

Kisumu County Participatory Climate Risk Assessment Report



WORLD BANK GROUP

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
DANIDA | INTERNATIONAL DEVELOPMENT COOPERATION



iii Financing Locally-Led Climate iii

iiii

iiii



KFW



Sweden
Sverige

MAY, 2023

Table of Contents

List of Figures	3
List of Tables.....	3
ACRONYMS	4
Acknowledgement	5
Executive Summary.....	6
Chapter One: Context of the Participatory Climate Risk Assessment (PCRA).....	7
1.1 Background	7
1.2 Policy Context.....	8
1.3 Purpose of the PCRA Report	9
1.4 Key steps in the county’s PCRA process	9
1.5 PCRA Process Cycle.	10
1.6 Photos depicting participatory process	11
Chapter Two: County Climate Hazard Profile.....	12
2.1 Profile Overview.....	12
2.2 Exposure and vulnerability profiles of the county	14
2.2.1 Vulnerability.....	14
2.2.2 Resource Poor Households	14
2.2.3 Women.....	15
2.2.4 Youth	15
2.2.5 Persons with disabilities.....	15
2.2.6 Other marginalized groups: elderly, children, street families and the Nubian community.....	16
2.3 Differentiated impacts of climate trends and risks	16
2.4 Spatial Distribution of Risks	17
Chapter Three: Future Climate Scenarios for The County	19
3.1 Current and Historical Climate Hazards and Trends.....	19
3.2 Changes in distribution and duration of seasonal rains.....	19
3.3 Temperature trends and projections	21
3.4 Seasonal Rainfall Projections/future climate	21
Chapter Four: Analysis of Existing Adaptation Strategies To Current And Future Climate Risks	27
4.1: Introduction	27
4.2 Existing adaptation strategies and their effectiveness.....	27
4.3 Effectiveness of adaptation/resilience strategies to future climate risks	Error! Bookmark not defined.

4.3.1 Drought	Error! Bookmark not defined.
4.3.2 Floods	32
4.3.3 Extreme temperatures	32
4.3.4 Rainstorms	33
4.3.5 Cumulative impacts.....	33
4.3.6 Augmenting interventions	35
4.3.6.1 Technology, ICT Education.....	35
4.3.6.2 Strengthening Existing Disaster Preparedness Systems.....	35
4.3.6.3 Conservation Alongside Livelihoods	35
4.3.6.4 Needs of The Vulnerable/Inclusion.....	36
4.3.6.5 Enforcement and Review of Existing Policies.....	36
4.3.6.6 Agricultural Insurance	36
Chapter Five: County Climate Strategic Adaptation Investment/Action.....	37
Chapter Six: Conclusion	40
Annexes.....	41

List of Figures

Figure 1.1 Participatory Climate Change Process.....	10
Figure 3.1 Rainfall Current state for Kisumu County.....	19
Figure 3.2 March, April may Seasonal rainfall Trends	20

List of Tables

Table 2.1 Spatial distribution of Hazards in Kisumu County	12
Table 2.2 Hazard risks distributed by Sub-County.....	13
Table 2.3 Impact, Group affected Groups and Climatic Trends.....	16
Table 2.4 Climate Risks, livelihoods and Geographical Areas affected	17
Table 3.1 Climatic trends and Projections in Kisumu County.....	21
Table 3.2 Vulnerable Groups, Exposure and Adaptive Capacity to Climate Hazards	23
Table 4.1 Effectiveness of the Adaptation strategies on various risk to groups of vulnerable people	29
<i>Table 4.2: Climate risks and future coping strategies.....</i>	34
Table 5.1 Hazard, Strategic Adaptation investment and Ward	37

ACRONYMS

IPCC- Intergovernmental Panel on Climate Change
FLLOCA-Financially Locally Lead Climate Action
UNFCCC- United Nations Framework Convention on Climate Change
GHG-Green House Gas
NCCAP- National Climate Change Action Plan
CIDPs- County Integrated Development Plan
PWDs-People With Disabilities
CGK-County Government Of Kisumu
NGK-National Government Of Kenya
KRCS-Kenya Red Cross Society
NEMA- National Environment Management Authority
JICA- Japan International Cooperation Agency
UoN-University of Nairobi
NGO- Non-governmental Organization
CSOs- Civil Society Organizations
KFS- Kenya Forest Service
WRUAs- Water Resources Users' Associations
KMD- Kenya Meteorological Department.
MOH-Ministry Of Health
GIZ- German Agency for International Cooperation
VMGs-Vulnerable and Marginalized Group
ICIPE- International Centre of Insect Physiology and Ecology
KISIP- Kenya Informal Settlement Improvement Project

Acknowledgement

This product of the County Government of Kisumu has been prepared through the support of the FLLOCA Program Funds from the World Bank, DANIDA, Kingdom of Netherlands, GIZ, KFW and Sweden. We want to thank His Excellency the Governor, Prof. Peter Anyang' Nyong'o, CECM, Maryline Agwa and the Chief Officer, Maurice Owino for the Moral support and motivation.

The document has been developed under the Coordination of Evans Gichana (Director Climate Change), and Ken Koyoo (Director Environment-WECCNR-CGK) with contributions from; Dr, Emmanuel Midheme, Rosemary Owigar, Chris Benard Ouma (Maseno University), Judith Nasambu, James Nyagol, Susan Omwa, Silvester, Henry Okello, Janet Ochele, Hazel Alai, Hawi Elvira,(WECCNR), Nakitare Joel(Agriculture-CGK), Lynett Ochuma (Social Services-National Government)

We sincerely appreciate the hard work and contributions of the larger team, (PCRA Technical working group) composed of Prof. Waga George, Severiano Odhiambo, Dr. Hellen Kamwele, George Ojuondo(Maseno University), Rodah, Hanington, Steve (Muungano), Lizian Onyango(SDI), Frida, Matina and Andrew(Lands and Physical Planning),Jacquiline Katu, Ludfine Kosome,(WECCNR), John Sande(City), Paul Oloo (Met Dept), Erick Ogadho(Agr) and Laban Okeyo (Energy)

The SDI team from Nairobi led by Kilion, we thank you for your technical and financial support in the FGDs and KIIs and for further development of adaptation plan in informal settlements.

Executive Summary

The participatory Climate Risk Assessment was conducted in the County between 2nd May, 2023 to 20th May, 2023. The objective of the PCRA was to conduct community assessments of hazards, vulnerabilities, and local coping strategies in a participatory way to provide a basis for the development of more effective and sustainable adaptation strategies and investments can support vulnerable groups. The validation was done together with local stakeholders in rural and urban communities.

The choice to involve people in driving their own agenda in climate action through public participation leads to sustainable development. It is important to implore the slogan “leave no one behind” when identifying and prioritizing projects for implementation. Participatory Climate Risk Assessment (PCRA) was conducted in 35 wards in Kisumu as a way of involving the community who are in reality with impacts of climate change.

Cumulatively, drought, storms, extreme temperatures and flooding have resulted in displacement of families, loss of crops and livestock, malnutrition among children and outbreak of water born diseases. A clear understanding of the resources that communities own were identified through mapping was processed by the people themselves. The communities also proposed priorities that can be turned to investment opportunities in every ward through climate finance. Financing Locally Led Climate Action (FLLOCA) which supported this work has given a condition that for Counties meet minimum conditions, they must conduct participatory Climate Risk Assessment.

To enhance the spirit of togetherness the Technical Working Group that was appointed reflected the phase of inclusivity both in gender, PWD, Maseno University, National Government, Muungano group from urban settlements and the NGOs in the city. The findings can be shared with students from university colleges

It's hoped that the PCRA will support that the priorities proposed by the community will guide the process of implementation and enhance adaptation and mitigation in the community. Kisumu County has established a bottom-up structure for climate actions which gives the community a voice about their investments.

Chapter One: Context of the Participatory Climate Risk Assessment (PCRA)

1.1 Background

Kisumu County is among the most-at-risk and most vulnerable Counties to climate change impacts in Kenya. The climate risks, which include flooding, drought, high temperatures and lake level rise make many communities exposed due to inadequate coping mechanisms and absolute poverty, which currently stands at 60%. Climate Change action in the County is guided by the National Climate Change Act, 2016 as well as the National Climate Change Action Plan (NCCAP, 2018-2022). In the recent past, mainstreaming of climate change action has been achieved through incorporation in the County Integrated Development Plan (CIDP) process. Besides, sectoral working groups and departmental strategic plans have been enriched through sensitization and capacity building workshops and strategic meetings aimed at mainstreaming climate change in various sectors of the county operations. However, inadequate data and nominal community involvement still remains a challenge that affects implementation of climate action, especially at the local (ward) level.

