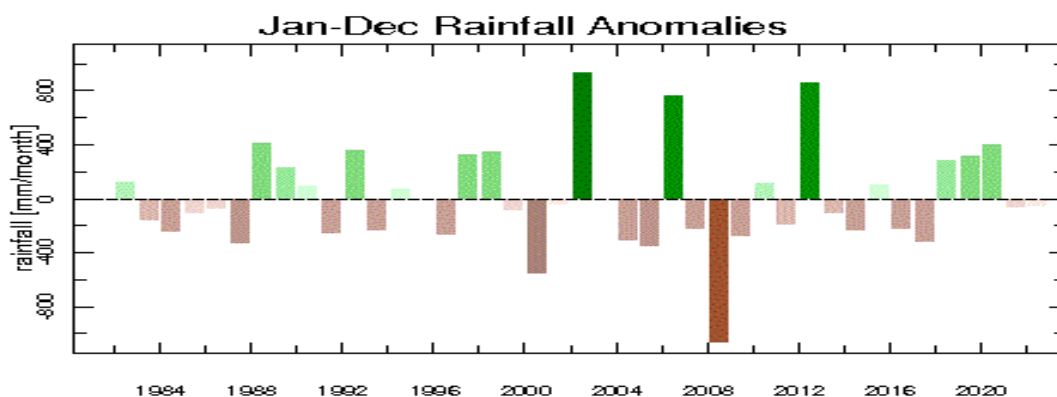
Figure 14: Kiambu County Rainfall Difference between Climatology and January-December (Annual) Rainfall (1981-2022)

Figure 15 shows the County MAM seasonal Rainfall trend shows a slight increasing trend from 1981 to 2022 and showing a lot of variability. The highest MAM seasonal rainfall attained during the period was in 2019 of more than 900mm. This caused floods and landslides/mudslides to be experienced in the County. The lowest MAM seasonal rainfall attained was in 1984 of less than 200mm. This caused drought to be experienced over the County.
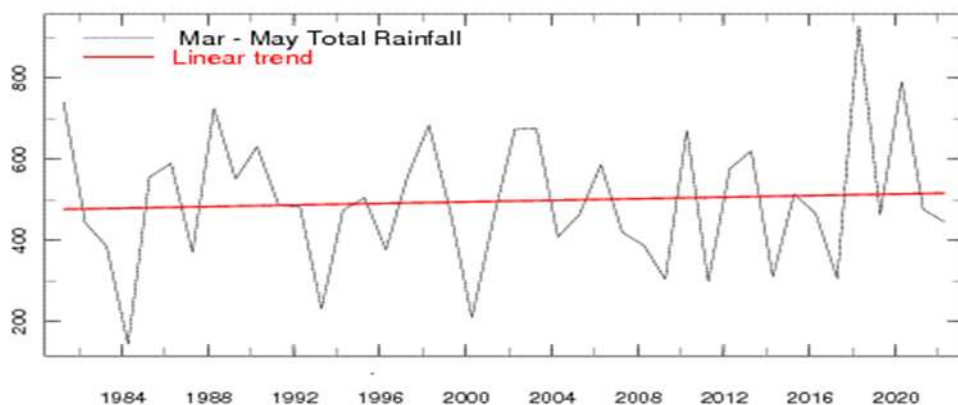
Figure 15: Kiambu County March. April-May (MAM) Seasonal Rainfall Long Rains (1981-2022)

Figure 16 shows 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 the lowest departure was observed in 1984 in the negative direction.
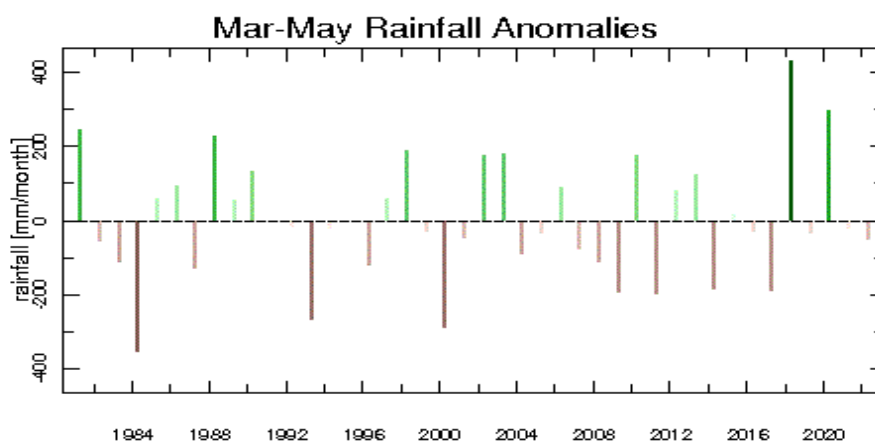
Figure 16: Kiambu County Rainfall Difference between Climatology and March-April-May (MAM) Seasonal Rainfall (1981-2022)

The probability of exceedance shows that the highest rainfall attained within the County in MAM season was about 750 mm as shown in figure 10 below.
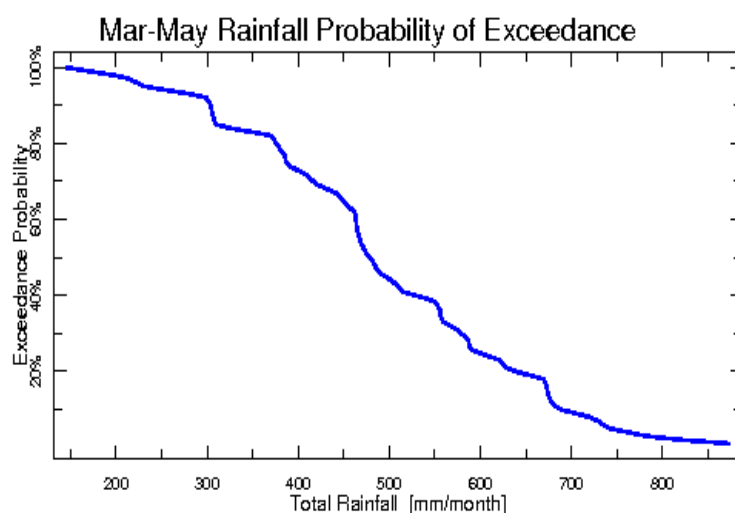
Figure 17: Kiambu County March to May Rainfall probability of exceedance

Figure 18 shows that OND Seasonal Rainfall trend shows an increasing trend in the OND seasonal rainfall from 1981 to 2022. The highest OND seasonal rainfall attained during the period was in 2020 of about 900 mm. The rainfall was associated with El Nino phenomenon which happened in 1998 and in 2020 while the lowest OND seasonal rainfall attained was in 1999 of less than 200mm.
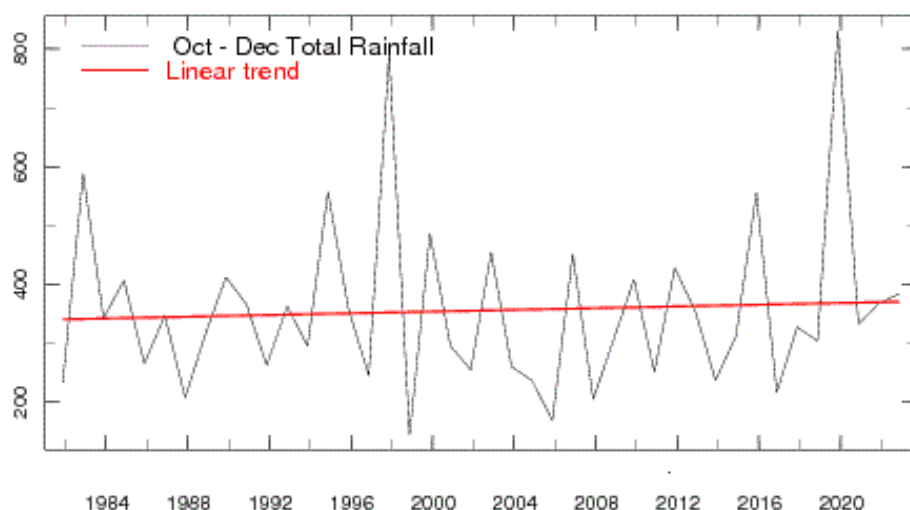
Figure 18: Kiambu County October-November-December (OND) Seasonal Rainfall Short Rains (1981-2022)

Figure 19 show varying departure from the mean of the OND seasonal rainfall within the county. The highest departure was observed in 2020 in the positive direction and the lowest departure was observed in 1999 in the negative direction.
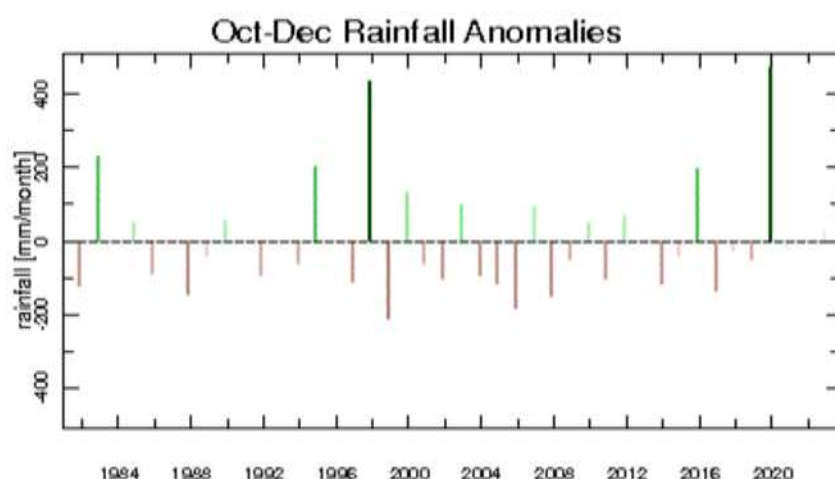
Figure 19: Kiambu County Rainfall Difference between Climatology and October-November-December (OND) Season

The probability of exceedance shows that the highest rainfall attained within the county in OND season was about 550 mm as shown in figure 20 below.
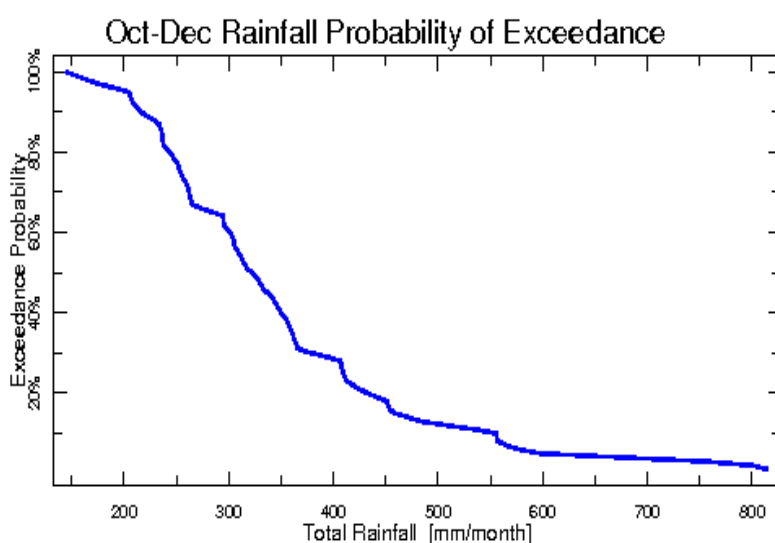
Figure 20: Kiambu County October to December Rainfall probability of exceedance

3.2 Exposure and Vulnerability Profiles of the County

This provides a summary of the exposure and vulnerability of key interest groups and their livelihood systems a far as climate hazards and trends are concerned in Kiambu County.

Kiambu can be categorized into four ecological zones four broad topographical zones: Upper Highlands found in Lari constituency and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 metres above sea level. It is very wet, steep and important as a water catchment area; Lower Highlands zone (lies between 1,500-1,800 metres above sea

level) covering Limuru and parts of Gatundu North and Gatundu South, Githunguri and Kabete constituencies, characterized by hills and high elevation plains (plateaus). The zone has a High rainfall regime characterized by tea and dairy farming, maize and horticulture farming and also pineapples in Thika constituency.

The upper midland zone (lies between 1,300-1,500 metres above sea level) covers most parts of Juja. The lower midland zone (lies between 1,200-1,360 metres above sea level) partly covers Thika town (Gatuanyaga), Limuru with physical features like steep slopes and valleys and Kikuyu constituencies. Large parts of Lari Gatundu North/South sub counties are covered by forests with physical features like steep slopes and valleys.

The distinct agro-climatic zones receive varied rainfall amounts that determine the type of livelihood adopted, potential hazards among others.

Kiambu County is endowed with various resources but also faces many developmental challenges. These are captured in the table below.

Table 2: Kiambu County Resources and Developmental Challenges

Subcounty	Resources	Development Challenges
Lari	• Forests i.e. Uplands Forest, Kireita Forest, Kinale forest, Kamae Forest, Kieni forest and Ragia Forest. • Hospitals i.e. Kijabe Mission Hospital, 18 public health facilities , Lari Level Four Hospital • Tea farms i.e. Kagwe, Kagaa, Gatamaiyu and Matimbei areas in Nyanduma and Kamburu ward • Kagwe tea factory in Nyanduma ward	• Limited and sub division of land resources has resulted to informal settlement • Insecurity • Poor road networks • Inadequate water • Poor and inadequate bridges connectivity • High cost of feeds, fertilizers and seeds • Indiscriminate/Poor waste disposal

Subcounty	Resources	Development Challenges
	• Vegetable farms i.e. cabbage, coriander, spinach and kale (sukuma wiki) • Markets i.e. Soko Mjinga Market and Nyambari Godown Sukuma Wiki Market • Pear Farms in Nyambari, Gitithia, Githirioni, Kirenga, Kimende and Kambaa locations • Dairy farming and dairy cooperatives i.e. Sundale Dairy Products in Uplands, Green Land Dairy in Nyambari, Afroden Milk processing Plant in Kinale, and Uplands Dairy and food processors [Pascha] in Kagwe • Carbacid Kenya Plant	
Limuru	• Water sources; such as rivers, water reservoirs, water pans, dams Manguo Swamp • Factories i.e. Tea, coffee factories, Bata • Infrastructures i.e. roads, railway line, sewerage system, playgrounds, quarries, bus parks, bridges, institutions • Tea and coffee plantations and Dairy farms • Water provision companies • Schools • Police stations • Health centers	• Insecurity caused by rising social evils such as theft as a result of unemployment. High insecurity has hampered growth as a lot of resources are spent on strategies to ensure the people are safe • Poor Road Services (Access Roads) • Lack of sewer line system thus leading to poor waste management. • Lack of employment for youths leading to drug abuse and alcoholism • Desertification caused by cutting of more trees to pave way for various infrastructures and industries

Subcounty	Resources	Development Challenges
	• Rehabilitation and treatment centers, • Churches and financial institutions. • Cemeteries • Stadiums • Markets, • Hotels and restaurants, • Public toilets • Slaughter houses, • Petrol stations and supermarkets.	• Pollution caused by emissions from industries and poor management of wastes • Flooding caused by blockage of sewer and drainage systems and poor management of wastes and poor terrain • Lack of proper waste management system • Inadequate education and health care facilities • Increased alcohol and substance abuse • Overcrowding of human population on some settlements • Poor environmental conservation policies leading to loss of biodiversity • Inadequate irrigation capacity • Lack of recreational infrastructure like stadium which would keep the youths busy
Kikuyu	• Underground water sources in Kikuyu i.e. Riu, Ma ya Ihii, Gichuhiro, Kerwa. Nderi and Sigona • Surface water sources i.e. Kanyariri. Kihuno. Gitwe. Gitiba. Rhino. • Dams i.e. Riu and Karai • Swamp i.e. Nyakumu • Forests i.e. Thogoto Njonjo, Karai Muslim.and Muguga Forest • Factories/ Industries i.e. Outlook in Gwathiru, Sidai Concrete in Ma ya Ihii, Steel formers Company in Ma	• Poor road network • Lack of enough health centers and inadequate drugs in health centers. • Lack of adequate ECDE centers and the necessary equipment and staff.

Subcounty	Resources	Development Challenges
	Ya Ihii, Gikambura Dairies Cooperative, Engineering concrete, Premier Distributors, Takataka solutions, Noma recycling posts, Empower transformers, Mega carrier bags, Build Africa stone works, Starehe maize flour, Pambo maize flour, Sopa maize flour. • Stadium i.e. Gikambura • Markets i.e. Lusigetti, Kamanga, Gikambura, Karinde and Kinoo market. • Railway i.e Standard Gauge Railway and the old railway line • Public cemetery i.e Renguti, Lusigetti and Mbomboini • Roads i.e Thogoto- Mutarakwa road, Njoroge-Kioi-Njumbi road (tarmacked), Kamangu-Makeresha road (tarmacked), Nachu-SGR road (proposed tarmac), Mbomboini-marengeta road, Lusigetti-muslim road (Grading), Ngong- S.G.R-Suswa (tarmacked), Kanyayo-Renguti- Kari (proposed tarmac),Kaigata- Karii-Road (Grading) • Hospitals i.e Gikambura Health Centre, Karai Muslim Dispensary, Oak wood Hospital (private) and Subcounty hospital (level iv).	

Subcounty	Resources	Development Challenges
	Dispensaries i.e Mbomboini, Kamangu and Kari.	
Kabete	• Rivers i.e. Gitathuru, Kanyariri, Nairobi, Githima, Mutugutu and Gathithima, Kang'ora stream • Dams • Health facilities • Institutions i.e. Nairobi University School of veterinary services, Wangari Mathai institute and Kanyiri polytechnic • Railway lines • Roads, police stations and markets. • Industries and factories e.g animal feeds factories, • Pigs' slaughter house in Uthiru ward	• Lack of sewerage system within the Sub County to support upcoming residential estates. These results to discharge of effluent to public streets. • Rising security issues: unemployment among the youths has led to drug abuse and subsequently result to increase in crime. • Poor road network making accessibility of some areas of the Sub County impossible especially in the rainy season • Poorly equipped health care facilities and learning institutions affecting delivery of quality health services and education.
Kiambaa	• Underground Water sources i.e. Dams, Boreholes, Springs • Surface water sources i.e. River Riara, River Gichii, River Karura • Shopping Centers i.e. Kawaida, Kasphat, Banana, Mucatha, Ruaka, Ndenderu, Karura, Kihara • Health Institutions i.e. Kihara Health Centre, Dispensaries • Industries/Factories i.e. Sasini Coffee, Whimsy Dairy, Ngorongo Tea Factory, Norbrook, Kiambaa Dairy • Fish farms	• Increased poor health especially among the vulnerable groups • Contaminated water sources interfering with water quality • Illegal dumping of waste especially along riverbanks, road reserves and vacant plots • Increased insecurity issues in places like Ruaka, Gachie • Poorly planned urban development: lack of storm water drainage system, lack of sewer line • Low productivity because of continuous farming affecting soil quality

Subcounty	Resources	Development Challenges
	• Learning Institutions i.e. Primary Schools, Secondary Schools, TVET Ndenderu • Rehabilitation Center i.e. Asumbi Rehabilitation Centre, Ngorongo Rehabilitation Centre • Plantations i.e. Njunu Tea farm, Sasini Plantation, Cianda Farm, Gatatha • Cemeteries • Flower farms i.e. Valentine growers, Black Petal • Recycling Company i.e. Takataka Solutions • Markets i.e. Kihara Market, Karuri Market • Social Football Field	• Drug abuse among the unemployed youths • Poor infrastructure i.e Inaccessible roads, lack of street lights • Uncontrolled sale of land
Kiambu	• Underground – Springs e.g Kairia, Kabae, Kariee, Kurumo,Kiono, kiongoini, Temenga and Gitwe, boreholes e.g Borehole 6 Kiambu Township,Riabai,Kamiti corner, Ngurunga Farm Ngegu Primary,Kangoya,Ndumberi,Njunu Police post. • Surface- swamps e.g Rurii,Karia and kimunyu,dams e.g Kabazi,Migaa,Kiora,Kiroma,Matro pi/Nyara,Muhugu,Ithuri&Sasini Kiamara,Paradise lost,Kairia,Kiamumbi, Rivers e,g Kaberaberi, Riara,Kiono,Kairia,	• Unplanned urbanization • Lack of way leave in most areas. • Narrow roads • Insecurity • Influx of population resulting in high population density • Inadequate water sources • Poor quality of ground water • Poor drainage system • Improper disposal of waste • Lack of lateral connectivity to main trunk sewer line • Inadequate public land

Subcounty	Resources	Development Challenges
	Kiuu,Mugwaitheki,Kamiti,Gatende, Ithuri,Riabai-Kwa Maiko, Gitangini water tank.	
	• Factories e.gRiabai,Ngaita,Sasini, Njunu,Gatitu and Kiamara coffee factories, Matron Maize millers,Animal feeds e.g premium,mike millers and happy,Milk industries e.g Tinganga Dairy,Ndumberi Dairies, Timber e.g A-Plus,Nzuri Furnitures, Malaika maize millers.	
	• Plantations e.g Paradise lost,Barua farm,Kasrini,Sasini, Lioki estate,Gatirima,Nyara,Sasini,Muhu gu,Manila,Ngurunga,Ndururumo,M unene,Kamwaki,Ngulumag,Kipisia Coffee farms.	
	• Roads e.g Kiambu-Nairobi Road,Kiambu-Githunguri Road,Kiambu-Ruiru Road,Kiambu-Banana Road and Kirigiti-Kwa Maiko Road.	
	• Hospitals- Icharia level 2 hospital,Tinganga Catholic Dispensary,Anmer,St Ann Lioki,Riabai Dispensary, St Teresa,Radiant,Kiambu Level5	
	• Schools & institutions-KIST,Kiambu High,Thindigua Pry,Kasarini Pry/sec,Kiambu Township Pry/sec, St Anns Lioki	
Subcounty	**Resources**	**Development Challenges**

Subcounty	Resources	Development Challenges
	Secondary,Anmer Sec,Kiu River Sec,HGM Tinganga Sec, Tinganga Sec, St Joseph Sec & Pry,Riabai Pry,Riabai High Sch. • Police Posts- Kiambu Police station,Thindigua Police post, Ngaita,Tinganga,Rungu Chief Post,Kamiti,Anmer,Kirigiti,Riabai • Stadiums-Kamunyonge, Kirigiti international stadium • Markets-Tinganga open air, Kangangi Market • Waterfalls and caves-Ndururumo/Ngurunga and Matropi • settlements e.g Ruturu informal settlement, Kiamumbi,Thindigua,Kiukenda,Indian Bazaar,Eden Ville,GG,Mushroom,Five star,Mathare slums • Waste water treatment plant at Rui • Cemetries-Riabai and Gitamayu • Cattle Dips-Kihingo • Correctional Facilities-Kiambu Prisons, Kirigiti Remand centre,Kirigiti Girls Rehab. centre • Administrative centers e. County HQs,Rednova County Offices,Kiambu Law courts,KIWASCO,NEMA,Kiambu County Commissioner, Riabai Chief office	
Subcounty	Resources	Development Challenges

Subcounty	Resources	Development Challenges
	- ECDEs-Gitamayu, - Quarries-Gatina - Public Sanitation Facilities-Kiambu Buspark, Opp. Posta, Kiambu Police Station, Indian Bazaar, Riabai, Ndumberi	
Ruiru	- Agricultural Resources: coffee farms such Kofinaff in Gitothua and dairy farm in Northlands and their respective products. - Water Resources: Rivers such as Ruiru River, dams such as Tatu dam and underground water consisting of various public and private boreholes. - Human Resources: Skilled workforce and non-skilled workforce - Institutions; Education Institutions, financial institutions, churches, health care institutions and county government offices. - Infrastructure: Transportation networks,busparks, stadiums, flood masts and streetlights, Petrol stations, supermarkets, foot bridges, roundabouts, scenic beauty zones and entertainment joints - Factories such as iron sheets manufacturing firms, milk processing firm, steel producing	- Increased vulnerability to climate-related hazards such as floods leading to damage of infrastructure, loss of livelihoods, and increased risks to health and safety. - Poor sewer and drainage systems, poor management of wastes especially in areas like Kiu and Mwiki ward leading to rise of waterborne diseases. - Rising Crime rates which undermine personal safety and business operations: Some highly populated and low income residential faces high crime rates such as theft and robbery. - Limited healthcare infrastructure including hospitals, clinics, and health centers that results in limited access to healthcare services for the growing population - Informal settlements otherwise known as slums characterized by overcrowded housing, poor inadequate access to clean water, sanitation facilities, and limited infrastructure.

Subcounty	Resources	Development Challenges
	firms, beauty firm, beverage firm, flower processing firms	• Increased alcohol and substance abuse due to high population and low level of employment
Githunguri	• Rivers i.e. Mukuyu • Dairy, poultry, pig, coffee, tea, horticulture and banana farming • Coorperatives i.e Fresha • Factories i.e Fresha	• Land subdivision in to small parcels that cannot sustain economic farming activities. • Soil erosion and degradation, mushrooming informal settlements with no proper plans • Poor infrastructures like roads, water and sewerage systems poor feeder road networks, • Water shortages due to poor and failed rains and famine.
Juja	• Rivers i.e Thiririka, Nairobi, ruiru and ndarugu ,Kirohi • Wildlife i.e hippos, hyenas • Farms i.e. Juja farm, twiga farm, ruera farm, wanjigi farm, orklands farms, daga farm • Quarries • Solar/wind energy i.e. • Households levels, windmills at Ndarugu kwa bob harris • Water- rivers and private water suppliers • Ndururumo borehole project • Dams i.e. Ruera dam Murera, Courtesy dam murera, Titanic dam, Daga dam, Orkland dam, Blood gate dam, Jacaranda dam, Dam 4	• Mushrooming of unplanned urbanization. • Lack of wayleave in most areas. • Poor road network • Lack of adequate water for domestic and farming • Poor health services • Poor waste collection and disposal mechanisms • Blocked sewer systems • Insecurity • Conflicts i.e. between Maasai pastoralists and residents • Population growth in Theta ward over the last two decades has grown immensely due to the fact that selling of affordable plots for

Subcounty	Resources	Development Challenges
	• Roads i.e Thika road, Kiganjo road • Railways i.e. Nairobi-Nanyuki railway • Hospitals i.e. Kalimoni,Gachororo • Learning institutions i.e. Primary, secondary, tertiary institutions i.e JKUAT and ZETECH Universities • Industries i.e. Maize flour and Coffee millers • Settlements i.e. Oaklands settlement, Macadmia settlements • Jacaranda coffee research in Murera	construction of residential and commercial buildings.- The above effect has led to demand for resources, and social amenities • Pollution due to population growth and lack of adequate amenities services has led to all kinds of pollution. • Unemployment, lack access to land more so by youths, weak educational systems.
Thika	• Underground – Boreholes e.g Kimuchu Primary, Kona Mbaya, Maguguni Primary, Gatundu, Army, Thika Primary, Athena Dispensary, Gatuanyaga Dispensary, Tosha Catholic (Our Lady of Assumption), Magana Primary, Githima Primary, Mary hill, Gatuanyaga • Surface- Rivers e.g Chania,Thika ,Athi , twin river, Swamps e.g Ndura, Dams e.g proposed soya dam, • Rain water harvesting • Factories/Industries –NCPD, Delmonte, Kenchic	• Unplanned urbanization • Lack of way leave in most areas. • Narrow roads • Insecurity • Influx of population resulting in high population density overwhelming existing infrastructure • Inadequate water sources • Poor quality ground and surface water • Poor drainage system • Improper disposal of waste • Low sewerage /sanitation services access and coverage • Inadequate public land • Poverty • High rate of unemployment amongst youth

Subcounty	Resources	Development Challenges
	• Plantations-Delmonte Pineapples,Coffee farms,flower farm • Transport infrastructure:Roads,bridges, Bus stations, storm water drains e.g Thika Superhighway,Thika-Garissa Road,Thika-Nyeri Road,Ndula Road • Railways • Hospitals- Thika Level 5,Central Memorial, Ngoliba health centre • Elementary,Primary schools ,secondary schools & Tertiary institutions-E.g; Mount Kenya University, Kilimambogo Teachers college Thika High,Amboselli,Imperial College, Matathia pry,Powerline pry,Waba Pry,maguguni pry, St. Mary's School, ,Ngoliba pry&sec, ECDEs • Security installations; Police Stations/Posts and military installations • Sports facilities ;Stadium,play grounds,gyms and fields • Markets- Moi,Jamhuri,Makongeni(madaraka),Ngoliba • Tourism sites,Waterfalls and caves- (Chania,Thika ,14 falls)	• Poor housing(informal settlements) • Inadequate and constrained resource allocations due competing priorities • Low public participation and awareness

Subcounty	Resources	Development Challenges
	• Informal settlements e.g Majengo,Biafra/Bahati,Kimathi,UTI/Kiboko,Jamofasta Posta,Madharau,Gichagi,Umoja/kiganjo,muthaiga,komu,kamenu,Ndula,mukunike, • Waste water treatment plant • Cemetries-Maguguni ,Kiandutu • Cattle Dips-Ngoliba • Correctional Facilities-Thika CG Prison • Administrative centers –Huduma Centre,Ngoliba chief office • Quarries-kilimambogo, Matathia,Maguguni,Komo,Githima, Munyu, • Public Sanitation Facilities- • Public recreational parks(Green spaces)	
Gatundu North	• **Water Resources** • Underground –Boreholes, wells and springs. • Surface- Rivers e.g Chania,Karimenu,Kirohi,Ndarugu, Githanjagua, Nduaci and dams e.g Karimenu. • Factories/Industries –Kairi coffee factory,Kiondini coffee factory,Kanjuku Coffee mills,Githueti coffee factory and Gachege & Mataara tea factory. • Plantations-tea,coffee,pineapples.	• Lack of way leave in most areas. • Narrow roads • Insecurity • Food insecurity • Improper disposal of waste • Inadequate public land

Subcounty	Resources	Development Challenges
	• Roads-Makwa-Ngethu,Thika-Mangu-Flyover, Kairi-Mataara, Ndarugu-Mangu. • Hospitals- Makwa Dispensary, Igegania Level 4,Makwa Kolpin Dispensary. • Schools & institutions-Mukuyuni sec/pry, Nyamang'ara sec/pry, Mukurwe sec/pry, Nyamatumbi sec/pry, Kamure pry, Gikendu sec/pry, Mangu youth polytechnic, Murigo pry,Kagaita Pry, Nguna polytechnic,Kanjuku pry,Mangu VTC • Police Stations/Posts-Gatukuyu,Makwa,Kamwangi • Markets-Kairi,Makwa,Kamwangi,Makwa,Gakui • Settlements-Kirasha,Mwea, • Water treatment plants-Karimenu,Chania,Ng'ethu • Cattle Dips-Makwa, Ha-Njiraini, Muiri, Nguna,Kanjuku • Administrative centers – Kamwangi DCC, • Quarrying-Gatukuyu	
Gatundu South	• Tea, Coffee, dairy, horticulture, pineapple, avocado plantations and fish farming	• Poor drainage system • Improper disposal of waste • Low sewerage /sanitation services access and coverage • Inadequate public land

Subcounty	Resources	Development Challenges
		• Poverty • High rate of unemployment amongst youth • Poor housing(informal settlements) • Inadequate and constrained resource allocations due competing priorities • Low public participation and awareness

3.2.1 Lari Sub County Climate Risks and Hazards Profile

Background Information

Lari Sub County is one of the 12 Sub Counties in the County. It is the largest sub County in size covering an area of 432.3Km2. It has 5 wards i.e. Kinale, Kijabe, Nyanduma, Kamburu and Lari/Kirenga. According to 2019 Kenya Population and Housing Census, the sub county had a population of 135,303 comprising of 67,061 males, 68,238 females and 4 intersex. This population was projected at 145,649 in 2022 and will reach 159,758 in 2027. The Sub County had the least population density of 313 persons per square kilometer in 2019 which was projected at 337 and 370 persons per square kilometer in 2022 and 2027 respectively.

Lari is largely forested, with Uplands Forest, Kireita Forest, Kinale forest, Kamae Forest, Kieni forest and Ragia Forest. The area is relatively cold because of its location on the windward side of the Aberdare ranges. As a result, it receives a considerable amount of rainfall per year.

Majority residents of Lari practice agriculture as the main source of livelihood, with the area dominated by subsistence farming. Tea farming is largely practiced by residents of the eastern part of Lari i.e Nyanduma and Kamburu ward. These areas include Kagwe, Kagaa, Gatamaiyu and Matimbei areas. Crops grown for sale include vegetables such as cabbage, coriander, spinach and kale (sukuma wiki). Vegetable farming in the Sub County is largely favored by the large amounts of rainfall received throughout the year and the continuous cold seasons.

There are two major markets for vegetables; Soko Mjinga Market and Nyambari Godown Sukuma Wiki Market. Both markets supply approximately 1,500 bags of kale per day to the major towns in Kenya. Lorries also ferry tonnes of cabbage from Kinale location daily to various towns in Kenya.

Lari also produces majority of the pears found in Kenya, with most of the crop grown in Nyambari, Gitithia, Githirioni, Kirenga, Kimende and Kambaa locations.

Many farmers in the area rear dairy cows. While the milk is produced mainly for personal consumption, the surplus is sold, usually to dairy cooperatives.There are four milk processing plants in the area: Sundale Dairy Products in Uplands, Green Land Dairy in Nyambari, Afroden Milk processing Plant in Kinale, and Uplands Dairy and food processors [Pascha] in Kagwe. There are a number of industries engaged in processing primarily agricultural products locally produced in Lari, such as the Farmers Choice Bacon Factory in Uplands, and the dairy processing plants for the milk produced in the area. Additionally, the Carbacid Kenya Plant was established to mine naturally existing carbon dioxide in the area. Kagwe tea factory in Nyanduma ward processes tea.

The Kijabe Mission Hospital is the largest private health facility in the area, located in Kijabe ward. Lari Level Four Hospital is the largest government health facility, located at Rukuma Shopping Center in Lari/Kirenga Ward. Lari Sub County has 18 public health facilities distributed across the five wards.

Hazards and their Ranking
Table below illustrates hazards/risks and their ranking position as identified by the community.

Table 3: Hazards in Lari

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Hazard 1: Flooding				
Agriculture	Crops and Livestock destruction Land degradation	Soil erosion Water logging Lack of proper civic education on soil conservation	Building of gabions Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation	Kijabe (Escarpment) Githirioni Kirenga (Kariani,Gitithia)
Hazard 2: Extreme cold temperatures				
Agriculture	Increased crops frost bites	Deforestation	Afforestation	Kinale, Kijabe (

		Carbon dioxide mining	Increase vegetation coverage within the forest e.g. bamboo trees	Kimende)
			Development, enactment and implementation of legislation on Carbon dioxide mining	
Health	Increased Respiratory diseases and nervous illness	Exposure to the low temperatures	Enhanced Universal health	All wards
			Awareness creation on warm house designs	
Transport and Infrastructure	Reduced visibility	Mist and Fog	Erect appropriate signage Proper road designs	Kijabe (Kimende), Kinale
Education	Low enrolment Frost Bites	Exposure to the low temperatures	Enhancement of feeding programmes	Kijabe (Kimende), Kinale
			Awareness creation on warm ECDE classes designs	
Water	Unpleasant smell	Bacteria are inactive	Construction of green houses in the treatment facility	Kijabe (Kimende), Kinale
Hazard 3: Landslides				
Agriculture	Destruction of crops and Livestock	Lack of proper soil conservation measures.	Building of gabions Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation	Kijabe(Bathi area, Escarpme nt road) Nyandum a(Kamahi ndu)
Environment	Destruction of bio diversity	Poor drainage	-Install proper drainage channels/structures -Tree planting	
Hazard 4: Drought				
Water	Increased scarcity of water	Erratic rainfall patterns	Increase public awareness on	Kijabe, Nyandum

			conservation of water	a Gatamayu High St Augustine ,Nyanduma,St Patrick,Gachoire Girls,Gachema,Kireita forest
		Destruction of water catchment areas	Promote water efficiency through monitoring, reducing wastage	
			Conservation of riparian land	
			Construct water harvesting & storage structures	Lari,Kirenga(Gitithia
			Installation of cofferdams at Kireita forest	
			Water control devices	
			Invest in early warning systems and infrastructure	
Environment	Loss of biodiversity	Delayed onset of rains	Establish water points around key biodiversity ecosystems	Kijabe, Nyanduma Gatamayu High St Augustine ,Nyanduma,St Patrick,Gachoire Girls,Gachema,Kireita forest
			Increase public awareness campaigns on natural resource and ecosystem management for communities in key biodiversity ecologies	Lari,Kirenga(Gitithia
Agriculture	Reduction in agricultural yield	Low soil moisture	Invest in capacity building on soil management	Matimbei/ Kamburu, Gatamaiyu /Nyanduma
		Delayed onset of rainfall	Installation of Irrigation systems	Matimbei/ Kamburu, Gatamaiyu /Nyanduma
			Invest in early warning systems and infrastructure	

			Subsidized farm inputs climate Smart agricultural farming	
	Loss of livestock	Pests and diseases Lack of feeds	Public awareness on conservation of animal feeds through silage, hay etc Introduction of appropriate and resilient breeds	Kijabe, Nyanduma Gatamayu High St Augustine ,Nyanduma,St Patrick,Gachoire Girls,Gachema,Kireita forest Lari,Kirenga(Gitithia
Health	Increased respiratory diseases	Dust and smoke	Increased public awareness on disease prevention. Vaccination for animals	Kijabe, Nyanduma Gatamayu High St Augustine ,Nyanduma,St Patrick,Gachoire Girls,Gachema,Kireita forest Lari,Kirenga(Gitithia
Trade	Economic losses	Loss of animals and plants	Increase crop productivity through improved irrigation	All wards
Hazard 5: Hailstorms				
Agriculture	Destruction of crops and Livestock	Erratic weather patterns	Invest in early warning systems Hail observations and monitoring	Kijabe(Kimende) Kinale
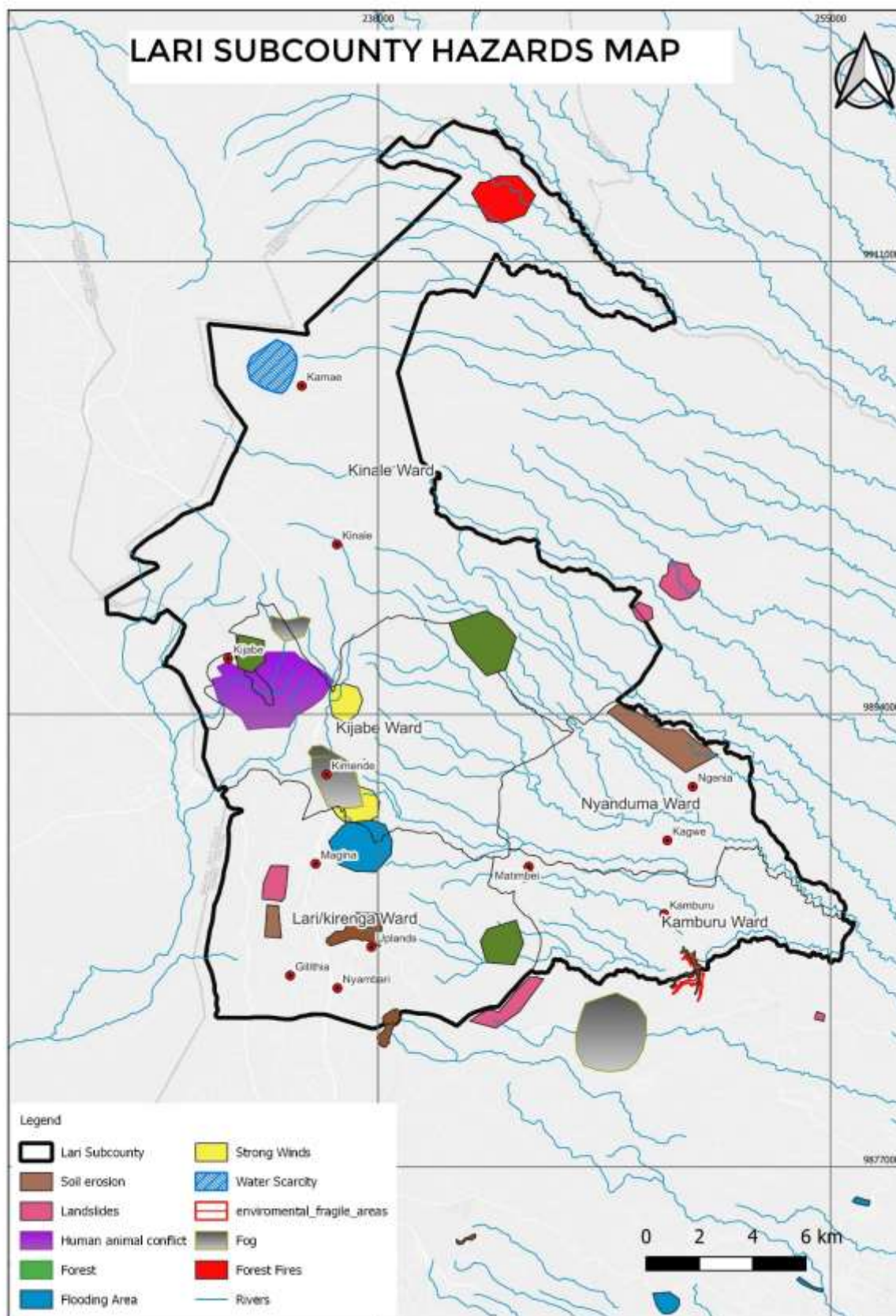
Figure 21: Lari Sub County Hazard Map

The Vulnerable

The following groups were identified as the most vulnerable to the impacts of climate change in Lari:

a) The informal settlers in Kirasha, Kinale ward are more at risk during flooding as the settlement is located at the lowlands receiving all the water draining from the higher lands. Pollution of the Karemenu River poses a health hazard to the settlers as it's the source of water for household use. Due to their poor housing structures they are also more vulnerable to extreme cold temperatures. The settlement sits on the catchment of Karemenu River where the water table is high therefore risk of water contamination.

b) The elderly; they are more susceptible to extreme cold leading to respiratory illnesses and arthritis. They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

c) PWDs; they are more prone to harsh climatic conditions such as extreme cold and flooding. Mobility limitations, reduced stamina, or compromised immune systems may make it difficult for them to seek shelter, evacuate, or engage in necessary protective measures.

d) Youths and children; they are more prone to dropping out of school as a result of floods and extreme cold temperatures. They may also engage in risky behaviors, such as playing in polluted areas or swimming in unsafe water bodies increasing health risks.

e) Orphans; because this group lack parental care, support and have limited access to resources, they may grapple to navigate and access basic needs increasing their vulnerability to the impacts of a harsh climate such as water shortage and pollution.

f) Poor households; they are more prone to drought as they have little or no income. They are also more prone to over flooding as they live in areas with poor urban planning. Also prone to water shortages and poor management of wastes.

3.2.2 Limuru Sub County Climate Risks and Hazards Profile

Background Information

Limuru Sub County is one of the 12 Sub Counties in the County. It covers an area of 285.1Km^2. It has 5 wards namely Bibirioni, Limuru Central, Ndeiya, Limuru East, Ngecha/Tigoni. According to 2019 Kenya Population and Housing Census, the sub county population stood at 159,314 comprising 79,632 males, 79,682 females. This population was projected at 171,517

in 2022 and will reach 188,157 in 2027. The Sub County had a population density of 559 persons per square kilometer in 2019 which was projected at 602 and 660 persons per square kilometer in 2022 and 2027 respectively.

Limuru sub-county is known for its rapid growth and development, fuelled by its proximity to Nairobi and its strategic location along the Nakuru Nairobi Highway. The sub county has experienced significant population growth over the years, accommodating both formal and informal settlements. It serves as a residential area for many people working in Nairobi due to its proximity to the city.

Agriculture plays a significant role in the local economy. There are huge chunks of tea plantations owned by Kenyan and multinational investors. The sub county has very conducive fertile land for farming. There are small-scale manufacturing and processing industries that contribute to the local economy.

Land Use

Limuru is a predominantly agricultural and rural area. A large part of Limuru East and parts of Ngecha Tigoni wards are covered with tea plantations. This has given rise to both multinational and local tea factories. The land also hosts residential buildings in Limuru Central and Limuru East as most people who work in Nairobi City County live here. Parts of Limuru Central, Limuru East, Limuru Central and Ndeiya wards have embraced greenhouse farming. Dairy farming through zero grazing is common in almost all wards. Agricultural activities are predominantly found in Bibirioni, Limuru Central and Ndeiya Wards. Majority of the population in this sub county depend on formal and informal employment for livelihoods.

Table 4: Hazards in Limuru Sub County

HAZARD 1. Flooding				
Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture & livestock	Crops & livestock destruction Land degradation Reduced crops & livestock production	Increased crop diseases Soil erosion Water logging Lack of proper civic education on soil conservation	Building of gabions Tree planting Conservation of riparian reserves Install proper drainage channels/structures	Limuru Central (Limuru Town,Tharuni,Kiroe Centre,Gituamba, Ngarariga, Manguo swamp,Ro

			Proper civic education on soil conservation, crop rotation, adoption of early maturing plants & farm planning Promote IPM Promote runoff water harvesting e.g. by construction of water ponds Crop and livestock insurance	ngai Market-Railways-Kwaheri Bata Underpass). Bibirioni(Njira Njeru,Free town,Mbu ru Mathenge). Tigoni/Ng echa(Manj iri). Ndeiya(L ower Region,N deru Swamp). Limuru East(Farm ers,Juakali)
Water	Pollution	Improper disposal of solid & liquid waste	Construction of waste transfer stations, provision of waste bins/skips, Harvesting of rain water in markets, schools and hospitals	All wards
	Contamination of drinking water, Contamination of Marine ecosystem	Industrial chemicals and emission, oil & lubricants from garages, Improper disposal of solid and liquid waste	Increase public awareness Enforce rules and regulations on waste & chemical disposal	All wards
Health	Increased Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	Stagnant water and water logged soils	Increased public awareness on disease prevention. Vaccination for animals. Early relocation of people and animals to safer grounds	All wards
Transport and Infrastructure	Clogging of drainages	Lack of maintenance on	Construction and maintenance of	All wards

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
		road, sewer and drainage structures Improper designs of roads	drainage systems Proper road designs	
Education	Disruption of school activities	Destruction of transportation infrastructure, classrooms and playgrounds	Landscaping of School compounds and paving of driveways/walkways, construction and maintenance of drainages, Early warning & preparedness	All wards
Hazard 2. Drought				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Water	Increased scarcity of water	Erratic rainfall patterns Destruction of water catchment areas Low awareness on water conservation and management	Construct water harvesting and storage structures Conservation of water catchment areas and sources Water control devices such as sluice gates, valves and master meters Increase public awareness Invest in early warning systems and infrastructure	Ndeiya Limuru East Limuru Central Bibirioni Ngecha Tigoni
Agriculture	Reduction in agricultural yield Crop failure Reduced income Increased food insecurity	Low soil moisture Delayed onset of rainfall Inadequate soil and water conservation structures at farm level.	Invest in capacity building of farmers on soil management Promote drought tolerant crop varieties Promote crop insurance Installation of Irrigation systems Invest in early warning systems and infrastructure Subsidized farm	Ndeiya Limuru East Limuru Central Bibirioni Ngecha Tigoni

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
			inputs, dam liners Promote Climate smart agricultural practices Engage youths in construction of soil and water conservation structures Promote Integrated pest management systems (IPM)	
	Loss of livestock	Pests and diseases, Lack of feeds and water	Conservation of animal feeds in form of silage, hay etc Introduction of appropriate and resilient breeds	Ndeiya Limuru East Limuru Central Bibirioni Ngecha Tigoni
	Human-wildlife conflict and intercommunity conflicts	Inadequate food for wildlife	Provision of food and watering points Planting fruit trees Compensation of victims	Ndeiya
Fisheries	Loss of fish	-Drying up of fish ponds -High rate of water evaporation	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish	Ndeiya
Health	Increased lung & eye diseases	Increased Dust	Increased public awareness on disease prevention.	Ndeiya
Hazard 3. Extreme Cold Temperatures				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Low crop production	Increased frost bites on crops	Crop diversification	Limuru Central,Bi

			Early planting	brioni,Tigoni/Ngecha & Limuru East
Livestock	Reduced production	Increased disease incidences on crops	Promote agronomic practices e.g. crop rotation	
		Increased disease incidences	Promote IPM Proper housing for livestock	
Health	Increased Respiratory diseases and nervous illness, Increased frostbite in human	Exposure to the low temperatures	Enhanced Universal medical cover Awareness creation on warm house designs and clothing	All wards
Transport and Infrastructure	Reduced Road visibility	Mist and Fog	Erect appropriate Road signages. Proper road designs	All wards
Education	Low enrolment/school absenteeism. Frost Bites	Exposure to the low temperatures	Enhancement of school, feeding programme. Construction of warm ECDE classrooms.	All wards
Water	Unpleasant smell of waste water treatment	Bacteria are inactive	Construction of green houses in the treatment facility	All wards
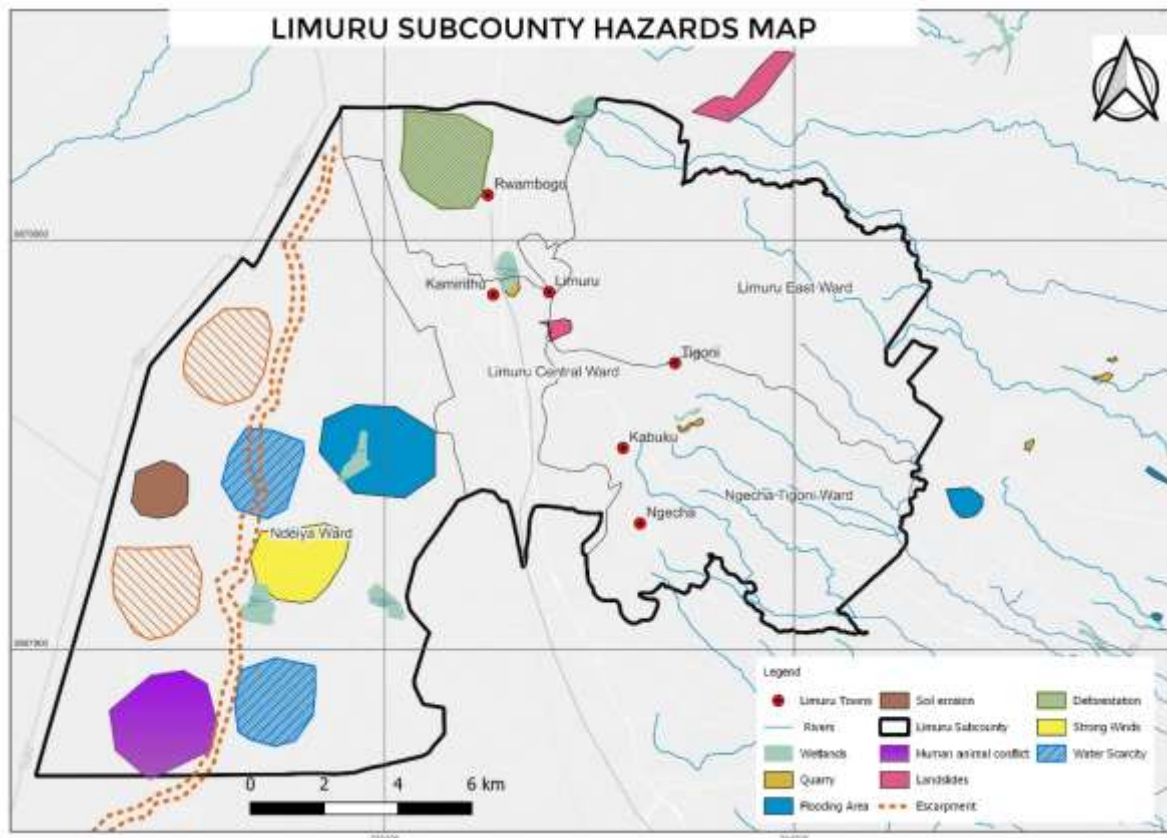
Figure 22: Limuru Sub County Hazards Map

The Vulnerable Groups

The vulnerable groups in Limuru were identified during the PCRA process and are described below:

a) Communities living in sloppy areas are prone to soil erosion and degradation thereby affecting crop yields.

b) Tea pickers from minority communities; are affected during drought when as tea production decreases affecting their income

c) Children; they are more prone to dropping out of school as a result of floods and extreme cold temperatures. They may also engage in risky behaviors, such as playing in polluted areas or swimming in unsafe water bodies increasing health risks.

d) Elderly; they are more susceptible to extreme cold leading to respiratory illnesses and arthritis. They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

e) People with disability; they are more prone to harsh climatic conditions such as extreme cold and flooding. Mobility limitations, reduced stamina, or compromised

immune systems may make it difficult for them to seek shelter, evacuate, or engage in necessary protective measures.

f) Youths; those in transport sector such as boda boda face mobility challenges during floods and respiratory illnesses during extreme cold temperatures

g) Orphans; have limited access to resources, thus grapple to navigate and access basic needs increasing their vulnerability to the impacts of a harsh climate such as drought, water shortage and pollution

h) Poor households; during drought they have little or no income to access food and other basic commodities. They are also more prone to flooding as they live in areas with poor urban planning. Also prone to water shortages and poor management of wastes.

i) HIV victims; their immunity is compromised during extreme cold temperatures due to increase in respiratory diseases

3.2.3 Kikuyu Sub County Climate Risks and Hazards Profile

1. **Background Information**

Kikuyu Sub County is one of the 12 Sub Counties in the County. It covers an area of 172.9Km^2. It has 5 wards ie Karai, Nachu, Sigona, Kikuyu and Kinoo. According to 2019 Kenya Population and Housing Census, the sub county population stood at 187,122 comprising 90,919 males, 96,198 females and 5 intersex. This population was projected at 201,384 in 2022 and will reach 220,961 in 2027. The Sub County had a population density of 1,082 persons per square kilometer in 2019 which was projected at 1,165 and 1,278 persons per square kilometer in 2022 and 2027 respectively.