In the year 2020, the County Government of Kisumu conducted a Climate Risk and Vulnerability Assessment in the entire County, with support from Transparency International. The findings indicated that high temperatures, flooding as well as drought are among the serious risks that need to be checked to enhance adaptation and resilience in the communities. According to the Assessment Report, temperatures are steadily rising across the County, and all the Intergovernmental Panel on Climate Change (IPCC) scenarios show that temperature will continue to increase significantly until the end of this century. In the Kano Plains for example, yearly flood-related losses are estimated at US\$ 850,000 (Masse et al., 2016), while relief needs amount to US\$ 600,000 annually. Such events represent significant barriers to food security and poverty alleviation efforts in the County. The vulnerable population which includes children, youth, women, elderly and marginalized groups are particularly adversely affected. Kisumu County is therefore vulnerable to climate change, necessitating the design and implementation of an ambitious climate change adaptation strategy. This Participatory Climate Risk Assessment (PCRA), supported by the FLLOCA Program, has come at the most opportune time to provide the necessary evidence needed to cushion the vulnerable segment of the population who bear the highest burden from climate change impacts.

1.2 Policy Context

Kisumu County has not been left out on the road map to achieving Sustainable Development Goal No. 13 and Vision 2030 on climate action and ensuring a safe and secure environment. The County is currently implementing a wide range of policies and instruments ranging from international conventions, to national statutes and local policies. These policies are implemented by key agencies in the respective line ministries in which the specific policies are domiciled. Moreover, the County Government has adopted a further decentralization of decision making and plan implementation processes in line with the principles of subsidiarity. This is deemed a *Masse plus* in the effective implementation of these policies. Kenya is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since 2005 and the County Directorate of Climate Change has been tasked with ensuring that County-level operations are aligned with the commitments framed under the UNFCCC. The Directorate of Climate Change further ensures effective alignment through the pursuit of low carbon development across the County. To achieve this, the Department engages in advocacy and awareness in the adaptation towards green energy and the reduction of pollution to reduce on the greenhouse gas emission. In 2020, the County Government conducted a GHG and emission inventory to assess the levels of GHG emissions and the findings indicate that 84% of GHG come from transport sector.

In terms of institutional framework, Kisumu County Government has been at the forefront of developing a robust framework that informs climate change response since 2016. This includes establishing a Climate Change Directorate, the development of County Climate Change Policy, conducting a climate Risk Assessment and creating a legislation i.e., Kisumu County Climate Change Act, 2020. The County derives its policy frameworks from the National Climate Change Act, 2016, the National Climate Response framework, Kenya's Updated National Determined Contribution (2020), National Adaptation Plan (NAP) 2015-2030, National Climate Change Action Plan (NCCAP 2013), Second National Climate Change Action Plan (NCCAP 2018-2022). The County legal and legislative framework provides the climate change Directorate the mandate to coordinate mainstreaming of climate change into sector programs in the CIDPs and sectoral policies. The County Climate Change Act, 2020 states that the County Government, through the Directorate of Climate Change will conduct annual climate risk assessments to inform project identification and adaptation and mitigation responses. To ensure no one is left behind, inclusion and participation of communities, the County Climate Change management and coordination structure starts from the ward level to the County Climate Council, chaired by the Governor.

1.3 Purpose of the PCRA Report

The purpose of conducting this Participatory Climate Risk Assessment was to understand how communityis in Kisumu are affected by the climate risks, their current adaptation strategies, government involvement and interventions and future climate scenarios to prepare for effective climate actions. This PCRA report is aimed at:

- a) Providing climate profiles and future scenarios, which can prepare the county and climate finance partners to set aside funds for climate action.
- b) Providing a basis for the development of more effective and sustainable adaptation and mitigation strategies in Kisumu County
- c) Providing areas of priority climate investments proposed by community members from every ward,
- d) Meeting the Minimum Access Conditions for accessing FLLOCA funding

The report shows that there are areas which are more vulnerable than others due to their unique geographical locations and exposure. For example, communities living in the Nyando River basin, lower and the shores of Lake Victoria are prone to floods and Lake level rise, which disrupts their livelihoods and housing annually. This mostly affects women, children and persons with disability. The community living in these areas identified collapsed dwellings, submerged toilets and flooded farms, rising burden of water-borne diseases and malaria as some of the impacts associated with these perennial floods. To support the communities to cope with such risks, sustainable adaptation measures have been proposed. The departments of Agriculture, Water, Environment and Climate Change, Health, Social Services and Infrastructure were named as key stakeholders in terms of overseeing the implementation of proposed interventions.

1.4 Key steps in the county's PCRA process

The process of developing the PCRA took about 30 days to conclusion and emphasized inclusivity as much as possible. The PCRA guidelines provided key information and support for effective delivery. The need to consider 50% vulnerable participants in the meetings was strictly enforced in identifying participants in the community workshops (lists of attendance attached). Further basis for inclusive action was grounded in relevant county legislation. Specifically, the County Public Participation Policy requires that not more than 2/3 of either gender, male or female should dominate a forum and that participants should be given adequate notice to attend such meetings. This was adhered to throughout the PCRA process. In each Ward, the mobilization of participants was carefully done through collaboration of the Village Aadministrator, Ward Aadministrators and chiefs. The County Ddepartment of communication publicized the PCRA meetings and

informed people about the PCRA activities by creating awareness through social media and targeted postings on the County Website.

1.5 PCRA Process Cycle.



Figure 1.1 Participatory Climate Change Process

1.6 Photos depicting participatory process



Participating in identifying vulnerable areas

Chapter Two: County Climate Hazard Profile

2.1 Profile Overview

Kisumu county experiences a modified equatorial climate. It is generally warm with minimal monthly variation in temperatures between 23°C and 33°C throughout the year. The rainfall is determined by a modified equatorial climate characterized by long rains (March to May) and short rains (September to November). The average annual rainfall varies from 1000- 1800mm during the long rains and 450-600 mm during the short rains. The altitude in the county varies from 1,144 meters above the sea level on the plains to 1,525 meters above sea level in the Maseno and Lower Nyakach areas. Coupled with land sea breeze from the lake greatly influences temperatures and rainfall in the County. Convictional rainfall is dominant in the lower regions (Kano, lower Nyakach, Seme, Nyando) while relief in upper regions (Maseno, Kajulu and upper Nyakach, Muhoroni). In view of the above climate trends, the following hazards are likely to occur within the county

- Floods
- Whirlwinds (Kalausis)
- Thunderstorm and lightning
- Heavy (intense) rainfall,
- Water spout (Nyakoi) over the Lake
- Extreme temperatures (high temperatures leading to heat stress)
- Flash floods
- Intense hailstones
- Drought

Table 2.1 Spatial distribution of Hazards in Kisumu County

Sub-County	Floods	Rise in temperatures	Drought	Hailstones	Lightning & thunderstorm	Intense rainfall
KISUMU CENTRAL	✘	✘	✘			✘
KISUMU EAST	✘	✘	✘	✘	✘	✘
KISUMU WEST	✘	✘	✘	✘	✘	✘
NYAKACH	✘	✘	✘	✘		✘
SEME	✘	✘	✘	✘		✘
NYANDO	✘	✘	✘			✘
MUHORONI	✘		✘			✘

Table 2.2 Hazard risks distributed by Sub-County

		Sub-County						
		Kisumu Central	Kisumu East	Kisumu West	Nyando	Seme	Nyakach	Muhoroni
Hazard	Risk							
Heavy rainfall	Floods		X	X	X	X	X	X
	landslides			X			X	
	Destruction of property	X	X	X	X	X	X	X
	Damage of dwellings	X	X	X	X		X	X
	Damage of infrastructure	X	X	X	X	X	X	X
	Loss of crops and livestock		X	X	X	X	X	X
Floods	Soil erosion		X	X	X	X	X	X
	Loss of human life	X	X	X	X		X	X
	Water pollution	X	X	X	X	X	X	X
	Water-borne diseases	X	X	X	X	X	X	X
	Destruction of infrastructure	X	X	X	X	X	X	X
	Destruction of property	X	X	X	X	X	X	X
Drought	Crop failure		X	X	X	X	X	X
	High food prices	X	X	X	X	X	X	X
	Water scarcity	X	X	X	X	X	X	X
	Disease outbreaks	X	X	X	X	X	X	X
	Human-wildlife conflicts		X	X				
	Crop/livestock insecurity/theft	X	X	X	X	X	X	X
Extreme Temperatures	Warming lake waters/biodiversity loss	X	X		X	X	X	
	Heat stress	X	X	X	X	X	X	X
	Post harvest losses (fish, vegetables, fruits)	X	X	X	X	X	X	X
Hailstones/storms	Destruction of crops	X	X	X	X	X		X

		Sub-County						
		Kisumu Central	Kisumu East	Kisumu West	Nyando	Seme	Nyakach	Muhoroni
	Reaping of roofs							
	Felling of trees							
	Destruction of infrastructure (electric poles)	X	X	X				