- Mbomboini-marengeta road
- Lusigetti-muslim road (Grading)

Land Use

The main land uses in Kikuyu are;

- Farming on individual farms
- KALRO, KEFRI and KFS are the major institutions involved in agriculture
- Gikambura (Dairy farming through zero grazing and subsistence farming)
- Gitiba and Karai Muslim (small subsistence farming such as vegetable farming)
- Construction of buildings for settlement especially in Kikuyu, Gikambura

Implication of Land use to the Environment – Climate Change

The interaction of land use and its implication to the environment was found to be as follows;
- Unsustainable farming practices that are undermining land's ability to sustain food production,
- Excess use of fertilizers has reduced soil fertility and weakened it.
- Mono crop farming practices affecting land productivity.
- Land degradation decreases the soil's ability to store carbon, terrestrial biodiversity loss resulting in the destruction of the habitats of many animals and plants.

Hazards and Risks in Kikuyu Sub County

The community identified the following as the main hazards in Kikuyu;

Table 5: Hazards in Kikuyu Sub County

HAZARD 1. DROUGHT				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Water, Environment, Energy and Natural Resources	Water scarcity Poor water quality Fire outbreaks which destroy vegetation and microorganism	Insufficient water storage capacity High utility bills Encroachment into the riparian reserves Reduced water tables Non-revenue water High rate of population growth, urbanization and industrialization Over abstraction of water resources Environmental degradation High concentration in water sources due to reduced water volumes Low awareness on water conservation and management Lack of awareness and preparedness for drought	Promote water harvesting technologies Solarization of boreholes Mapping and pegging of riparian reserves Promotion of water conservation and management measures Construction of water harvesting and storage facilities and structures for roof and surface run off Water saving control devices Awareness creation on water conservation and management Invest in early warning systems and infrastructure Enforcement of guidelines on integrated land use	Karai, Nachu Sigona Kinoo Kikuyu
Agriculture	Reduction in agricultural yield	-Low soil moisture -Delayed onset of rainfall -Inadequate soil and water conservation structures at farm	-Engage youths in construction of soil and water conservation structures -Water harvesting for crop production -Installation of	

		level	Irrigation systems -Promote drought tolerant crop varieties -Invest in early warning systems and infrastructure -Promote subsidised farm inputs	
	Pests and diseases	Unfavourable weather conditions	-Promote crop insurance -Climate smart agricultural farming -Promote Integrated pest management systems (IPM)	
	-Loss of livestock -Reduction in production	-Lack of feeds -Pests and diseases	-Conservation of animal feeds through silage, hay etc -Introduction of appropriate and resilient breeds -Vaccination and disease control measures -Fencing off of forests -Provision of food and watering points for wildlife -Compensation of victims	
	Human Wildlife Conflict	Inadequate food for wildlife		
Fisheries	Loss of fish	-Drying up of fish ponds -High rate of water evaporation	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish	
Education	Low enrolment in schools	Water shortage	Water harvesting and storage	

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
	School drop outs Poor performance Malnutrition Respiratory illnesses	Food shortage /Famine Generation of dust	Increase access to water supply through drilling of boreholes and piped water supply Introduction of school feeding programmes Immunization programmes Sensitization of learners on environmental conservation and climate change	
Trade Markets	Reduced income for the traders and their customers Shortage of commodities in the market Low profit margins Losses in business Inability to buy new stock	Customers changing consumption habits High cost of commodities Shorter shelf life especially for perishable goods such as vegetables and fruits Exposure to heat Reduced income	Construction of solar powered cold storage rooms Establishment of post-harvest management facilities such as cold rooms Improvement of designs of the markets to allow for free circulation of air and to shield the traders from extreme heat Adoption of green designs of the markets	Karai, Nachu Sigona Kinoo Kikuyu

Hazard 2. Extreme Cold Temperatures

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture Livestock	-Low crop production Reduced production	-Increased frost bites on crops -Increased disease incidences on crops -Increased disease incidences	-Crop diversification -Early planting -Promote agronomic practices e.g. crop rotation -Promote IPM Proper housing for livestock	Nachu Kinoo Kikuyu

Hazard 3. Flooding				
Agriculture & Livestock	-Crops and Livestock destruction -Reduced crop and animal production	-Waterlogging -Soil nutrient leaching -Increased animal and crop disease incidences	-Construction of soil and water conservation structures -Promote runoff water harvesting e.g. by construction of water ponds -Crop and livestock insurance -Tree planting -Conservation of riparian reserves -Install proper drainage channels/structures -Proper farm planning	
Health	Increased incidences of waterborne diseases such as cholera.	Blocked drainage systems Cotton soils which are poorly drained hence restrict water percolation into ground Encroachment on the water ways Quarry pits that get filled with water and become breeding grounds for mosquitoes	Unclogging of drainage systems	
Roads Transport, Utilities and Public works	Disruption of transport routes Destruction of infrastructure such as roads and buildings	Poor storm water drainage systems	Climate proof the transport infrastructure	

Water, Environment Energy and Natural Resources	Poor water quality due to pollution	Pollution from surface runoff	Water management infrastructure	
	Pollution of water sources	Poor waste management	Proper waste management	
	Drowning			
		Quarrying pits which get filled with water during the rainy season		
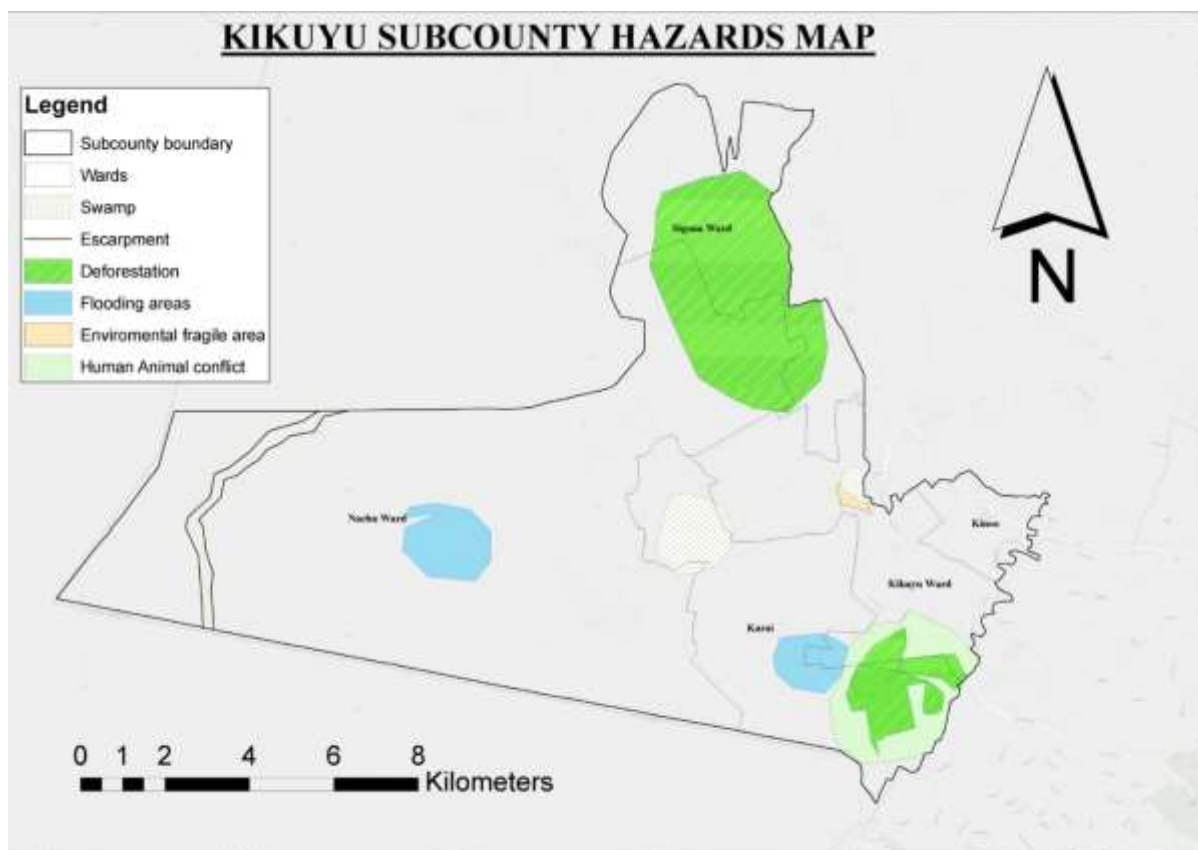
Figure 23: Kikuyu Sub County Hazards Map

The Vulnerable Groups

Vulnerable groups in Kikuyu Sub County include People with Disability (PWD), the elderly, women and youth.

  a) PWDs; these are at risk of accessing basic needs like food and clean water during drought and floods. Their mobility is also affected during floods when roads are impassible

  b) Elderly; the extreme cold weather and dust during drought makes the elderly prone to respiratory diseases and arthritis. Poor access to food and nutrition can expose them to diet related illnesses. This is mainly in Nachu and Karai wards.

c) Women; Those in reproductive age face challenge in mobility while seeking health care during floods.

d) Youth; Most are in transport sector which is adversely affected during floods.

e) Children; they miss school due to respiratory illnesses and inadequate food during drought.

3.2.4 Kabete Sub County Climate Risks and Hazards Profile

Brief Description

Kabete Sub County covers an area of 60. 7Km2.It has 5 wards ie Gitaru, Muguga, Nyathuna, Kabete and Uthiru. According to 2019 Kenya Population and Housing Census, the sub county population stood at 199,653 comprising of 97,794 males, 101,845 females and 14 intersex. This population was projected at 214,881 in 2022 and will reach 235,751 in 2027. The Sub County had the highest population density of 3,289 persons per square kilometer in 2019. This was projected at 3,540 and 3,884 persons per square kilometer in 2022 and 2027 respectively.

The main economic activities in the sub county include: Trade, farming i.e poultry rearing and horticulture, transport and real estate.

Land Use

Kabete Sub County is predominantly urban hosting real estates and higher learning institutions such as Nairobi University School of veterinary services, Wangari Mathai institute and Kanyiri polytechnic.

Other land uses identified by the community includes; Horticulture, dairy farming, poultry farming, pig farming, quarrying and human settlement.

Implication of Land use to the Environment – Climate Change

Community members identified undernoted as implication of land use in the sub county.

1) Air pollution
2) Effluent discharge
3) Land degradation
4) Soil erosion
5) Water pollution

Table 6: Hazards in Kabete Sub County

HAZARD 1. Flooding				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	-Destruction of crops and livestock -Reduced crop and animal production -Land degradation	- Soil-borne and water borne diseases - Soil nutrients leaching -Water logging	-Building of gabions -Vaccination and immunization of livestock -Planting of cover crops -Tree planting -Conservation of riparian reserves -Install proper drainage structures -Early warning systems to enable farmers take preventive measures	-Kiambaa in Muguga ward -Mwimuto in Kabete
Water	Pollution	-Storm Water -Soil erosion -Poor waste management -Poor drainage and sewerage system	-Design and Construction of proper water storm structures -Planting of trees/ building of gabions -Public Awareness and education on proper waste management	-Kiambaa in Muguga ward -Mwimuto in Kabete ward
Health	Increased water borne diseases	Stagnant water and water logged soil	Increased public awareness on disease prevention. Vaccination for animals	-Mwimuto in Kabete ward
Transport and Infrastructure	Transportation disruptions	High water tables Poor drainage and sewerage system	-Construction and maintenance of proper drainage systems -Proper road designs	-Mwimuto in Kabete ward -Kiambaa in Muguga ward
Education	Disruption of daily school activities	-Displacement of students -Damage of transport infrastructures	-Proper landscaping of schools -Construction of proper drainage system and transport infrastructures -Early warning systems and Preparedness	-Mwimuto in Kabete ward -Kiambaa in Muguga ward

Hazard 2. Extreme Cold Temperatures				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Crop and livestock damage	Frost and freezing temperatures	Practice smart climate agriculture such as adoption of cold resistant crops and livestock.	All Wards
Water	Unpleasant smell	Bacteria are inactive	Construction of green houses in the treatment facility	All wards
Health	Increased respiratory diseases and frostbites	Exposure to low temperatures	Enhanced Universal health Awareness creation on warm house designs	All Wards
Education	High rate of absenteeism	-Exposure to low temperatures -Frostbites	Enhancement of feeding programmes Awareness creation on warm housing designs and clothing	All Wards
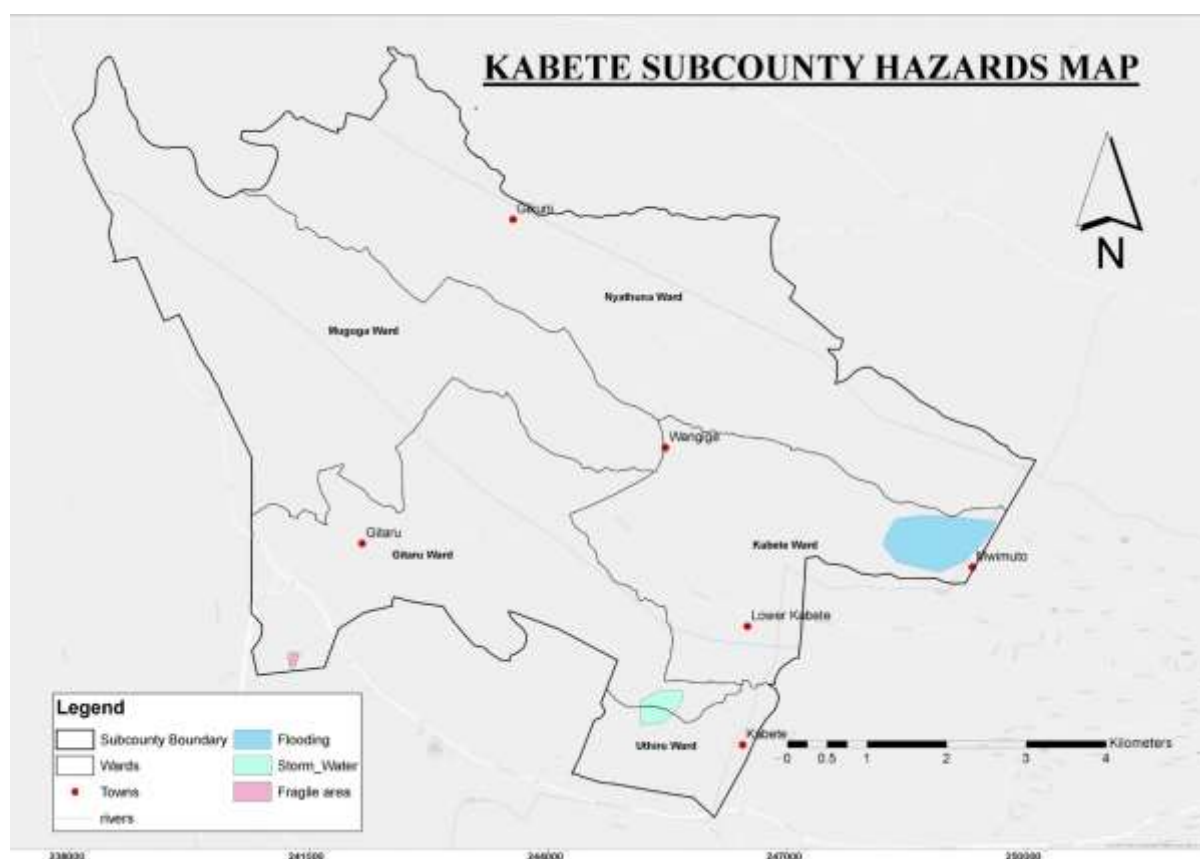
Figure 23: Kabete Sub County Hazards Map

The Vulnerable Groups
The community members identified the following vulnerable groups:

a) Informal settlers in Gitigiti and Kosovo as vulnerable during floods due to poor sanitation conditions that make settlers prone to water borne diseases. They are also prone to extreme temperatures due to poor housing structures.

b) The elderly are more susceptible to extreme cold temperatures leading to respiratory illnesses. They also have reduced mobility during floods making it challenging for them to escape or reach medical facilities in case of illnesses.

c) PWDs; they are more prone to harsh climatic conditions such as extreme cold and flooding. Mobility limitations, reduced stamina, or compromised immune systems may make it difficult for them to seek shelter, evacuate, or engage in necessary protective measures.

d) Youths and children; they are more prone to dropping out of school as a result of floods and extreme cold temperatures or hunger during drought.

e) Orphans; they have limited access to resources and challenges in accessing basic needs hence increasing their vulnerability to the impacts of drought or floods.

f) Poor households; they are more prone to drought as they have little or no income. They are also more prone to over flooding as they live in areas with poor urban planning. Also prone to water shortages and poor management of wastes.

3.2.5 Kiambaa Sub County Climate Risks and Hazards Profile

Background Information

Kiambaa Sub County borders Kabete and Limuru Sub Counties to the West, Kiambu and Githunguri Sub Counties to the East and North with Nairobi City County bordering on the south. The Sub County covers an area of 91.1Km^2 and has 5 wards namely Cianda, Karuri, Ndenderu, Muchatha and Kihara. According to 2019 Kenya Population and Housing Census, the sub county had a population of 236,400 comprising 115,690 males, 120,695 females and 15 intersex. This population was projected at 254,430 in 2022 and will reach 279,150 in 2027. The Sub County is densely populated and had a population density of 2,595 persons per square kilometer in 2019. This was projected at 2,793 and 3,064 persons per square kilometer in 2022 and 2027 respectively.

From the PCRA process, it was established that the settlements are mostly in the shopping centres and within the plantations. There are coffee and tea plantations on majority of the land within the sub county and very little arable land left for farming activities. The residents practice subsistence farming within plots and along river banks for family use. Most of the food products are purchased in markets from other areas to guarantee a balanced meal for the whole

family. The main economic activity in the Sub County is agriculture with coffee, tea and dairy farming as the main sources of livelihood.

Table 7: Hazards in Kiambaa Sub County

HAZARD 1. Flooding				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Crops and Livestock destruction Land degradation	Soil erosion Water logging Lack of proper civic education on soil conservation Change of user from agricultural to commercial	Construction of Soil and water conservation structures Promote water harvesting Tree planting Conservation of riparian reserves Installation of proper drainage channels/structures Proper civic education on soil conservation Implementation of County Spatial Plan	Karuri ward (Mombasa, Karuri high school) Kihara ward (Kanungu, Rivalori, Kihara hospital& market, Shamoka road, Gatume close off Kyuna road) Ndenderu ward (Ruaka market &Square) Cianda ward (Kawaida sports ground to Cianda river)
Water	Pollution	Storm Water	Design and Construction of Proper Storm water structures Reclamation and protection of wetlands	Cianda ward- Dam 10, Dam 6, Dam 3 Kihara ward – Red hill dam in

		Illegal dumping Dust and smoke	Development, enactment and implementation of legislation on liquid and solid waste management	Karura Karuri ward -Ite dam Muchatha ward-Havilah corner stone dam Karuri ward
Health	Increased respiratory and Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	Stagnant water and water logged soil Dust and smoke	Increased public awareness on disease prevention. Vaccination for animals	All wards
Transport and Infrastructure	Clogging of drainages	Lack of maintenance on road, sewer and drainage structures Improper designs of roads Encroachment on the roads	Construction and maintenance of drainage systems Proper road designs Enforcement of relevant legislations (EMCA 1999, Water Act 2016)	All wards
Education	Disruption of school activities	Inaccessible classrooms/offices Displacement of students	Construction of proper drainage system Landscaping of school compound Water harvesting	All wards
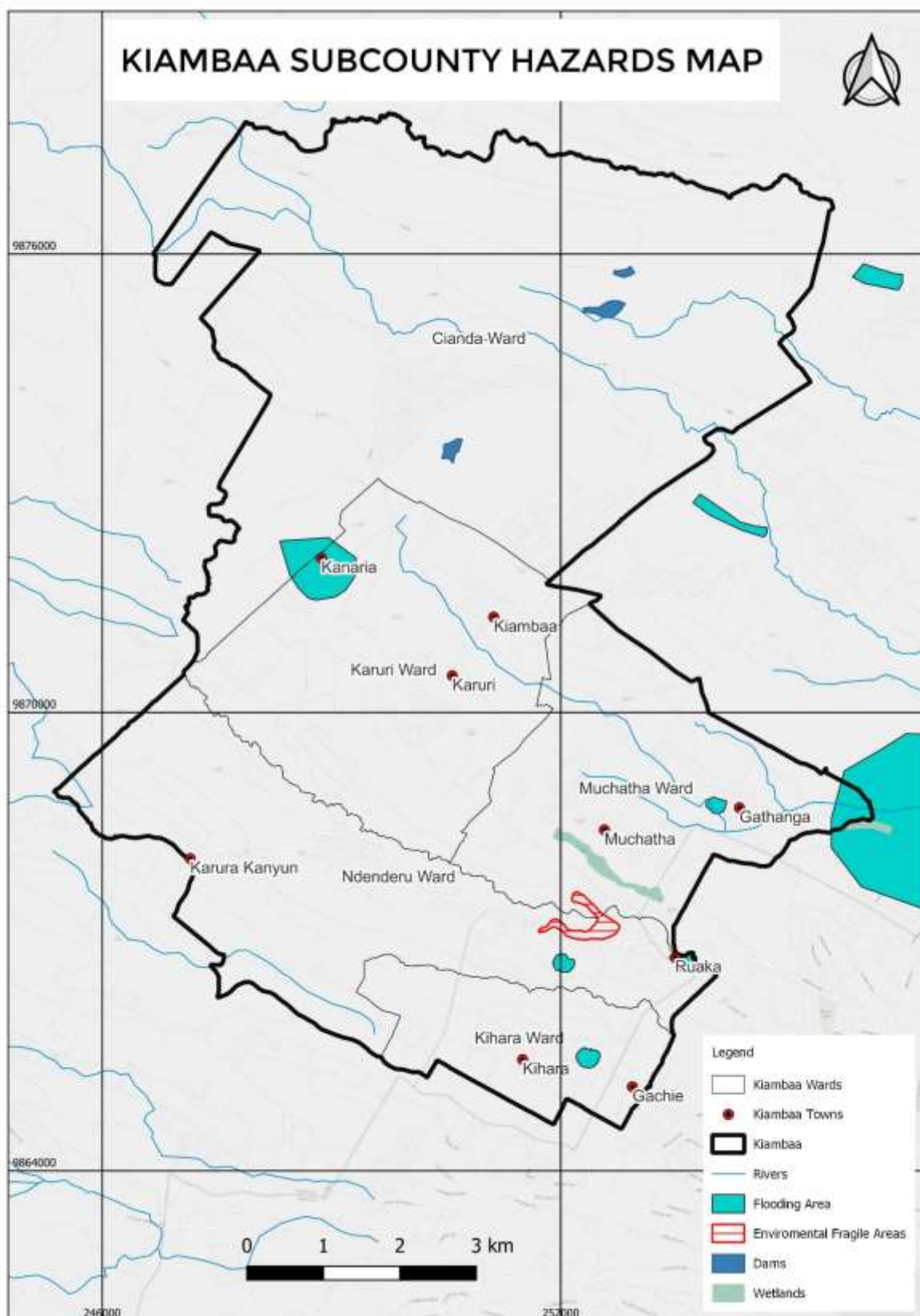
Figure 24: Kiambaa Sub County Hazard Map

The Vulnerable Groups

Vulnerable groups in Kiambaa Sub County include People with Disability (PWD), the elderly, women and youth.

a) Informal Settlers e.g Kibagare – Karura; they are prone to poor sanitation during floods which could lead to water borne diseases.

b) PWDs; these are at risk of accessing basic needs like food and water during drought and floods. Their mobility is also affected during floods when roads are impassible

c) Elderly; the extreme cold weather and dust during drought makes the elderly prone to respiratory diseases and arthritis. Poor access to food and nutrition can expose them to diet related illnesses.

d) Women; Those in reproductive age face challenge in mobility while seeking health care during floods. For example in Muchatha ward.

e) Youth; Most are in transport sector which is adversely affected during floods.

f) Children; they miss school due to respiratory illnesses and inadequate food during drought. They also lack access to clean drinking water resulting to water borne diseases

3.2.6 Kiambu Sub County Climate Risks and Hazards Profile

Background Information

Kiambu Sub County is one of the 12 Sub Counties in the County. It covers an area of 98.3Km^2. It has 4 wards namely Ting'ang'a, Ndumberi, Riabai and Township. According to 2019 Kenya Population and Housing Census, the sub county population stood at 145,903 comprising of 69,661 males, 76,225 females and 17 intersex. This population was projected at 156,798 in 2022 and will reach 172,246 in 2027. The Sub County had a population density of 1,484 persons per square kilometer in 2019 which was projected at 1,597 and 1,753 persons per square kilometer in 2022 and 2027 respectively.