2.2 Exposure and vulnerability profiles of the county

2.2.1 Vulnerability

The most vulnerable groups in Kisumu County consists of the resource-poor households who are 61% of the total county population.¹ From the latest census reports, women constitute 51.4%, youth, 40 %, PWD, 1 %, elderly, 2.9% of the total county population. All these groups are deemed vulnerable and in need of targeted interventions in terms of climate action. There are also the marginalized groups such as the Nubians who have settled in Kibos, Manyatta Arabs, Kaloleni, Mkendwa areas of Kisumu City and in parts of Muhoroni Town. In this group are also the street families, child- and female-headed households. These groups are greatly exposed to climate risks due to several predisposing factors which increases their vulnerability. The characteristics of the vulnerable groups are as follows:

2.2.2 Resource Poor Households

They have settled mainly in the rural areas of Kisumu County and informal settlements like Obunga, Nyalenda, Manyatta and Bandani. The major characteristics of these households is that they are food- poor. The malnutrition rate is high for example in Nyando Sub- County, with stunting rates of 40%. They are mainly engaged in subsistence farming of crops and livestock. Localized variability in climatic factors adversely affect the subsistence productive systems within the rural areas. The same is true for small and micro enterprises, which perform poorly due to low purchasing power. On the other hand, most of the informal settlements in Kisumu are located within urban flood prone areas and often bear the brunt during heavy flood episodes, compromising the sanitation services. The rate of school dropout is high and the children are involved in child labour

¹ Kenya Household Budget Survey, 2018

2.2.3 Women

The women are disproportionately affected by floods, drought and changes in temperature within Kisumu County mainly because of their physiological status and traditional gender roles. Pregnant and lactating mothers are more at risk. The women majorly rely on surface water for domestic use and forest for fuelwood. They are also engaged in farming, being mostly the tillers of the land. In addition, most of them do not own land. They are engaged in selling vegetables and fruits (mama mboga), tailoring, hotel industry, mitumba business, saving and loaning schemes and majority are house wives. Income flows from these sources have drastically decreased as a result of climatic hazards. There is also high increase in gender-based violence, mostly at the evacuation centers in flood prone areas. Furthermore, undignified shelter has also adversely affected the psychological well-being of women and young girls seeking refuge at evacuation and rescue centers.

2.2.4 Youth

The youth in Kisumu County are about 40% of the County total population as per 2019 population census. The unemployment rate is at 61% (County CIDP review, 2022). The majority in urban centers are in informal work mainly jua kali and boda-boda sectors. Those in the rural areas are engaged in brick-making, sand harvesting, horticulture, poultry farming, tree nursery, fishing, or in sugar and rice irrigation schemes as casual laborers. The youths are mainly concentrated in urban and peri-urban informal settlements, which are located within the areas prone to climatic risks. The climate risks interfere with their SMEs. In addition, most youths do not own land, which denies them access to credit facilities that otherwise would make their businesses more resilient. The female youth are even more vulnerable because of being young mothers and 28.8% are in early marriages (Kisumu County Fact Sheet, 2019).

2.2.5 Persons with disabilities

Persons with disabilities are about 1% of the total county population and have different forms of impairment like visual, speech, physical and hearing. This puts them at great risk when exposed to climate hazards as their conditions puts them at a disadvantaged position, exacerbating vulnerability. The characteristics are mainly engagement in small and micro enterprises like selling of water, sweets, or as cobblers. They mainly operate within the market centres, they are discriminated when it comes to climatic actions although they make efforts to engage in adaptation matters such as afforestation.

2.2.6 Other marginalized groups: elderly, children, street families and the Nubian community

The elderly, children, street families and the Nubian community, are usually left out when it comes to decision-making process on climate issues, yet they are equally exposed to climate risks. Often, their survival is pegged on menial jobs with income hardly enough to take them through the tough economic times occasioned by climate change where many livelihoods have become precarious.

2.3 Differentiated impacts of climate trends and risks

Climate change impacts on the vulnerable groups differ mainly as a result of the multi dimensions of poverty, gender inequality, environmental degradation and the heavy burden of disease as shown on the table below.

Table 2.3 Impact, Group affected Groups and Climatic Trends

Special interest groups	Current Climate & None Climate Risks & Trends	Climatic Impact
Women	Increased water borne diseases as a result of floods and drought	Women are most likely to be infected /affected by malaria and diarrheal diseases because of the vulnerability as expectant and lactating mothers.
	Increased floods and drought	Women SMEs are likely not to cope with shocks of climatic hazards and are likely to swept by floods because of their physic. In case of floods displacement, they are exposed to undignified living conditions and sexual harassment.
	Drought and Floods effect on land production	Women do not own land and yet bear the great burden in agricultural production. Often gender-based violence arise as a result of sharing of the meagre farm produce During droughts women go through so much distress in search of safe water for domestic use
Youth	Drought exacerbates natural resource Conflicts	Unsustainable utility of scarce natural resources has contributing to degradation of environment and compromised natural capital that otherwise would support community livelihood. Degraded lands are at high risk of catastrophic events.
Persons with disability	Repercussions of displacement as a result of floods	At the evacuation centers the sanitation facilities are not disability friendly Inadequate information on climate change e.g. few sign interpreters, lack of braille The persons with severe disability suffer the brunt of negligence when it comes to rescue measures in times of emergency

Special interest groups	Current Climate & None Climate Risks & Trends	Climatic Impact
Elderly	Food insecurity as result of droughts	Most suffer from chronic diseases that require specialized diet, during droughts they are not able to meet their dietary intake
Children	Malnutrition occasioned by crop failure due to floods and drought	Droughts, famine adversely affect children, floods affect the feeding schedule of infants, famine make children not to meet the minimum acceptable diet
	Poor school performance	In adverse climatic conditions children cannot access schools, schools are used as evacuation centers, school feeding program is disrupted, high rate of absenteeism because children are engaged in child labour
Marginalized groups	Poor housing located in fragile ecosystems affected by floods	They have mainly settled in informal settlements, during floods they suffer from poor drainage, houses are submerged and the environment is insecure

2.4 Spatial Distribution of Risks

Climatic hazards affect communities in Kisumu County variedly based on their geographical location. Wards lying on county's lowlands are mostly affected by flash floods, whirlwinds and drought, while those on the highlands are faced with the challenge of heavy rainfall and soil erosion, amongst other as presented in Table 2.5.

Table 2.4 Climate Risks, livelihoods and Geographical Areas affected

	Hazard	Climate Risk	Livelihood/ Economic sector	Sub - County / Wards
1	Intense floods	damaging property, infrastructure and posing health	Crop farming Livestock Farming Trade and Marketing Education Fishing Health sector Infrastructure	Nyando (Ahero, East Kano-Wawidhi, Awasi Onjiko, Kobura & Kabonyo-Kanyagwal) Muhoroni (Masogo-Nyang'oma, Chemelil-Tamu, Miwani, Ombeyi & Koru Kisumu E (Kajulu, Kolwa Central Kolwa East, Manyatta B & Nyalenda A) Nyakach (North, Central and West) Kisumu Central (Migosi, Mkt Milimani, Nyalenda A, Nyalenda B, Manyatta A and Manyatta B)
		Lake Level rise		
2	Erratic rainfall	Seasonal crop failure	Crop farming Trade and Market	All the Wards in the County save for Market Milimani in Kisumu Central
3	Whirlwind	Damaging crop resulting to reduction on production	Crop Farming	Nyando (Ahero, East Kano Wawidhi, Awasi Onjiko, Kobura & Kabonyo-Kanyagwal) Muhoroni (Chemelil-Tamu) Nyakach (North Nyakach and West Nyakach)
4	Intense Drought	Loss of crop and livestock thus food insecurity Scarcity of water and	Crop farming Livestock farming Fisheries Water supply Tarde and Market	All the Wards

	Hazard	Climate Risk	Livelihood/ Economic sector	Sub - County / Wards
		food stuff trade commodity		
5	Longer periods of High temperatures	Seasonal Crop failure stress to livestock and human	Crop farming Livestock farming Health	Nyando (Ahero, East Kano Wawidhi, Awasi Onjiko, Kobura & Kabonyo-Kanyagwal) Muhoroni (Masogo-Nyang'oma, Chemelil-Tamu, Miwani, Ombeyi & Koru Kisumu E (Kajulu, Kolwa Central Kolwa East, Manyatta B & Nyalenda A) Seme (Central Seme, East Seme, North Seme and West Seme) Kisumu East (Kajulu, Kolwa Central Kisumu West (West, North West, South West, and North wards)

Chapter Three: Future Climate Scenarios for the County

3.1 Current and Historical Climate Hazards and Trends

Under normal circumstances the start date of rains over Western Kenya, including Kisumu County, begins during the first to second week of the rainy season either during March to May (long rains) or during October to December (short rains). The current trend is that there is usually a late onset coming during the third to fourth week of either March or October. The end dates for the rains in Kisumu County are from the month of June (during the long rains) and end by the third to fourth week of December (during the short rains). The current trend is that there is usually an early cessation during the second to third week of May, while for the short rains the cessation might come during the first to second week of December.