Main socio-economic activities in the sub county are cash such as coffee farming and subsistence food crop farming. There are few coffee and milk processing plants. There is no forest cover.

Land Use

The land use in Kiambu Sub County is as follows;

- Agricultural use e.g coffee farming, zero grazing, growing of fodder, staple crops and vegetables.
- Commercial and residential buildings.
- Quarrying.

Implication of Land use to the Environment – Climate Change

The land use affects the environment in the following ways;

- Converting agricultural land to commercial use leads to food insecurity, deforestation, soil erosion and increased flooding.
- Increased industrialization increases emission of GHGs
- Quarrying leads land degradation.
- Unutilized land

Table 8: Hazards in Kiambu Sub County

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Hazard 1: Air pollution				
Environment	Greenhouse effects	Production of greenhouse gases (Carbon dioxide, carbon monoxide smoke)	Tree planting/incentives for carbon credit	Kiambu township
Health	Respiratory diseases	Vehicular emissions, hospital incinerator fumes	Wearing of face masks	Kiambu township
Hazard 2: Excessive Rainfall				
Agriculture	Soil erosion Damage to crops Reduced crop production	Urbanization and uncontrolled land conversion Deforestation Lack of drainage channels or blocked waterways Poor soil/water conservation structures Encroachment on riparian reserves	Afforestation Zoning of agricultural land to avoid encroachment on agricultural areas Rain Water harvesting Opening up of waterways	Ting'ang'a Riabai Kiambu township
Physical infrastructure	Destruction of bridge cutting off transport (e.g. Ting'ang'a bridge) Blockage of drains Flooding	Lack of drainage channels or blocked waterways Encroachment on waterways Less seepage of water due to rapid urbanization Heavy rainfalls	Proper design of bridges and other road infrastructure Construction of drains Opening up of waterways Controlled development to allow for open spaces/water seepage zones	Ting'ang'a Kiambu township Kiamumbi
Livelihoods	Impended movement of people due to impassable roads Reduced food security due to Soil erosion and crop damage Increased food prices	Flash floods Poor designed storm water structures	Proper design of bridges and other road infrastructure Soil and water conservation structures e.g. cut-off drains, bench terraces, water harvesting	Ting'ang'a
Trade	Impended movement of goods and services due to impassable roads	Flash floods Poorly designed storm water structures	Proper design of bridges and other road infrastructure	Ting'ang'a Kiamumbi
Health	Outbreak of diseases due	Floods	Construction of	Ting'ang'

	to water stagnation/contamination of underground water		drains Opening up of waterways	a and Kiambu township Kiamumbi
Hazard 3: Drought				
Environment	Loss of biodiversity e.g. loss of certain bird species in Ting'ang'a	Deforestation and conversion of agricultural land to urban development	Afforestation Cleaning of rivers	Ting'ang'a Riabai
Health	Outbreak of diseases	Inadequate water to maintain hygiene	Water harvesting Provision of potable water	Kiambu township Ting'ang'a
Agriculture	Reduction of agricultural yields	Low soil moisture Delayed onset of rains Inadequate soil and water conservation structures	-Engage youths in the construction of soil and water conservation structures -Water harvesting for crop production -Installation of Irrigation systems -Promote drought-tolerant crop varieties -Invest in early warning systems and infrastructure -Promote subsidized farm inputs	Ting'ang'a Riabai
Livelihoods	Famine High food prices	Low crop/livestock production	Adopt farming practices Urban agriculture	Ting'ang'a Riabai Kiamumbi Kiambu township
Trade	Fluctuation of food prices Low supply of agricultural produce Less variety of agricultural produce	Low crop/livestock production	Construction of food reserves/silos	Ting'ang'a Riabai Kiamumbi Kiambu township
Hazard 4: Excessive Temperatures				
Environment	Fire outbreaks	Dry matter	Planting of trees Provision of fire hydrants/firefighting equipment	Ting'ang'a Riabai Kiamumbi Kiambu township
Health	Skin diseases	Strong radiation from the sun	Urban greenery and planting of trees	Kiambu township
Agriculture	Wilting of crops	High transpiration Emission of	Plant drought-resistant crops/fast-	Ting'ang'a

		Greenhouse gases	maturing plants	Riabai
Trade	Increased perishability of agricultural/livestock produce	Emission of Greenhouse gases	Provision of cooling facilities	Kiamumbi and Kiambu township
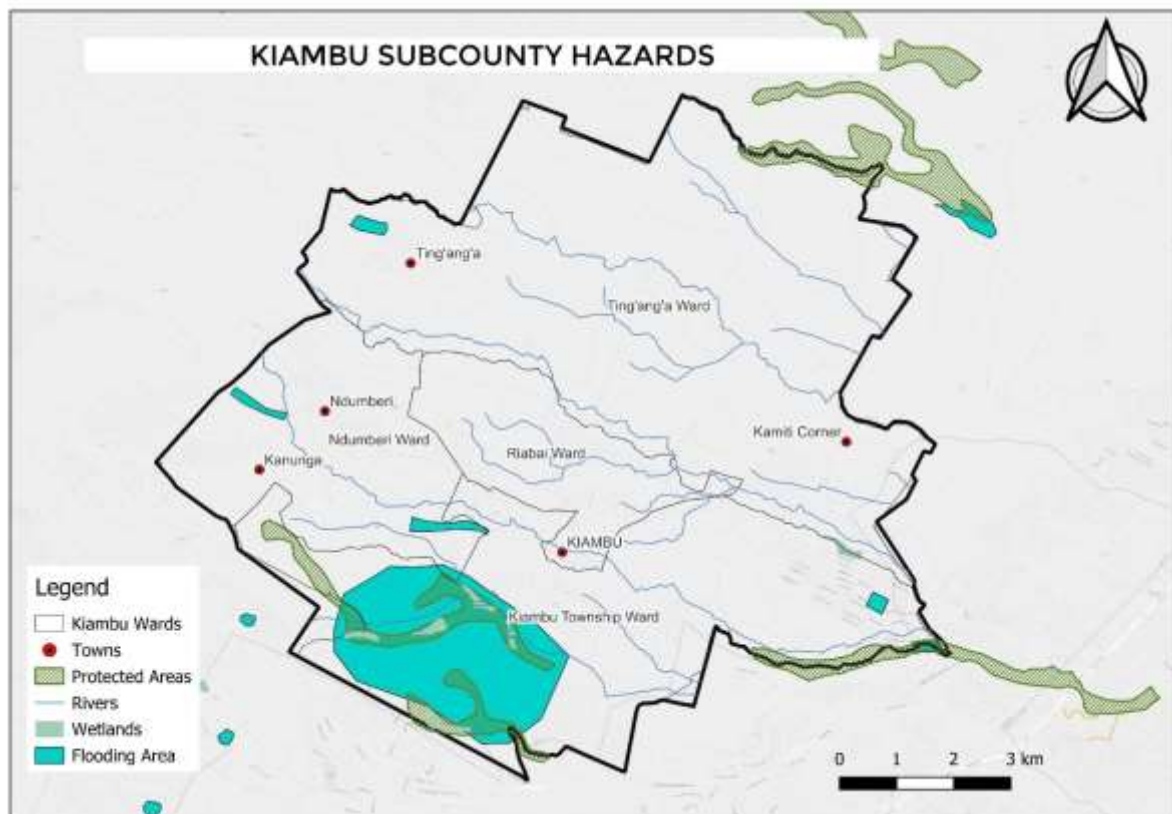
Figure 25: Kiambu Sub County Hazard Map

The Vulnerable Groups

These were identified as:-

a) The informal settlers in Ruturu- Ting'ang'a ward are more at risk during flooding due to inadequate sanitation facilities. Due to their poor housing structures they are also more vulnerable to extreme cold temperatures.

b) The elderly; they are more susceptible to extreme cold leading to respiratory illnesses and arthritis. They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

c) PWDs; they are more prone to harsh climatic conditions such as extreme cold and flooding. Mobility limitations, reduced stamina, or compromised immune systems may make it difficult for them to seek shelter, evacuate, or engage in necessary protective measures.

d) Children; they are more prone to dropping out of school as a result of floods and extreme cold temperatures. There are increased respiratory illnesses during extreme temperatures.

e) Poor households; they are more prone to drought as they have little or no income. They are also more prone to over flooding as they live in areas with poor urban planning. Also prone to water shortages and poor management of wastes.

3.2.7 Ruiru Sub County Climate Risks and Hazards Profile

Background Information

Ruiru Sub-county is a region located in Kiambu County, Kenya. It is situated approximately 20 kilometers northeast of Nairobi, the capital city of Kenya. Ruiru Sub-county covers an area of about 292 square kilometres and is characterized by a mix of urban, peri-urban, and rural areas. The sub-county is known for its rapid growth and development, fuelled by its proximity to Nairobi and its strategic location along the Thika Superhighway. The area has experienced significant population growth over the years, attracting both residential and commercial investments. It serves as a residential area for many people working in Nairobi and Kiambu County, offering a more affordable living option while maintaining close proximity to the city. According to the 2019 census, the sub county has approximate population of 490,120 people. Due to its dense population, the subcounty hosts 8 wards namely; Gitothua, Biashara, Gatongora, Kahawa Sukari, Kahawa Wendani, Kiuu, Mwiki and Mwihoko.

Land Use

Ruiru Subcounty encompasses various areas with diverse land use patterns that include;

- Residential Areas: characterized by housing developments and neighborhoods. Examples include: Membley Estate, Kahawa Sukari, Green valley garden and Mwalimu farm

- Agriculture: large amount of agricultural land given its rich agricultural heritage. Examples include: Coffee Farm in Gitothua and milk production firm in Northlands.

- Industrial Zones: Examples include: Ruiru Industrial Park located along the Eastern bypass that hosts various industries, including manufacturing, processing, and logistics.

- Commercial centers that serve as business and trading hubs. Examples include: Tatu city in Gitothua ward and Githurai 45 town which features a bustling commercial area.

- Transport infrastructures: that include roads, bridges, roundabouts, bus parks, tunnels, railway, bike paths and walkways.

Implication of Land use to the Environment – Climate Change

In Ruiru, land use has affected the environment in the following ways;

- Commercial use of land has led to food insecurity, deforestation, soil erosion and increased flooding.

- Deforestation and Habitat Loss: The conversion of green spaces into agricultural fields, and built-up areas reduces the available habitat for various organisms and disrupts ecological balance.

- Soil degradation and Erosion: Improper land use practices, such as intensive agriculture without proper soil conservation measures results in soil degradation and erosion, nutrient depletion, increasing the risk of flooding and sedimentation in water bodies.

- Pollution and Resource Depletion: Increased use of land for road construction, mining and industrial production has led to rise of air, soil and water pollution. Improper disposal of industrial effluents, improper sewage systems can contaminate water sources, depleting water quality and posing risks to human health and aquatic ecosystems.

- Extreme temperatures: Increased impervious surfaces such as concrete and asphalt contribute to the urban heat island effect. These surfaces absorb and radiate heat, leading to higher temperatures in urbanized areas compared to surrounding rural area.

- Loss of biodiversity: The conversion of natural habitats into agricultural or built-up areas can result in the loss of biodiversity. As habitats are fragmented or destroyed, plant and animal species lose their homes and face increased vulnerability to extinction.

Table 9: Hazards in Ruiru Sub County

HAZARD 1. flooding				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Health	Increased incidences of waterborne diseases such as cholera.	Blocked drainage systems Cotton soils which are poorly drained hence restrict water percolation into ground Encroachment on the water ways Quarry pits that get filled with water and become breeding grounds for mosquitoes	Unclogging of drainage systems	Gitothua Kiu - Bosnia area Kahawa Wendani Biashara – Ruiru foot bridge and Ruiru stadium Mwihoko -Githurai Kimbo Gatong'ora
Roads Transport, Utilities and Public works	Disruption of transport routes Destruction of infrastructure such as roads and buildings	Poor storm water drainage systems	Climate proof the transport infrastructure	Gatong'ora Mwihoko Kiuu Gitothua Biashara Kahawa Wendani Kahawa Sukari Mwiki
Agriculture, Livestock and Fisheries	Crop destruction	Water logging Poorly drained soils	Soil conservation measures Storm water management	Mwihoko Gatongora Kiuu Gitothua

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
			Tree planting	
Water, Environment Energy and Natural Resources	Poor water quality due to pollution	Pollution from surface runoff	Water management infrastructure	Mwihoko Gatongora Kiuu Gitothua
	Pollution of water sources	Poor waste management	Public awareness on proper waste management Cleaning/ unblocking of waste water drainage systems	Gatong'ora Mwihoko Kiuu Gitothua Biashara Kahawa Wendani Kahawa Sukari Mwiki
	Drowning	Quarrying pits which get filled with water during the rainy season	Promote rehabilitation of quarries /derelict land Enforcement of guidelines on integrated land use	Gatong'ora

Drought

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Water, Environment, Energy and Natural Resources	Water scarcity Poor water quality Fire outbreaks which destroy vegetation and microorganism	Insufficient water storage capacity High utility bills Encroachment into the riparian reserves Reduced water tables Non-revenue water High rate of population	Promote water harvesting technologies Solarization of boreholes Mapping and pegging of riparian reserves Promotion of water conservation and management measures Construction of	Gaton'gora Gitothua Mwiki Kiu Mwihoko

| | | growth, urbanization and industrialization

Over abstraction of water resources

Environmental degradation

High concentration in water sources due to reduced water volumes

Low awareness on water conservation and management

Lack of awareness and preparedness for drought | water harvesting and storage facilities and structures for roof and surface run off

Water saving control devices

Awareness creation on water conservation and management

Invest in early warning systems and infrastructure

Enforcement of guidelines on integrated land use | |
|---|---|---|---|---|
| Agriculture, livestock fisheries | Reduced crop yields

Food insecurity

Loss of livestock

Scarcity of fodder

Drying up of fish ponds | Delayed onset of rain

Inadequate soil conservation measures | Invest in capacity building on soil management

Introduction of more climate tolerant fish species

Adoption of drought tolerant crops

Diversification of irrigation sources

Practicing climate smart agriculture technologies

Zero grazing and fodder conservation

Invest in early warning systems and infrastructure | Mwiki

Mwihoko

Gatong'or a |
| Education | Low enrollment in schools

School drop outs

Poor performance | Water shortage

Food shortage /Famine

Generation of dust | Water harvesting and storage

Increase access to water supply through drilling of | Gatong'or a

Mwihoko Kiuu |

			boreholes and piped water supply	Gitothua
	Malnutrition			Biashara
	Respiratory illnesses		Introduction of school feeding programmes	Kahawa Wendani
			Immunization programmes	Kahawa Sukari
			Sensitization of learners on environmental conservation and climate change	Mwiki
Trade Markets	Reduced income for the traders and their customers	Customers changing consumption habits	Construction of solar powered cold storage rooms	Gatong'ora
	Shortage of commodities in the market	High cost of commodities	Establishment of post-harvest management facilities such as cold rooms	Mwihoko Kiuu
	Low profit margins	Shorter shelf life especially for perishable goods such as vegetables and fruits	Improvement of designs of the markets to allow for free circulation of air and to shield the traders from extreme heat	Gitothua
	Losses in business			Biashara
	Inability to buy new stock			Kahawa Wendani
				Kahawa Sukari
		Exposure to heat		Mwiki
		Reduced income	Adoption of green designs of the markets	

Figure 26: Ruiru Sub County Hazard Map

Vulnerable Groups

The vulnerable groups to climate change in Ruiru Sub County include the following;

a) The elderly; they are more susceptible to extreme heat or cold and pollution leading to health issues. They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

b) PWDs; they are more prone to harsh climatic conditions such as extreme heat, cold and flooding. Mobility limitations, reduced stamina, or compromised immune systems may make it difficult for them to seek shelter, evacuate, or engage in necessary protective measures.

c) Youths and children; they are more prone to dropping out of school as a result of drought. They may also engage in risky behaviors, such as playing in polluted areas or swimming in unsafe water bodies increasing health risks.

d) Orphans; because this group lack parental care, support and have limited access to resources, they may grapple to navigate and access basic needs increasing their vulnerability to the impacts of a harsh climate such as water shortage and pollution.

e) Poor households; they are more prone to drought as they have little or no income. They are also more prone to over flooding as they live in areas with poor urban planning. Also prone to water shortages and poor management of wastes.

3.2.8 Githunguri Sub County Climate Risks and Hazards Profile

Background Information

Githunguri Sub County is one of the 12 Sub Counties in Kiambu County. It has 5 wards namely Githiga, Ngewa, Githunguri, Komothai and Ikinu.

The main economic activities are; - dairy, poultry, pig, coffee, tea, horticulture and banana farming. In terms of dairy the Sub County is leading in milk production.

The key resources in the Sub County are; - land, water, livestock, coffee, tea and banana bushes.

Table 10: Hazards in Githunguri Sub County

HAZARD 1. DROUGHT				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Water	Increased scarcity of water	Erratic rainfall patterns Destruction of water catchment areas	Increase public awareness on climate change Construct water harvesting & storage structures installation of cofferdams Install Water control devices Invest in early warning systems and infrastructure	Komothai ward
Environment	Loss of biodiversity	Delayed onset of rains Deforestation	Establish water points around key biodiversity ecosystems Tree planting Increase public awareness on natural resource and ecosystem management for	Komothai ward

Agriculture	Reduction in agricultural yield	Low soil moisture	Invest in capacity building on soil management	Komothai ward
		Uneconomical sub division of land	Implementation of County Spatial Plan	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
		-Inadequate soil and water conservation structures at farm level	Construction of soil and water conservation structures	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
		Delayed onset of rainfall	Installation of Irrigation systems Invest in early warning systems and infrastructure subsidized farm inputs Practice climate smart agricultural farming	Komothai ward
	Loss of livestock	Pests and diseases Lack of feeds	Public awareness on conservation of animal feeds through silage, hay etc Introduction of appropriate and resilient breeds Vaccination of animals	Komothai ward
Health	Increased respiratory diseases	Dust and smoke	Increase awareness on disease prevention Vaccination of animals	Komothai ward

Hazzard 2. Flooding

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Crops and Livestock destruction	Soil erosion Water logging	Construction of Soil and water conservation	Ikinu ward (Karia)

			structures	
	Land degradation	Lack of proper civic education on soil conservation Change of user from agricultural to commercial	Promote water harvesting Tree planting Conservation of riparian reserves Installation of proper drainage channels/structures Proper civic education on soil conservation Implementation of County Spatial Plan	
Water	Pollution	Storm Water Illegal dumping	Design and Construction of Proper Storm water structures Reclamation and protection of wetlands Development, enactment and implementation of legislation on liquid and solid waste management	Githiga ward (Gichogocho area, Gathangari, Ruiru dam) Ikinu ward(Ikinu Chief's office, Karia, Komothai ward (Thuita primary Marige Chief's office) Ngewa ward (Ngewa market) Githunguri ward(Githunguri market and buspark)
Health	Increased respiratory and Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	Stagnant water and water logged soil Dust and smoke	Increased public awareness on disease prevention. Vaccination for animals	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
Transport and Infrastructure	Clogging of drainages	Lack of maintenance on road, sewer and drainage structures	Construction and maintenance of drainage systems	Githunguri, Githiga, Ngewa, Ikinu and Komothai

			Proper road designs	wards
		Improper designs of roads	Enforcement of relevant legislations (EMCA 1999, Water Act 2016)	
		Encroachment on the roads		
		Poor planned informal sector	Implementation of County Spatial Plan	
Education	Disruption of school activities	Inaccessible classrooms/offices	Construction of proper drainage system	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
		Displacement of students	Landscaping of school compound	
			Water harvesting	

Hazards 3. Mudslides

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Destruction of crops and Livestock	Water logging	Construction of Soil and water conservation structures Tree planting	Githiga ward (Gathangari)
Water	Poor water quality in rivers and streams	High silt load	Design and construction of proper soil and water conservation structures Invest in early warning systems and infrastructure	Githiga ward (Gathangari)
Environment	Loss of diversity	Loose soil destabilizing the landmass Mass clearing of vegetation cover	Increase Public awareness on environmental conservation Tree planting	Githiga ward (Gathangari)
Trade	Human and Economic losses	Urbanization/ migration from mudslide prone areas	Increase public awareness on reducing activities on areas prone to mudslides	Githiga ward (Gathangari)

Hazard 4. Green House gases

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards

Environment	Pollution	Untreated animal wastes (cow dung)	Construction of green houses in the treatment facility	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
			Promotion of clean cooking	
Health	Increased respiratory diseases	Exposed animal wastes (cow dung)	Increased public awareness on disease prevention.	Githunguri, Githiga, Ngewa, Ikinu and Komothai wards
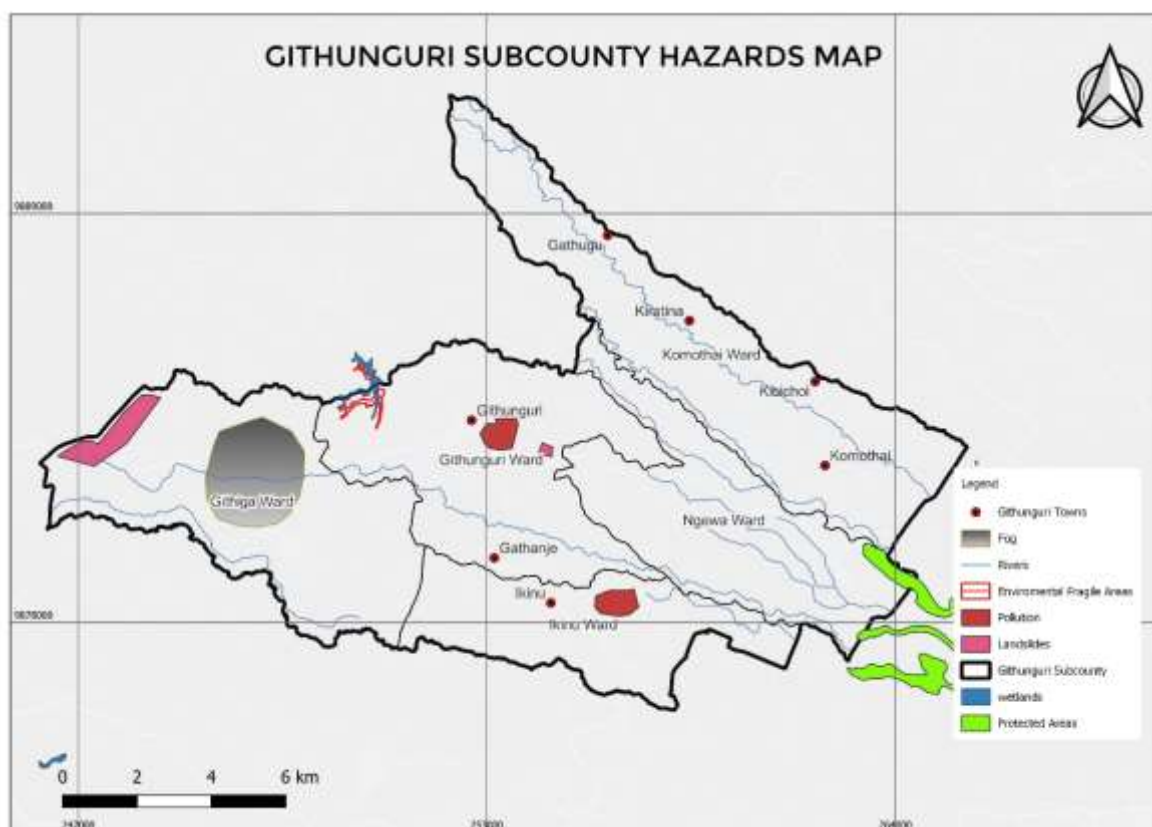
Figure 27: Githunguri Sub County Hazard Map

The Vulnerable Groups

Some groups of people were identified as being adversely affected to hazards as described below;

a) The farmers are affected through crop failures, death of livestock because of drought while during floods there is soil erosion

b) The sick, children and elderly cannot access food during floods and droughts as these extreme conditions lead to food shortages

c) The economically disadvantaged such as those in informal settlements cannot access basic commodities

d) There outbreak of diseases due to water contamination during floods and extreme weather conditions.

3.2.9 Juja Sub County Climate Risks and Hazards Profile

Background Information

Juja Sub County is one of the 12 Sub Counties in the County. It covers an area of 342Km2. It has 5 wards ie Murera, Theta, Juja, Witeithie, Kalimoni. According to 2019 Kenya Population and Housing Census, the sub county population stood at 300,948 comprising of 148,446 males, 152,480 females and 22 intersex. This population was projected at 323,927 in 2022 and will reach 355,376 in 2027. The Sub County had a population density of 880 persons per square kilometer in 2019 which was projected at 947 and 1,039 persons per square kilometer in 2022 and 2027 respectively.

The key social economic activities include Industries such as Del Monte, and premier Bag and Cordage, farming i.e. coffee and dairy farming, small micro enterprises, quarry mining, trading in the markets and shopping centres and large scale plantations.

Table 11: Hazards in Juja Sub County

Hazard 1. Drought				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Water	Increased scarcity of water	Erratic rainfall patterns Destruction of water catchment areas Low awareness on water conservation and management	- Community Based Water Management activities (water harvesting/ storage / recycling / water rationing) Conservation of water catchment areas and sources Water control devices such as sluice gates, valves and master meters - Invest in early warning systems and infrastructure Invest in early warning systems and infrastructure	- Kalimoni – Athi Juja farm, Marana, Komo and Mutharaa.
Agriculture	Reduction in agricultural yield Crop failure	Low soil moisture Delayed onset of rainfall	Invest in capacity building of farmers on soil management Promote drought	- Juja - Witeithie - Murera - Theta - Kalimoni

	Reduced income Increased food insecurity	Inadequate soil and water conservation structures at farm level.	tolerant crop varieties Promote crop insurance Installation of Irrigation systems Invest in early warning systems and infrastructure Subsidized farm inputs, dam liners Promote Climate smart agricultural practices Engage youths in construction of soil and water conservation structures Promote Integrated pest management systems (IPM)	
	Loss of livestock	Pests and diseases, Lack of feeds and water	Conservation of animal feeds in form of silage, hay etc Introduction of appropriate and resilient breeds	- Juja - Witeithie - Murera - Theta - Kalimoni
	Human-wildlife conflict and intercommunity conflicts	Inadequate food for wildlife	- Habitat management - Community education - Compensation of victims - Apply – GPS tracking and camera traps to monitor movement	- Kalimoni - Witeithie
Health	Increased lung & eye diseases	Increased Dust	Increased public awareness on disease prevention.	Kalimoni
Flooding				
Agriculture & livestock	Crops &livestock destruction	Increased crop diseases	Building of gabions	- Juja - Witeithie

	Land degradation Reduced crops & livestock production	Soil erosion Water logging Lack of proper civic education on soil conservation	Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation, crop rotation, adoption of early maturing plants & farm planning Promote IPM Promote runoff water harvesting e.g. by construction of water ponds Crop and livestock insurance	- Murera - Theta - Kalimoni
Water	Pollution	Improper disposal of solid & liquid waste	Construction of waste transfer stations, provision of waste bins/skips, Harvesting of rain water in markets, schools and hospitals	
	Contamination of drinking water, Marine ecosystem	Industrial chemicals and emission, oil & lubricants from garages, Improper disposal of solid and liquid waste	Increase public awareness Enforce rules and regulations on waste & chemical disposal	
Health	Increased Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	- Stagnant water and water logged soils -	Increased public awareness on disease prevention. Vaccination for animals. Early relocation of people and animals to safer grounds	- Juja - Witeithie - Murera - Theta - Kalimoni - Juja - Witeithie - Murera - Theta - Kalimoni
Transport and Infrastructure	Clogging of drainages	Lack of maintenance on	Construction and maintenance of	

		road, sewer and drainage structures Improper designs of roads	drainage systems Proper road designs	
Education	Disruption of school activities	Destruction of transportation infrastructure, classrooms and playgrounds	Landscaping of School compounds and paving of driveways/walkways, construction and maintenance of drainages, Early warning & preparedness systems	

Figure 28: Juja Sub County Hazard Map

The Vulnerable Groups

In Juja Sub County, these groups were identified as being most vulnerable to impacts of climate change;

   a) Children are vulnerable during floods due to impassable roads and open quarries left unattended. They are also affected by dust pollution which results in respiratory illnesses such as asthma causing school absenteeism.

b) PWDs are prone to hunger during drought since they have challenges meeting basic needs due to low incomes. Immobility is also a challenge during floods.

c) The elderly whose immune systems are weak are prone to respiratory diseases that are activated by strong winds during drought that cause dust pollution. They also face challenges accessing food during drought.

d) Farmer households are vulnerable due to crop failure which is common during extreme hot temperatures and drought.

e) Youth engaged in quarrying are prone to respiratory illnesses due to exposure to dust

3.2.10 Thika Sub County Climate Risks and Hazards Profile
Background Information

Thika Sub County is one of the 12 Sub Counties in the County. It covers an area of 201.3Km2. It has 5 wards ie Township, Kamenu, Hospital, Gatuanyaga and Ngoliba. According to 2019 Kenya Population and Housing Census, the sub county population stood at 284,776 comprising 140,386 males, 144,368 females and 22 intersex. This population was projected at 306,517 in 2022 and will reach 336,274 in 2027. The Sub County had a population density of 1,415 persons per square kilometer in 2019 which was projected at 1,523 and 1,671 persons per square kilometer in 2022 and 2027 respectively. Main socio-economic activities in the sub county are farming that include cash crops like coffee, pineapples, subsistence farming and manufacturing. There are few coffee, milk, tobacco, vegetable edible oil, flour mills, and paper mills among other processing plants. There is no forest cover.

Land Use

The main land uses in Thika are;

- Agricultural use e.g coffee farming, pineapple plantations, mangoes, zero grazing, growing of fodder, staple crops and vegetables.
- Commercial and residential buildings.
- Industries
- Quarrying.

Implication of Land use to the Environment – Climate Change

The implication of land use was examined and the results below were obtained;

- Massive change of land use from agricultural, to commercial, industrial and residential, use leading to reduced carbon sink, deforestation, soil erosion ,soil fertility loss, increased flooding, food insecurity unpredictable weather, change in weather patterns, prolonged drought increased pollution and overwhelming existing infrastructure

- Excessive quarrying and abandoned quarry pits degrading land and posing life risk and security

- Increased Green House Gases (CHGs) emissions from industries

- land degradation, vegetation loss, air pollution, noise pollution, ground and surface water pollution

- Eutrophication of water bodies occasioned by extensive farming in plantations

- Reduced surface and ground water resulting in conflicts

- Increased intensity of locust swarms invasion resulting to crops lost to insect pests

Table 12: Hazards, Risks and their ranking in Thika

HAZARD 1. DROUGHT				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Water, Environment, Energy and Natural Resources	Water scarcity Poor water quality Fire outbreaks which destroy vegetation and microorganism	Insufficient water storage capacity High utility bills Encroachment into the riparian reserves Reduced water tables Non-revenue water High rate of population growth, urbanization and industrialization Over abstraction of water resources Environmental degradation	Promote water harvesting technologies Solarization of boreholes Mapping and pegging of riparian reserves Promotion of water conservation and management measures Construction of water harvesting and storage facilities and structures for roof and surface run off Water saving control devices	Township (Kiandutu…) Hospital (Majengo, Madharau, Gachagi…) Kamenu Gatuanyaga (Munyu…) Ngoliba (Mukunike…)

| | | High concentration in water sources due to reduced water volumes

Low awareness on water conservation and management

Lack of awareness and preparedness for drought | Awareness creation on water conservation and management

Invest in early warning systems and infrastructure

Enforcement of guidelines on integrated land use | |
|---|---|---|---|---|
| Agriculture | Reduction in agricultural yield | -Low soil moisture
-Delayed onset of rainfall
-Inadequate soil and water conservation structures at farm level | -Engage youths in construction of soil and water conservation structures
-Water harvesting for crop production
-Installation of Irrigation systems
-Promote drought tolerant crop varieties
-Invest in early warning systems and infrastructure
-Promote subsidised farm inputs | Township

Hospital

Kamenu

Gatuanyaga

Ngoliba |
| | Pests and diseases | Unfavourable weather conditions | -Promote crop insurance

-Climate smart agricultural farming
-Promote Integrated pest management systems (IPM) | |
| | -Loss of livestock
-Reduction in production | -Lack of feeds
-Pests and diseases | -Conservation of animal feeds through silage, hay etc
-Introduction of appropriate and resilient breeds | Township

Hospital

Kamenu

Gatuanyaga |

			-Vaccination and disease control measures	Ngoliba
	Human Wildlife Conflict	Inadequate food for wildlife	-Fencing off of forests -Provision of food and watering points for wildlife -Compensation of victims	
Fisheries	Loss of fish	-Drying up of fish ponds -High rate of water evaporation	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish	●
Education	Low enrolment in schools School drop outs Poor performance Malnutrition Respiratory illnesses	Water shortage Food shortage /Famine Generation of dust	Water harvesting and storage Increase access to water supply through drilling of boreholes and piped water supply Introduction of school feeding programmes Immunization programmes Sensitization of learners on environmental conservation and climate change	Township Hospital Kamenu Gatuanyaga Ngoliba
Trade Markets	Reduced income for the traders and their customers Shortage of commodities in the market Low profit margins Losses in business Inability to buy new stock	Customers changing consumption habits High cost of commodities Shorter shelf life especially for perishable goods such as vegetables and fruits	Construction of solar powered cold storage rooms Establishment of post-harvest management facilities such as cold rooms Improvement of designs of the markets to allow for free circulation of air and to shield the	Township Hospital Kamenu Gatuanyaga Ngoliba

		traders from extreme heat		
		Exposure to heat		
		Reduced income	Adoption of green designs of the markets	

HAZARD 2. Flooding

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Crops and Livestock destruction Land degradation	Soil erosion Water logging Lack of proper civic education on soil conservation	Building of gabions Tree planting Conservation of riparian reserves Grass planting eg vertiva grass Install proper drainage channels/structures	Township (Ngoingwa) Kamenu (Kiganjo, Muthaiga, Kiangombe) Hospital Ngoliba Gatuanyaga
Water	Water Pollution	Contamination of water in rivers, swamps and other water sources, , damage to aquatic eco system	Design and Construction of Proper Storm water structures	Township ward Ngoliba ward Kamenu Ward Hospital Ward Gatuanyaga
Health	Increased Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	Stagnant water causing increased breeding sites for mosquitoes	Increased public awareness on disease prevention. Vaccination for animals Provision of mosquito nets	Gatuanyaga ward Kamenu ward
Transport and infrastructure design	Clogging of drainages	Increased buildings and tarmacking in town area Lack of maintenance on road, sewer and drainage structures Improper design and maintenance of bridges	Provision of culverts and excavator Construction and maintenance of drainage systems Proper regulations on constructions Increase green areas Proper road designs	Kamenu-Jerusalem Bombolulu-kisii Gretsa University Hospital Salama landless ngoingwa murrum road Kisii estate, thika river estate makongeni

				bus park Landless' riverside Muthaiga'kiga njo
Water, Environment Energy and Natural Resources	Poor water quality due to pollution Pollution of water sources Drowning	Pollution from surface runoff Poor waste management Quarrying pits which get filled with water during the rainy season	Water management infrastructure Proper waste management	Township ward Ngoliba ward Kamenu Ward Hospital Ward Gatuanyaga
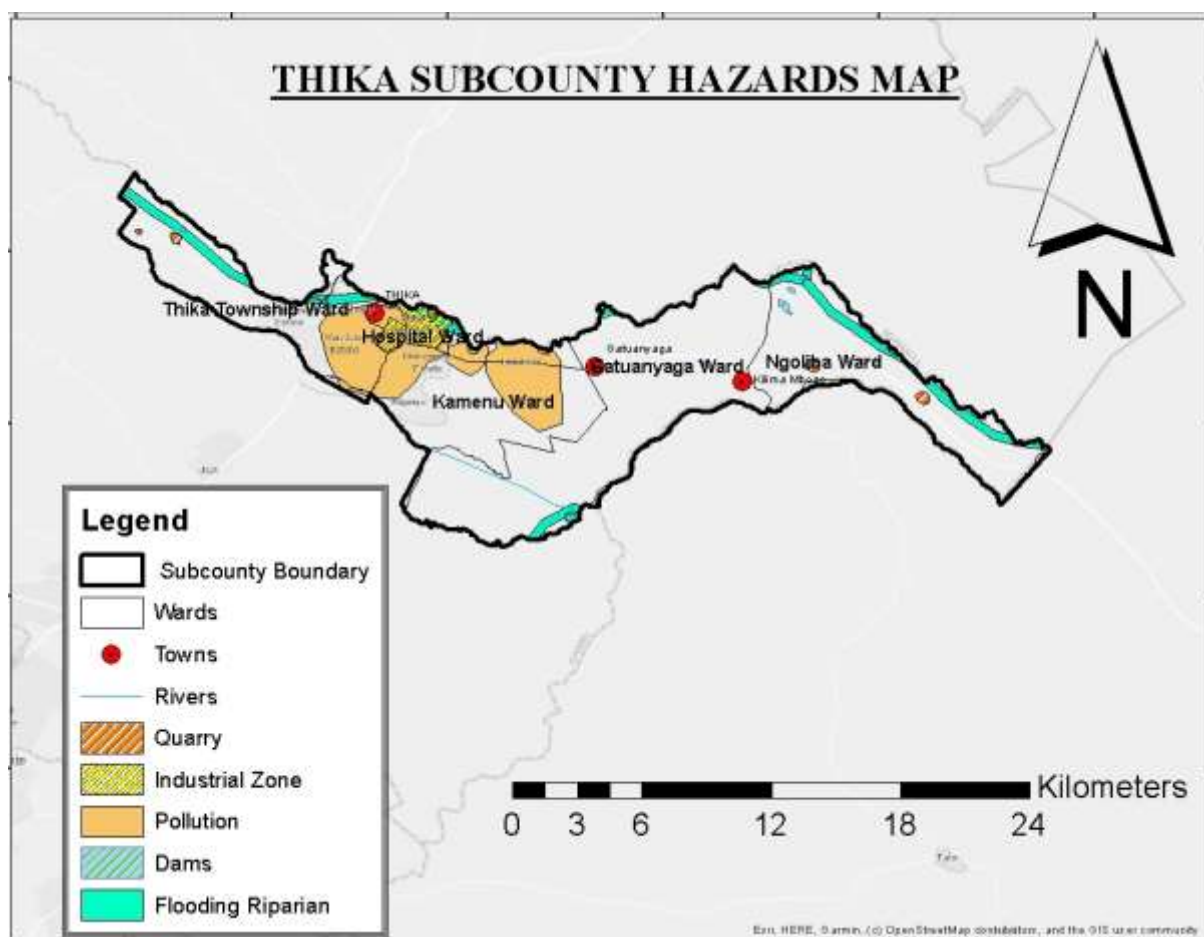
Figure 29: Thika Sub County Hazard Map

The Vulnerable Groups

During the PCRA process, several vulnerable groups were identified in Thika Sub County and classified as follows:

a) Waste pickers in Kangoki dumpsite were found to be vulnerable to diseases to the nature of their work.

b) Street children are also vulnerable due to lack of socials safety nets.

c) Informal settlers in Kiandutu in hospital ward are vulnerable to water borne diseases during floods due to water contamination as a result of poor sanitation.

d) People living near Kangoki dumpsite in Kamenu ward are prone to water borne diseases due to water contamination during flooding.

e) Children are vulnerable to water borne illnesses during floods due to poor waste disposal. They are also affected by dust pollution during drought which results in respiratory illnesses such as asthma causing school absenteeism.

f) PWDs are prone to hunger during drought since they have challenges meeting basic needs due to low incomes. Immobility is also a challenge during floods.

g) The elderly whose immune systems are weak are prone to respiratory diseases during drought are a result of dust pollution. They also face challenges accessing food during drought.

h) Farmer households are vulnerable due to crop failure and wildlife/ human conflict which is common in Ngoliba and Gatuanyaga wards during extreme hot temperatures and drought.

i) Youth engaged in transportation are challenged during floods.

3.2.11 Gatundu North Sub County Climate Risks and Hazards Profile
Background Information

Gatundu North Sub County is situated at the upper eastern part of Kiambu County. It is one of the 12 sub counties. It covers an area of 285.9 Km^2. It has 4 wards i.e Gituamba, Githobokoni, Chania and Mang'u. According to 2019 Kenya Population and Housing Census, the sub county population stood at 109,870 comprising of 54,189 males, 55,678 females and 3 intersex. This population was projected at 118,264 in 2022 and will increase to 129,746 in 2027. The Sub County had a population density of 384 persons per square kilometer in 2019 which was projected at 414 and 454 persons per square kilometer in 2022 and 2027 respectively.

The main socio-economic activities includes: tea & coffee farming, dairy farming, pig farming,poultry farming,pineapple farming,vegetable farming,arrow roots and sweet potatoes farming and small micro-enterprises.

Land Use

The main land uses in Gatundu North are as follows;

- Agricultural use e.g coffee farming, pineapple farming, avocado farming, tea farming, zero grazing, growing of fodder, staple crops and vegetables.
- Commercial and residential buildings.
- Quarrying

Implication of Land use to the Environment – Climate Change

The interaction between land use and the environment in Gatundu North is analyzed below;

- Converting agricultural land to commercial use leads to food insecurity, deforestation, soil erosion and increased flooding.
- Quarrying leads land degradation.
- Unutilized land.
- Construction of big dams changes the local microclimate e.g Karimenu I dam

Table 13: Hazards, Risks and their ranking in Gatundu North

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
HAZARD 1. Drought				
Water	Increased scarcity of water	Erratic rainfall patterns Destruction of water catchment areas	Increase public awareness on conservation of water Promote water efficiency through monitoring, reducing wastage Construct water harvesting & storage structures Conservation of riparian land Water control devices Invest in early warning systems and infrastructure	Chania,Mangu,Githobokoni and Gituamba

| Environment | Loss of biodiversity | Delayed onset of rains | Establish water points around key biodiversity ecosystems

Increase public awareness campaigns on natural resource and ecosystem management for communities in key biodiversity ecologies | Chania,Mangu,Githo bokoni and Gituamba |
|---|---|---|---|---|
| Agriculture | Reduction in agricultural yield | Low soil moisture | Invest in capacity building on soil management | Chania,Mangu,Githo bokoni and Gituamba |
| | | Delayed onset of rainfall | Installation of Irrigation systems

Invest in early warning systems and infrastructure

Subsidized farm inputs climate

Smart agricultural farming | Chania,Mangu,Githo bokoni and Gituamba |
| | Loss of livestock | Pests and diseases

Lack of feeds | Public awareness on Conservation of animal feeds through silage, hay etc

Introduction of appropriate and resilient breeds | Chania,Mangu,Githo bokoni and Gituamba |
| | Human wildlife conflicts | Lack of food | Smart agricultural farming | Githoboko ni |
| Health | Increased air borne diseases | Dust and smoke | Increased public awareness on disease prevention.

Vaccination for animals | |
| Trade | Economic losses | Loss of animals and plants | Increase crop productivity through improved irrigation | Chania,Mangu,Githo bokoni and Gituamba |

HAZARD 2. LAND SLIDE				
Sector	**Risk**	**Stressor/shock/ca use/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Destruction of crops and Livestock	Erratic weather patterns Loose soil causing soil erosion	Planting of trees Increase public awareness campaigns on use of quarries	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara,
Environment	Loss of biodiversity	Loose soils that distabilise the landmass Mass clearing of vegetation cover	Tree planting Increase public awareness on Environmental conservations	
Water	Negatively affecting water quality in rivers and streams Increase of floods	High silt load	Soil and water conservation structures Invest in early warning systems and infrastructure Increase public awareness on reducing human activities on landslide prone areas	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara
Trade	Human and Economic losses	Increased urbanization and development in landslide prone areas	Increase public awareness on reducing human activities on landslide prone areas	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
				(Kiriko/Kariminu Mataara

HAZARD 3. Flooding

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Crops and Livestock destruction Land degradation	Soil erosion Water logging Lack of proper civic education on soil conservation	Construction of Soil and water conservation structures Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara,
Water	Pollution	Storm Water Poor waste management	Design and Construction of Proper Storm water structures Conservation of riparian reserves and wetlands Development, enactment and implementation of legislation on liquid and solid waste management	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara,
Health	Increased Water Borne diseases in human and Livestock i.e. Cholera, Typhoid, rift valley fever	Stagnant water and water logged soil	Increased public awareness on disease prevention. Vaccination for animals	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure)

				Gituamba (Kiriko/Ka riminu Mataara,
Transport and Infrastructure	Clogging of drainages	Lack of maintenance on road, sewer and drainage structures Improper designs of Roads Change of user from agricultural to commercial	Construction and maintenance of drainage systems Proper road designs Implementation of County Spatial Plan	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara,
Education	Disruption of schools activities	Inaccessible classrooms/offices Displacement of students	Design and Construction of Proper Storm water structures Landscaping of school compound Water Harvesting	Githoboko ni (Kamunya ka/Kanjabi Kaibere/T ambaya) Mangu (Gatukuyu ,Karure) Gituamba (Kiriko/Ka riminu Mataara,
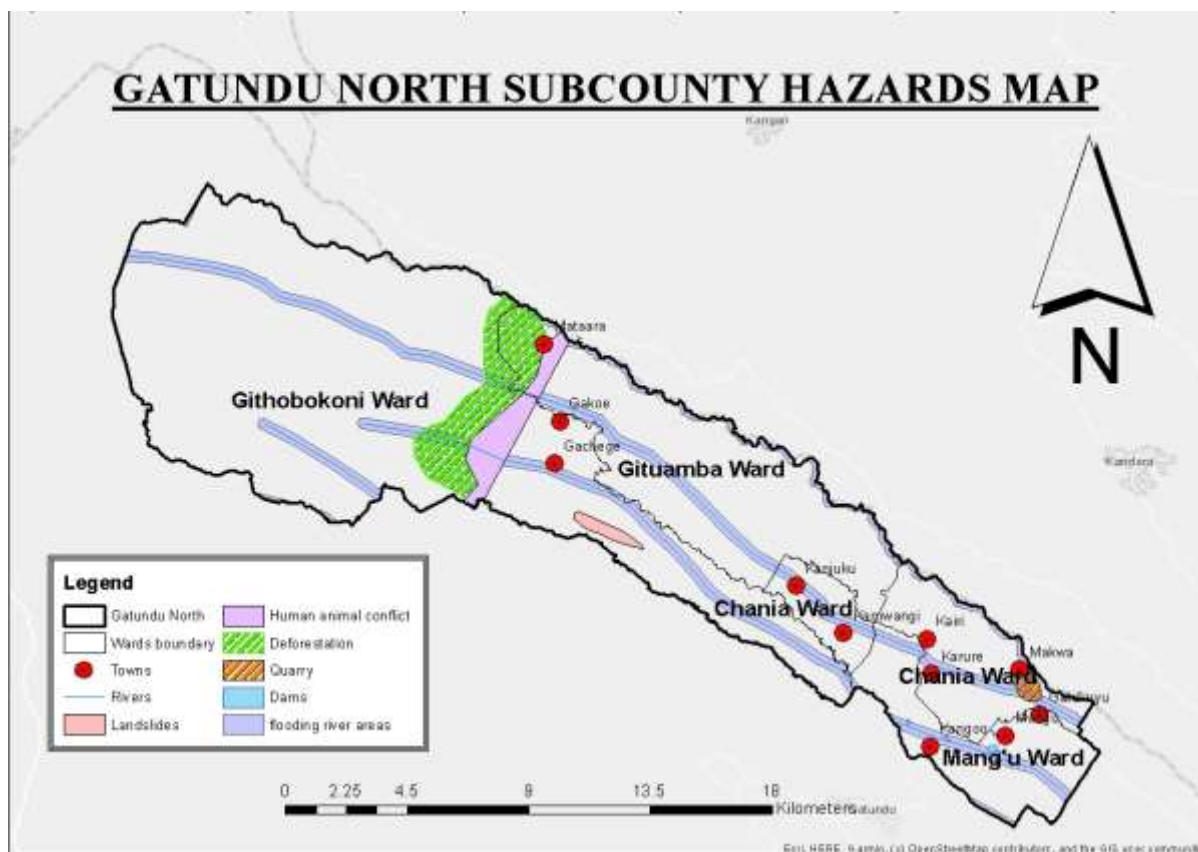
Figure 30: Gatundu North Sub County Hazard Map

5.0 The Vulnerable Groups

There were several vulnerable groups identified in Gatundu North.

a) People living in sloppy areas are prone to landslides during extreme rainy conditions which loosens the soils and may cause destruction of homes and farms.

b) The elderly are more susceptible to extreme cold temperatures resulting in respiratory illnesses.

c) PWDs; They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

d) Children are more prone to dropping out of school as a result of floods. They are also more susceptible to infections during extreme cold temperatures.

e) Farmer households are vulnerable to crop failure and animal/wildlife conflict as a result of drought. They are also more prone to flooding which results in crop and livestock destruction and further food insecurity.

3.2.12 Gatundu South Sub County Climate Risks and Hazards Profile

Brief Description

Gatundu South Sub County is one of the 12 Sub Counties in Kiambu County located in the upper central part of the County. It covers an area of 193.6Km2 and consists of four wards i.e. Kiamwangi, Kiganjo, Ndarugo and Ngenda. According to 2019 Kenya Population and Housing Census, the sub county had a population of 122,103 comprising of 60,384 males, 61,714 females and 5 intersex. This population was projected at 131,434 in 2022 and will reach 144,184 in 2027. The Sub County had a population density of 631 persons per square kilometer in 2019 which was projected at 679 and 745 persons per square kilometer in 2022 and 2027 respectively. The Social Economic activities include; farming, trading and timber trade. Farming activities include tea, Coffee, dairy, horticulture, pineapple, avocado and fish farming.