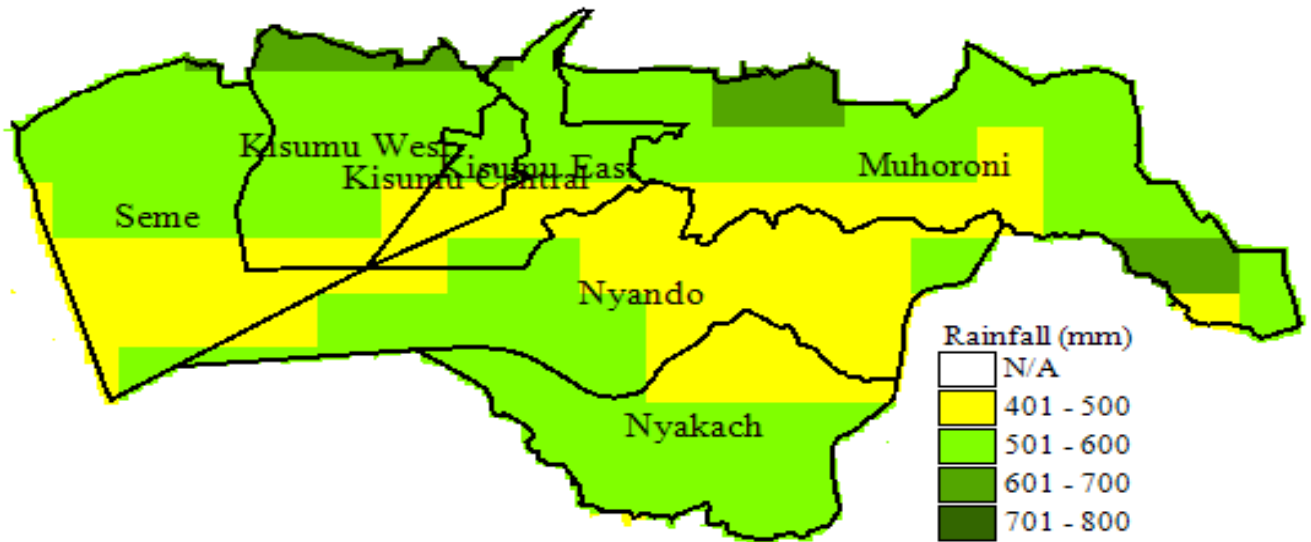


Figure 3.1 Rainfall Current state for Kisumu County

The amount of rainfall received varies depending on the season. More rainfall occurs during the long rains (Chiri) than the short rains (Opon). The amount of rainfall received is also not uniform across the County, with some areas receiving more while other areas receive less rainfall. During March to May the average rainfall varies from 400 to 700mm. During October to December the average rainfall varies from 200 in some areas to 400mm in other areas.

3.2 Changes in distribution and duration of seasonal rains

In the old days, the seasonal rainfall distribution used to be regular with good distribution in time and space. Lately, seasonal rainfall distribution has mainly been irregular, the space and time distribution has been poor.

The duration of the seasonal rains has reduced from 75 to 85 days to slightly between 50 and 70 days. The length of dry spells has increased from less than 5 days to mainly more than 10 days.

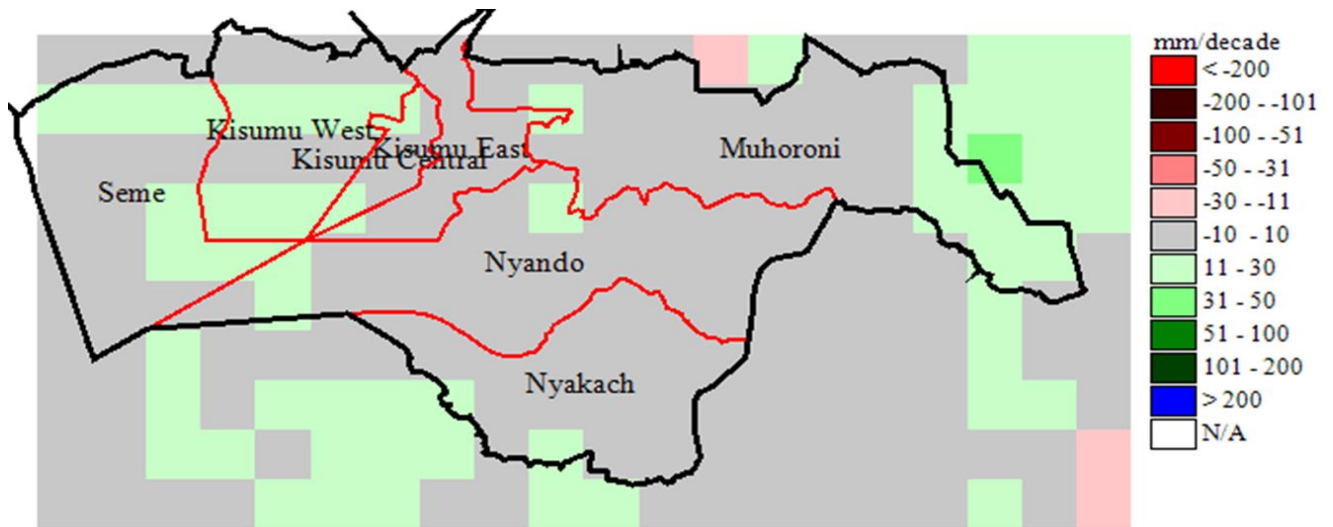


Figure 3.2 March, April may Seasonal rainfall Trends

The long rainfall season (March–April–May) has shown a long-term drying trend between 1986 and 2007. Since 2005, drought frequency has doubled from one in every six years to one in every three years.

OND Seasonal Rainfall Trends

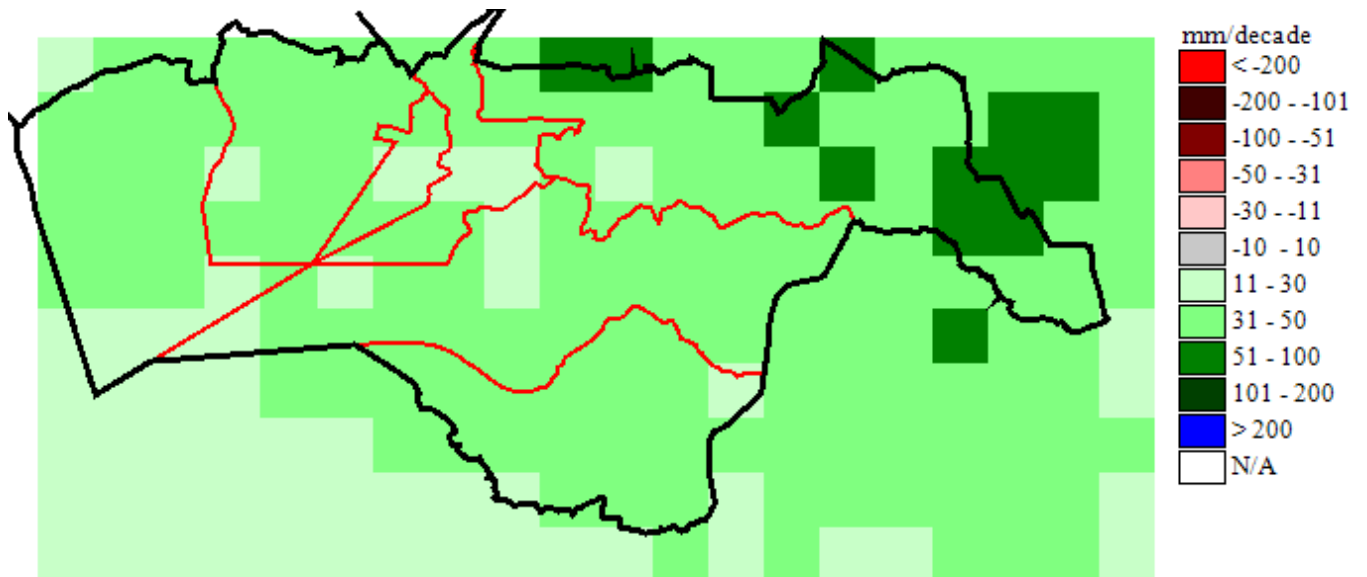


Figure 3.3 October November December Seasonal Rainfall Pattern

The short rains (October–November–December) have shown a long-term wetting trend from the 1960s to present. Increase in frequency of floods, can come with increase in hailstorms, and increase in rainfall frequency occurring within a few numbers of days.

3.3 Temperature trends and projections

Analysis of temperature trends in the county over 25 years (1980 to 2005), showed that although mean OND season temperatures have remained relatively constant, there has been a significant increase of approximately 0.5°C in mean MAM season temperatures. Mean temperatures have increased by 0.7°C to 1°C from 1973 to 2013, depending on the season. The temperature projections at 1.5°C, 2°C, and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.6°C, 1.1°C, and 2.1°C warmer than the 1994–2005 average, respectively.

3.4 Seasonal Rainfall Projections/future climate

The March to May and October to December season frequency and intensity of heavy precipitation events are projected to increase, leading to more flooding events. Flooding events may occur in terms of increase in intense heavy precipitation events, flash floods and intensity of hailstones which may occur within a few numbers of days. Seasonal rainfall duration is projected to increase during OND with no significant change during MAM. In view of the above climate trends, the following hazards are likely to occur within the county. Table 3.1 shows the climatic trends within Kisumu, whilst Table 3.2 shows the vulnerability and impacts to the risks.

Table 3.1 Climatic trends and Projections in Kisumu County

Current locally experienced trend	Relevant climate projection	Likely future hazard scenario
Unpredictable seasons - The current trend is that there is usually a late onset coming during the third to fourth week of either March or October and an early cessation during the second to third week of May, while for the short rains the cessation might come during the first to second week of December.	Seasonal rainfall distribution has mainly been irregular, the space and time distribution has been poor. The duration of the seasonal rains has reduced from 75 to 85 days to slightly between 50 and 70 days, The length of dry spells has increased from less than 5 days to mainly more than 10 days. The long rainfall season (March–April–May) has shown a long-term drying trend and also the short rains (October–November–December) have shown a long-term wetting trend from the 1960s to present.	There is more uncertainty in start and end dates duration and intensity of rainfall affecting crop cycle and water availability.
Increased long periods of droughts	The combination of increased temperatures and decreased precipitation make for an increase in drought risk. drought frequency has doubled	A highly likelihood of more drought i.e., the long rains of March-May in 2022 and 2023

Current locally experienced trend	Relevant climate projection	Likely future hazard scenario
	from one in every six years to one in every three years	failed within the whole country leading to increased crop failure, water scarcity, human-animal and crop diseases, scarcity of pasture, human wildlife conflict (hippos feeding on farm) and school absenteeism across the county.
Frequent flooding due to intense rainfall (Flash riverine, flash and lake shore)	<p>The short rains (October–November–December) have shown a long-term wetting trend from the 1960s to present. Increase in frequency of floods and increase in rainfall frequency occurring within a few numbers of days.</p> <p>The OND season has experienced increase in precipitation.</p> <p>Riverine flood observations suggests that there has been an increase Model results vary with scenario and region, but they suggest that present 1 in 100-year floods could become as frequent as 1 in 40 years under low warming scenarios and 1 in 20 under higher warming.</p> <p>Water level in the lake is rising due to extreme rainfall and/or the deposition of sediment brought in by the rivers upstream.</p>	High probability of flooding events. In April 2023 several homes and farms were submerged by floods due to heavy down pour in central and Kolwa East within Kisumu East Sub- County and Nyando sub county displacing more than 600people leading to water pollutions, deaths, destruction of properties and infrastructure (Rota bara access road in Kisumu west), displacement of people and discontinuity of learning in schools.
Increased extreme temperatures	<p>Analysis of temperature trends in the county over 25 years (1980 to 2005), showed that although mean OND season temperatures have remained relatively constant, there has been a significant increase of approximately 0.5°C in mean MAM season temperatures.</p> <p>Mean temperatures have increased by 0.7°C to 1°C from 1973 to 2013, depending on the season.</p> <p>The temperature projections at 1.5°C, 2°C, and 3°C of global warming above pre-industrial levels, mean annual temperatures are projected to be 0.6°C, 1.1°C, and 2.1°C</p>	High likelihood of increase of temperatures coupled with water pollution enhancing water hyacinth and hippo-grass leading to declined fish stock and species and difficulty in accessing fishing zones within the lake, post-harvest losses for perishable products (fish, vegetables and fruits) and heat stress to dairy cattle reducing milk production.
Amplified hailstones/storms/lightening	Increase in frequency of rainfall can come with increase in hailstones/storms /lightening within a few numbers of days	Climate change is going to lead to larger hailstones. The rains in April 2023 were accompanied with hailstones destroying rice schemes in Nyando sub county. In Maseno town Kisumu West Sub- County. Lightening caused power outage and destructions of electrical appliances for the institutions and small and medium enterprises. Strong wind storms lead to destruction of houses and soil erosion in

Current locally experienced trend	Relevant climate projection	Likely future hazard scenario
		Kobura, Kabonyo-Kanyagwal in Kadibo Sub-County

Table 3.2 Vulnerable Groups, Exposure and Adaptive Capacity to Climate Hazards

Hazard /Risk	Impact	Vulnerable Group/Regions	Reasons On Vulnerability		
			Exposure	Sensitivity	Adaptive Capacity
Unpredictable seasons	Change in crop cycle	Peasant farmers, school going children urban poor, women PWDs, Youths	Over reliance on rain fed farming	Undiversified livelihood	Lack of access to early maturing seeds and weather information Lack of awareness on changing weather patterns
Droughts	Crop failure/high food prices and Nutritional diseases	Peasant farmers and the urban poor, children and women, PWDs	Over reliance on rain fed farming	-use of seeds that are not early maturing -Poor soil management Low purchasing power limiting food options Food rationing	Lack of weather information Access to early maturing crop varieties Lack of diversified livelihoods Lack of access to food
	Water availability for small scale irrigation	Small scale irrigation farmers PWDs	Their sources of water are at risk off long dry spells (water pans, wetlands, shallow wells, rivers)	Water sources are small shallow Rivers are silted	Lack of access to intermittent irrigation systems Improper soil conservation measures such as mulching
	Lack of pasture	Livestock farmers, dairy farmers	Over reliance on natural pasture	-Natural pastures are sensitive to drought -Competing land uses -land in fragmentation due to increase in population	Lack of fodder conservation and preservation technology
	Lack of water for domestic use/ high prices	Women Young girls Public institutions such as Schools and hospitals school going children urban poor PWDs Elderly	Heavy Reliance on natural water resources that are sensitive to drought	The water sources are sensitive to drought such as rivers, pans, wells	Lack of domestic water storage facility

Hazard /Risk	Impact	Vulnerable Group/Regions	Reasons On Vulnerability		
			Exposure	Sensitivity	Adaptive Capacity
	Pest and diseases	Crop and livestock farmers, PWDs	Open and uncontrolled grazing Prolonged dry spells leading to pest and disease build up	Use of common pasture and water sources	<ul style="list-style-type: none"> • Lack of access to animal farm input
	Human diseases - Food borne diseases- cholera, respiratory diseases	Children Women The elderly Vegetable, fruit and fish vendors Youths in boda-boda PWDs	Poor sanitation and hygiene	Poor sanitation facilities and access to health services	<ul style="list-style-type: none"> • Inadequate finance to put up proper domestic sanitation facilities
	Human wildlife conflict	Shoreline communities Women, children Shoreline farmers Fishermen Fishmongers Communities ordering forest	Proximity to the wildlife habitats	Poor management of wildlife	<ul style="list-style-type: none"> • Inadequate capacity of Kenya wildlife Service to manage wildlife • Lack of community sensitization
	School absenteeism	School going children and students	Lack of food/hunger	They need frequent meals.	<ul style="list-style-type: none"> • Inability to contain hunger
Floods	Displacement of people	Communities along the shoreline, riverine, sloppy areas, and poorly drained areas, PWDs	Location Poorly drained soil Topography	Most houses are earth walled hence washed away by flowing waters poor drainage siltation of rivers	<ul style="list-style-type: none"> • Inadequate technology to construct flood resilience houses • Lack of early warning information and adherence to early warning system • Lack of capacity to de-silt rivers • Poor drainage systems along the roads
	Infrastructural destruction	The rural poor Public institutions Transport operators (youths) School children and teachers Traders (SMEs) PWDs The elderly	Location and topography	Construction and building materials (buildings, roads and bridges)	<ul style="list-style-type: none"> • Inadequate funds to climate proof the infrastructures
	Water pollution	Water service providers, young Girls, women	Proximity to polluted water	Their activities revolve around water	<ul style="list-style-type: none"> • Lack of alternative water sources