HAZARD MAPPING

During the risk assessment, the residents mapped the hazards they face and the corresponding proposed interventions.

Table 14: Hazards and their Ranking in Gatundu South

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Hazard 1: drought				
Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Reduction in agricultural yield	Low soil moisture	Promote Drought tolerant varieties and breeds	Kiganjo Ndarugu Ngenda
		Erratic weather patterns leading to delayed onset of rainfall	Food conservation by value addition e.g. freezing, drying, packaging	
	Loss of livestock			
		Lack of feeds	Conservation agriculture e.g mulching, zero-tillage	
			Installation of Irrigation systems	
			Invest in early warning systems and infrastructure	
			Subsidized farm	

			inputs climate	
			Smart agricultural farming	
			Government programs to buy livestock(destocking)	
			Crops and livestock insurance	
Fisheries	Loss of fish	-Drying up of fish ponds -High rate of water evaporation	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish	Ngenda Kiamwan gi Kiganjo Ndarugo
Water	Water Pollution	Felling of eucalyptus trees near water sources Water i.e River Thiririka Storm water causing release of tea chemicals to the rivers	Water harvesting and conservation in schools and public institutions Powering of boreholes within the ward using solar, Proper construction of sewer lines and drainages Enforcement of laws Planting windbreaker trees Harnessing wind /water power	Thiririka river
Health	Increased air borne diseases	Dust and smoke	Conduct Civic education about hygiene and sanitation Increased public awareness on disease prevention. Vaccination for animals	

HAZARD 2. LAND SLIDE				
Sector	**Risk**	**Stressor/shock/ca use/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Loss/Destruction of crops and Livestock and People	Erratic weather patterns Loose soil causing soil erosion	Planting of indigenous trees Conducting civic education to create awareness on soil conservation measures Constructing proper drainage systems	Kiganjo ward (Mundoro, Gathiru Wangui areas) Kiamwan gi ward
Roads, utilities and Transport	Destruction of roads	Loose soil	Putting up gabions	Kiganjo ward (Mundoro, Gathiru Wangui areas) Kiamwan gi ward
Water	Negatively affect water quality in rivers and streams Increase of floods	Loose soil	Rehabilitation or healing of quarries Design and Construction of Proper drainage away from the slope	Kiganjo ward (Mundoro, Gathiru Wangui areas) Kiamwan gi ward
Trade	Economic losses	Increased urbanization and development in landslide prone areas	Increase public awareness campaigns on reducing human activities on landslide prone areas	Kiamwan gi ward (Kiamwan gi shopping center) Kiganjo ward Kiganjo ward (Mundoro, Gathiru Wangui areas) Kiamwan gi ward
HAZARD 3.Flooding				

Sector	Risk	Stressor/shock/cause/what is behind the risk	Adaptation strategies	Wards
Agriculture	Crops and Livestock destruction Land degradation	Soil erosion Water logging Lack of proper civic education on soil conservation	Construction of Soil and water conservation structures Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation	Ndarugu Kiganjo ward (Mundoro, Gathiru Wangui areas) Kiamwangi ward(Nembu-Mutati sublocation)
Water	Pollution Poor sanitation	Storm Water Poor waste management	Design and Construction of Proper Storm water structures Proper construction of pit latrines in schools Conservation of riparian reserves and wetlands Development, enactment and	Mugutha river in kiganjo Ngenda ward

			implementation of legislation on liquid and solid waste management	
Health	Loss of lives in humans Increased Water Borne diseases in human and Livestock i.e.Bilharzia Cholera, Typhoid, rift valley fever	Stagnant water and water logged soil	Increased public awareness on disease prevention. Vaccination for animals	Kiamwangi ward magomano(Nembu-Mutati sublocation) Gathiru and kirangi in Kiganjo ward
Transport and Infrastructure	Loss of lives Clogging of drainages Blocking culverts Growth of shrubs Silting	Storm water Electric wires hanging on tree branches causing sparks Lack of maintenance on road, sewer and drainage structures Improper designs of Roads Change of user from agricultural to commercial	Construction of Ndumiti bridge and Gaitabiri-Kianda Kinene Maintenance of electric wires. Construction and maintenance of drainage systems Proper road designs Implementation of County Spatial Plan Construction of culverts	Ndarugo ward-(Ndumiti bridge of Rwahura River in Kirangi Kibiru sublocation) Karatu area in kiganjo Ndarugo ward-(Karatu-Kagewa

			Construction of guardrail	Road Wanugu-Kuri-Ituramiro road)

HAZARD 4. HUMAN WILDLIFE CONFLICT				
Sector	**Risk**	**Stressor/shock/cause/what is behind the risk**	**Adaptation strategies**	**Wards**
Agriculture	Destruction of crops and animals	Encroachment of animal habitat.	Compensation and Insurance to cover any damage - Installing electric fences or other physical barriers to create a separation between human settlements and wildlife habitats	

Figure 31: Gatundu South Sub County Hazard Map
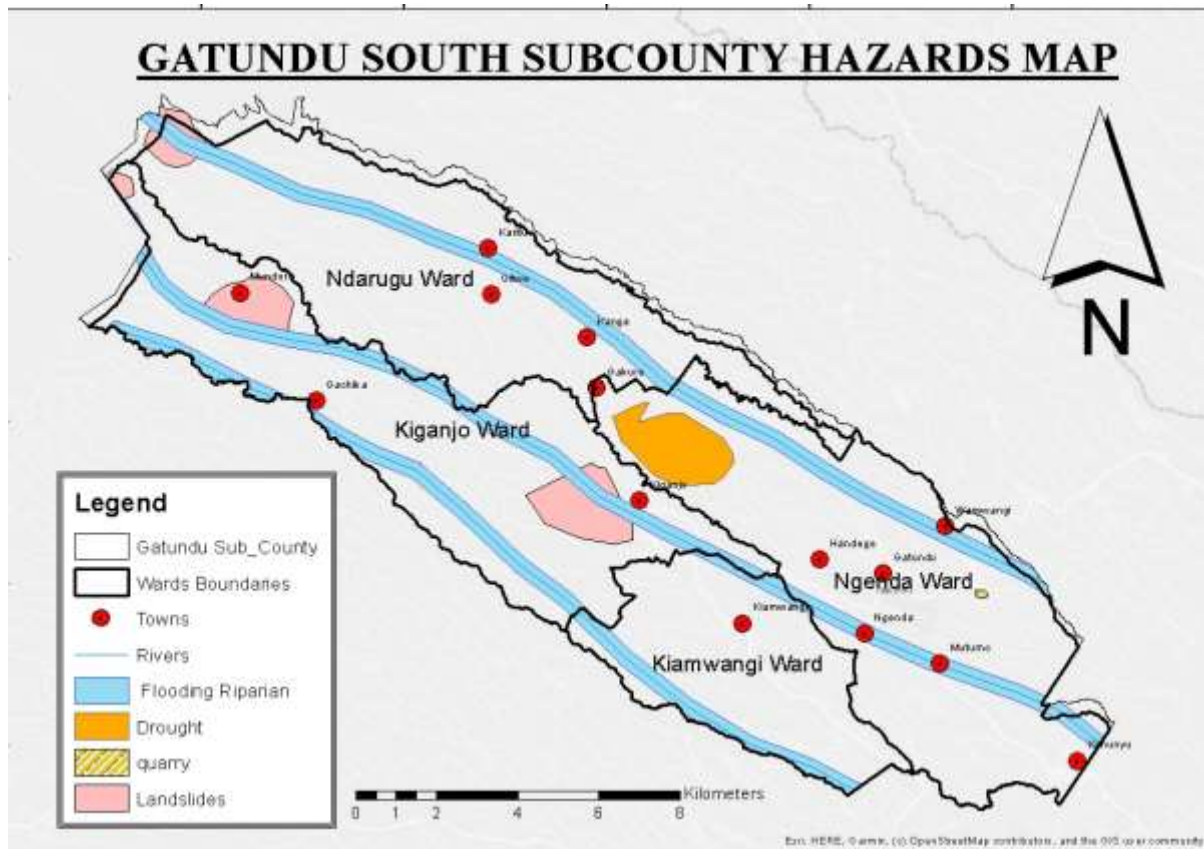
Vulnerable groups

The residents came up with categories of vulnerable groups in the area and they are described hereunder.

a) Farmer households are vulnerable to animal/wildlife conflict as a result of drought. They are also more prone to flooding which results in crop and livestock destruction and further food insecurity.

b) People living in sloppy areas are prone to landslides during extreme rainy conditions which loosens the soils and may cause destruction of homes and farms.

c) The elderly are more susceptible to extreme cold temperatures resulting in respiratory illnesses.

d) PWDs; They have reduced mobility as a result of harsh climatic conditions such as flooding, making it challenging for them to escape or find relief and reaching medical facilities in case of weather-related health issues.

e) Children are more prone to dropping out of school as a result of floods. They are also more susceptible to infections during extreme cold temperatures.

3.3 Differentiated Impacts of Climate Trends and Risks

There are many factors that determine the severity of climate change consequences at the individual level. They can be found in many realms: biophysical, social, cultural, economic, institutional, policy, and infrastructure, among many others. Women and youth are generally more vulnerable to the impacts of climate change than men because of their limited access to resources such as land. Their decision-making capacity in land sustainability issues is, therefore, limited, making them vulnerable.

CHAPTER FOUR: KIAMBU COUNTY FUTURE CLIMATE SCENARIOS

4.1 Future Climate 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.

The models used for these projections are Coupled Model Inter-comparison Project 5 (CMIP5). CMIP5 data ensemble for global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Models are based around 4 different greenhouse gas emissions pathways (called RCP2.6, RCP4.5, RCP6.0 and RCP8.5) which correspond to different mitigation scenarios (the degree to which global emissions have been successfully reduced). A medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile were employed for the downscaled county scenarios over four different time horizons.

4.1.1 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, RCP 4.5, RCP 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.

Accordingly, the top four performing runs are the REMO 2009 forced by MPI-M-MPI-ESM-LR GCM for r1i1p1 ensemble member, SMHI Rossby Center Regional Atmospheric Model (RCA4) driven by the r1i1p1 members of CNRM-CERFACS-CNRM-CM5 and MPI-M-MPI-ESM-LR GCMs, and RCA4 driven by r2i1p1 member of MPI-M-MPI-ESM-LR GCM.

All four models data were used for the present assessment of projected precipitation changes

over Kenya under RCP8.5 scenarios, but only three of the models with r1i1p1 ensemble members were available to assess projected changes under the RCP4.5 scenario.

Annual mean precipitation projections for Kenya

Future projections of precipitation are less certain than projections of temperature change due to high natural year-to-year variability. Under RCP2.6, median model projections indicate a slight increase towards the year 2030 but an overall decrease towards the end of the century. Under RCP6.0, the projected rainfall increase is likely to intensify after 2050, reaching 53 mm per year at the end of the century compared to 2000. Higher concentration pathways suggest an overall wetter future for Kenya. For the A1B emissions scenario, projections for temperature increases over Kenya, of up to around 3°C, show good agreement between the CMIP3 ensemble members.
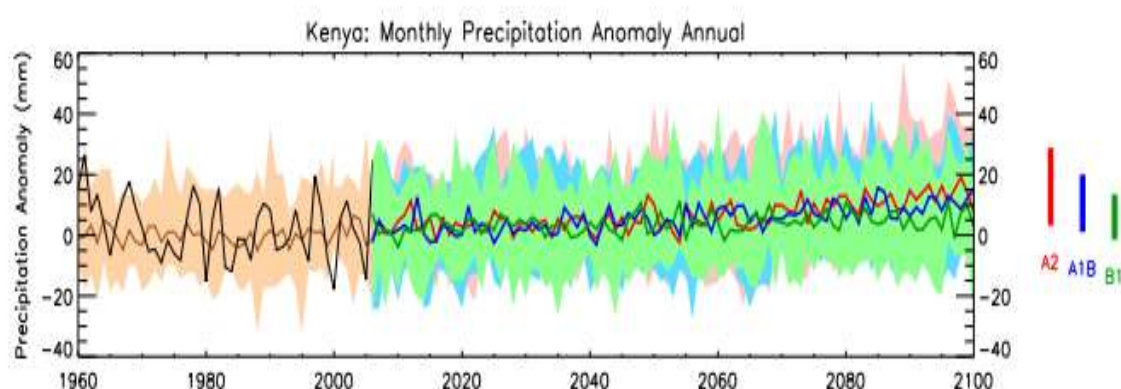
Figure 32: Annual mean precipitation projections for Kenya for different GHG emissions scenarios, relative to the year 2000.

Decadal MAM and OND seasonal rainfall changes (mm/day) over Kenya

Figures 33 and **34** shows 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 respectively. Spatial variability is noticed over the 8 future decades where in general a reduction in projected seasonal rainfall over northern Kenya and increase over southern regions for both RCP4.5 (**Fig. 32**) and RCP 8.5 (**Fig. 33**) scenarios compared to the 1981-2005 present climate simulations of best-model ensemble mean. Under the RCP 8.5 (**Fig. 33**) scenario, MAM 2081-2090 decadal rainfall change, the projected reduction appears to intensify and expand southwards.

MAM 2021-2030	MAM 2031-2040	MAM 2041-2050	MAM 2051-2060

Figure 33: March-May 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 (Decadal) from 2021 relative to historical simulations for the period 1981–2005.

Figure 34: 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 (Decadal) from 2021 relative to historical simulations for the period 1981–2005.

Figures 34 and **35** shows 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 respectively. 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. 34)** and RCP 8.5 **(Fig. 35)** scenarios compared to the 1981-2005 present climate simulations of best-model ensemble mean. **Fig. 35,** The OND 2081-2090 decadal rainfall change shows the highest increase in future rainfall under the RCP 8.5 scenario.

Figure 35: 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 (Decadal) from 2021 relative to historical simulations for the period 1981–2005.
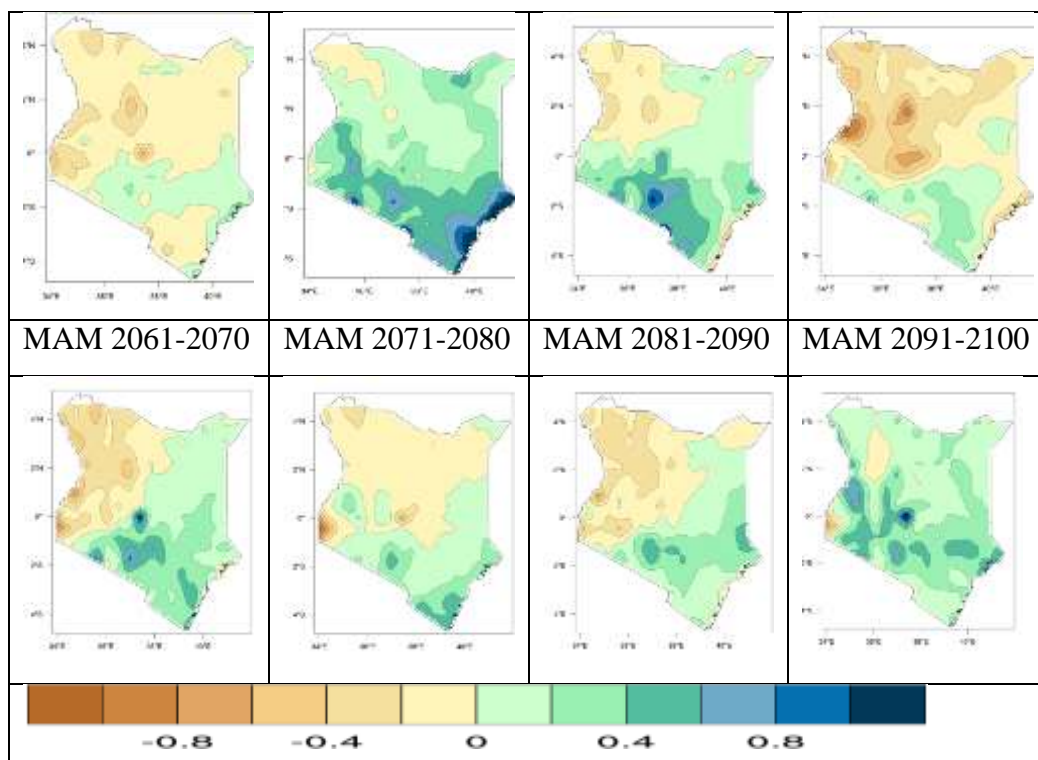

Figure 36: October-December seasonal rainfall changes (mm/day) over Kenya obtained from ensemble means of four top performing RCMs under the RCP8.5 scenario for future ten-year periods (Decadal) from 2021 relative to historical simulations for the period 1981–2005.
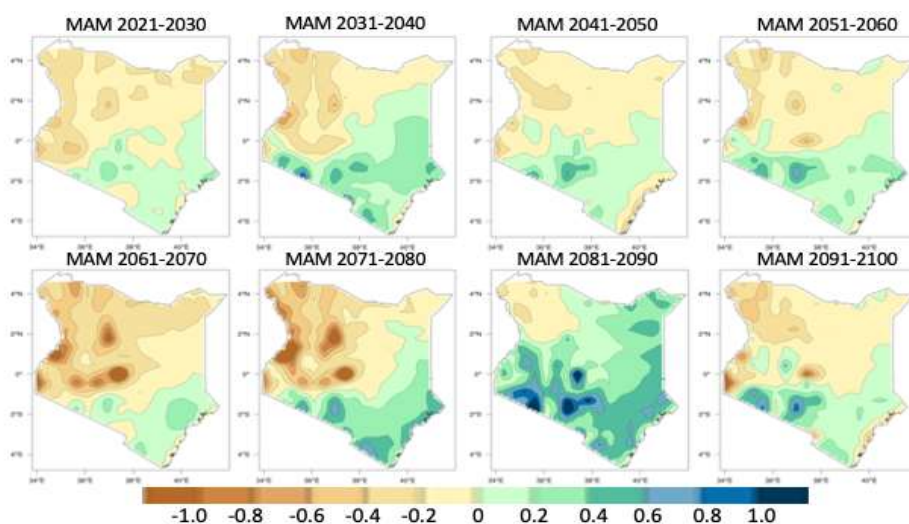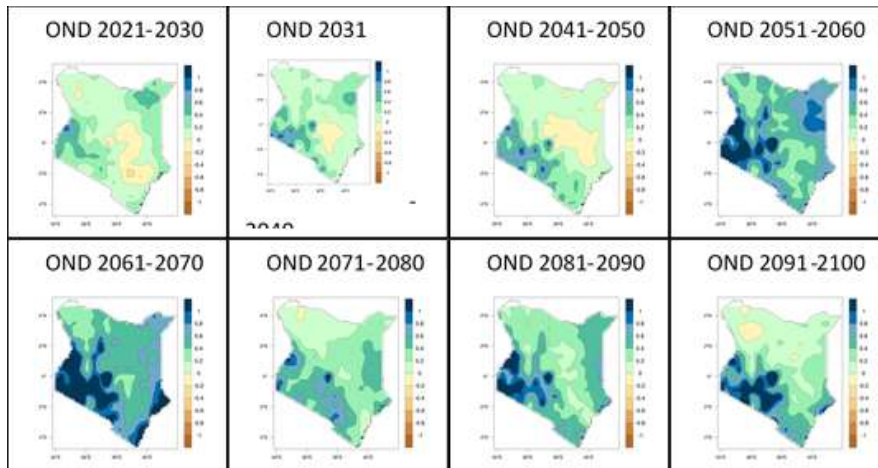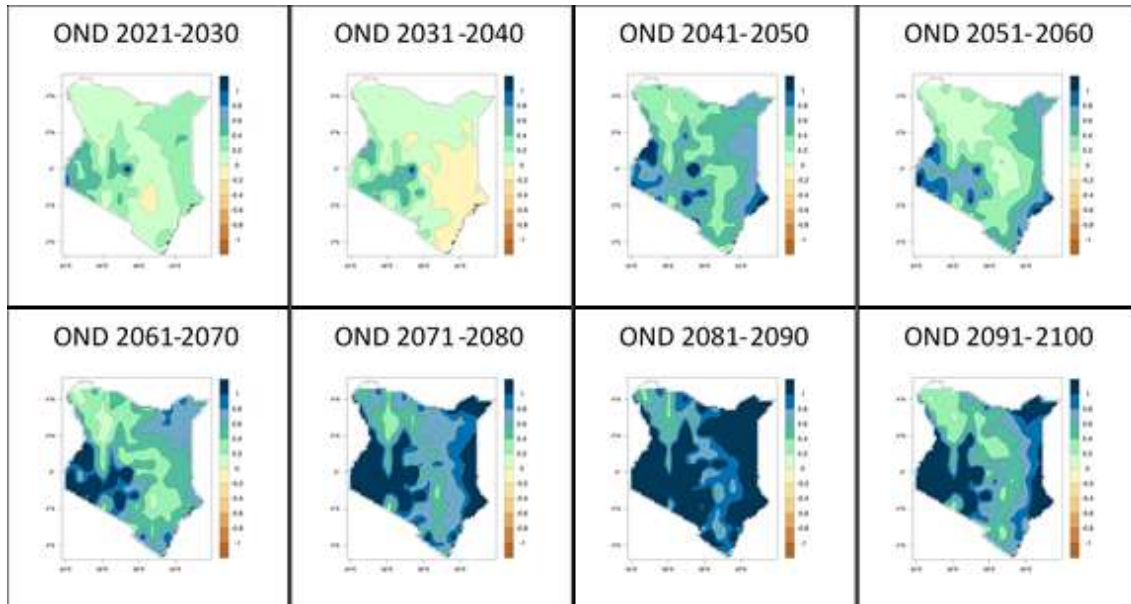
Rainfall

1) Precipitation in Kenya is projected to remain highly variable and uncertain, however average rainfall is expected to increase by mid-century, particularly during the 'short rains', which occur between October and December by 2050.

2) Extreme rainfall events (heavy downpours) are likely to increase in frequency, duration and intensity. Additionally, land degradation and soil erosion, exacerbated by recurrent floods, will negatively impact agricultural productivity disproportionately affecting the livelihoods of the rural poor.

3) The period between heavy rainfall events is likely to increase

4) Rainfall in the arid zones is generally projected to decrease.

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

6) The pattern and temporal distribution of rainfall is likely to change. Where proportion of rainfall that occurs in extreme rainfall events (heavy downpours) is likely to increase

Key Trends

Climate change is expected to increase the risk and intensity of flood events, as well as increase average annual rainfall amounts, while also furthering drought likelihoods for some areas across Kenya. Intense rainfall and flooding may increase the likelihood of mudslides and landslides, particularly in mountainous areas. As the incidence of extreme rainfall rises, additional soil erosion and water logging of crops is likely to reduce yields and increase food insecurity.

4.1.2 Temperature Projections

Future climate trends on temperature and rainfall show that Kenya's economy will continue to be affected. Global Climate Modelling (GCM) data indicates that the mean annual temperature is projected to increase by between 0.8 and 1.5°C by the 2030s and 1.6°C to 2.7°C by the 2060s. Compared to pre-industrial levels, median climate model temperature increases over Kenya amount to approximately 1.4 °C by 2030 and 1.7 °C by both 2050 and 2080 under the low emissions scenario RCP2.6. Under the medium/high emissions scenario RCP6.0, median climate model temperature increases amount to 1.3 °C by 2030, 1.6 °C by 2050 and 2.2 °C by 2080. Under the worst case RCP8.5 scenario: Temperatures in Kenya on average are projected to continue rising by 1.7°C by the 2050s and by approximately 3.5°C at the end of the century.

 All projections indicate decreases in the frequency of days and nights that are considered 'cold' in current climate. These events are expected to become exceedingly rare, and do not occur at

all under the highest emissions scenarios (A2 and A1B) by the 2090s.
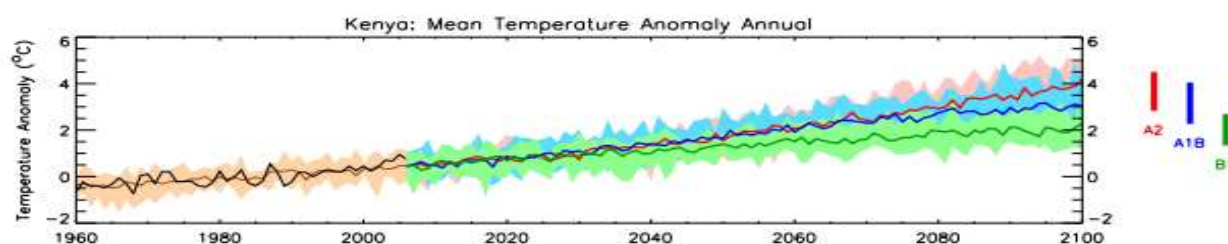
Figure 37: Air temperature projections for Kenya for different GHG emissions scenarios.

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. Temperatures are also likely to increase the periods of aridity in the northwest regions. Furthermore, as temperatures rise and droughts are prolonged, water storage capacities will be reduced. This may result in significant economic losses, damage to agricultural lands and infrastructure as well as human casualties.

4.2 COUNTY FUTURE CLIMATE SCENARIOS

Understanding the potential impacts of climate change is essential for informing both adaptation strategies and actions to avoid dangerous levels of climate change at sub-national level. A range of valuable national studies have been carried out and published, and the Intergovernmental Panel on Climate Change (IPCC) has collated and reported impacts at the global, regional, national and to some extent sub-national scales. But assessing the impacts is scientifically challenging and has, until now, been fragmented. To date, only a limited amount of information about past climate change and its future impacts has been available at national level, while approaches to the science itself have varied between countries. It is therefore vital to develop these scenarios at a local scale to guide the community driven interventions. Kiambu County being an agricultural, industrial and business county is likely to benefit from such climate products.