Hazard /Risk	Impact	Vulnerable Group/Regions	Reasons On Vulnerability		
			Exposure	Sensitivity	Adaptive Capacity
					<ul style="list-style-type: none"> • Inadequate access to domestic water treatment
	Loss of crops and livestock	Communities in flood prone areas especially riverine and shoreline floods	Location (riverine and shoreline flood prone areas.	<p>Prolonged days of water logging leading to crop root rot hence crop failure.</p> <p>Prolonged days of water logging leading to cold related infections in livestock</p>	<ul style="list-style-type: none"> • Poor land use practices from the upstream communities • Inadequate finance to rehabilitate the shoreline to cushion the shoreline communities from lake water intrusion to land
	Disruption of learning	School going children, students and teachers	Location and topography	Construction and building materials (buildings, roads and bridges). Type of soil	<ul style="list-style-type: none"> • Inadequate funds to climate proof the infrastructures • Inadequate technology to put up climate structures in water logged areas
Extreme temperature	Invasive species	Fish vendors, fishermen (water hyacinth and hippo grass)	Location (river mouth and lake inlets)	Polluted waters, sediments	<ul style="list-style-type: none"> • Lack of technology to manage invasive species
	Declining fish stock and species	Fish vendors, fishermen,	Location (winam gulf)	Shallow waters due to siltation coupled with warming leading to migration of fish to deep waters	<ul style="list-style-type: none"> • Inadequate finance to acquire appropriate fishing gears (motor oars, coolers, • Inadequate finance, and infrastructure to promote aquaculture value chain
	Post harvest losses	Crop farmers, grain vendors	Location (open markets	The crops are perishable	<ul style="list-style-type: none"> • Inadequate finance to establish climate proof fresh produce markets
	Heat stress to dairy cattle	Dairy farmers	Location	Milk production is sensitive to heat	<ul style="list-style-type: none"> • Inadequate technologies to control temperatures in the dairy units • Lack of technology to up develop heat stress breeds
	Amplified hailstones,	Horticultural farmers (youth and women)	Location	Low forest cover for	<ul style="list-style-type: none"> • Lack of lightening arrestors • Lack of alternative

Hazard /Risk	Impact	Vulnerable Group/Regions	Reasons On Vulnerability		
			Exposure	Sensitivity	Adaptive Capacity
	storms and lightening	Rice, sugarcane , beans, maize farmers		hailstones and storms	Sources of fuel and livelihoods

Chapter Four: Analysis of existing Adaptation Strategies to Current and future Climate Risks

4.1: Introduction

This section presents the strategies that various stakeholders are currently implementing within the county to address climate related risks and hazards. Various actors including county government, national government, non-governmental organizations and parastatals together with communities have been implementing various actions to deal with the impacts of climate change. The strategies include both software and hardware components like construction of infrastructure and humanitarian services, capacity building and awareness creation among others. Examples include construction of evacuation centers by JICA and NEMA, research on flood-resistant housing by University of Nairobi, building of dykes and irrigation schemes by the Ministry of Irrigation, opening up of drainages and streams by the County Government, flood response and recovery by KRCS.



Figure 4.1: Residents of Ombaka in Kabonyo Kanyagwal displaced by flooding moving to higher grounds

4.2 Effectiveness of adaptation/resilience strategies to future climate risks

This section highlights the main adaptation/resilience strategies envisaged under future scenarios of climate-related risks. The climate regime within the Lake Victoria Basin, in which Kisumu County falls, is highly variable with a higher natural susceptibility to frequent extremes than neighbouring regions. Women, Children, VMGs, PWDs and the elderly have particularly felt the burden of these impacts. The following sections outline some of the strategies envisaged under various conditions of climate variability and change. Some of the sectors impacted by these climatic hazards and their current coping strategies are summarized in the Table 4.1 Overleaf.

4.2.1 Drought

Droughts is one such anticipated climate extreme in the County which is slowly and progressively affecting most parts of the County in majorly in areas like Nyakach, Nyando, Muhoroni, Kisumu Eats and Seme Sub-Counties. The effects of future droughts on food security and health are thus likely to be severe with costly recovery mechanisms.

4.2.2 Floods

Historical extreme flood events in Kisumu County shows periods of high flood intensity negatively impacting on human activities through overflow of rivers and lack back flow, damage to agricultural produce and properties, outbreak of diseases like cholera.

4.2.3 Extreme temperatures

The projections for Kisumu County show clear and consistent trends towards higher mean temperatures and more frequent warm days and nights and fewer cold days and nights, together with longer warm spells and shorter cold spells. Specifically, the projected increases in warm nights are considerably larger than those in warm days, indicating greater night-time heat stress.

4.2.4 Rainstorms

The projections for rainfall are more uncertain than those for temperature. It is notable that areas for which little change in total precipitation is projected may still experience an increase in extreme rainfall, usually associated with storms. Risks associated with intense heavy rainfall events projected for Kisumu County include increased surface erosion and run-off, increase flood risk, increased risks to transport infrastructure and implications for water quality and sanitation.

Table 4.1 Effectiveness of the Adaptation strategies on various risk to groups of vulnerable people

Hazard/ Risk	Economic & Social Sectors	Current Adaptation Strategies	Stakeholders	Vulnerable Groups	Effectiveness of the Strategies
Floods	Housing	Moving to higher grounds Building of flood-resistant houses Construction of evacuation centers in Nyando/Kadibo sub-counties	CGK/NGK, KRCS, NEMA, Partners (JICA, UoN)	PWDs, Women, Children, Elderly, Youth	Building of flood resistant houses is highly effective compared to moving to higher grounds and building evacuation centers
	Agriculture, Livestock & Fisheries	Planting flood tolerant crops e.g., rice in Nyando Food preservation e.g., Obambla	CGK/NG, NGOs,	PWDs, Women, Farmers, Children, Elderly, Youth	Planting flood tolerant crops is considered effective
	Water	De-siltation of rivers, pans, drainages, streams Construction of dykes, bridges, culverts	CGK/NG, KRCS, NEMA, Partners, NGOs	PWDs, Women, Farmers, Children, Elderly, Youth	All the strategies are considered to be highly effective
	Transport & Infrastructure	Construction of bridges, culverts, drainages	CGK, NG,	PWDs, Women, Farmers, Children, Elderly, Youth	Highly effective
	Trade	Drainage of flooding markets Upgrading of markets (Kibuye, Uhuru)	CGK, NG,	PWDs, Women, Farmers, Children, Elderly, Youth	Highly effective
	Environment	Planting of trees River-bank protection (Nyando, Awach)	CGK, NG, CSOs, KFS, WRUAs	PWDs, Women, Farmers,	Highly effective

Hazard/ Risk	Economic & Social Sectors	Current Adaptation Strategies	Stakeholders	Vulnerable Groups	Effectiveness of the Strategies
				Children, Elderly, Youth	
	Sanitation & Health	Medical outreaches Construction of modern toilets	CGK, KRCS, MOH, NGOs	PWDs, Women, Farmers, Youth Children, Elderly	Highly effective
	Special Programs & Disaster Managemen t	Aid and relief Early warning systems from Meteorological department	CGK, KRCS, NG, NGOs, KMD	PWDs, Women, Farmers, Children, Elderly, Youth	Early warning systems is considered to be more effective compared to the aid and relief
Drought	Agriculture, Livestock & Fisheries	Promotion of horticulture and drought-resistant crops/value- chains Promotion of Irrigation and kitchen gardening Buying food from boarder counties	CGK, KCSAP, NG, NGOs	PWDs, Women, Farmers, Children, Elderly, Youth	Buying food from bordering counties is less effective
	Water	Drilling of boreholes Rain-water harvesting	CGK, KRCS, NG, NGOs	PWDs, Women, Farmers, Children, Elderly, Youth	Highly effective
	Environmen t	Planting of trees	CGK, NG, CSOs, KFS	Women, Farmers, Children, Elderly, Youth	Highly effective
	Energy	Promotion of solar energy and improved cook-stoves Solarization of water boreholes	CGK, NG, CSOs, GIZ	PWDs, Women, Farmers, Children, Elderly, Youth	Highly effective

Hazard/ Risk	Economic & Social Sectors	Current Adaptation Strategies	Stakeholders	Vulnerable Groups	Effectiveness of the Strategies
Storms (hailstones, thunderstor ms, lightning	Agriculture, Livestock & Fisheries	Planting dwarf crops and hail- resistant crops in Seme & Kisumu West sub-counties	CGK, NG,	Women, Farmers, Children, Elderly, Youth	Highly effective
	Housing	Installing lightning arrestors in buildings Planting of trees to serve as wind- breakers	CGK, NG, KFS	Women, Farmers, Children, Elderly, Youth	Highly effective
Higher Temperatur es	Environmen t	Outdoor activities/green spaces Planting of trees	CGK, NG, CSOs, KFS	Women, Farmers, Children, Elderly, PWD, Youth	Highly effective

4.3.2 Floods

Historical extreme flood events in Kisumu County from 1980 to 2015, shows periods of high and low flood intensity. In fact, during the years 1980-1995, the months of January to June were the periods that observed high flooding in Kisumu County. During these periods the extreme floods occurred during the first half of the year (January-June). In the second half of the year (July–December), the floods recorded during this period (1980-1995) were of low intensity and even very variable, with less than 20 mm of rainfall per day (for five days). From the years 1995-2015, the extreme floods recorded in this period were observed during the whole year. But the most extreme were in 1997 and 2017 in the second half of the year (July–December). In this same period (1995–2015) the floods observed during January to June recorded high intensity between 2000–2005. Furthermore, these flooding events show that Kisumu is experiencing a strong annual flooding trend over the last two decades. Trends show that high intensity floods are likely to be observed during the first half of the year (January to June).

The impacts of these floods on human activities are not minimal. High intensity flooding in the County negatively impacts water quality and availability. These floods run off chemicals, pesticides and residues into the water bodies. These sources of pollution greatly influence water quality in Kisumu. In addition, these high intensity floods lead to the overflow of rivers that leave their beds and cause severe flooding and damage to agriculture (crops and livestock). The recrudescence of these floods induces other impacts such as the distribution of certain waterborne diseases. Pointedly, floods not only destroy farmlands and livestock, but also damage critical infrastructure such as roads and facilities such as hospitals, thereby exacerbating household vulnerability.

4.3.3 Extreme temperatures

The projections for Kisumu County show clear and consistent trends towards higher mean temperatures and more frequent warm days and nights and fewer cold days and nights, together with longer warm spells and shorter cold spells. Specifically, the projected increases in warm nights are considerably larger than those in warm days, indicating greater night-time heat stress.

For Kisumu County, the potential impacts and risks associated with projected increases in high temperature extremes include:

- human heat stress and other negative health effects including potential increases in mortality
- negative impacts and constraints on labour productivity, particularly for outdoor workers
- greater heat stress and discomfort for residents and tourists, leading to potential increased demand for air conditioning, which would increase energy demand.

4.3.4 Rainstorms

The projections for rainfall are more uncertain than those for temperature. The general tendency for Kisumu is for mean annual total rainfall to increase. It is notable that areas for which little change in total precipitation is projected may still experience an increase in extreme rainfall, usually associated with storms. In general, these increases are fairly small, reaching a maximum for Kisumu in the case of heavy rainfall days. The number of consecutive dry days generally shows little or very uncertain change.

Risks associated with the higher annual rainfall totals and more frequent/intense heavy rainfall events projected for Kisumu include:

- increased surface erosion and runoff, with a potential increase in flood risk, particularly where urban and transport developments lead to an increase in non-permeable surfaces
- increased risks to transport infrastructure
- possible implications for water quality and sanitation.

4.3.5 Cumulative impacts

Cumulatively, droughts, storms, extreme temperatures and floods have resulted in displacement of families, loss of crops and livestock, malnutrition among children and outbreak of water-borne diseases. Other impacts have included increased absenteeism by school-going children and inability to access critical services. There is also pollution and contamination of water sources through open defecation and effluent discharge. In general, vulnerable and marginalized groups (VMGs), persons living with disability (PWDs), women, children and the elderly have particularly borne the burden of these climate-related risks and their impacts. Table 1 below provides a summary of the sectors and livelihoods affected by these hazards and their future coping strategies.

Table 4.2: Climate risks and future coping strategies

Risk Hazard	Sectors Affected	Climate Resilient Strategies	Stakeholder Group Applying the Strategy	Vulnerable Groups Affected
Drought	Trade Rice farming Horticulture Livestock farming Water supply and access Agribusiness Fishing Seedlings production Environment Nutrition Health (physical and psychological)	Promotion of drought resistant crops Promotion of hybrid seeds Promotion of artificial insemination Promotion of drought-resistant livestock breeds Production and preservation of hay and fodder crops Promotion of the uptake of feed supplements Construction and drilling of climate smart water pans and boreholes Value-addition of agricultural produce Provision of water storage tanks and water harvesting strategies Support for setting up of modern irrigation systems Promotion and support for briquette making Promotion of Integrated Pest Management Introduction of highland rice varieties Adoption of Climate Smart Agriculture	Department of Meteorology CGK Department of Renewable Energy Lake Basin Development Authority National Water Harvesting and Storage Authority GIZ ICIPE KISIP JICA M-Kopa Solar CGK Department of Gender and Social services	Children Women Minorities Elderly PWDs
Floods	Rice farming Horticulture Trade Livestock farming Transport Housing (displaced families) Education (school absenteeism)	Promotion of hydroponics and other modern farming technologies Construction of raised livestock pens Construction of climate smart roads and houses Construction of dykes and gabions Tree planting and bamboo planting Construction of canals along rivers Desilting of rivers	CGK Department of Roads CGK Department of Livestock CGK Directorate of Irrigation CGK Directorate of Environment and Climate Change KMD, UN -Habitat National Housing Cooperation	PWDs Children Elderly Minority groups
Extreme Temperatures, Whirlwinds	Fishing, Crop farming, Environment Horticulture, Sugar-cane farming Livestock farming, Trade Health (physical and psychological)	Putting up of appropriately-sited <i>juakali</i> sheds Promotion of modern irrigation technologies	CGK Directorate of Trade CGK Directorate of Irrigation	Children Women elderly
Storms	Masons and construction work Fishing Crop farming	Installation of lightening arrestors on buildings Planting trees as wind breaks Promotion of agroforestry	Directorate of Environment and Natural Resources	PWDs Elderly women

4.3.6 Augmenting interventions

Over and above the climate resilient strategies listed in the foregoing, there is need for other interventions to supplement the existing strategies, particularly to address the wider scope of risks, some of which might not necessarily be climate risks. Accordingly, a number of interventions are proposed to buttress those summarized in the table above.

4.3.6.1 Technology, ICT Education

Adoption of technology, particularly in the design and operation of early warning systems (EWS) and disaster preparedness is deemed crucial. This will facilitate among other things, accessibility by farmers to timely weather information through appropriate MET apps and or media platforms. This would boost farmers use of reliable information as compared to current trends where many rely heavily on traditional ways of weather forecasting. In addition, there is need for the county to set up a climate change Information Centre(s) where locals, including students, can easily learn and educate themselves on climate trends and acquire practical knowledge and skills on adaptation strategies for climate change.

This will not only ensure that residents are equipped to make informed decisions on factors contributing to global warming as well as the individual role they can play in adaptation and mitigation. Adoption of geo-information technology will also enhance climate change adaptation planning. For example, a GIS flood maps would be of great help in infrastructure planning. Such maps can also enable farmers to make sound decisions in the choice of crops as well as support spatial multi-criteria evaluation in setting up emergency response systems and evacuation centers. In the building and construction industry, construction materials will need to be more climate-resilient, with designs that can withstand extreme weather conditions.

4.3.6.2 Strengthening Existing Disaster Preparedness Systems

Given the projected trends of increased intensity and frequency of the current hazards, there will most likely be more emergencies. It is therefore necessary to strengthen existing emergency response systems and improve on their effectiveness. There is need for personnel to be better trained and equipped to handle these cases, including issues of mental health. In addition, emergency systems operations need to leverage modern technologically to enhance efficiency and effectiveness.

4.3.6.3 Conservation Alongside Livelihoods

This is a concept that is key in the conservation and sustainable utilization of natural ecosystems such as wetlands and forests. Many of the wetland ecosystems across the county are currently threatened through unsustainable fishing and harvesting of papyrus reeds and other wetland resources, in the process destroying

breeding grounds for fingerlings. While conservation without economic benefit may be counter-productive, when supportive livelihood aspects such as eco-tourism are included, community groups are more likely to participate in conservation interventions. Climate action programs in these areas therefore need to be designed in such a manner as to involve locals in biodiversity conservation through training and other appropriate and sustainable incentives.

4.3.6.4 Needs of The Vulnerable/Inclusion

Climate risks tend to affect vulnerable populations more disproportionately. As such, women, elderly, children, PWDs, and other minorities tend to bear the brunt of climate impacts, decimating their livelihoods and general ability to cope in an uncertain future. There is therefore need for targeted specifically aimed at cushioning these populations, including social protection schemes designed to boost coping adaptation and coping mechanisms.

4.3.6.5 Enforcement and Review of Existing Policies

Although there exists a rich corpus of climate-relevant policies and legislation, most of these are not effectively implemented, with little or low penalties imposed on offenders. Without proper enforcement of the Forest Act of 2016 for example, deforestation on hilltops continues unabated, negating the current afforestation efforts and tree planting in other areas leading to slow or stagnating forest recovery rate. The efforts to take up solar energy, green or renewable energy are also slowed by the subsequent Finance Acts that have been pronounced over the past 3 years. Therefore, despite the desire and need for transition to solar energy, the uptake of solar power for domestic use including cooling, heating lighting and cooking has been minimal. There is therefore need to streamline existing policies to promote these and other similar technologies.