4.2.1 Rainfall Projections

Rainfall extremes over Kiambu County, either excess or deficit, can be hazardous to human health, societal infrastructure, and livestock and agriculture. While seasonal fluctuations in Rainfall as shown in Figs. 37 to 40 are normally indeed important for a number of societal sectoral planning (e.g. tourism, agriculture, livestock, energy, water and physical infrastructure

etc.), serious negative impacts can arise from flooding or drought. These are complex phenomena and often the result of accumulated excesses or deficits or other compounding factors such as changes in land use and planning. The analysis section below deals purely with precipitation and temperature changes expressed as percentages.

Annual Rainfall Projection

The projected change of annual rainfall is presented in **Fig.38 and Fig.39** with both the RCP4.5 and 8.5 depicting a positive change in annual rainfall in both near future and mid-century scales. The least change is likely to occur in eastern sub-counties of Thika, Juja and Ruiru and south-western sub-county of Kikuyu and Kabete. The highest changes are observed in the sub-counties of Lari, Gatundu South, Gatundu North, Githunguri, Limuru, Kiambaa and Kiambu in RCP 4.5 at both near future and mid-century scales. This paints a picture of a likely wet future in both scenarios which is likely to result in increased flood frequency. According to the ward PCRA reports, from Githunguri and Lari region is prone to land degradation and therefore this scenario may lead to increased incidences of soil erosion and mud slides with key resources such as roads being highly impacted. High precipitation amounts can lead to flooding of transport infrastructure, especially in areas with low altitudes and dense population such as Thika, Kabete and Kiambu. This will necessitate higher maintenance costs. Transport infrastructure is vulnerable to extreme weather events, yet essential for agricultural livelihoods. Roads serve communities to trade goods and access healthcare, education, credit and other services. During the RCP8.5 least change in trends are observed in the western sub-counties of Lari, Limuru and Kikuyu.

Figure 38: Spatial change of annual rainfall over Kiambu County during RCP4.5
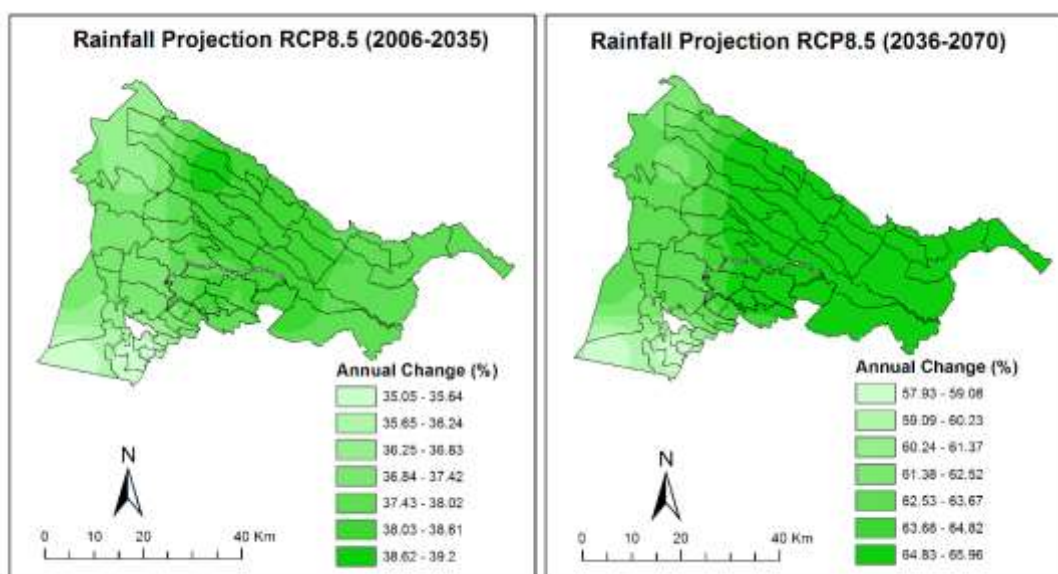
Figure 39: Spatial change of annual rainfall over Kiambu County during RCP8.5

Seasonal Rainfall Projection

Kiambu County depends mainly on rain-fed agriculture to support its crop and livestock production which mainly include the coffee, tea and horticultural sectors. Smallholder farmers in Kiambu are increasingly challenged by the uncertainty and variability of weather caused by climate change at seasonal scale which presents mainly in failed long and short rains, and fluctuation in the onset and cessation dates. Since most crops are rain fed, yields depend on water availability from rainfall which should be spread throughout the rainfall season.

However, the length and intensity of the rainy season is becoming increasingly unpredictable and the use of irrigation facilities remains limited due to poor extension services and irrigation management, and lack of credit and technical equipment.

Most of the wards experience two rainfall maxima which is observed in March-April-May (MAM) and October-November-December (OND) and confirmed by the historical calendar developed during the PCRA process conducted over the County. The PCRA process further developed the seasonal scale rainfall projections for the two RCPs 4.5 and 8.5 to determine the seasonal rainfall change. **Figs. 40 and 41** demonstrates the seasonal patterns of rainfall change over Kiambu County in the latter climate scenario. During MAM, the near future scenario which extends to 2035, projects an enhancement in rainfall over the county while all the other scenarios at different scales show a decreased rainfall with the eastern sector having a significant decrease represented by up to 50-55% in RCP4.5 in the mid-century timescale. However, under RCP8.5, the changes in both the near future and in mid-century scale are depicting a significant drying in both scales. This observation calls for more climate financing in the agricultural and water sectors to meet the demand for water stress which may be caused by this projected scenario. The research and climate smart agricultural practices should be focused on promoting varieties and species that will be tolerant to these climate conditions.
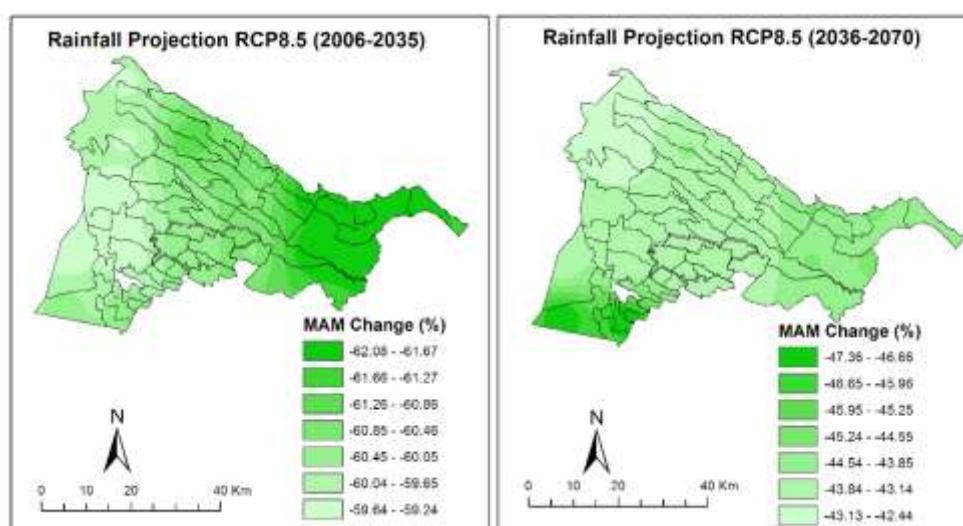
Figure 40: Spatial change of MAM rainfall over Kiambu County during RCP8.5
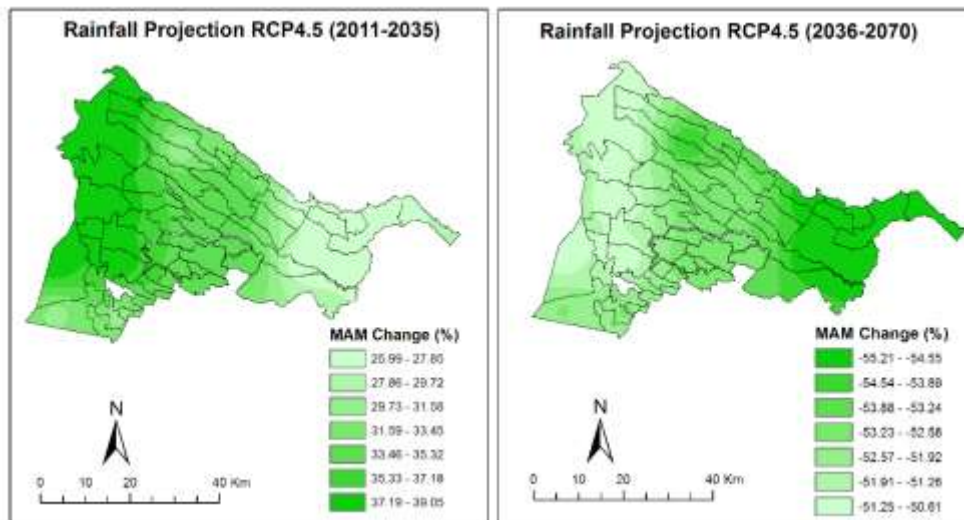
Figure 41: Spatial change of MAM rainfall over Kiambu County during RCP4.5

During the OND season, the RCP4.5 show that the near future projection of rainfall over Kiambu County is heterogeneous with Thika, Juja and Kiambu sub-counties showing a decline in rainfall, however the other sub-counties showing an increase in projected rainfall. The other scenarios show a decrease in rainfall with up to 55% decline projected under RCP8.5 in Limuru, Lari, Kikuyu and central sub-counties of Gatundu South, Gatundu North and Githunguri.
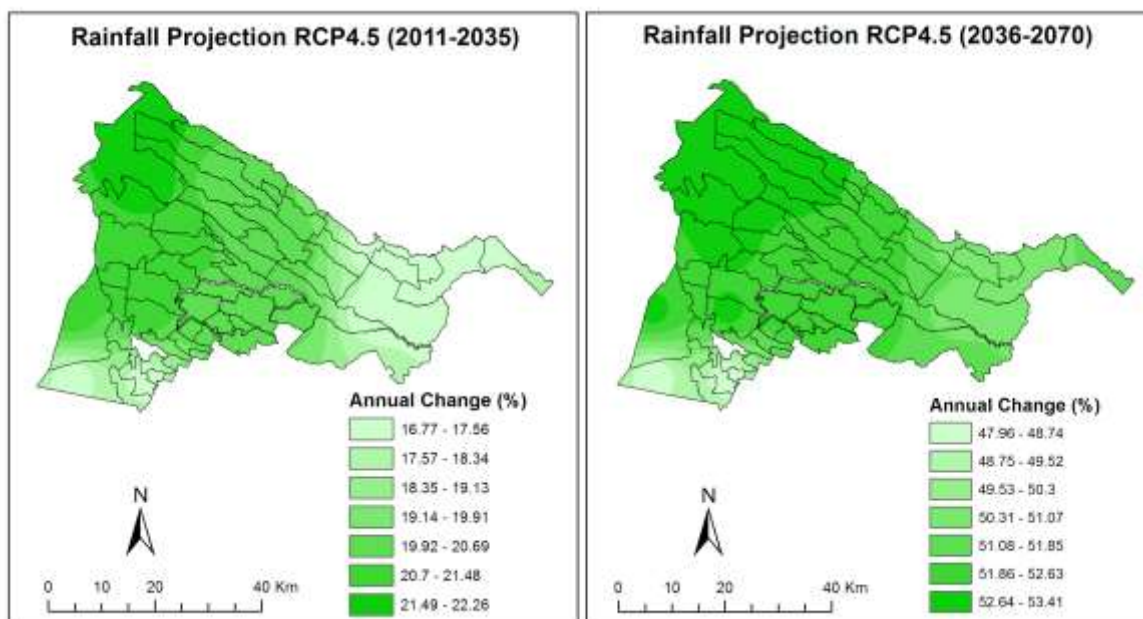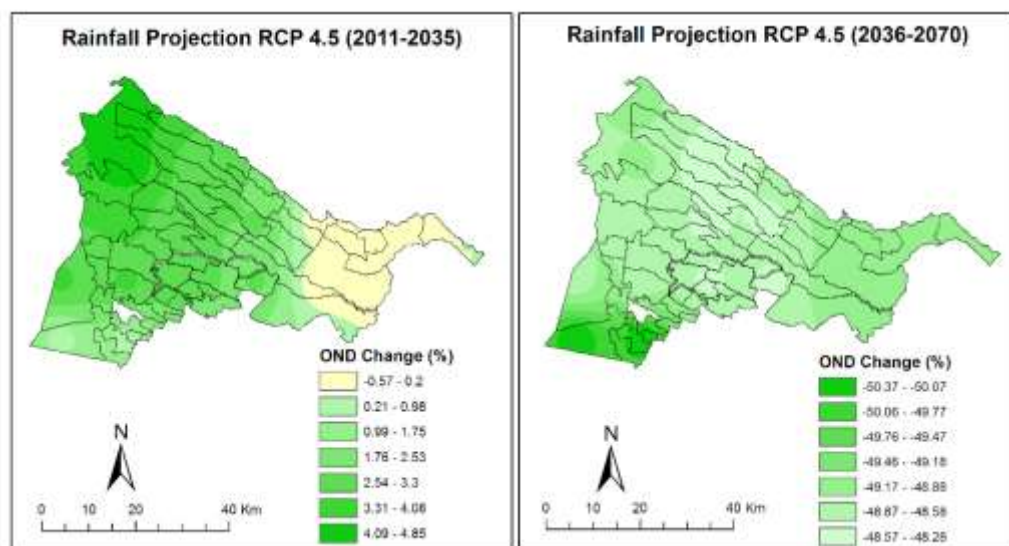

Figure 42: Spatial change of OND rainfall over Kiambu County during RCP4.5
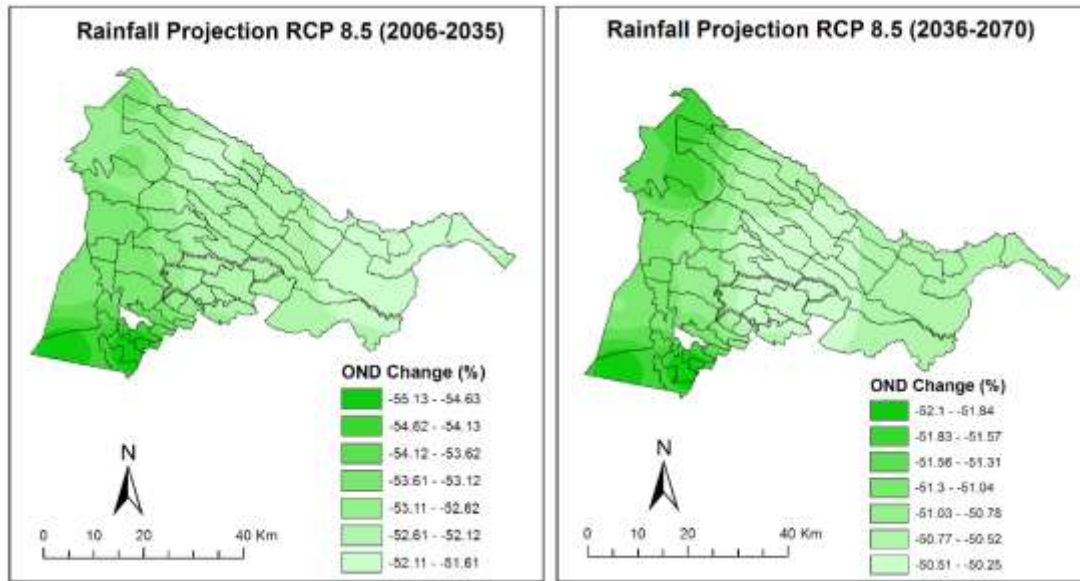
Figure 43: Spatial change of OND rainfall over Kiambu County during RCP8.5

4.2.2 Temperature Projections

Both hot and cold temperature extremes can place many demands on society. While seasonal changes in temperature are normal and indeed important for a number of societal sectors (e.g. tourism, farming etc.), extreme heat or cold can have serious negative impacts. Importantly, what is 'normal' for one ward in the county may be extreme for another region that is less well adapted to such temperatures. **Figs. 44 and 45** shows a rising pattern of both the minimum (night time) and maximum (day time) temperatures over Kiambu county.

Climate change is expected to have a significant influence on the ecology and distribution of tropical ecosystems, even though the magnitude, rate and direction of these changes are uncertain. With rising temperatures and increased frequency and intensity of droughts, wetlands and riverine systems are increasingly at risk of being converted to other ecosystems, with plant populations being succeeded and animals losing habitats. Increased temperatures and droughts can also affect succession in forest systems while concurrently increasing the risk of invasive species, all of which affect ecosystems. In addition to these climate drivers, low agricultural production and population growth might motivate further agricultural expansion resulting in increased deforestation, land degradation and forest fires, all of which will impact animal and plant biodiversity.
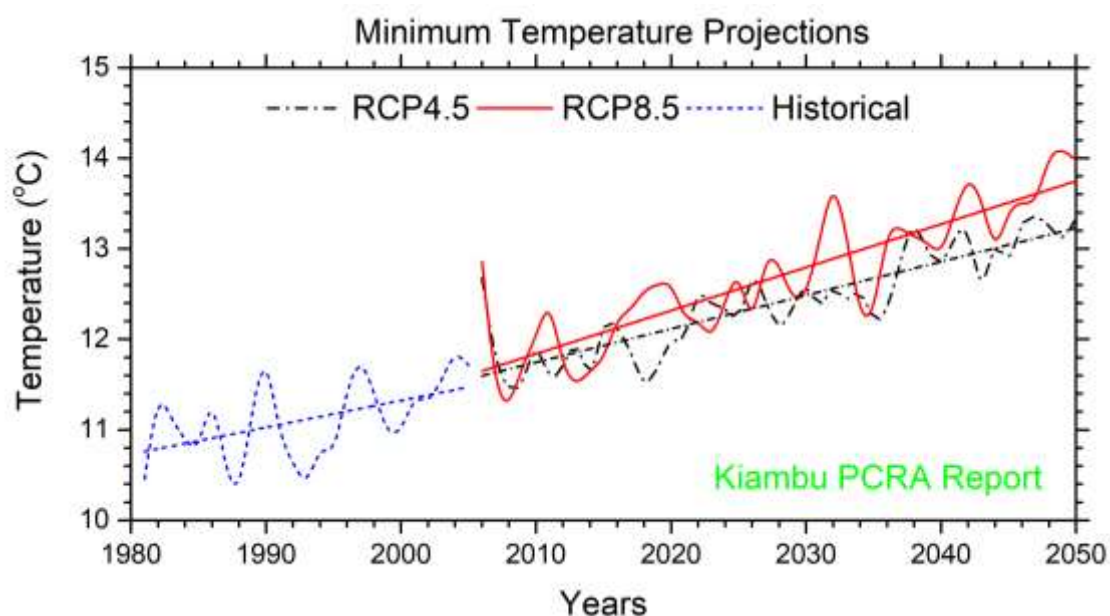
Figure 44: Minimum projected temperature trends

While the projected areal average trend of both maximum and minimum temperatures are showing a rising pattern, the historical maximum temperatures show a declining pattern. These patterns may have an impact on the crop calendar and post-harvest practices adopted by the farmers. The priority areas for climate investment therefore, should consider the having technologies that would address such changes in the surface temperatures over the county.
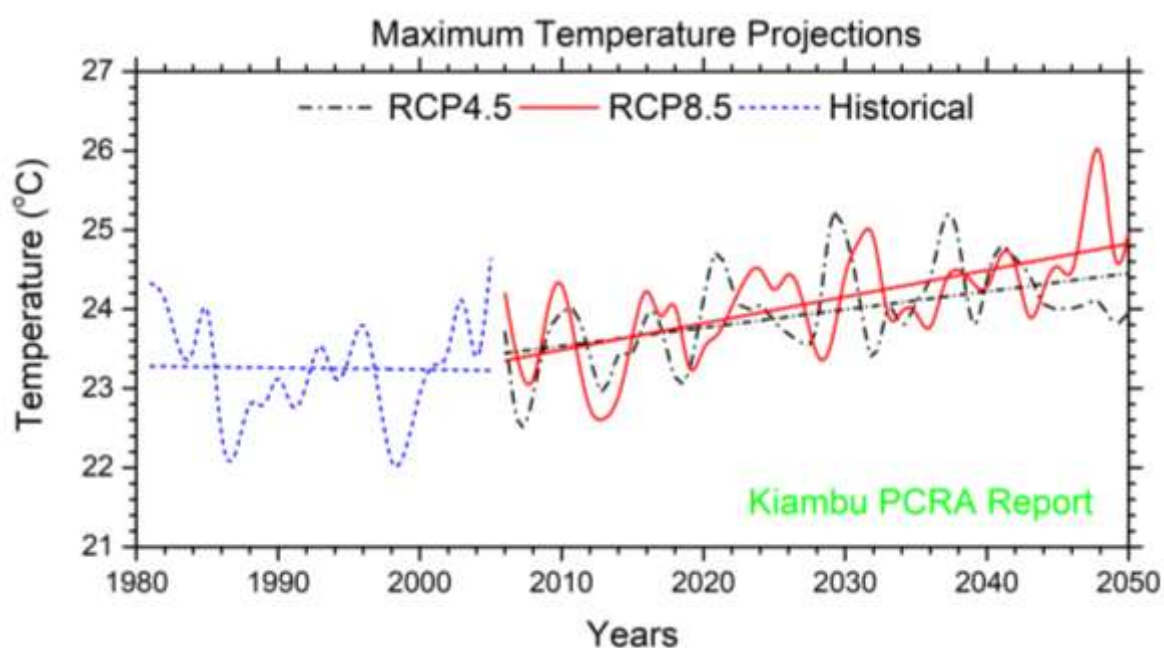
Figure 45: Maximum projected temperature trends

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

5.1 Overview of Existing Adaptation/Resilience Strategies and their Effectiveness to Current Climate Risks

The existing adaptation strategies that are already being implemented were examined as presented below:

Table 15: Analysis of Existing Resilience/Adaptation Strategies to Current and Future Climate Risks

Hazard	Sectors	Existing Adaptations/ Current Strategies	Alternative Interventions
Drought	Agriculture, livestock fisheries and Crop development	Diversification of irrigation sources	Promotion of water efficient irrigation techniques
		Introduction of more climate tolerant fish species	Adoption of early maturing species
		Adoption of drought tolerant crops	Adoption of early maturing and drought tolerant varieties
		Zero grazing	Drought-tolerant crops that require less water and can serve as alternative livestock feed sources
		Practicing kitchen farming and tower gardening	Practicing kitchen farming and tower gardening
	Water, Environment, Energy &Natural Resources	Construction of additional water storage facilities	Implementing advanced water management technologies
		Planting of more tress	Investing in drought resistant trees
		Use of energy-efficient sources such as solar	Green energy public awareness and trainings
		Drilling of boreholes	Water rationing
			Storm water harvesting e.g. use of dams and water reservoirs
	Land, housing and Physical planning	Community awareness through education and outreach program	Engage residents, stakeholders, and local communities in the planning process, ensuring their perspectives and needs are considered

		Water harvesting in buildings	Incorporate climate-responsive design principles into urban planning.
	Trade, Industries, Development, Tourism, &Investment	use of energy efficient methods when drying cereals	Encouraging use of sun energy when drying cereals
		Use of renewable energy.	Promotion of use of solar energy
	Roads, Transport, Public works and utilities	Electric street lights	Solar street lights
		Public awareness and education on climate change	Sustainable infrastructures projects: use of renewable energy sources, implementing energy efficient building designs
Flooding	Roads, Transport, Public works and utilities	Gabions to control soil erosion	Public awareness campaigns on sustainable soil management practices such as conservation tillage and crop rotation
		Rehabilitation of existing roads, drainage systems and flood barriers	Adoption of climate-resilient road design.
		Digging of trenches	Construction of flood barriers
		Regular maintenance of drainage systems	
Extreme Temperatures	Water, Environment, Energy & Natural Resources	Afforestation	Promote energy-efficient technologies to reduce overall heat emissions.
			Strengthen building codes to ensure proper insulation and ventilation in homes.
		Drinking hot beverages to cope with extreme cold	Establishing community support networks to provide assistance and resources to vulnerable individuals during extreme cold events
		Use of light clothes during extreme hot weather	
	Agriculture, livestock fisheries and Crop development	Mulching of crops	Climate smart agriculture such as zero tillage
Soil erosion	Agriculture, livestock fisheries and Crop development	Crop rotation	Runoff water harvesting

	Water, Environment, Energy &Natural Resources	Afforestation	Soil conservation measures such as terracing and contour plowing
		Wind erosion physical barriers, wind fences, or sand fences,	Planting windbreaks along field edges helps to reduce wind velocity and prevent soil erosion
Pollution	Agriculture, livestock fisheries and Crop development	Airborne disease control	Air quality management – Developing policies and programs that reduce air pollution
	Water, Environment, Energy &Natural Resources	Use of biogas for energy	Promotion of use of alternative source of energy e.g. solar water heating system
		Obtaining clean water from wells	Diversification of water sources
		Burning of wastes	Promote circular economy in waste management
			provision of waste material recovery facilities
			Increasing number of skips
		Boiling of drinking water	Water treatment points
		Community clean ups of streets and river banks	Encouraging community involvements in clean ups during staff clean up days
			Promotion of Adopt- A river initiative
			Construction and maintenance of sewer lines
			Promote agroforestry and bamboo planting along the river line
	Land, housing and Physical planning	Promoting Green built environment	Green infrastructure planning; integration of green infrastructure into urban planning
	Trade, Industries, Development, Tourism, &Investment	Advocacy of resource-efficient manufacturing processes	Advocacy of waste reduction and recycling programs in manufacturing
		Sourcing of products that are environmentally friendly	Adoption of Sustainable supply chains from environmentally responsible suppliers.

		Carbon footprint reduction	Decarbonization efforts through adopting cleaner technologies and transitioning to low-carbon energy sources.
	Roads, Transport, Public works and utilities	Promoting energy-efficient driving practices	-Promotion of hybrid and electric vehicles
			-Promotion of alternative transportation modes e.g. use of bicycles
Land slides	Land, housing and Physical planning	Afforestation and increased vegetation cover	Advocate for sustainable land management practices such as preventing construction or development in high-risk landslide areas.
Human – wildlife conflict	Water, Environment, Energy &Natural Resources	Utilizing guard animals like dogs to alert residents of wildlife presence and protect livestock or property	Early Warning Systems such as use of drones to detect and provide early warnings of wildlife presence, allowing communities to take preventive measures
			Compensation and Insurance to compensate farmers or communities for wildlife-related losses
		Scare Tactics such as scarecrows, noise-making devices to deter wildlife from approaching human settlements	Installing electric fences or other physical barriers to create a separation between human settlements and wildlife habitats
Pest and Diseases	Agriculture, livestock fisheries and Crop development	Use of livestock pest and disease control measures	-Developing early warning systems to anticipate livestock disease outbreaks associated with climate changes
			Adoption of an integrated pest control and management system
	Water, Environment, Energy &Natural Resources	Clearing of bushes	Introduction of biological insects control method
	Health Services	Use of medicated nets in informal settlements	Develop surveillance and early warning systems

			Introduction of biological insects control
	Health services	Public health education and communication	Conducting Climate change and health assessments
Fire	Roads, Transport, Public works and utilities	Fire station and firefighting machines	Strategic location of hydrants

5.2 Effectiveness of Adaptation/Resilience Strategies to Future Climate Risks

Prioritizing development of climate resilient infrastructure such as green infrastructure that helps boost the community's capacity to cope with climate change related risks such as floods, landslides and extreme weather events, is crucial. To make these strategies more effective, it's important to ensure inclusive planning processes that considers the needs and perspectives of marginalized and vulnerable groups. Allocating sufficient resources and providing technical support will help overcome financial and capacity barriers.

Promoting climate-smart agriculture, including crop diversification, sustainable land management, water conservation techniques, and drought resistant and early maturing crops is essential for food security. To enhance effectiveness, targeted financial incentives, capacity building programs and access to markets can be provided to marginalized farmers, women, and youth. Tailored support should consider their specific needs and challenges, such as land ownership rights and access to credit.

Preserving and restoring natural ecosystems, such as forests and wetlands like Ondiri Swamp provides multiple benefits in climate resilience. To maximize effectiveness, involving local communities, particularly indigenous groups, in ecosystem management decisions is crucial. Supporting their traditional knowledge, land rights, and capacity-building efforts can enhance the success and sustainability of these strategies.

Implementing integrated water resource management approaches will help enhance resilience to changing precipitation patterns. To ensure effectiveness, it's important to address water access and sanitation challenges faced by vulnerable groups, including women, elderly and people with disabilities. Investing in inclusive water infrastructure and providing equitable water distribution will help reduce vulnerability.

Strengthening healthcare systems to address climate-related health risks is crucial. It's essential to prioritize marginalized and vulnerable groups' healthcare needs, considering factors like accessibility and affordability. Investing in healthcare infrastructure, capacity-building, and

community-based health services can enhance the effectiveness of adaptation strategies. Promoting climate change education and awareness creation programs that target vulnerable groups is important for building resilience. This can be achieved through inclusive and culturally appropriate educational materials, training and community engagement.

Establishing and strengthening social safety nets and social protection mechanisms can provide a vital lifeline to vulnerable groups during climate-related shocks and stresses. These strategies should be designed to specifically address the needs of women, youth, elderly and people with disabilities, ensuring inclusivity and equity in accessing support.

CHAPTER SIX: KIAMBU COUNTY CLIMATE STRATEGIC ADAPTATION INVESTMENT/ACTION PRIORITIES

During the climate change risk assessment, the community members identified the hazards faced in the 12 sub Counties and the proposed areas of investment. The risks and corresponding investments are provided in the table below:

Table 16: Kiambu County Climate Strategic Adaptation Investment/Action Priorities

Lari Sub County

Hazard	Sector	Adaptation strategies
Flooding	Agriculture	Building of gabions Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation
Extreme Cold Temperatures	Agriculture	Afforestation Increase vegetation coverage within the forest e.g. bamboo trees Development, enactment and implementation of legislation on Carbon dioxide mining
	Health	Enhanced Universal health Awareness creation on warm house designs
	Transport and Infrastructure	Erect appropriate signage Proper road designs
	Education	Enhancement of feeding programmes Awareness creation on warm ECDE classes designs
	Water	Construction of green houses in the treatment facility
Landslides	Agriculture	Building of gabions Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation
	Environment	-Install proper drainage channels/structures -Tree planting
Drought	Water	Increase public awareness on conservation of water Promote water efficiency through monitoring, reducing

Hazard	Sector	Adaptation strategies
		wastage
		Conservation of riparian land
		Construct water harvesting & storage structures
		Installation of cofferdams at Kireita forest
		Water control devices
		Invest in early warning systems and infrastructure
Drought	Environment	Establish water points around key biodiversity ecosystems
		Increase public awareness campaigns on natural resource and ecosystem management for communities in key biodiversity ecologies
	Agriculture	Invest in capacity building on soil management
		Installation of Irrigation systems
		Invest in early warning systems and infrastructure
		Subsidized farm inputs climate
		Smart agricultural farming
		Public awareness on conservation of animal feeds through silage, hay etc
		Introduction of appropriate and resilient breeds
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Trade	Increase crop productivity through improved irrigation
Hailstorms	Agriculture	Invest in early warning systems
		Hail observations and monitoring

Limuru Sub County

Hazard	Sector	Adaptation strategies
Flooding	Agriculture & livestock	Building of gabions
		Tree planting
		Conservation of riparian reserves
		Install proper drainage channels/structures
		Proper civic education on soil conservation, crop rotation, adoption of early maturing plants & farm planning
		Promote IPM

Hazard	Sector	Adaptation strategies
		Promote runoff water harvesting e.g. by construction of water ponds Crop and livestock insurance
Flooding	Water	Construction of waste transfer stations, provision of waste bins/skips, Harvesting of rain water in markets, schools and hospitals
		Increase public awareness Enforce rules and regulations on waste & chemical disposal
	Health	Increased public awareness on disease prevention. Vaccination for animals. Early relocation of people and animals to safer grounds
	Transport and Infrastructure	Construction and maintenance of drainage systems Proper road designs
	Education	Landscaping of School compounds and paving of driveways/walkways, construction and maintenance of drainages, Early warning & preparedness
Drought	Water	Construct water harvesting and storage structures Conservation of water catchment areas and sources Water control devices such as sluice gates, valves and master meters Increase public awareness Invest in early warning systems and infrastructure
	Agriculture	Invest in capacity building of farmers on soil management Promote drought tolerant crop varieties Promote crop insurance Installation of Irrigation systems Invest in early warning systems and infrastructure Subsidized farm inputs, dam liners Promote Climate smart agricultural practices Engage youths in construction of soil and water conservation structures Promote Integrated pest management systems (IPM)
	Livestock	Conservation of animal feeds in form of silage, hay etc

Hazard	Sector	Adaptation strategies
		Introduction of appropriate and resilient breeds
Drought	Wildlife and Tourism	Provision of food and watering points Planting fruit trees Compensation of victims
	Fisheries	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re- circulatory systems -Adoption of resilient species e.g catfish
	Health	Increased public awareness on disease prevention.
Extreme Cold Temperatures	Agriculture	Crop diversification Early planting Promote agronomic practices e.g. crop rotation Promote IPM
	Livestock	Proper housing for livestock
	Health	Enhanced Universal medical cover Awareness creation on warm house designs and clothing
	Transport and Infrastructure	Erect appropriate Road signages. Proper road designs
	Education	Enhancement of school, feeding programme. Construction of warm ECDE classrooms.
	Water	Construction of green houses in the treatment facility

Kikuyu Sub County

Hazard	Sector	Adaptation strategies
Drought	Water, Environment, Energy and Natural Resources	Promote water harvesting technologies Solarization of boreholes Mapping and pegging of riparian reserves Promotion of water conservation and management measures Construction of water harvesting and storage facilities and structures for roof and surface run off Water saving control devices Awareness creation on water conservation and management

Hazard	Sector	Adaptation strategies
		Invest in early warning systems and infrastructure Enforcement of guidelines on integrated land use
Drought	Agriculture	-Engage youths in construction of soil and water conservation structures -Water harvesting for crop production -Installation of Irrigation systems -Promote drought tolerant crop varieties -Invest in early warning systems and infrastructure -Promote subsidised farm inputs
		-Promote crop insurance -Climate smart agricultural farming -Promote Integrated pest management systems (IPM)
		-Conservation of animal feeds through silage, hay etc -Introduction of appropriate and resilient breeds -Vaccination and disease control measures -Fencing off of forests -Provision of food and watering points for wildlife -Compensation of victims
	Fisheries	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re- circulatory systems -Adoption of resilient species e.g catfish
	Education	-Water harvesting and storage -Increase access to water supply through drilling of boreholes and piped water supply -Introduction of school feeding programmes -Immunization programmes -Sensitization of learners on environmental conservation and climate change
	Trade Markets	-Construction of solar powered cold storage rooms -Establishment of post-harvest management facilities such as cold rooms -Improvement of designs of the markets to allow for free circulation of air and to shield the traders from extreme heat -Adoption of green designs of the markets
Extreme Cold Temperatures	Agriculture	-Crop diversification -Early planting -Promote agronomic practices e.g. crop rotation -Promote IPM
	Livestock	Proper housing for livestock
Flooding	Agriculture & Livestock	-Construction of soil and water conservation structures -Promote runoff water harvesting e.g. by construction of water ponds -Crop and livestock insurance -Tree planting -Conservation of riparian reserves -Install proper drainage channels/structures

Hazard	Sector	Adaptation strategies
		-Proper farm planning
Flooding	Health	Unclogging of drainage systems
	Roads Transport, Utilities and Public works	Climate proof the transport infrastructure
	Water, Environment Energy and Natural Resources	Water management infrastructure Proper waste management

Kabete Sub County

Hazard	Sector	Adaptation strategies
Flooding	Agriculture	-Building of gabions -Vaccination and immunization of livestock -Planting of cover crops -Tree planting -Conservation of riparian reserves -Install proper drainage structures -Early warning systems to enable farmers take preventive measures
	Water	-Design and Construction of proper water storm structures -Planting of trees/ building of gabions -Public Awareness and education on proper waste management
	Health	Increased public awareness on disease prevention. Vaccination for animals
	Transport and Infrastructure	-Construction and maintenance of proper drainage systems -Proper road designs
	Education	-Proper landscaping of schools -Construction of proper drainage system and transport infrastructures -Early warning systems and Preparedness
Extreme Cold Temperatures	Agriculture	Practice smart climate agriculture such as adoption of cold resistant crops and livestock.
	Water	Construction of green houses in the treatment facility
	Health	Enhanced Universal health Awareness creation on warm house designs
	Education	Enhancement of feeding programmes Awareness creation on warm housing designs and clothing

Kiambaa

Hazards	Sector	Adaptation strategies
Flooding	Agriculture	Construction of Soil and water

		conservation structures
		Promote water harvesting
		Tree planting
		Conservation of riparian reserves
		Installation of proper drainage channels/structures
		Proper civic education on soil conservation
		Implementation of County Spatial Plan
	Water	Design and Construction of Proper Storm water structures
		Reclamation and protection of wetlands
		Development, enactment and implementation of legislation on liquid and solid waste management
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Transport and Infrastructure	Construction and maintenance of drainage systems
		Proper road designs
		Enforcement of relevant legislations (EMCA 1999, Water Act 2016)
	Education	Construction of proper drainage system
		Landscaping of school compound
		Water harvesting

Kiambu

Hazard	Sector	Adaptation strategies
Air pollution	Environment	Tree planting/incentives for carbon credit
	Health	Wearing of face masks
Flooding	Agriculture	Afforestation
		Zoning of agricultural land to avoid encroachment on agricultural areas

			Rain Water harvesting Opening up of waterways
		Physical infrastructure	Proper design of bridges and other road infrastructure Construction of drains Opening up of waterways Controlled development to allow for open spaces/water seepage zones
		Livelihoods	Proper design of bridges and other road infrastructure Soil and water conservation structures e.g. cut-off drains, bench terraces, water harvesting
		Trade	Proper design of bridges and other road infrastructure
		Health	Construction of drains Opening up of waterways
Drought		Environment	Afforestation Cleaning of rivers
		Health	Water harvesting Provision of potable water
		Agriculture	-Engage youths in the construction of soil and water conservation structures -Water harvesting for crop production -Installation of Irrigation systems -Promote drought-tolerant crop varieties -Invest in early warning systems and infrastructure -Promote subsidized farm inputs
		Livelihoods	Adopt farming practices Urban agriculture
		Trade	Construction of food reserves/silos
Extreme Temperatures		Environment	Planting of trees Provision of fire hydrants/firefighting equipment
		Health	Urban greenery and planting of trees
		Agriculture	Plant drought-resistant crops/fast-maturing plants
		Trade	Provision of cooling facilities

Ruiru

Hazard	Sector	Adaptation strategies
Flooding	Health	Unclogging of drainage systems

	Roads Transport, Utilities and Public works	Climate proof the transport infrastructure
	Agriculture, Livestock and Fisheries	Soil conservation measures Storm water management Tree planting
	Water, Environment Energy and Natural Resources	Water management infrastructure
		Public awareness on proper waste management
		Cleaning/ unblocking of waste water drainage systems
		Promote rehabilitation of quarries /derelict land
		Enforcement of guidelines on integrated land use
Drought	Water, Environment, Energy and Natural Resources	Promote water harvesting technologies Solarization of boreholes Mapping and pegging of riparian reserves Promotion of water conservation and management measures Construction of water harvesting and storage facilities and structures for roof and surface run off Water saving control devices Awareness creation on water conservation and management Invest in early warning systems and infrastructure Enforcement of guidelines on integrated land use
	Agriculture, livestock fisheries	Invest in capacity building on soil management Introduction of more climate tolerant fish species

		Adoption of drought tolerant crops
		Diversification of irrigation sources
		Practicing climate smart agriculture technologies
		Zero grazing and fodder conservation
		Invest in early warning systems and infrastructure
	Education	Water harvesting and storage
		Increase access to water supply through drilling of boreholes and piped water supply
		Introduction of school feeding programmes
		Immunization programmes
		Sensitization of learners on environmental conservation and climate change
	Trade Markets	Construction of solar powered cold storage rooms
		Establishment of post-harvest management facilities such as cold rooms
		Improvement of designs of the markets to allow for free circulation of air and to shield the traders from extreme heat
		Adoption of green designs of the markets

Githunguri

Hazard	**Sector**	**Adaptation strategies**
Drought	Water	Increase public awareness on climate change
		Construct water harvesting & storage structures
		installation of cofferdams
		Install Water control devices
		Invest in early warning systems and infrastructure

	Environment	Establish water points around key biodiversity ecosystems
		Tree planting
		Increase public awareness on natural resource and ecosystem management for communities in key biodiversity ecologies
	Agriculture	Invest in capacity building on soil management
		Implementation of County Spatial Plan
		Construction of soil and water conservation structures
		Installation of Irrigation systems
		Invest in early warning systems and infrastructure
		subsidized farm inputs
		Practice climate smart agricultural farming
	Livestock	Public awareness on conservation of animal feeds through silage, hay etc
		Introduction of appropriate and resilient breeds
		Vaccination of animals
	Health	Increase awareness on disease prevention
		Vaccination of animals
Flooding	Agriculture	Construction of Soil and water conservation structures
		Promote water harvesting
		Tree planting
		Conservation of riparian reserves
		Installation of proper drainage channels/structures
		Proper civic education on soil conservation
		Implementation of County Spatial Plan
	Water	Design and Construction of Proper Storm water structures

		Reclamation and protection of wetlands
		Development, enactment and implementation of legislation on liquid and solid waste management
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Transport and Infrastructure	Construction and maintenance of drainage systems
		Proper road designs
		Enforcement of relevant legislations (EMCA 1999, Water Act 2016)
		Implementation of County Spatial Plan
	Education	Construction of proper drainage system
		Landscaping of school compound
		Water harvesting
Landslides	Agriculture	Construction of Soil and water conservation structures
		Tree planting
	Water	Design and construction of proper soil and water conservation structures
		Invest in early warning systems and infrastructure
	Environment	Increase Public awareness on environmental conservation
		Tree planting
	Trade	Increase public awareness on reducing activities on areas prone to mudslides
Pollution	Environment	Construction of green houses in the treatment facility
		Promotion of clean cooking
	Health	Increased public awareness on disease prevention.

Juja

Hazard	Sector	Adaptation strategies
Drought	Water	- Community Based Water Management activities (water harvesting/ storage / recycling / water rationing) Conservation of water catchment areas and sources Water control devices such as sluice gates, valves and master meters - Invest in early warning systems and infrastructure Invest in early warning systems and infrastructure
	Agriculture	Invest in capacity building of farmers on soil management Promote drought tolerant crop varieties Promote crop insurance Installation of Irrigation systems Invest in early warning systems and infrastructure Subsidized farm inputs, dam liners Promote Climate smart agricultural practices Engage youths in construction of soil and water conservation structures Promote Integrated pest management systems (IPM)
		Conservation of animal feeds in form of silage, hay etc Introduction of appropriate and resilient breeds
		- Habitat management - Community education - Compensation of victims - Apply – GPS tracking and camera traps to monitor movement
	Health	Increased public awareness on disease prevention.

Flooding	Agriculture & livestock	Building of gabions
		Tree planting
		Conservation of riparian reserves
		Install proper drainage channels/structures
		Proper civic education on soil conservation, crop rotation, adoption of early maturing plants & farm planning
		Promote IPM
		Promote runoff water harvesting e.g. by construction of water ponds
		Crop and livestock insurance
	Water	Construction of waste transfer stations, provision of waste bins/skips, Harvesting of rain water in markets, schools and hospitals
		Increase public awareness
		Enforce rules and regulations on waste & chemical disposal
	Health	Increased public awareness on disease prevention.
		Vaccination for animals.
		Early relocation of people and animals to safer grounds
	Transport and Infrastructure	Construction and maintenance of drainage systems
		Proper road designs
	Education	Landscaping of School compounds and paving of driveways/walkways, construction and maintenance of drainages, Early warning & preparedness systems

Thika

Hazard	Sector	Adaptation strategies
Drought	Water, Environment, Energy and Natural Resources	Promote water harvesting technologies
		Solarization of boreholes

		Mapping and pegging of riparian reserves
		Promotion of water conservation and management measures
		Construction of water harvesting and storage facilities and structures for roof and surface run off
		Water saving control devices
		Awareness creation on water conservation and management
		Invest in early warning systems and infrastructure
		Enforcement of guidelines on integrated land use
	Agriculture	-Engage youths in construction of soil and water conservation structures -Water harvesting for crop production -Installation of Irrigation systems -Promote drought tolerant crop varieties -Invest in early warning systems and infrastructure -Promote subsidised farm inputs
		-Promote crop insurance -Climate smart agricultural farming -Promote Integrated pest management systems (IPM)
		-Conservation of animal feeds through silage, hay etc -Introduction of appropriate and resilient breeds -Vaccination and disease control measures -Fencing off of forests -Provision of food and watering points for wildlife -Compensation of victims
	Fisheries	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish

	Education	Water harvesting and storage
		Increase access to water supply through drilling of boreholes and piped water supply
		Introduction of school feeding programmes
		Immunization programmes
		Sensitization of learners on environmental conservation and climate change
	Trade Markets	Construction of solar powered cold storage rooms
		Establishment of post-harvest management facilities such as cold rooms
		Improvement of designs of the markets to allow for free circulation of air and to shield the traders from extreme heat
		Adoption of green designs of the markets
Flooding	Agriculture	Building of gabions
		Tree planting
		Conservation of riparian reserves Grass planting eg vertiva grass
		Install proper drainage channels/structures
	Water	Design and Construction of Proper Storm water structures
	Health	Increased public awareness on disease prevention.
		Vaccination for animals Provision of mosquito nets
	Transport and infrastructure design	Provision of culverts and excavator Construction and maintenance of drainage systems Proper regulations on constructions Increase green areas Proper road designs
	Water, Environment Energy and Natural Resources	Water management infrastructure
		Proper waste management

Gatundu North

Hazards	Sector	Adaptation strategies
Drought	Water	Increase public awareness on conservation of water
		Promote water efficiency through monitoring, reducing wastage
		Construct water harvesting & storage structures
		Conservation of riparian land
		Water control devices
		Invest in early warning systems and infrastructure
	Environment	Establish water points around key biodiversity ecosystems
		Increase public awareness campaigns on natural resource and ecosystem management for communities in key biodiversity ecologies
	Agriculture	Invest in capacity building on soil management
		Installation of Irrigation systems
		Invest in early warning systems and infrastructure
		Subsidized farm inputs climate
		Smart agricultural farming
		Public awareness on Conservation of animal feeds through silage, hay etc
		Introduction of appropriate and resilient breeds
		Smart agricultural farming
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Trade	Increase crop productivity through improved irrigation
Landslide	Agriculture	Planting of trees Increase public awareness campaigns on use of quarries
	Environment	Tree planting
		Increase public awareness on Environmental conservations

	Water	Soil and water conservation structures
		Invest in early warning systems and infrastructure
		Increase public awareness on reducing human activities on landslide prone areas
	Trade	Increase public awareness on reducing human activities on landslide prone areas
Flooding	Agriculture	Construction of Soil and water conservation structures
		Tree planting
		Conservation of riparian reserves
		Install proper drainage channels/structures
		Proper civic education on soil conservation
	Water	Design and Construction of Proper Storm water structures
		Conservation of riparian reserves and wetlands
		Development, enactment and implementation of legislation on liquid and solid waste management
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Transport and Infrastructure	Construction and maintenance of drainage systems
		Proper road designs
		Implementation of County Spatial Plan
	Education	Design and Construction of Proper

| | | Storm water structures |
| | | Landscaping of school compound Water Harvesting |

Gatundu South

Hazard	Sector	Adaptation strategies
Drought Landslide	Agriculture	Promote Drought tolerant varieties and breeds
		Food conservation by value addition e.g. freezing, drying, packaging
		Conservation agriculture e.g mulching, zero-tillage
		Installation of Irrigation systems
		Invest in early warning systems and infrastructure
		Subsidized farm inputs climate
		Smart agricultural farming
		Government programs to buy livestock(destocking)
		Crops and livestock insurance
	Fisheries	-Water harvesting -Climate smart aquaculture technologies e.g. raised ponds & re-circulatory systems -Adoption of resilient species e.g catfish
	Water	Water harvesting and conservation in schools and public institutions
		Powering of boreholes within the ward using solar,
		Proper construction of sewer lines and drainages
		Enforcement of laws Planting windbreaker trees Harnessing wind /water power
	Health	Conduct Civic education about hygiene and sanitation
		Increased public awareness on

		disease prevention. Vaccination for animals
	Agriculture	Planting of indigenous trees Conducting civic education to create awareness on soil conservation measures Constructing proper drainage systems
	Roads, utilities and Transport	Putting up gabions
	Water	Rehabilitation or healing of quarries Design and Construction of Proper drainage away from the slope
	Trade	Increase public awareness campaigns on reducing human activities on landslide prone areas
Flooding	Agriculture	Construction of Soil and water conservation structures Tree planting Conservation of riparian reserves Install proper drainage channels/structures Proper civic education on soil conservation
	Water	Design and Construction of Proper Storm water structures Proper construction of pit latrines in schools Conservation of riparian reserves and wetlands

		Development, enactment and implementation of legislation on liquid and solid waste management
	Health	Increased public awareness on disease prevention.
		Vaccination for animals
	Transport and Infrastructure	Construction of Ndumiti bridge and Gaitabiri-Kianda Kinene Maintenance of electric wires.
		Construction and maintenance of drainage systems
		Proper road designs
		Implementation of County Spatial Plan
		Construction of culverts
		Construction of guardrail
Human Wildlife Conflict	Agriculture	Compensation and Insurance to cover any damage - Installing electric fences or other physical barriers to create a separation between human settlements and wildlife habitats

CHAPTER SEVEN: CONCLUSION

The Kiambu County Participatory Climate Risk Assessment has examined the hazards facing the county and the need to institute measures to address them. The process that produced this report was locally driven by the communities at the ward level. It was established that major hazards include drought, floods, strong winds, extreme temperatures, landslides, while some major risks were; pests, diseases and pollution. However, a myriad of challenges were faced when developing the report. Some of the challenges were; late disbursement of funds to undertake the PCRA process, huge expectations from the public, and strict deadlines for submission of PCRA and CCAP reports to the Program Implementation Unit (PIU) for counties to meet the Minimum Conditions.

The opportunities presented encompassed strengthening community engagement and enhanced their knowledge on local issues pertaining to climate change. The PCRA process was also guided by the locally led climate action principles which; devolved decision making to the lowest appropriate ward level. Additionally, the PCRA process addressed structural inequalities faced by women, youth, children; disabled, displaced people, indigenous and marginalized groups i.e. Shona and Ndorobo groups who were highly engaged to participate in the process. Further, the community engagements built a robust understanding of climate risk and uncertainty, and the community members understood the need to invest in local resources and capabilities.

Future recommendations should focus more on climate change awareness campaigns, capacity building for the county staff and the local community to empower them to implement climate change sustainable solutions. The county should invest in robust data collection methods to ensure that the data collected is comprehensive, including local knowledge to generate meaningful investment priorities. Additionally, advocate for policies that support community-based adaptation strategies. Also, the county should establish a robust monitoring and evaluation framework, to regularly assess the progress of the PCRA report. This report will feed into the county action plan that will provide more concise actions, steps and timelines. The investments identified will provide adaptive capacity to combat climate change and make the residents resilient to the erratic harmful events.