4.3.6.6 Agricultural Insurance

Just as homes, commercial properties and goods are insured against risk, farming too a key livelihood activity accounting for 60% of jobs in Kenya, needs to be insured across the value chain. Insurance companies and other stakeholders need to work out modalities to facilitate rolling out insurance policies tailor-made to suit the small-scale farmer against the vagaries of a changing climate.

Chapter Five: County Climate Strategic Adaptation Investment/Actions

This section of the report presents priority adaptation strategies by sector and hazards as prioritized in respective Wards within Kisumu County. The section flows sequentially indicating the hazards, priority actions by Ward and the vulnerable beneficiary groups. Investment have ideally been prioritized based on the following priority sectors: Water, Environment, Agriculture, Infrastructure (Roads and Public Works), Energy, Health and Disaster risk management. Table 5.1 gives a summary of the community prioritized adaptive investments by targeted groups, wards and sector.

Table 5.1 Hazard, Strategic Adaptation investment and Ward

Risk/ Hazard	Strategic adaptation investments	Sector	Sub-County and Ward
Drought	Construction of resilient and multipurpose water pans for water storage, water supply and irrigation	Water Irrigation Public works Agriculture	Muhoroni: Masogo/Nyang'oma, Chemelil/Tamu, Ombeyi, Miwani Nyando: Ahero, East Kano/Wawidhi, Awasi/Onjiko Nyakach: West Nyakach, North Nyakach, Central Nyakach, South East Nyakach Kisumu East; Kolwa Central, Kolwa East Seme; North Seme
	Supporting crop value chain through introduction of drought resistant seeds, crops and livestock	Agriculture Livestock	Muhoroni: Masogo/Nyangoma, Chemelil/Tamu Miwani Kisumu West: North West Kisumu
	Drilling and equipping of boreholes fitted with solar panels and elevated water tanks	Water Energy	Muhoroni: Masogo/Nyang'oma, Chemelil/Tamu Nyando/Kadibo: Ahero, East Kano/Wawidhi Kisumu East; Kolwa Central, Manyatta B Kisumu Central; Kaloleni/Shauri Moyo Kisumu West; West Kisumu, South West Kisumu Seme; Central Seme
	Supporting of fodder establishment, conservation and preservation technologies e.g., hay conservation and silage preservation	Agriculture Livestock	Muhoroni; Masogo/Nyang'oma, Chemelil/Tamu, Ombeyi Nyando/Kadibo: Awasi/Onjiko, Kobura, Kabonyo/ Kanyagwal Kisumu East: Kolwa East, Nyalenda A Kisumu West: North West Kisumu
	Promotion of conservation agriculture-Kitchen gardening, urban agriculture	Agriculture Forestry	Muhoroni: Chemelil/Tamu, Miwani, Ombeyi Kisumu Central: Migosi, Railways, Kondele
	Rehabilitation and expansion of water projects	Water	Muhoroni: Miwani, Ombeyi Nyando/Kadibo; Ahero, Kabonyo/Kanyagwal Kisumu East; Kajulu, Kolwa East Kisumu Central; Railways, Nyalenda B, Kondele Kisumu West; North West Kisumu, North Kisumu Seme: Central Seme, West Seme
	Promotion of livestock value chains (poultry, apiculture, dairy)	Livestock	Muhoroni: Masogo/Nyang'oma, Chemelil/Tamu North West, West Kisumu Nyando/Kadibo: East Kano/Wawidhi, Kobura

Risk/ Hazard	Strategic adaptation investments	Sector	Sub-County and Ward
			Kisumu East; Kajulu, Kolwa Central, Kolwa East, Nyalenda A Kisumu Central; Nyalenda B Kisumu West; North West Kisumu, North Kisumu Seme; North Seme
	Promotion of aquaculture	Fisheries	Nyando: East Kano/Wawidhi
	Supporting of water and energy saving irrigation systems through provision of solar water pumps and promotion of intermittent irrigation	Irrigation	Muhoroni: Chemelil/Tamu, Ombeyi Kisumu East: Manyatta B Seme; Central Seme, West Seme
	Construction and installation of water kiosks and water dispensers	Water Climate Change	Kisumu Central: Market Milimani, Kondele, Kaloleni Shauri Moyo Nyakach: South East Nyakach
Floods	Construction/ Opening of flood control structures (Dykes, water pans, rivers, gabions and canals)	Infrastructure & Water	Muhoroni: Masogo/Nyang'oma, Chemelil/Tamu Miwani, Ombeyi Nyando/Kadibo: Ahero, East Kano/Wawidhi, Kobura, Kabonyo/Kanyagwal Kisumu East; Kajulu, Kolwa Central, Kolwa East, Nyalenda A Kisumu Central: Nyalenda B, Kaloleni Shauri Moyo Kisumu West: West Kisumu, North West Kisumu, South West Kisumu Seme: East seme Nyakach; Central Nyakach, West Nyakach
	Catchment protection through establishment of bamboo buffers and bamboo planting	Climate Change Environment and Natural Resources	Muhoroni: Chemelil/Tamu, Koru/Muhoroni Nyando/Kadibo: East Kano/Wawidhi Kisumu East; Kajulu, Kolwa central, Manyatta B, Nyalenda A Kisumu West: North West Kisumu
	Establishment of evacuation centres equipped with ecosan toilets	Health and Sanitation and Disaster	Muhoroni: Ombeyi Kisumu Central; Migosi
	Establishment of bio toilets and biogas plants at market and Beach areas	Health and Sanitation Energy	Muhoroni: Koru/Muhoroni Kadibo; Kobura
	Climate proofing of access and feeder roads (Bridges, culverts, drainages.	Infrastructure Public Works	Muhoroni: Koru/Muhoroni, Masogo/Nyang'oma Chemelil/Tamu, Miwani Nyando/Kadibo: Ahero, East Kano/ Wawidhi, Kobura, Kabonyo/Kanyagwal Kisumu East; Kolwa Central, Kolwa East, Manyatta B, Nyalenda A Kisumu Central; Market Milimani, Kaloleni/ Shauri Moyo Kisumu West; West Kisumu, North West Kisumu, South West Kisumu, North Kisumu Seme; Central Seme, East Seme Nyakach; North Nyakach
Extreme temperat ures	Promotion of clean energy options for lighting, cooking – Briquettes; biogas; solar, food preservation/processing, solar fruits and vegetables driers	Energy	Muhoroni: Masogo/Nyang'oma, Chemelil/Tamu Miwani, Ombeyi Nyando/Kadibo: Awasi/Onjiko Kisumu central; Kondele Kisumu East; Kajulu, Kolwa Central, Nyalenda A Kisumu Central; Nyalenda B, Kondele Nyakach; South East Nyakach

Risk/ Hazard	Strategic adaptation investments	Sector	Sub-County and Ward
	Afforestation through tree nurseries establishment, institutional greening projects, beautification of public place, roadside tree planting and establishment of recreational parks	Climate Change Directorate Environment and Natural Resources	Muhoroni: Masogo/Nyang’oma, Chemelil/Tamu Miwani, Ombeyi Nyando/Kadibo; Ahero, Kobura, Kabonyo/Kanyagwal Kisumu West: West Kisumu, North West Kisumu, South West Kisumu, North Kisumu Seme; Central Seme, East Seme, North Seme Nyakach; North Nyakach, Central Nyakach
	Solid waste management and establishment of waste transfer stations	Environment and Natural Resources	Nyando/Kadibo: East Kano/Wawidhi Kisumu East: Manyatta B, Nyalenda A Kisumu Central; Migosi, Railways, Kondele Kisumu West; North Kisumu Nyakach; North Nyakach
Storms	Climate proofing of infrastructure (Lightening arrestors), wind breakers	Infrastructure	<u>Nyando</u> (Ahero, East Kano Wawidhi, Awasi Onjiko, Kobura & Kabonyo-Kanyagwal) <u>Muhoroni</u> (Chemelil-Tamu) <u>Nyakach</u> (North Nyakach and West Nyakach)

Chapter Six: Conclusion

The impacts of climate change within Kisumu County are already becoming a severe burden to the county's economic development and its people. The county is however addressing some of these risks for example construction of roads and supporting communities in highly exposed areas. This assessment will help the county develop a framework for both short- and long-term interventions based on climate risk identified during the PCRA process.

The current climate change is extremely rapid within the Western part of Kenya which places additional stresses to the capacity of the ecosystem to adapt and has adverse effect on the lifespan of existing infrastructure. The county therefore through this process, has an opportunity to build resilient systems to address the impacts of climate change. This will require policy interventions and climate resilient financial investments that put stakeholders in the Centre of planning. The implementation of PCRA Actions will enhance professional and technical direction to county adaptations to the impacts of climate change. This PCRA report is thus a critical document in preparation of a collectively driven process in the development of the county climate change action for 2023-2028.

Annexes

Table 1 (Refer ADDENDUM)

Table 2 (Refer ADDENDUM)